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NEW TERRITORIES WEST DEVELOPMENT OFFICE

Agreement No. 合約編號 CE 26/94

Tsuen Wan Bay
Further Reclamation, Area 35

Engineering, Planning and Environmental Investigation

荃灣海灣進一步的填海工程-第 35 區

工程、規劃及環境研究

VOLUME 2 OF 3 : TANG LUNG CHAU DANGEROUS GOODS ANCHORAGE ENVIRONMENTAL MONITORING AND AUDIT MANUAL

卷二 ：燈籠洲危險貨品船隻碇泊區環境監督與審核手冊

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MAUNSELL CONSULTANTS ASIA LTD
茂盛（亞洲）工程顧問有限公司

AGREEMENT NO. CE 26/94
TSUEN WAN BAY FURTHER RECLAMATION, AREA 35
TANG LUNG CHAU DGA
ENVIRONMENTAL IMPACT ASSESSMENT STUDY

ENVIRONMENTAL MONITORING AND AUDIT MANUAL
FINAL REPORT

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1 INTRODUCTION

1.1 Purpose of the Manual

The purpose of this Environmental Monitoring and Audit (EM&A) Manual is to guide the set up of an EM&A programme to ensure compliance with the Detailed Environmental Impact Assessment (EIA) study recommendations, to assess the effectiveness of the recommended mitigation measures and to identify any further need for additional mitigation measures or remedial action. This Manual outlines the monitoring and audit programme for the construction period and maintenance dredging of the Tang Lung Chau Dangerous Goods Anchorage (TLCDGA). It aims to provide systematic procedures for monitoring, auditing and minimizing environmental impacts associated with construction works and operational activities.

Hong Kong environmental regulations including those for water quality and waste management and the Hong Kong Planning Standards and Guidelines have served as environmental standards and guidelines in the preparation of this Manual. In addition, the EM&A Manual has been prepared in accordance with the requirements stipulated in Annex 21 of the *Technical Memorandum (TM) on the EIA Process*.

This Manual contains the following:

- responsibilities of the Contractor, the Engineer or Engineer's Representative (ER), Environmental Team (ET), and the Independent Checker (Environment) (IC(E)) with respect to the environmental monitoring and audit requirements during the course of the project;
- information on project organization and programming of construction activities for the project;
- the hypotheses of potential impacts, the basis for, and description of the broad approach underlying the environmental monitoring and audit programme;
- requirements with respect to the construction schedule and the necessary environmental monitoring and audit programme to track the varying environmental impact;
- full details of the methodologies to be adopted, including all field laboratory and analytical procedures, and details on quality assurance and quality control programme;
- the rationale on which the environmental monitoring data will be evaluated and interpreted and the details of the statistical procedures that will be used to interpret the data;
- definition of Action and Limit levels;
- establishment of event and action plans;
- requirements of reviewing pollution sources and working procedures required in the event of non-compliance of the environmental criteria and complaints;
- requirements of presentation of environmental monitoring and audit data and

appropriate reporting procedures; and

- requirements for review of EIA predictions and the effectiveness of the mitigation measures/environmental management systems and the EM&A programme.

For the purpose of this manual, the ET leader who shall be responsible for and in charge of the ET, shall refer to the person delegated the role of executing the environmental monitoring and audit requirements.

1.2 Background

The Territory Development Department commissioned Maunsell Consultants Asia Ltd. to undertake the "*Tsuen Wan Bay Further Reclamation, Area 35 - Planning, Environmental and Engineering Investigations*" study on 20 June 1995. As a result of the proposed reclamation, existing marine facilities including the Tsuen Wan Public Cargo Working Area and Tsuen Wan Dangerous Goods Anchorage (TWDGA) will have to be relocated to allow Tsuen Wan Bay Further Reclamation (TWBFR) to proceed.

The Marine Department (MD) has commissioned separate site search studies for relocating the TWDGA. The "*Tsuen Wan Dangerous Goods Anchorage: Alternative Site Search Study - Stage 2 Study*" (the Site Search Study) undertaken by MD has recommended a site to the south of Ma Wan and adjacent to Tang Lung Chau (now known as the Tang Lung Chau site) as the most preferred site for the DGA. The Site Search Study was completed in early 1996 with an Initial Environmental Impact Assessment (IEIA). Following completion of the IEIA, a more detailed quantitative water quality impact assessment was carried out as the initial assessment was not detailed enough to demonstrate that the Tang Lung Chau site would not result in any insurmountable water quality impacts. Upon confirmation that the Tang Lung Chau site is feasible in terms of overall hydraulics and water quality impacts, work related to the Detailed Environmental Impact Assessment (DEIA) of the Tang Lung Chau DGA (TLCDGA) commenced.

The selected site for the TLCDGA is located to the south of Ma Wan Island, adjacent to Tang Lung Chau, and in close proximity to the Ma Wan Fairway (**Figure 1.1**). The southern part of Ma Wan is currently zoned as Green Belt by the Outline Zoning Plan No. S/I-MWI/2. There is a traditional burial area at the southern tip, which is unpopulated and away from any major developments. The main populated areas are in the west to north-west of the Island. A comprehensive residential development has been approved by the Town Planning Board (TPB) to accommodate a total population of 11,536 in the northeastern 'Comprehensive Development Area' (CDA). The adjacent 'Village Type Development' zone will be developed to accommodate about 2,817 people. A developer has proposed a theme park (Ma Wan Park) at the western CDA, to the north of Lantau Link. The planning application for this proposed theme park has been "approved with conditions" by the TPB. In addition, there is a proposal for a "Film City" development at the 'Recreation Priority Area' zone to the south of Lantau Link. However, the TPB rejected the Section 17 Review submitted by the proponent for this development in June 1998.

Dangerous goods (DG) vessels using the current TWDGA would be the potential users of the new TLCDGA, which comprise vessels licensed to carry Category 2 DG (Liquified Gas) and Category 5 DG (Substances giving off inflammable vapours). The only restriction on the usage of the DGA is that vessels which are carrying Category 1 DG (Explosives) are not permitted to enter and use the DGA. From a study of the allocation of moorings at the

TWDGA undertaken in 1998 and 1993,[1] most of the vessels using the TWDGA moorings and anchorage are fuel delivery vessels (Category 5 DG, Class 3 fuel oils), typically carrying 400 tonnes of fuel. The largest vessel can have a fuel capacity of 1200 tonnes. The fuels carried by these vessels are diesel, kerosene and bunker fuel.

The shape of the TLCDGA has been modified since its conception in the IEIA. Main features including the following have been investigated:

- the DGA is enclosed by breakwaters to prevent strong waves from entering the DGA; and
- at least two entrances to the DGA for emergency evacuation purposes.

The latest layout plan is shown in **Figure 1.2**. The breakwaters are not physically connected to Tang Lung Chau because this will reduce potential ecological impacts on the strip of natural coastline of Tang Lung Chau facing the DGA. The effective area of the DGA is calculated to be 44.8 ha, as measured in line with the MD's criteria. The proposed DGA is able to provide a total of 72 moorings and will accommodate all the vessels currently registered at the TWDGA.

1.3 Environmental Monitoring and Audit Requirements

The EIA study assessed the key environmental issues arising from the construction and operation of the DGA at Tang Lung Chau. The identified key issues include water quality, fuel spillage, air quality, noise, waste management and mud contamination, and ecology. Their impact summary are given as follows:

Noise

The IEIA concluded that there would be no exceedance of the Acceptable Noise Levels stipulated under the Noise Control Ordinance (NCO) during construction activities. In addition, the IEIA predicted that there would be no noise impact at the identified noise sensitive receivers from unmitigated operational activities. No significant difference in noise levels from the IEIA is anticipated for the proposed construction activities. Therefore no unacceptable noise impacts have been predicted during the construction and operational stages. Noise mitigation measures are thus not necessary during the construction and operation of the DGA.

Air Quality

The IEIA described that the casting of concrete armours is likely to be the only source of dust during the construction of the breakwaters. This was not expected to result in unacceptable air quality impacts. The IEIA also stated that no unacceptable air quality impact was anticipated from the operation of the DGA.

To assess potential odour emissions from vessels within the DGA during operation, computer dispersion modelling was undertaken to determine the potential odour impacts in the vicinity of the proposed DGA based on the odour levels measured at the existing TWDGA. The dispersion modelling predicted that the maximum distance of the 5 odour units (OU) odour level contour would be around 500 m from the boundary of the proposed

1 The study undertaken in 1998 is the recent site visit undertaken by CES Ltd. in July 1998. The 1993 study is the previous site survey undertaken from 19 June to 2 July 1993, and reported in *Risk Assessment at TWDGA Phase 1, Volume 2 Appendices, ERM Hong Kong 1994.*

DGA. Since the nearest air sensitive receivers on Ma Wan are located more than 550m from the boundary of the DGA, it is not anticipated that there would be any exceedance of the odour limit of 5 OU (5-second average) at these air sensitive receivers. No air quality mitigation measures are therefore necessary during the operation of the DGA.

Water Quality

The key issues during the construction phase would be potential impacts from dredging and sandfilling works for the breakwater foundations, the release of contaminants during dredging of marine sediment, and potential cumulative impacts on water quality should there be other marine-based projects in progress near the study area. During the operational phase, key water quality issues include local impacts related to the discharge of sewage from vessels inside the DGA and potential impacts from maintenance dredging.

Sediment plume modelling of the effects on water quality of fine sediment lost to suspension during dredging was conducted. A worst-case scenario was assumed for the sediment plume modelling, with loss rates for fine particles based on three open grab dredgers working concurrently without the employment of silt curtains. The predicted increases in suspended solids (SS) concentrations above ambient levels are less than 1 mg/L for all of the beaches except Tung Wan Tsai. The maximum predicted increases in SS concentrations at Tung Wan Tsai during the dry season spring tide and wet season neap tide are above the acceptable level stipulated by the Water Quality Objectives (WQO) for SS. The full implementation of the recommended mitigation measures will be necessary to reduce impacts resulting from the dredging works to within acceptable levels and to maintain the water quality in accordance with the WQO. The recommended measures include the use of closed grab dredgers or trailing suction hopper dredgers (with no overflow nor ALMOB), the specification of an upper limit on the dredging rate to be employed and no concurrent dredging and sandfilling works. At the Ma Wan fish culture zone, the predicted maximum increases in SS concentrations are in compliance with the WQO. The release of heavy metals from sediment pore water during dredging of contaminated sediment is not predicted to result in any adverse impacts on water quality.

The predicted increases in SS concentrations at Tung Wan Tsai and the Ma Wan fish culture zone during filling activities by bottom dumping are well in exceedance of the allowable increase under the WQO. It should be noted that even if the THD was filled to half capacity (2,500 m^3), the increase in SS concentration at Tung Wan Tsai would still be very high and well above the WQO. Therefore sandfilling by bottom dumping is not considered to be an environmentally acceptable method. In view of the predicted high concentrations at the sensitive receivers, the recommended method for sandfilling is the use of a trailer suction hopper dredger, or other suitable vessel, with sandfill placement by pipeline discharge relatively close to the breakwater trench. With this proposed mitigated method, the maximum elevations in SS concentrations at Tung Wan Tsai and the Ma Wan fish culture zone are shown to be in compliance with the WQO for SS. The mitigated sandfilling works are therefore not anticipated to result in any unacceptable impacts on water quality at the water sensitive receivers.

To further reduce the potential impact to the water sensitive receivers during the dredging and sandfilling works, particularly at the Ma Wan fish culture zone, the adoption of additional mitigation measures is recommended. These additional measures comprise restricting the number of closed grab dredgers to not more than two working at one time; and conducting one of the weekly water quality monitoring events for impact monitoring during night-time hours should there be dredging or sandfilling works at this time. The

proposed mitigatory measures would provide further protection at the water sensitive receivers.

Based on the available information, the potential has been identified for construction activities for the DGA to be concurrent with dredging and filling works for the Penny's Bay Reclamation and CT9. An assessment of potential cumulative impacts on water quality resulting from these concurrent works indicates that the predicted maximum increases in SS concentrations during the mitigated dredging and sandfilling works for the DGA construction are within the allowable increases stipulated by the WQO. Therefore, it is anticipated that the construction activities for the TLCDGA are unlikely to result in unacceptable impacts on water quality should there be marine-based works in progress near the study area for the Penny's Bay Reclamation and CT9.

Bacterial plume modelling was carried out to simulate the dispersion of bacteria generated from sewage discharged by vessels moored within the DGA. The results show that only minimal *Escherichia coli (E. coli)* concentrations occur at Tung Wan Tsai and Tung Wan beach. Bacterial concentrations at the Ma Wan fish culture zone would be almost undetectable.

Based on the findings of the preliminary siltation study[2] carried out to give an initial estimate of the likely sediment deposition rate within the DGA, the volume of maintenance dredging required within the DGA is likely to be minor in scale on comparison to the construction phase dredging. Sediment plumes generated during dredging will largely be contained by the breakwaters, due to the weak tidal currents within the DGA, and therefore no unacceptable impacts on water quality are anticipated to result at the sensitive receivers. Nevertheless, it is recommended that good operational practices be observed during maintenance dredging to minimize potential impacts on water quality.

Fuel Spillage

Simulations of the movement and shoreline stranding of fuel spilt at a site near the centre of the DGA and at sites near the northern and southern entrances were conducted for spring and neap tides in the dry and wet seasons for the defined worst-case scenario. The model results correspond to the prevailing environmental conditions (tide type, wind, etc), and have been used to assist in contingency planning.

The frequency of the worst-case spill from a 1,200 tonne vessel (loss of 90% of spill cargo) happening outside the DGA was found to be once in 2,600 years. For a smaller typical vessel of 400 tonnes capacity, the frequency of a spill event is estimated to be once in 190 years. These frequencies are considered to be low. The surface fuel thicknesses predicted at the sensitive receivers are for the event that no containment actions are implemented at the source of the spill nor mitigation measures implemented at the sensitive receivers, and thus represent likely maximum values.

The results of the fuel spill modelling indicate that the shortest time in which the fuel slick is shown to impact bathing beaches is within 1 hour for the two beaches on Ma Wan for a spill location near the northern entrance of the DGA (dry season tides). For the gazetted beaches along the southern coastline of the north-west New Territories, there is a time lag of

2 It should be noted that the siltation assessment study provides only an initial estimate of siltation effects for the purpose of providing a preliminary estimate of the likely maintenance dredging requirements. Reliable estimates of siltation and scouring effect would require 3D siltation modelling. The findings of the 3D siltation modelling would form the basis for determining maintenance dredging requirements.

at least 7 hours until the fuel slick affects the beaches. At the Ma Wan fish culture zone, the fuel slick is shown to first affect the fish culture zone at Kung Tsai Wan between 1 to 2 hours following a spill at the southern entrance of the DGA (dry season tides). MD have advised that their response time to activate the Oil Pollution Contingency Plan (OPCP) is within 2 hours in the harbour limit and that the same time frame shall apply to the DGA. For a fuel slick reaching the fish culture zone within 2 hours, it would require flood tide conditions in the dry season with an east-south wind direction. Coupled with the low frequency of a fuel spill event near the DGA southern entrance, the frequency of the spill reaching the fish culture zone within 2 hours is even lower. Anti-oil pollution equipment is available at gazetted bathing beaches and appropriate action will be taken in accordance with the OPCP in the event of a fuel spill. Therefore, oil pollution mitigation measures in addition to the OPCP are not considered to be required.

Prompt response action will be required in the event of a major fuel spill near the northern and southern entrances of the TLCDGA so as to limit the spread of fuel at the source and thereby minimize the potential for adverse environmental impacts on the two beaches at eastern Ma Wan and the Ma Wan fish culture zone. Provided that the protocols and operational procedures defined in the MD's OPCP are implemented immediately, it is considered that the potential for adverse environmental impacts would be kept to a minimum.

If the fuel spill occurs within the DGA, it is shown that the majority of the slick is contained by the breakwaters and that only very small quantities of fuel can pass through the northern entrance of the DGA. On examining possible spill plumes from chronic vessel seepage, it is found that the majority of the fuel seepage plume formed is likely to remain within the DGA due to the weak tidal currents inside the DGA. Furthermore, it is considered unlikely that any significant impacts on water quality would arise at the sensitive receivers due to the very low surface fuel thickness predicted.

Ecology

The sensitive ecological receivers identified are:

- the Ma Wan fish culture zone;
- the fishery resources in the vicinity;
- beaches along the coastline of Ma Wan, southern North-West New Territories and Lantau;
- intertidal organisms on Tang Lung Chau; and
- Chinese White Dolphins (*Sousa chinensis*) which may be present in the area.

Dredging activities during the construction phase of the DGA are likely to locally increase the turbidity of water, smother or disturb sensitive species and modify the bottom substratum, and hence potentially affect the above sensitive receivers. The sediment plume modelling simulations, undertaken to simulate the fate of sediment lost to suspension during dredging, predicted elevations in SS levels in compliance with the WQO at the Ma Wan fish culture zone. It is considered that the loss of suspended solids to the marine environment and the resulting impacts on ecological sensitive receivers can be minimized, provided that the recommended mitigation measures for dredging works are fully implemented. In the long term, after construction is complete, areas no longer subject to disturbance are likely to be recolonised by benthic fauna. The breakwaters can also function as habitat enhancing devices by providing suitable hard substrates for the colonisation and establishment of intertidal and subtidal faunal assemblages.

In the event of a major fuel spill near the entrances of the DGA, the identified ecological sensitive receivers may be adversely affected. However, as described under *Fuel Spillage* above, the event frequency of a fuel spill near the DGA is low and the frequency of a fuel slick reaching the fish culture zone in less than 2 hours is even lower. Prompt response action will be required in the event of a major fuel spill near the northern and southern entrances of the TLCDGA so as to minimize the potential for adverse environmental impacts at the Ma Wan fish culture zone. The immediate implementation of the OPCP would ensure impacts upon the marine environment and ecological sensitive receivers would be minimized as far as possible.

Impacts from dredging on *Sousa chinensis* are not considered to be significant as the area does not comprise a core area for these species as revealed by the sighting records. Potential impacts to the dolphin are primarily indirect including effects on food availability arising from sediment resuspension in the water column, and less significant direct impacts from noise disturbance and physical harm potential from vessel movements. Practicable efforts should be taken to minimize potential impacts on dolphins arising from the construction works. No blasting of rock 'outcrops' on the seabed will be carried out. It is considered that the full implementation of the recommended mitigation measures is likely to minimize the potential for both direct and indirect impacts on dolphins from the DGA construction and operation.

Waste Management and Mud Contamination

The assessment has concluded 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*, are strictly implemented. Dredged sediment identified as seriously contaminated material (i.e. Class C) will require disposal at the East Sha Chau Contaminated Mud Pits. Dredged sediments classified as Class A and B will be suitable for disposal at a gazetted marine disposal ground. The quantities of contaminated and uncontaminated sediment and the required disposal ground allocation will be confirmed at the detailed design stage following detailed sediment quality analysis. It is therefore anticipated that no unacceptable impacts will result from the dredging, transport and disposal of the marine sediments.

It is anticipated that no adverse environmental impacts will arise during the construction period, provided that the non-sediment construction waste arisings are handled, transported and disposed of using approved methods and that no solid or liquid wastes (other than sewage discharges) enter the surrounding marine waters. Similarly, provided that the recommended mitigation measures are also followed during maintenance dredging, no unacceptable impacts on water quality and marine biota are anticipated. As discussed under water quality, the results of the bacteria dispersion modelling indicate that minimal *E. coli* concentrations were predicted at the nearest sensitive receivers on Ma Wan.

Conclusions

It is anticipated that water quality impacts during the construction phase can be reduced to acceptable levels with the full implementation of the recommended mitigation measures for the dredging and sandfilling works (including the adoption of an upper limit on the rate of dredging and sandfill discharge). However, in order to ensure compliance with the WQO for SS, a requirement for baseline and impact monitoring for water quality during construction of the DGA has been identified. In addition, it is recommended that auditing of construction waste disposal be undertaken at the TLCDGA to ensure that the correct

disposal requirements for the various waste arisings are being implemented. These requirements are detailed in subsequent sections of this Manual.

Based on the findings of the preliminary siltation study, the volume of maintenance dredging required within the DGA is estimated to be minor in scale on comparison to the construction phase dredging. As described in Section 3.7.2 of the EIA Report, no unacceptable impacts on water quality are anticipated to result at the sensitive receivers during maintenance dredging and thus it is considered that monitoring of marine water quality during these dredging works will not be necessary. Monitoring of barge loading would be required, however, during the transport of dredged material to the allocated marine disposal ground, as for the construction phase dredging works.

It is considered that recommendations specific to monitoring of marine ecology will not be required since potential impacts on marine ecology are primarily the result of changes in water quality. The environmental mitigation of water quality impacts, including in particular suspended solids and dissolved oxygen concentrations, will effectively mitigate these potential indirect impacts on marine ecology. In accordance with Annex 21 of the *Technical Memorandum* (TM) *on Environmental Impact Assessment Process,* the proposed marine water quality monitoring programme shall be approved by the Director of Agriculture and Fisheries (DAF) (in view of Ma Wan fish culture zone being identified as a sensitive receiver).

Baseline and impact monitoring of odour levels are not considered necessary as the detailed assessment has shown that there would be no exceedance of the agreed odour limit of 5 odour units (5-second average) at the identified air sensitive receivers (ASR). The ASRs are located further than 500m from the boundary of the proposed DGA, which is the maximum odour impact distance predicted. Similarly, baseline and impact monitoring of noise levels are not considered necessary as the IEIA predicted no unacceptable noise impact during construction activities. The IEIA also predicted no noise impact from unmitigated operational activities.

During the operational phase, annual surveys would be conducted by Marine Department (MD) to ensure that the vessels using the DGA meet the safety requirements of the MD. The "Declaration of Fitness for Vessel to Carry Petroleum" which specifies the type of DG cargo that the vessel is licensed to carry would be renewed following the satisfactory outcome of this survey. Furthermore, spillages or discharges of petroleum products from vessels moored within the DGA would not be permitted under the *Merchant Shipping (Prevention of Oil Pollution) Regulations* and would be controlled by MD. With the implementation of these operational controls at the TLCDGA, it is considered that an EM&A programme would not be required during the operation of the DGA.

1.4 Existing Sensitive Receivers and Evaluation Criteria

Sensitive receivers in terms of marine water quality have been identified in accordance with the definitions given in the HKPSG. These sensitive receivers are shown on **Figure 1.3.** The closest sensitive receivers to the proposed DGA site are described in Table 1.1.

Table 1.1 Existing Water Sensitive Receivers

SR Identification	Approximate Distance to TLCDGA (km)	Description
Tung Wan	1	Gazetted beach
Anglers	3	Gazetted beach
Gemini	2.1	Gazetted beach
Ho Mei Wan	2.4	Gazetted beach
Casam	2.4	Gazetted beach
Lido	2.4	Gazetted beach
Ting Kau	2.7	Gazetted beach
Approach	3	Gazetted beach
New Cafeteria	9.6	Gazetted beach
Old Cafeteria	9.6	Gazetted beach
Kadoorie	10	Gazetted beach
Castle Peak	10	Gazetted beach
Butterfly	11.7	Gazetted beach
Silvermine Bay	11.7	Gazetted beach
Tung Wan Tsai	1.2	Non-gazetted beach
Discovery Bay	7.2	Non-gazetted beach
Kau Yi Chau Fishery	6.6	Fishery area
Ma Wan fish culture zone at Tam Shui Wan	1.9	Gazetted fish culture zone
Ma Wan fish culture zone at Shek Tsai Wan	1.8	Gazetted fish culture zone
Ma Wan fish culture zone at Kung Tsai Wan	1.1	Gazetted fish culture zone

Criteria for evaluating impacts on water quality at the sensitive receivers during the construction works are summarised as follows:

Marine Water Quality

Principal legislation for planning against water pollution is the Water Pollution Control Ordinance (WPCO), which allows for the gazetting of Water Control Zones (WCZs) within which the discharge of liquid effluent and the deposit of matter directly into water bodies or into drains are controlled. The proposed TLCDGA site is located within the Western Buffer WCZ which was gazetted in 1993. Details of the Water Quality Objectives (WQOs) statement for this WCZ are listed in Table 1.2. Of particular relevance for the water quality assessment undertaken in the EIA study is the WQO for suspended solids (SS), which states that the marine activities during the construction works must not cause the natural ambient level to be raised by more than 30% nor give rise to accumulation of suspended solids.

Beach Water Quality

At bathing beaches, permissible standards for effluent must be consistent with the Bathing Beach WQO which set standards for the indicator bacterium, *Escherichia coli (E. coli)*. This WQO states that the annual geometric mean of *E. coli* should not exceed 610 counts per 100 mL in secondary contact recreation subzones and fish culture subzones. For bathing beach subzones, the annual geometric mean of *E. coli* should not exceed 180 counts per 100 mL during the bathing season (i.e. from March to October inclusive).

The primary concern for safeguarding water quality at gazetted beaches is to limit pollutants that pose a risk to health, such as bacteria and other pathogens. The HKPSG states that no discharge outlet should be located within 100 m of the boundaries of any bathing beach. In addition, Section 9.1 of the TM states that no new effluent will be allowed within 100 m of the boundaries of a gazetted beach in any direction, including rivers, streams and stormwater drains.

Table 1.2 Water Quality Objectives for Marine Waters of Western Buffer WCZ

Parameter	Objective	Part(s) of Zone
E. coli	annual geometric mean not to exceed 610/100 ml	Secondary contact recreation subzones; fish culture subzones
	geometric mean not to exceed 180/100 ml during March to October inclusive in 1 year; sample should be taken at least 3 times in 1 calendar month at intervals of between 3 to 14 days	bathing beach subzones
	geometric mean of the most recent 5 consecutive samples taken at intervals of between 7 and 21 days not to be less than 1/100 ml	water gathering ground subzones
	geometric mean of the most recent 5 consecutive samples taken at intervals of between 7 and 21 days not to exceed 1000/100 ml	other inland waters
Dissolved Oxygen within 2 m of bottom	not less than 2 mg/L for 90% samples	marine waters
	not less than 2 mg/L for 90% samples	fish culture subzones
Depth averaged Dissolved Oxygen	not less than 4 mg/L for 90% samples	marine waters except fish culture subzones
	not less than 5 mg/L for 90% samples	fish culture subzones
pH value	within the range 6.5 to 8.5; change due to waste discharge not to exceed 0.2	marine waters except bathing beach subzones
	within the range 6.5 - 8.5	water gathering ground subzones
	within the range 6.0 - 9.0	other inland waters
Salinity	change due to waste discharge not to exceed 10% of natural ambient level	whole zone
Temperature	change due to waste discharge not to exceed 2 °C	whole zone
Suspended solids	waste discharge not to raise the natural ambient level by 30%, nor cause the accumulation of suspended solids which may adversely affect aquatic communities	marine waters
	annual median not to exceed 20 mg/L	water gathering ground subzones
	annual median not to exceed 25 mg/L	other inland waters

Parameter	Objective	Part(s) of Zone
Toxicants	not to be present at levels producing significant toxic effect, carcinogenic, mutagenic or teratogenic effects in humans, fish or any other aquatic organisms, with due regard to biologically cumulative effects in food chains and to interactions of toxic substances with each other	whole zone
	not to cause a risk to any beneficial use of the aquatic environment	whole zone
Un-ionized ammonia	annual mean not to exceed 0.021 mg/L	whole zone
Nutrients	not to be present in quantities that cause excessive growth of algae or other aquatic plants	marine waters
	annual mean depth average inorganic nitrogen not to exceed 0.4 mg/L	marine waters

1.5 Project Organization

The proposed project organization and lines of communication with respect to environmental protection works are shown in **Figure 1.4**.

The ET leader shall be an independent party from the contractor and have relevant professional qualifications, or have sufficient relevant EM&A experience subject to approval of the Engineer's Representative (ER) and the Environmental Protection Department (EPD).

The responsibility of respective parties are:

The Contractor:

- Employ an Environmental Team (ET) to undertake monitoring, laboratory analysis and reporting of environmental monitoring and audit;
- Provide assistance to ET in carrying out monitoring;
- Submit proposals on mitigation measures in case of exceedances of Action and Limit levels in accordance with the Event and Action Plans;
- Implement measures to reduce impact where Action and Limit levels are exceeded; and
- Adhere to the procedures for carrying out complaint investigation in accordance with *Section 4.3*.

Engineer or Engineer's Representative:

- Supervise the Contractor's activities and ensure that the requirements in the EM&A Manual are fully complied with;
- Inform the Contractor when action is required to reduce impacts in accordance with

the Event and Action Plans;

- Employ an Independent Checker (Environment)(IC(E)) to audit the results of the EM&A works carried out by the ET; and
- Adhere to the procedures for carrying out complaint investigation in accordance with *Section 4.3*.

Environmental Team:

- Monitor the various environmental parameters as required in the EM&A Manual;
- Analyse the environmental monitoring and audit data and review the success of EM&A programme to cost-effectively confirm the adequacy of mitigatory measures implemented and the validity of the EIA predictions and to identify any adverse environmental impacts arising;
- Carry out site inspection to investigate and audit the Contractors' site practice, equipment and work methodologies with respect to pollution control and environmental mitigation, and effect proactive action to pre-empt problems;
- Audit and prepare audit reports on the environmental monitoring data and site environmental conditions;
- Report on the environmental monitoring and audit results to the IC(E), Contractor, the ER and EPD or its delegated representative;
- Recommend suitable mitigation measures to the Contractor in the case of exceedance of Action and Limit levels in accordance with the Event and Action Plans; and
- Adhere to the procedures for carrying out complaint investigation in accordance with *Section 4.3*.

Independent Checker (Environment):

- Review the EM&A works performed by the ET (at not less than monthly intervals);
- Audit the monitoring activities and results (at not less than monthly intervals);
- Report the audit results to the ER and EPD in parallel;
- Review the EM&A reports (monthly & quarterly summary reports) submitted by the ET;
- Review the proposal on mitigation measures submitted by the Contractor in accordance with the Event and Action Plans; and
- Adhere to the procedures for carrying out complaint investigation in accordance with *Section 4.3*.

Sufficient and suitably qualified professional and technical staff shall be employed by the respective parties to ensure full compliance with their duties and responsibilities, as required

under the EM&A programme for the duration of the project. A flow chart indicating the duties and responsibilities of the respective parties during the monitoring and auditing procedure is shown in **Figure 1.5**.

1.6 Construction Programme and Activities

The latest estimate on the programme is for commencement of the works in late 2000. The overall construction schedule is of approximately 33 months duration. The completion of the works would be approximately mid 2003. A tentative construction programme is shown in **Figure 1.6.** The programme will be reviewed at the detailed design stage.

The construction of the TLCDGA will involve a total length of 3,372 m of breakwaters. Breakwater construction will require the removal of soft marine deposits from a seabed trench for the breakwater foundation and replacement with sand fill. Based on the most up-to-date information, underwater blasting of rock on the seabed would not be required. (A vibrocore survey undertaken in July 1998 found high rock levels in the north-east corner of the proposed DGA, near the northern entrance, and in the north-west corner). The south-west breakwater is to be constructed first which can help to protect the remaining construction work. This breakwater can minimize any down-time due to wave exposure from the south and effectively prevent cross traffic at a relatively early stage. For the dredged foundations, the craft is likely to include grab and trailing suction hopper dredgers for dredging and sandfilling, and towed barges for rockfill and armour placement.

To meet the MD's minimum requirement of 3 m of soft material cover at the mooring anchorages for the safe mooring of vessels, a possible measure is the dumping of soft material to overlay the seabed where in-situ hard material is found in place. Following the completion of the breakwaters construction, it is proposed that filling materials be dumped at the necessary areas within the DGA to make up the required 3 m thickness of soft material at the mooring locations. It is anticipated that sediment plumes generated from this dumping will largely remain localized due to the weak tidal currents inside the DGA and be contained by the breakwaters, and thus no unacceptable impacts on water quality are anticipated at the sensitive receivers.

As discussed in the EIA Final Assessment Report, the results of the preliminary sediment quality analysis indicate the marine sediment at three vibrocore locations along the proposed south-west breakwater to be classified as seriously contaminated, Class C material. A detailed sediment quality assessment to identify precisely the location and extent of any contamination would be required at the detailed design stage.

The ET Leader shall make reference to the actual works progress and programme during the construction stage to schedule the EM&A works, and the Contractor shall provide the respective information to the ET Leader for formulating the EM&A schedule.

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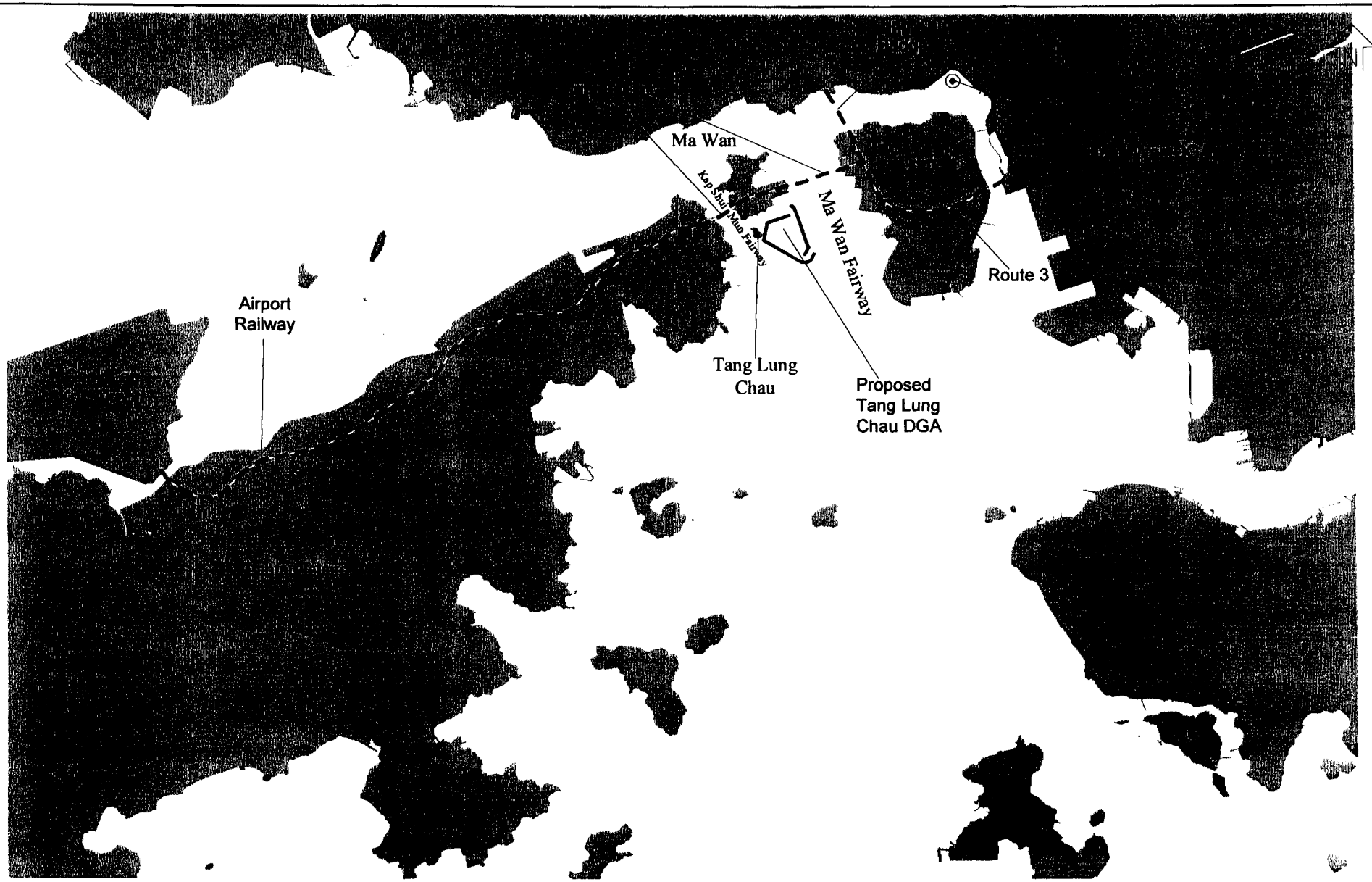
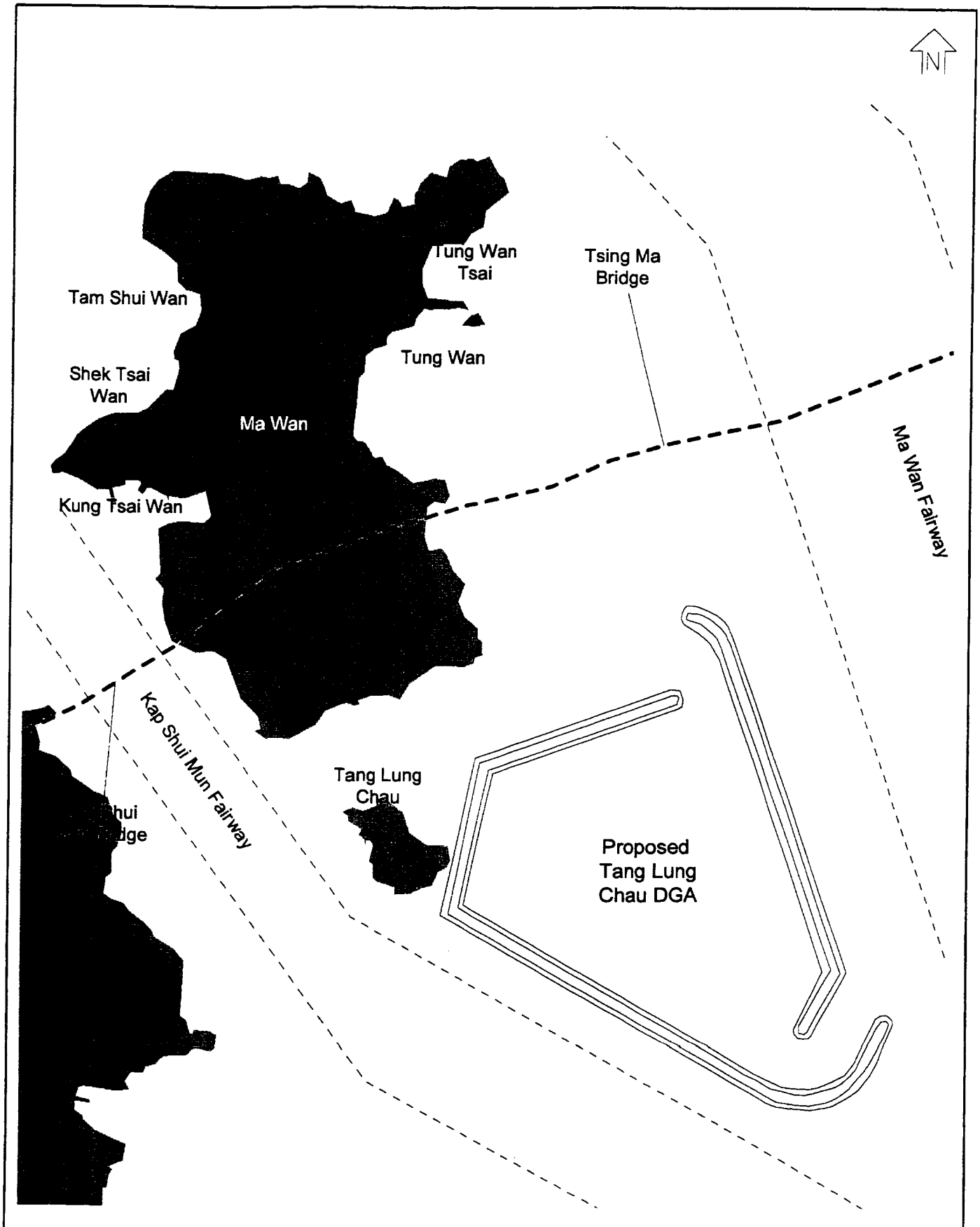


LOCATION PLAN OF TANG LUNG CHAU DANGEROUS GOODS ANCHORAGE (TLCDGA)

FIGURE	1.1
SCALE	1 : 120000



LAYOUT OF TANG LUNG CHAU
DANGEROUS GOODS ANCHORAGE (TLCDGA)

FIGURE	1.2
SCALE	1 : 16000

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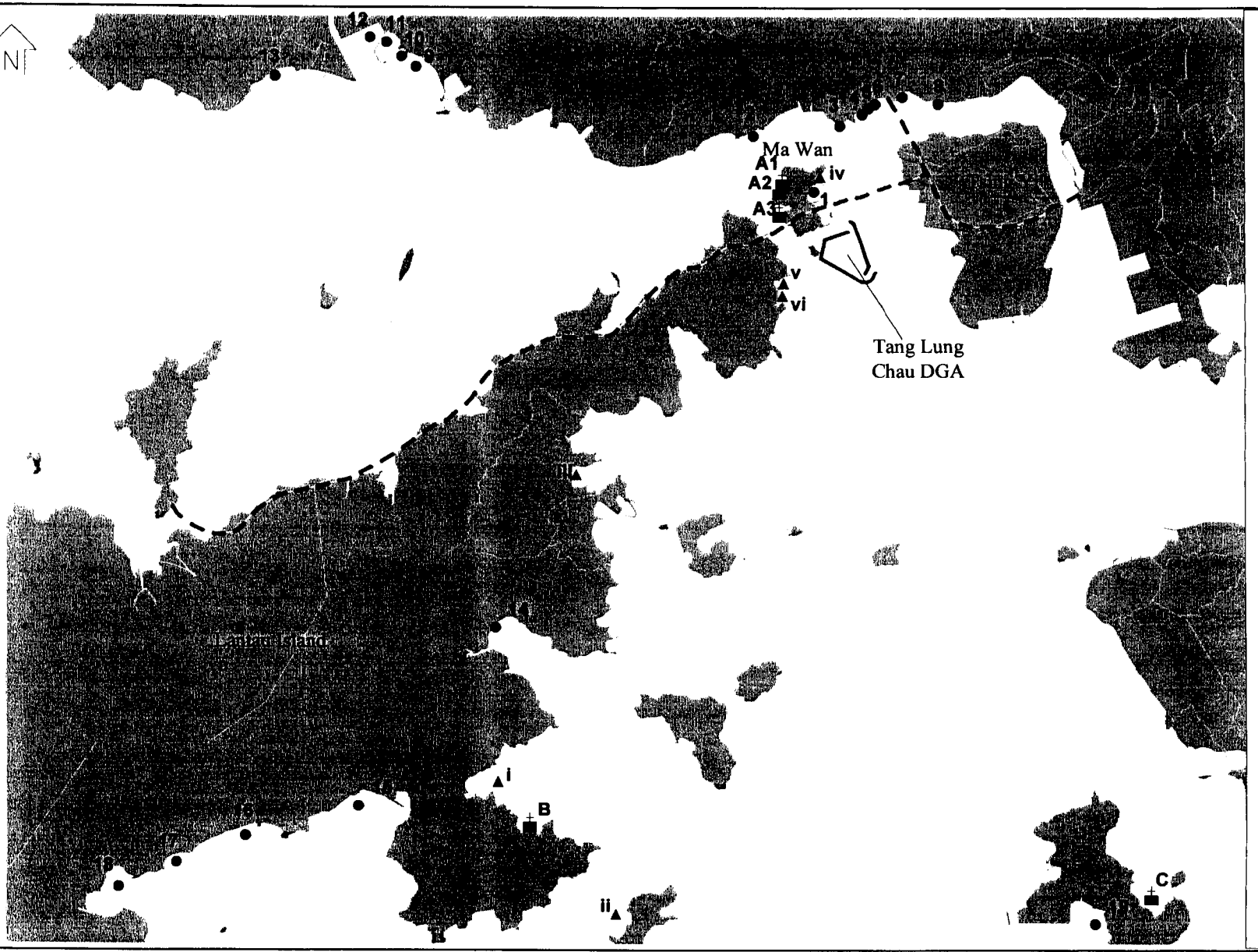


Legend

- Gazetted Beach
- Ungazetted Beach
- Fish Culture Zone

Gazetted Beach

1 Tung Wan, Ma Wan
2 Anglers'
3 Gemini
4 Hoi Mei Wan
5 Casam
6 Lido
7 Ting Kau
8 Approach
9 New Cafeteria
10 Old Cafeteria
11 Kadoorie
12 Castle Peak
13 Butterfly
14 Sivermine Bay
15 Pui O
16 Cheung Sha Lower
17 Cheung Sha Upper
18 Tong Fuk
19 Hung Shing Yah

Ungazetted Beach

i Chi Ma Wan
ii Tai Kwai Wan
iii Discovery Bay
iv Tung Wan Tsai
v NE Lantau (north)
vi NE Lantau (south)

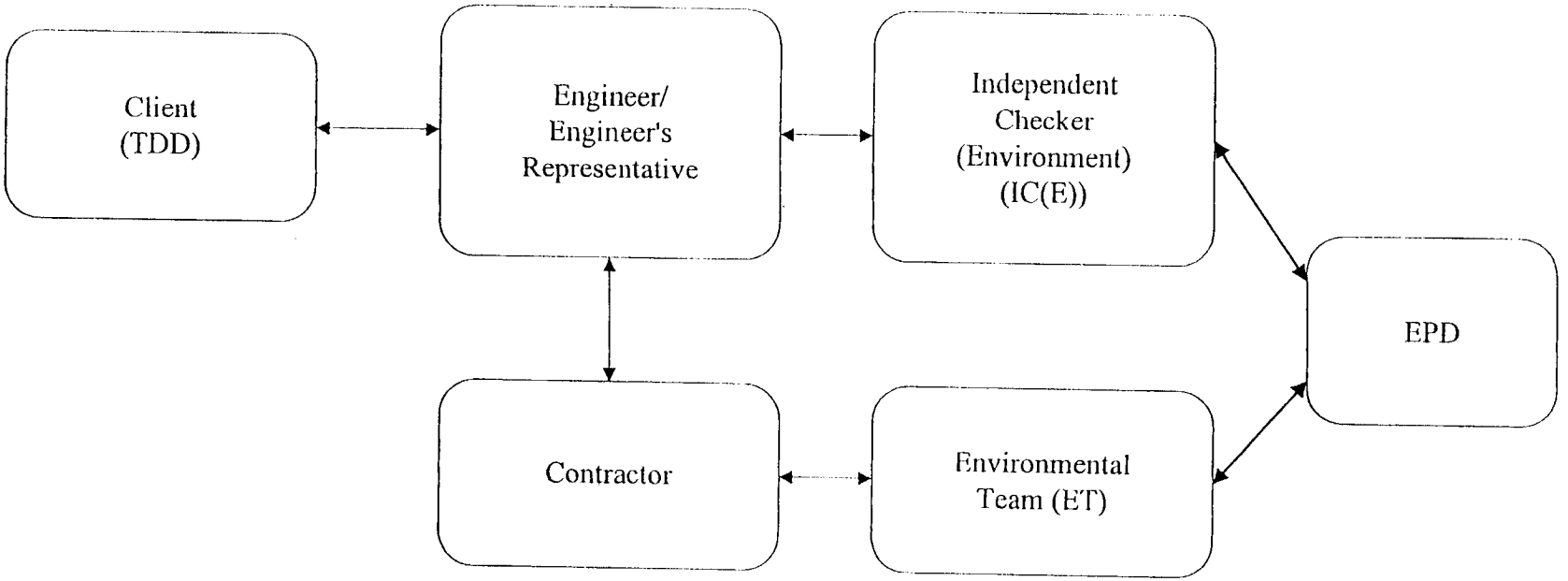
Fish Culture Zone

A Ma Wan :
A1 Tam Shui Wan
A2 Shek Tsai Wan
A3 Kung Tsai Wan
B Cheung Sha Wan
C Lo Tik Wan

LOCATIONS OF MARINE WATER QUALITY SENSITIVE RECEIVERS

FIGURE 1.3

SCALE 1 : 120000



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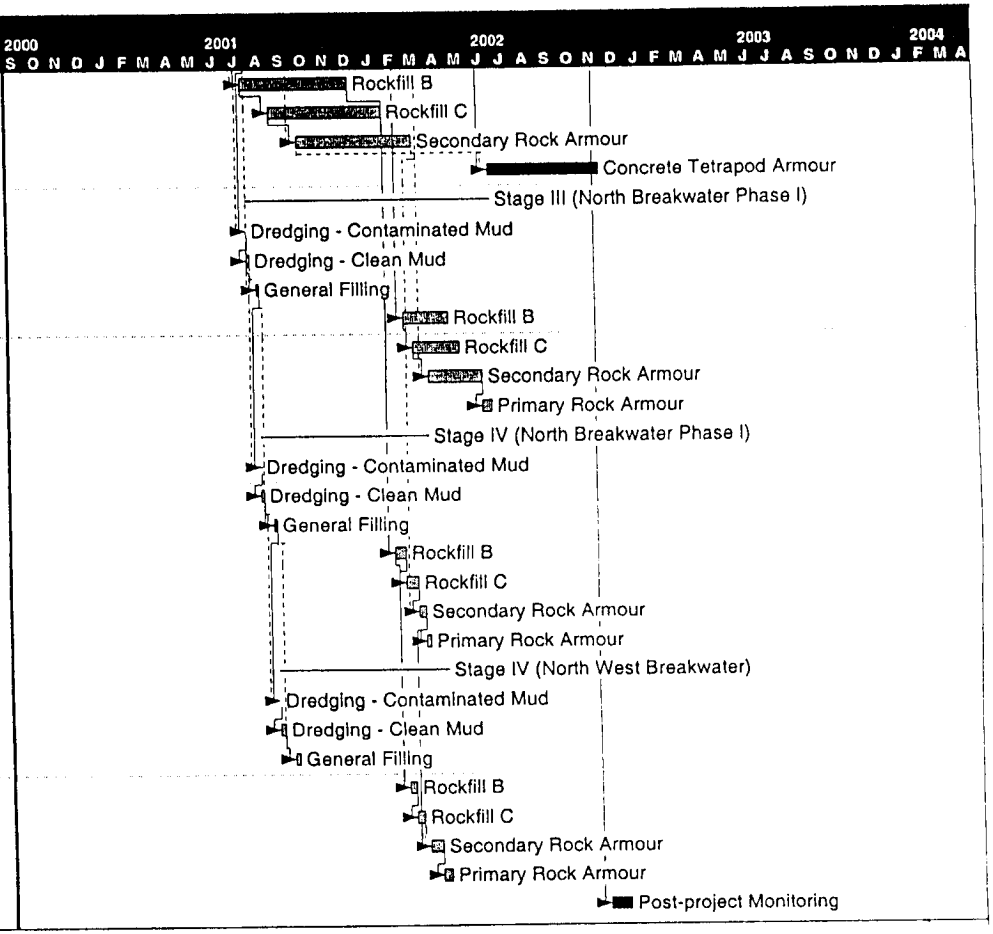
TANG LUNG CHAU DGA
PROJECTS ORGANIZATION STRUCTURE

FIGURE 1.4

SCALE not to scale

Act ID	Description	Orig Dur	Early Start	Early Finish
1340	Rockfill B	148	25JUL01	19DEC01
1350	Rockfill C	155	01SEP01	02FEB02
1360	Secondary Rock Armour	158	09OCT01	15MAR02
1370	Concrete Tetrapod Armour	153	27JUN02	26NOV02
1400	Stage III (North Breakwater Phase I)	334 *	30JUL01	28JUN02
1410	Dredging - Contaminated Mud	0	30JUL01	29JUL01
1420	Dredging - Clean Mud	4	30JUL01	02AUG01
1430	General Filling	3	12AUG01	14AUG01
1440	Rockfill B	62	28FEB02	30APR02
1450	Rockfill C	64	13MAR02	15MAY02
1460	Secondary Rock Armour	74	03APR02	15JUN02
1470	Primary Rock Armour	13	16JUN02	28JUN02
1500	Stage IV (North Breakwater Phase I)	230 *	15AUG01	01APR02
1520	Dredging - Contaminated Mud	0	15AUG01	14AUG01
1530	Dredging - Clean Mud	4	15AUG01	18AUG01
1540	General Filling	4	01SEP01	04SEP01
1550	Rockfill B	15	13FEB02	27FEB02
1560	Rockfill C	17	28FEB02	16MAR02
1570	Secondary Rock Armour	10	17MAR02	26MAR02
1580	Primary Rock Armour	6	27MAR02	01APR02
1610	Stage IV (North West Breakwater)	232 *	05SEP01	24APR02
1620	Dredging - Contaminated Mud	0	05SEP01	04SEP01
1630	Dredging - Clean Mud	7	05SEP01	11SEP01
1640	General Filling	6	25SEP01	30SEP01
1650	Rockfill B	9	28FEB02	08MAR02
1670	Rockfill C	10	09MAR02	18MAR02
1690	Secondary Rock Armour	17	27MAR02	12APR02
1700	Primary Rock Armour	12	13APR02	24APR02
1710	Post-project Monitoring	28	27NOV02	24DEC02



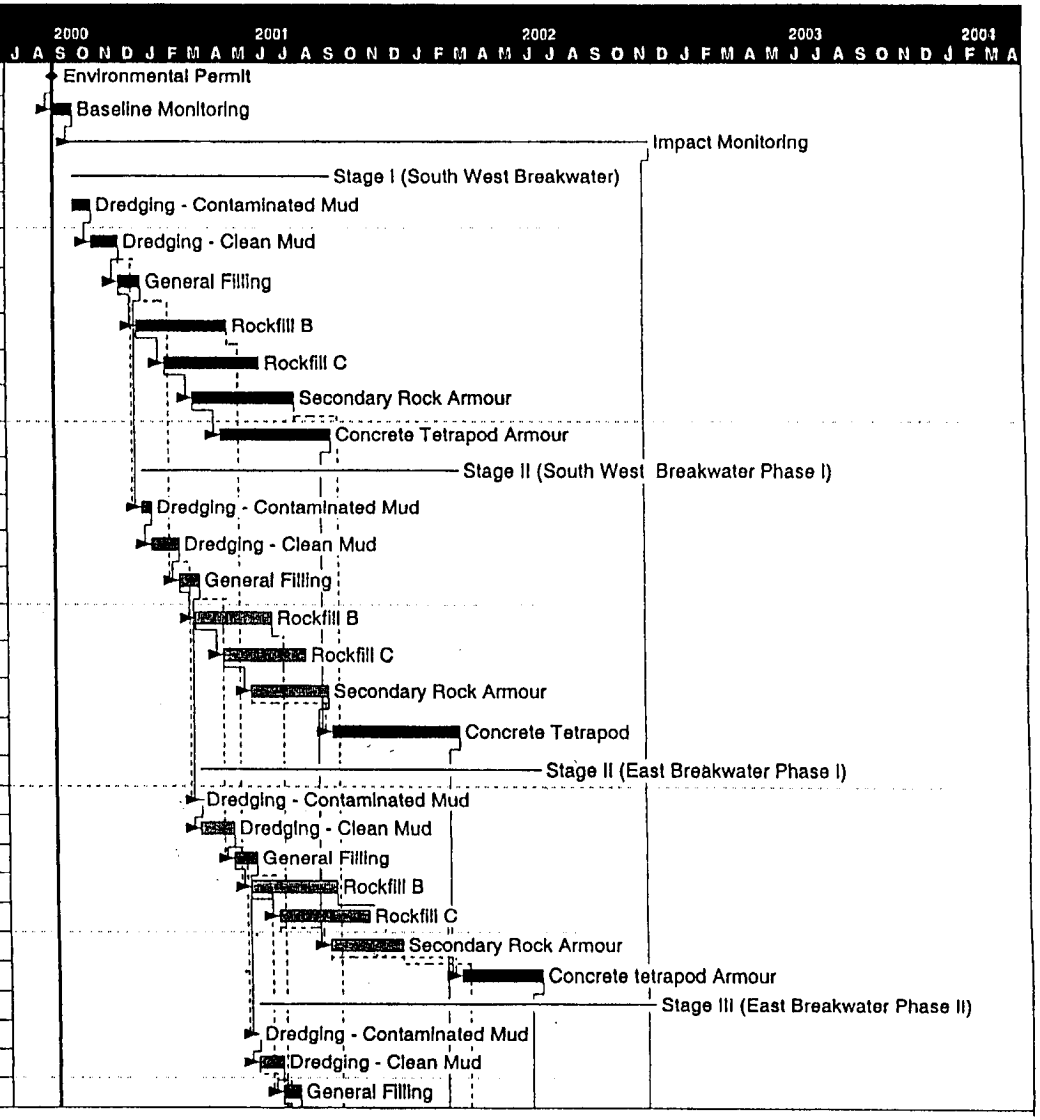
TSUEN WAN BAY FURTHER RECLAMATION, AREA 35

TANG LUNG CHAU DANGEROUS GOODS ANCHORAGE TENTATIVE CONSTRUCTION PROGRAMME

FIGURE 1.6

SCALE not to scale

Act ID	Description	Orig Dur	Early Start	Early Finish
1045	Environmental Permit	0	04SEP00	
1025	Baseline Monitoring	27	04SEP00	30SEP00
1024	Impact Monitoring	787	01OCT00	26NOV02
1014	Stage I (South West Breakwater)	350 *	01OCT00	15SEP01
1015	Dredging - Contaminated Mud	25	01OCT00	25OCT00
1018	Dredging - Clean Mud	37	26OCT00	01DEC00
1020	General Filling	30	02DEC00	31DEC00
1030	Rockfill B	124	26DEC00	28APR01
1040	Rockfill C	130	02FEB01	11JUN01
1050	Secondary Rock Armour	139	12MAR01	28JUL01
1060	Concrete Tetrapod Armour	150	19APR01	15SEP01
1160	Stage II (South West Breakwater Phase I)	433 *	01JAN01	09MAR02
1090	Dredging - Contaminated Mud	13	01JAN01	13JAN01
1100	Dredging - Clean Mud	37	14JAN01	19FEB01
1110	General Filling	28	20FEB01	19MAR01
1120	Rockfill B	104	14MAR01	25JUN01
1130	Rockfill C	112	21APR01	10AUG01
1140	Secondary Rock Armour	105	29MAY01	10SEP01
1150	Concrete Tetrapod	175	16SEP01	09MAR02
1190	Stage II (East Breakwater Phase I)	464 *	20MAR01	26JUN02
1200	Dredging - Contaminated Mud	0	20MAR01	19MAR01
1210	Dredging - Clean Mud	45	20MAR01	03MAY01
1220	General Filling	31	04MAY01	03JUN01
1230	Rockfill B	117	27MAY01	20SEP01
1240	Rockfill C	123	04JUL01	03NOV01
1250	Secondary Rock Armour	99	11SEP01	18DEC01
1260	Concrete tetrapod Armour	109	10MAR02	26JUN02
1290	Stage III (East Breakwater Phase II)	541 *	04JUN01	26NOV02
1310	Dredging - Contaminated Mud	0	04JUN01	03JUN01
1320	Dredging - Clean Mud	33	04JUN01	06JUL01
1330	General Filling	23	07JUL01	29JUL01



TSUEN WAN BAY FURTHER RECLAMATION, AREA 35

TANG LUNG CHAU DANGEROUS GOODS ANCHORAGE
TENTATIVE CONSTRUCTION PROGRAMME

FIGURE 1.6

SCALE not to scale

2. WATER QUALITY

2.1. Water Quality Parameters

As identified in the EIA Final Assessment Report, a key water quality issue of the construction phase will be dredging and sandfilling works for the breakwater foundations. Marine water quality monitoring shall be carried out during the construction phase to ensure that any unacceptable increase in suspended solids/turbidity and decrease in dissolved oxygen due to dredging and filling activities could be readily detected and timely action be taken to rectify the situation.

Dissolved oxygen (DO), turbidity and suspended solids (SS) levels shall be monitored at designated marine water quality monitoring stations during construction of the breakwaters. DO and turbidity should be measured *in-situ* whereas SS should be determined by laboratory.

The water quality impact assessment undertaken in the DEIA study concluded that adverse impacts on water quality arising from the release of heavy metals in contaminated sediment are not anticipated during the dredging works. A quantification of the release of heavy metals from the sediment pore water indicated that the predicted instantaneous concentrations in the marine waters surrounding the dredging site would not exceed the UK Water Quality Standards. The monitoring of heavy metals in the water column is therefore not considered necessary during the dredging works.

Other relevant data shall also be recorded, such as: monitoring location/position, time, water depth, tidal stages, weather conditions and any special phenomena or work underway at the construction site. A sample monitoring record sheet is presented in **Appendix A** for ease of reference.

The proposed water quality monitoring schedule shall be faxed to EPD on or before the first day of the monitoring month. EPD shall also be notified immediately for any changes in schedule by fax.

2.2. Monitoring Equipment

Dissolved Oxygen and Temperature Measuring Equipment

(i) The instrument should be a portable and weatherproof dissolved oxygen (DO) measuring instrument complete with cable and sensor, and use a DC power source. The equipment should be capable of measuring:

- a DO level in the range of 0-20 mg/l and 0-200% saturation; and
- a temperature of 0-45 degree Celsius.

(ii) It should have a membrane electrode with automatic temperature compensation complete with a cable.

(iii) Should salinity compensation not be built-in in the DO equipment, *in-situ* salinity should be measured to calibrate the DO equipment prior to each DO measurement.

test methods for the analysis of waters" should be observed.

Sufficient stocks of spare parts shall be maintained for replacements when necessary. Backup monitoring equipment shall also be made available so that monitoring can proceed uninterrupted even when some equipment is under maintenance, calibration, etc.

2.3. Laboratory Measurement / Analysis

Duplicate samples from each independent sampling event are required by EPD for all parameters. Analysis of suspended solids shall be carried out in a HOKLAS or other international accredited laboratory. Water samples of about 1000 ml shall be collected at the monitoring stations for carrying out the laboratory SS determination. The detection limit shall be 1 mg/l or better. The SS determination work shall start within 24 hours after collection of the water samples. The SS determination shall follow APHA 19ed 2540D or equivalent methods subject to approval of EPD.

If a site laboratory is set up or a non-HOKLAS and non-international accredited laboratory is hired for carrying out the laboratory analysis, the laboratory equipment, analytical procedures, and quality control shall be approved by EPD. All the analysis shall be witnessed by the ER. The ET Leader shall provide the ER with one copy of the relevant chapters of the "APHA Standard Methods for the Examination of Water and Wastewater" 19th edition and any other relevant document for his reference.

Additional duplicate samples may be required by EPD for inter laboratory calibration. Remaining samples after analysis shall be kept by the laboratory for 3 months in case repeat analysis is required. In any circumstance, the sample testing shall have comprehensive quality assurance and quality control programmes. The laboratory shall prepare to demonstrate the programmes to EPD or his representatives when requested.

2.4. Monitoring Locations

The marine water quality monitoring stations during the construction works are shown in **Figure 2.1**. These stations are chosen based on the following criteria:

(i) Locations close to the boundary of the mixing zone, i.e. to just outside the sediment plume generated by dredging works (as indicated in the EIA Final Assessment Report);

(ii) Close to the sensitive receivers which are directly or likely to be affected;

(iii) For monitoring locations located in the vicinity of the sensitive receivers, care should be taken to cause minimal disturbance during monitoring; and

(iv) Two or more control stations which shall be at locations representative of the project site in its undisturbed condition. Control stations should be located, as far as is practicable, both upstream and downstream of the works area.

The co-ordinates of the proposed monitoring stations are listed in Table 2.1. As shown on **Figure 2.1**, the proposed locations for the sensitive receiver monitoring stations represent the sensitive receivers which are predicted to be affected by the sediment plume modelling undertaken in the DEIA Study. As described in Section 3.6.2 of the EIA Final Assessment Report, the plume modelling predicted increases in SS concentrations of less than 1 mg/L on

Turbidity Measurement Instrument

The instrument should be a portable and weatherproof turbidity measuring instrument using a DC power source. It should have a photoelectric sensor capable of measuring turbidity between 0-1000 NTU (e.g. Hach model 2100P or an approved similar instrument).

Sampler

A water sampler is required. It should comprise a transparent PVC cylinder, with a capacity of not less than 2 litres, and can be effectively sealed with latex cups at both ends. The sampler should have a positive latching system to keep it open and prevent premature closure until released by a messenger when the sampler is at the selected water depth (e.g. Kahlsico Water Sampler or an approved similar instrument).

Water Depth Detector

A portable, battery-operated echo sounder should be used for the determination of water depth at each designated monitoring station. This unit can either be hand held or affixed to the bottom of the work boat, if the same vessel is to be used throughout the monitoring programme.

Salinity

A portable salinometer capable of measuring salinity in the range of 0-40 part per thousand (ppt) should be provided for measuring salinity of the water at each monitoring location.

Sample Containers and Storage

Water samples for SS determination should be stored in high density polythene bottles with no preservative added, packed in ice (cooled to 4°C without being frozen) and delivered to the laboratory and analyzed as soon as possible after collection.

Monitoring Position Equipment

A hand-held or boat-fixed type digital Differential Global Positioning System (DGPS) with way point bearing indication and Radio Technical Commission for maritime (RTCM) Type 16 error message 'screen pop-up' facilities (for real-time auto-display of error messages and DGPS corrections from the Hong Kong Hydrographic Office), or other equipment instrument of similar accuracy, should be provided and used during marine water monitoring to ensure the monitoring vessel is at the correct location before taking measurements.

Calibration of In-Situ Instruments

The pH meter, DO meter and turbidimeter shall be checked and calibrated before use. DO meter and turbidimeter shall be certified by a laboratory accredited under HOKLAS or any other international accreditation scheme, and subsequently re-calibrated at 3 monthly intervals throughout all stages of the water quality monitoring. Responses of sensors and electrodes should be checked with certified standard solutions before each use. Wet bulb calibration for a DO meter shall be carried out before measurement at each monitoring location.

For the on site calibration of field equipment, the BS 127:1993, "Guide to Field and on-site

fish culture zones are involved).

Table 2.2 Summary of Effectiveness of Recommended Mitigation Measures and Proposed Monitoring and Audit Requirements

Construction Works	Identified Affected Sensitive Receivers (SRs) – Unmitigated works	Effectiveness of Recommended Mitigation Measures	Predicted Impacts after Mitigation / Proposed EM&A Requirements
Dredging*	Tung Wan Tsai – 14 mg/L (8.6 mg/L) Ma Wan fish culture zone – 4.5 mg/L (2.9 mg/L)	Use of closed grab dredger & reduction in production rate (with not more than two dredgers working at one time). Estimated reduction in sediment loss rate from 6.84 kg/s to 2.15 kg/s	Tung Wan Tsai – 4.4 mg/L (2.7 mg/L) Ma Wan fish culture zone – 1.4 mg/L (0.9 mg/L) Impact monitoring recommended at these SRs
Sandfilling*	Tung Wan Tsai – 802 mg/l Ma Wan fish culture zone – 258 mg/l	Use of pipeline discharge method & reduction in sandfill discharge rate. Estimated reduction in sediment loss rate from 392 kg/s to 2.08 kg/s	Tung Wan Tsai – 4.3 mg/l (2.6 mg/l) Ma Wan fish culture zone – 1.4 mg/l (0.9 mg/l) Impact monitoring recommended at these SRs

Notes:
1. WQO : allowable increase in SS (depth averaged value) is < 5.7 mg/L
2. WQO : allowable increase in SS at bottom water depth is < 8.7 mg/L
3. * Predicted maximum elevations in SS concentrations (above ambient levels) during dredging and sandfilling works (dry season spring tide). Values given in brackets indicate the predicted depth-averaged SS concentration

2.5. Baseline Monitoring

Baseline conditions for marine water quality shall be established and agreed with EPD prior to the commencement of works. The purposes of the baseline monitoring are to establish ambient conditions prior to the commencement of the works and to demonstrate the suitability of the proposed impact and control monitoring stations. The baseline conditions shall normally be established by measuring the water quality parameters specified in *Section 2.1*. The measurements shall be taken at all designated monitoring stations including control stations, three days per week, at mid-flood and mid-ebb tides, for at least four weeks prior to the commencement of marine works.

Other relevant data shall also be recorded, such as: monitoring location/position, time, water depth, tidal stages, weather conditions and any special phenomena underway near the monitoring station. There shall not be any marine construction activities in the vicinity of the stations during the baseline monitoring.

In exceptional cases when insufficient baseline monitoring data or questionable results are obtained, the ET Leader shall seek approval from the IC(E) and EPD on an appropriate set of data to be used as baseline reference.

Baseline monitoring schedule shall be faxed to EPD one week prior to the commencement of baseline monitoring. The interval between two sets of monitoring shall not be less than thirty-six hours.

both tides for all of the beaches except Tung Wan Tsai. (For the dry season spring tide, Butterfly, Cafeteria and Lido beach are not affected by the dredging works and predicted SS concentrations at Anglers, Hoi Mei Wan, Casam and Gemini beach are negligible. Similarly, for the wet season neap tide, Butterfly, Cafeteria and Lido beach are not affected by the dredging works and predicted SS concentrations at Anglers, Casam Gemini and Hoi Mei Wan beach are negligible).

Table 2.1 Proposed Marine Water Quality Monitoring Stations

Station	Easting	Northing
S1	823790	822870
S2	823520	823490
S3	824440	823460
S4	824610	823810
M1	824100	821600
M2	826350	822630
C1	825910	824350
C2	826790	821270
C3	824210	820340

Table 2.2 summarizes the predicted effectiveness of the recommended water quality mitigation measures (Section 2.10) during the construction works. The maximum predicted increase in SS concentrations occurs at Tung Wan Tsai in the dry season spring tide (as shown in Figure 56 of Appendix B, EIA Final Assessment Report, this increase occurs near the bed layer for less than one hour in the tidal cycle). With the recommended mitigation measures in place for the dredging works (including the additional mitigation measures for further protection), the maximum predicted increase in SS concentrations at Tung Wan Tsai is 4.4 mg/L which would comply with the WQO for SS (i.e. allowable increase of 5.7 mg/L for depth averaged value). For the mitigated sandfilling works, the maximum elevation in SS concentrations at Tung Wan Tsai is estimated to be approximately 4.3 mg/L for the dry season spring tide. At the Ma Wan fish culture zone, the predicted maximum increase in SS concentrations during the mitigated dredging and sandfilling works is 1.4 mg/L (dry season spring tide). In terms of the WQO, the predicted increases in SS concentrations at the Ma Wan fish culture zone comply with the acceptable increase of 5.7 mg/L (depth-averaged value). It is recommended that impact monitoring should be undertaken at stations near the Ma Wan fish culture zone and Tung Wan and Tung Wan Tsai beaches to act as a check on whether SS concentrations generated during construction activities exceeds the WQO. By monitoring marine water quality at these stations, the effectiveness of the implemented mitigation measures will be assessed.

Control stations are necessary to compare the water quality from potentially impacted sites with the ambient water quality. Control stations shall be located within the same body of water as the impact monitoring stations but should be outside the area of influence of the works and, as far as practicable, not affected by any other works.

Measurements shall be taken at 3 water depths, namely, 1 m below water surface, mid-depth and 1 m above sea bed, except where the water depth is less than 6 m, the mid-depth station may be omitted. Should the water depth be less than 3 m, only the mid-depth station will be monitored. The status and locations of water sensitive receivers and the marine activities may change after issuing this Manual. If such cases exist, the ET Leader shall propose with justification for changes to monitoring locations or other requirements of the EM&A programme, and seek approval from the IC(E) and DEP (and DAF if monitoring locations for

of the environmental management system (i.e. of the overall EM&A programme) should be reviewed by the ET Leader on a quarterly basis. The findings of this review should be included in the quarterly EM&A summary reports, together with any recommendations to improve the performance of the EM&A programme.

Table 2.3 Action and Limit Levels for Marine Water Quality

Parameters	Action	Limit
DO in mg/l (Surface, Middle & Bottom)	Surface & Middle 5%-ile of baseline data for surface and middle layer Bottom 5%-ile of baseline data for bottom layer	Surface & Middle 4 mg/l except 5 mg/l for fish culture zone or 1%-ile of baseline data for surface and middle layer Bottom 2 mg/l or 1%-ile of baseline data for bottom layer
SS in mg/l (depth-averaged)	95%-ile of baseline data or 120% of upstream control station's SS at the same tide of the same day	99%-ile of baseline or 130% of upstream control station's SS at the same tide of the same day
Turbidity in NTU (depth-averaged)	95%-ile of baseline data or 120% of upstream control station's Turbidity at the same tide of the same day	99%-ile of baseline or 130% of upstream control station's Turbidity at the same tide of the same day

Notes:
1 "depth-averaged" is calculated by taking the arithmetic means of reading of all three depths.
2 For DO, non-compliance of the water quality limits occurs when monitoring result is lower than the limits.
3 For turbidity and SS, non-compliance of the water quality limits occurs when monitoring result is higher than the limits.
4 All the figures given in the table are used for reference only and the EPD may amend the figures whenever it is considered as necessary.

2.6. Impact Monitoring

During the dredging and sandfilling works for the breakwater foundations, monitoring shall be undertaken three days per week, at mid-flood and mid-ebb tides, with sampling/measurement at the designated monitoring stations. The interval between two sets of monitoring shall not be less than thirty-six hours except where there are exceedances of Action and/or Limit levels, in which case the monitoring frequency will be increased. In case of any night-time dredging or sandfilling works, one of the weekly monitoring events shall be conducted during night-time hours so as to coincide with periods of night-time works.

After a period of 2 weeks from the completion of all dredging and sandfilling works and provided that no deterioration in water quality is shown during this period, the monitoring frequency shall be reduced in view of these being the key activities with the potential to impact on marine water quality. Monitoring shall then be undertaken at a frequency of one day per week (daytime hours) for the remainder of the construction period. Sampling/measurement shall be conducted at the designated monitoring stations, at mid-flood and mid-ebb tides. Again, the monitoring frequency will be increased in the event of any exceedance of Action and/or Limit levels.

2.7. Post-construction Monitoring

Upon completion of all marine-based construction activities, a post-project monitoring exercise on water quality shall be carried out for four weeks in the same manner as the impact monitoring.

2.8. Environmental Quality Performance Limits

Marine water quality criteria, namely Action and Limit levels, are shown in Table 2.3. These criteria should be applied to ensure that any deteriorating water quality could be readily detected. When the monitoring results of the water quality parameters at any designated monitoring stations exceed the water quality criteria, the actions in accordance with the Action Plan in Table 2.4 shall be carried out.

2.9. Impact Prediction Review Procedures

In the event of exceedance of the marine water quality criteria (i.e. Action and Limit levels as described above), an impact prediction review checklist (**Appendix E**) should be employed to check the extent of discrepancy between the actual and predicted impact at the designated sensitive receiver monitoring stations.

It is recommended that if monitoring results indicate that the dredging or sandfilling works have caused an adverse impact on water quality at the Ma Wan fish culture zone and Tung Wan Tsai and Tung Wan beaches, the construction programme should be carefully reviewed so as to slow down the rate of dredging or sandfilling such that the water quality at these sensitive receivers is in compliance with the WQOs. The working schedule and the mitigation measures should be reviewed by the Contractor, the IC(E), the ET Leader and the ER, and if necessary, works should be slowed down or suspended until such impact is reduced to an acceptable level.

The ET Leader should assess the effectiveness and efficiency of the proposed mitigation measures and/or remedial actions for the on-going construction activities. The performance

Table 2.4 Event and Action Plan for Marine Water Quality (Continued)

Event	ET Leader	IC(E)	ER	Contractor
Limit level being exceeded by two or more consecutive sampling days	Repeat measurement on next day of exceedance to confirm findings; Identify source(s) of impact; Inform IC(E), contractor, ER and EPD; Check monitoring data, all plant, equipment and Contractor's working methods; Discuss mitigation measures with IC(E), ER and Contractor; Ensure mitigation measures are implemented; Increase the monitoring frequency to daily until no exceedance of Limit level for two consecutive days. .	Check monitoring data submitted by ET and Contractor's working method; Discuss with ET and Contractor on possible remedial actions; Review the Contractor's mitigation measures whenever necessary to assure their effectiveness and advise the ER accordingly; Supervise the implementation of mitigation measures.	Discuss with IC(E), ET and Contractor on the proposed mitigation measures; Request Contractor to critically review the working methods; Make agreement on the mitigation measures to be implemented; Ensure mitigation measures are properly implemented; Consider and instruct, if necessary, the Contractor to slow down or to stop all or part of the construction activities until no exceedance of Limit level.	Take immediate action to avoid further exceedance; Submit proposal of mitigation measures to ER within 3 working days of notification and discuss with ET, IC(E) and ER; Implement the agreed mitigation measures; Resubmit proposals of mitigation measures if problem still not under control; As directed by the Engineer, to slow down or to stop all or part of the construction activities until no exceedance of Limit level.

Table 2.4 Event and Action Plan for Marine Water Quality

Event	ET Leader	IC(E)	ER	Contractor
Action level being exceeded by one sampling day	Repeat *in-situ* measurement on next day of exceedance to confirm findings; Identify source(s) of impact; Inform IC(E), contractor and ER; Check monitoring data, all plant, equipment and Contractor's working methods.	Check monitoring data submitted by ET and Contractor's working methods.	Confirm receipt of notification of non-compliance in writing; Notify Contractor.	Inform the ER and confirm notification of the non-compliance in writing; Rectify unacceptable practice; Amend working methods if appropriate.
Action level being exceeded by two or more consecutive sampling days	Repeat measurement on next day of exceedance to confirm findings; Identify source(s) of impact; Inform IC(E), contractor, ER and EPD; Check monitoring data, all plant, equipment and Contractor's working methods; Discuss mitigation measures with IC(E), ER and Contractor; Ensure mitigation measures are implemented; Increase the monitoring frequency to daily until no exceedance of Action level.	Check monitoring data submitted by ET and Contractor's working method; Discuss with ET and Contractor on possible remedial actions; Review the proposed mitigation measures submitted by Contractor and advise the ER accordingly; Supervise the implementation of mitigation measures.	Discuss with IC(E) on the proposed mitigation measures; Ensure mitigation measures are properly implemented; Assess the effectiveness of the implemented mitigation measures.	Inform the Engineer and confirm notification of the non-compliance in writing; Rectify unacceptable practice; Check all plant and equipment and consider changes of working methods; Submit proposal of mitigation measures to ER within 3 working days of notification and discuss with ET, IC(E) and ER; Implement the agreed mitigation measures.
Limit level being exceeded by one sampling day	Repeat measurement on next day of exceedance to confirm findings; Identify source(s) of impact; Inform IC(E), contractor, ER and EPD; Check monitoring data, all plant, equipment and Contractor's working methods; Discuss mitigation measures with IC(E), ER and Contractor.	Check monitoring data submitted by ET and Contractor's working method; Discuss with ET and Contractor on possible remedial actions; Review the proposed mitigation measures submitted by Contractor and advise the ER accordingly.	Confirm receipt of notification of failure in writing; Discuss with IC(E), ET and Contractor on the proposed mitigation measures; Request Contractor to review the working methods.	Inform the ER and confirm notification of the non-compliance in writing; Rectify unacceptable practice; Check all plant and equipment and consider changes of working methods; Submit proposal of mitigation measures to ER within 3 working days of notification and discuss with ET, IC(E) and ER;

- minimize disturbance to the seabed while dredging;
- minimize leakage of dredged material during lifting;
- prevent loss of material during transport of dredged material;
- prevent discharge of dredged material except at approved locations;
- dredging operations should involve leaving sediment in place whenever practicable; and
- ensure that the construction works will cause no visible foam, oil, grease, scum, litter or other objectionable matter to be present in the water within and adjacent to the site or dumping grounds.

The licensee should formulate his design and construction methods with these factors in mind, and provide specification in the tender submission.

Pollution Avoidance Measures During Dredging and Dumping

Pollution avoidance measures shall include, but not be limited to, the following:

- mechanical grabs shall be designed and maintained to avoid spillage and shall seal tightly while being lifted (closed-grab dredgers);
- where trailing suction hopper dredgers are in use, overflow from the dredger and the operation of automatic lean mixture overboard (ALMOB) systems shall not be permitted;
- all vessels shall be sized such that adequate clearance is maintained between vessels and the sea bed at all states of the tide to ensure that undue turbidity is not generated by turbulence from vessel movement or propeller wash;
- all pipe leakages shall be repaired promptly and plant shall not be operated with leaking pipes;
- excess material shall be cleaned from the decks and exposed fittings of barges and hopper dredgers before the vessel is moved;
- adequate freeboard shall be maintained on barges to ensure that decks are not washed by wave action;
- all barges and hopper dredgers shall be fitted with tight fitting seals to their bottom openings to prevent leakage of material; and
- loading of barges and hoppers shall be controlled to prevent splashing of dredged material to the surrounding water, and barges or hoppers shall not be filled to a level which will cause the overflow of materials or polluted water during loading or transportation.

2.10. Water Quality Mitigation Measures

Introduction

Mitigation measures for the construction activities are summarised below. If the below measures are not sufficient to restore the water quality to an acceptable level upon the advice of the ET Leader, the Contractor shall liaise with the ET Leader on some other mitigation measures, propose to IC(E) and ER for approval, and carry out the approved mitigation measures. The implementation schedule of the recommended water quality mitigation measures is presented in **Appendix B**.

Dredging Works

The proper selection of appropriate dredging methods will reduce the amount of sediment resuspension, and this in turn will minimize adverse impacts on water sensitive receivers. Based on the predicted impacts, low impact dredging techniques such the closed grab dredger or trailing suction hopper dredger (THD), with no overflow nor ALMOB, are recommended.

To further reduce the potential impact to the water sensitive receivers during the dredging and sandfilling works, particularly at the Ma Wan fish culture zone, the adoption of additional mitigation measures is recommended. These additional measures comprise restricting the number of dredgers to not more than two working at one time; and conducting one of the weekly water quality monitoring events for impact monitoring during night-time hours should there be dredging or sandfilling works at this time. The proposed mitigatory measures would provide further protection at the water sensitive receivers.

It is recommended that the maximum total daily dredging rate (i.e. for dredging of both contaminated and uncontaminated sediment) shall not exceed 9,524 m^3/day, as based on the reduced weekly production rate following adoption of the above additional mitigation measure on restricting the number of dredgers working at one time. For dredging of contaminated sediment alone, the maximum daily dredging rate shall not exceed 7,143 m^3/day, as based on the preliminary weekly production rate adopted in the water quality assessment of 50,000 m^3/week. Dredging works and sandfill placement for the breakwater foundations shall not be carried out concurrently. This restriction on there being no concurrent dredging and sandfilling works includes such works for different stages of the breakwater construction at one time.

As described in Section 3.6.2 of the EIA Final Assessment Report, the tidal flow modelling results for the baseline case, i.e. without the breakwaters, indicate maximum current speeds of around 0.8 m/s in the eastern and southern area of the proposed DGA (wet season spring tide). The use of silt curtains is therefore not considered to be a practicable mitigation measure during dredging works due to the high current speed.

Good Operational Practices

The contractor will be required to minimize potential adverse impacts on water quality resulting from dredging and dumping operations to within acceptable levels as defined by the WQO. To achieve these requirements the contractor should design and implement methods of working, to the maximum practicable extent, that:

(ii) transport designated contaminated marine mud by split barge of not less than 750m^3 capacity, well maintained and capable of rapid opening and discharge at the disposal site;

(iii) design properly and maintain carefully all operational plant so as to minimize the risk of sediments or other pollutants being released into the water column and deposited in the seabed other than designated locations. The Contractor's work shall cause no visible foam, oil, grease, scum, litter or other objectionable matter to be present in the water within the site;

(iv) fit all barges and hopper dredgers with tight fitting seals to their bottom openings to prevent leakage of material;

(v) release the mud rapidly and close the hoppers immediately; any material adhering to the sides of the hopper shall not be washed out of the hopper and the hopper shall remain closed until the barge next returns to the disposal site. The Contractor shall ensure that the dumping vessel shall be stationary throughout the dumping operation;

(vi) size all vessels such that adequate clearance is maintained between the seabed and vessels at all states of the tide, to ensure that undue turbidity is not generated by turbulence from vessel movement or propeller wash. Adequate freeboard shall be maintained on barges to ensure that decks are not washed by wave action;

(vii) employ only barges equipped with automatic self-monitoring devices for the dumping operation, and shall co-operate with and facilitate the DEP to inspect the device and retrieve the record stored in the device on a regular basis;

(viii) provide experienced full time personnel on board all dumping vessels and provide suitable training to ensure that appropriate methods to minimize pollution are implemented. Records shall be maintained to satisfy the DEP that there is no short dumping or dumping outside the Designated Dumping Area. The Contractor shall also make available to the DEP and the secretary of Fill Management Committee (S/FMC), Civil Engineering Department, at any time upon the written request of the DEP, all information and records relevant to the dredging and mud disposal operation. This information shall include, but not be limited to, all data on the plant used by the Contractor, up-to-date periodic data on production rates and record copies of Notification of Dumping which have been sent to the Management Team, etc.

Sandfilling Activities

The recommended method for sandfilling of the breakwater foundations is the use of a trailer suction hopper dredger (THD), or other suitable vessel, with sandfill placement by discharging through a pipeline. It is recommended that the sandfilling placement rate shall not exceed 2,500 m^3 over one hour.

Contaminated Marine Sediments

Additional provisions will be required where marine sediments are contaminated. Preliminary sediment analyses indicate that the marine sediments along the south-west breakwater (vibrocore locations VC2, VC3 and VC4) are seriously contaminated (Class C). Further to the sediment sampling undertaken during the DEIA Study, which is indicative of the sediment contamination levels within the area of the DGA, the successful Tenderer (detailed design stage) would be required to undertake a detailed sediment quality assessment to identify precisely the location and extent of any contamination and to present the findings within a Sediment Quality Report.

Once determined, the locations and depths of any areas of contaminated marine sediments shall be indicated in the construction contract. The contractor shall ensure that contaminated marine sediments, if present, are dredged, transported and placed in approved special dumping grounds in accordance with the *EPD Technical Circular No. 1-1-92 Classification of Dredged Sediments for Marine Disposal, Works Branch Technical Circular (WBTC) No. 22/92 Marine Disposal of Dredged Mud* and *WBTC No. 6/92 Fill Management*. Special EPD procedures for the avoidance of pollution during the dredging, transportation and disposal of designated contaminated marine sediment are listed below:

(a) Uncontaminated mud shall not be dumped other than in dumping grounds as may be approved for the purpose by the Director of Environmental Protection (DEP) and in accordance with the Dumping at Sea Ordinance. If the contaminated mud cannot be left in situ, it shall be dumped at East Sha Chau Contaminated Mud Disposal Pits (CMPs) or other disposal pits as may be approved for the purpose by the DEP. The Contractor shall be responsible for obtaining all necessary licences for these operations.

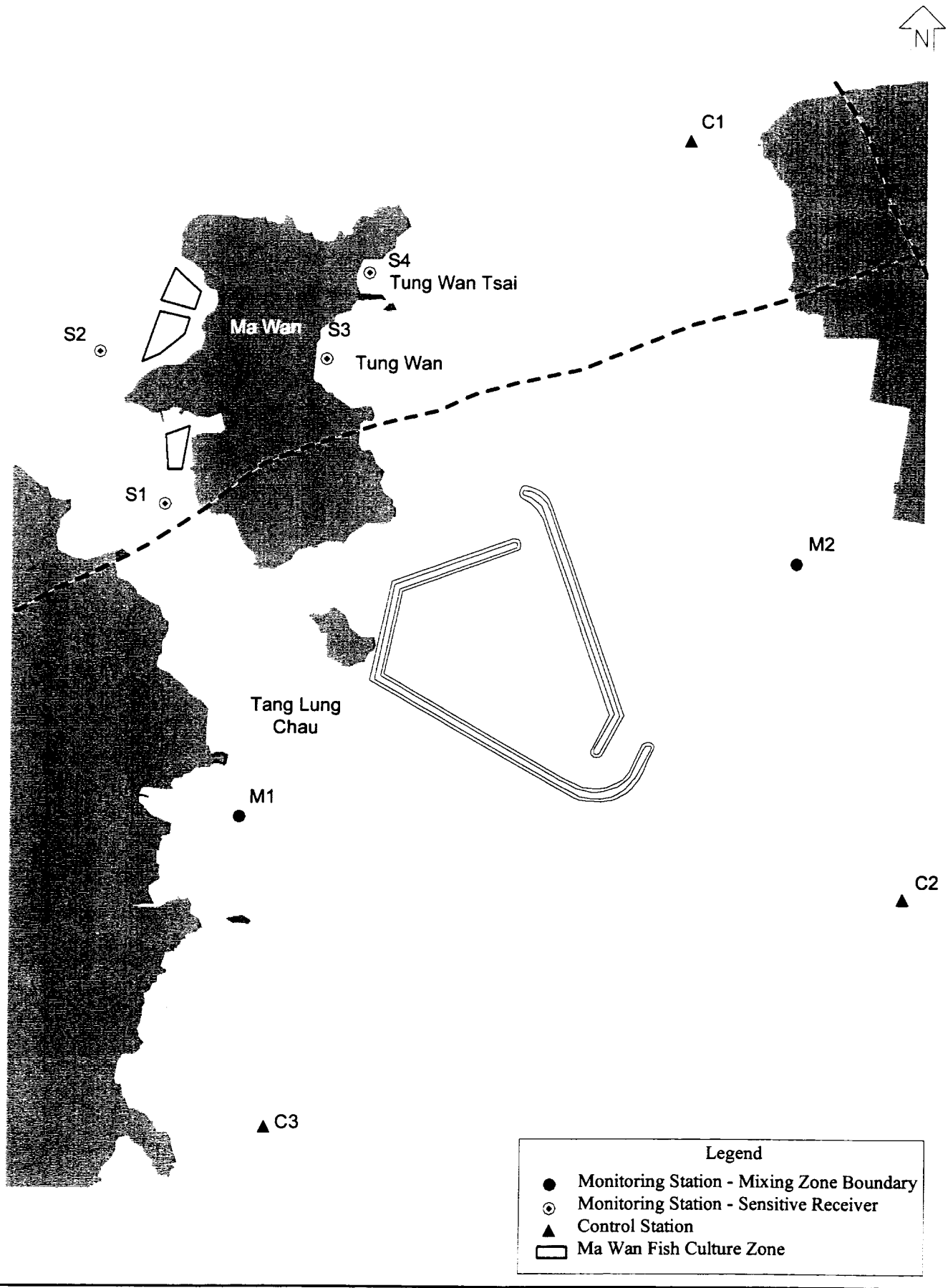
Notes: The Engineer shall ensure that the Contractor has access to WBTC No. 22/92; EPD TC No. 1.1.92; and Fill Management Committee General Allocation Conditions for Marine Borrow Areas and Mud Disposal Sites.

(b) When the Contractor dumps the contaminated mud at East Sha Chau CMPs, he shall place the contaminated mud at a location and in such a manner as directed by the Management Team of the Civil Engineering Department. The Contractor shall proceed with the disposal operation as instructed by the Management Team and in accordance with guidance notes which are issued by the Management Team. The Contractor shall not carry out any dumping without permission of the Management Team or when the Management Team is not in operation.

(c) The Contractor shall carry out the dumping operation in strict accordance with the method statement agreed by the DEP, any non-compliance with the agreed method shall be a breach of conditions of the relevant licence issued by the DEP and is an offence under the Dumping at Sea Ordinance.

(d) When dredging, transporting and disposing of designated contaminated marine mud, the Contractor shall implement additional special procedures for the avoidance of pollution which shall include, but not be limited to, the following:

(i) employ a grab dredger with a closed watertight grab for dredging of designated contaminated marine mud;



PROPOSED MARINE WATER QUALITY MONITORING LOCATIONS

FIGURE 2.1

SCALE 1 : 22000

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This method would require the vessel to hook up to a floating pipeline leading to a diffuser pontoon stationed over the breakwater trench. The diffuser pipe would enable sandfill to be discharged relatively close to the seabed level thus minimizing the loss of fines in the middle and upper parts of the water column. The position of the diffuser pontoon would need to be adjusted during discharge and this would be possible using either a self powered pontoon or a separate craft. Adjustments to the elevation of the diffuser to suit the seabed levels along the breakwater trenches could be made prior to periods of sandfill discharge.

Mitigation During Placement of Sediment within DGA

It is recommended that the dumping of filling materials in the necessary areas within the DGA, so as to make up the required thickness of soft material cover at the mooring anchorages, be undertaken after the completion of the breakwaters construction. With this works method, sediment plumes generated from the dumping of mud will largely be contained by the breakwaters.

3. WASTE MANAGEMENT

3.1. Introduction

Waste management will be the contractor's responsibility to ensure that all wastes produced during the construction of the proposed TLCDGA are handled, stored and disposed of in accordance with good waste management practices and EPD's regulations and requirements. The contractor will be required to ensure that loss of dredged material does not take place during transportation of the material in barges to the designated marine disposal ground (including dredged material from maintenance dredging).

Other waste materials generated during construction activities, such as waste construction materials, chemical wastes and general refuse from the workforce, are recommended to be audited at regular intervals (at least monthly) to ensure that proper storage, transportation and disposal practices are being implemented. This monitoring of waste management practices will ensure that these solid and liquid wastes generated during construction are not disposed into the surrounding marine waters. The Contractor will be responsible for the implementation of any mitigation measures to minimise waste or redress problems arising from the waste materials.

3.2. Waste Control and Mitigation Measures

Mitigation measures for waste management during the construction phase and maintenance dredging are summarised below. The reuse and recycling of materials is recommended wherever possible. With the appropriate handling, storage and removal of waste arisings during the construction of the DGA, as defined below, the potential to cause adverse impacts on water quality and marine ecology will be minimized. The implementation schedule of recommended mitigation measures for waste management is presented in **Appendix B**.

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 2.8*, the marine sediment at three vibrocore locations along the proposed south-west breakwater of the DGA is classified as Class C, seriously contaminated material. The mud dredged at these areas 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 mud. Since the dredged sediments at the other areas of the breakwaters are identified as Class A or B, they will be suitable for disposal at a gazetted marine disposal ground.

General Refuse

General refuse generated on the vessels shall be stored separately from other construction and chemical wastes. 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 these waste management practices, including appropriate staff training, be employed to ensure that refuse arising during the construction works do not enter the marine waters at the works area.

Operational Phase Maintenance Dredging

During the operational phase, the only issue with respect to waste management will be marine sediment disposal from maintenance dredging. As discussed in the EIA Final Assessment Report (Section 3.7.2), a preliminary siltation assessment[3] has been carried out to give an initial estimate of siltation effects for the purpose of providing a preliminary estimate of the likely maintenance dredging requirements for the DGA. Reliable estimates of siltation and scouring effects would require 3D siltation modelling. The findings of the 3D siltation modelling would form the basis for determining the maintenance dredging requirements. Based on the findings of the preliminary siltation study, the volume of dredged material is estimated to be minor in scale on comparison to the construction phase dredging.

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.

3.3. Control Measures and Auditing Procedures

The Contractor shall pay attention to the Waste Disposal Ordinance, the Dumping at Sea Ordinance, the Public Health and Municipal Services Ordinance and the Water Pollution Control Ordinance, and carry out the appropriate waste management work. The relevant licence/permit, such as the chemical waste producer registration, etc. shall be obtained. The Contractor shall refer to the relevant booklets issued by EPD when applying for the licence/permit.

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. Training of site personnel in proper waste management and chemical handling procedures shall be undertaken.

During the site inspections and the document review procedures as described in *Sections 4.1* and *4.2* of this Manual, the ET Leader shall pay special attention to the issues relating to waste management, and check whether the Contractor has followed the relevant contract specifications and the procedures specified under the laws of Hong Kong. Stringent control and audit will be necessary to ensure that effective waste management practices and correct storage, transportation and disposal requirements for the various waste materials are being implemented.

3 Siltation Assessment for the Tang Lung Chau Dangerous Goods Anchorage, MCAL October 1998.

The Contractor will be required to ensure that all dredged material (i.e. both contaminated and uncontaminated sediment) is disposed of at the approved locations. During transportation and disposal of the dredged sediments, the following measures shall be taken by the Contractor to minimize potential impacts:

- Bottom opening of barges and hopper dredgers 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 dredgers before the vessel is moved.

- Loading of barges and hopper dredgers shall be controlled to prevent splashing of dredged material to the surrounding water, and barges or hoppers shall not be filled to a level which will cause the overflow of materials or polluted water during loading or transportation.

- Employ only transport barges or vessels equipped with automatic self-monitoring devices for the dumping operation, as specified by the Director of Environmental Protection (DEP). The Contractor shall co-operate with and facilitate the DEP to inspect the device and retrieve the record stored in the device on a regular basis;

- Records shall be maintained to satisfy the DEP that there is no short dumping or dumping outside the Designated Dumping Area. The Contractor shall also make available to the DEP and the secretary of Fill Management Committee (S/FMC), Civil Engineering Department (CED), at any time upon the written request of the DEP, all information and records relevant to the dredging and mud disposal operation. This information shall include, but not be limited to, all data on the plant used by the Contractor, up-to-date periodic data on production rates and record copies of Notification of Dumping which have been sent to the Management Team of CED.

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

Any chemical waste produced shall be disposed to a licensed treatment facility such as the Chemical Waste Treatment Centre (CWTC) located at Tsing Yi, which is designed to treat most of the chemical waste from the territory. Disposal of chemical wastes at the CWTC will ensure that environmental, health and safety risks are reduced to a minimum, provided that correct storage procedures are instigated on the marine vessels.

The Contractor should contact EPD and the Contractor operating the CWTC, who offer a chemical waste collection service. In addition, the Contractor shall check to ensure that the handling methods for the wastes in question are appropriate, and that separation of chemical wastes from other waste arisings is conducted. Any other Contractor employed for the collection of chemical waste must be a registered chemical waste collector under the Ordinance.

4. SITE ENVIRONMENTAL AUDIT

4.1. Site Inspections

Site inspections provide a direct means to initiate and enforce specified environmental protection and pollution control measures. These shall be undertaken routinely to inspect construction activities in order to ensure that appropriate environmental protection and pollution control mitigation measures are properly implemented. The site inspection is one of the most effective tools to enforce the environmental protection requirements at the works area.

The ET Leader shall be responsible for formulating the environmental site inspection, the deficiency and action reporting system, and for carrying out the site inspection works. Within 21 days of the construction contract commencement he shall submit a proposal for site inspection and deficiency and action reporting procedures to the Contractor for agreement, and to the ER for approval. The ET's proposal for rectification would be made known to the IC(E).

Regular site inspections shall be carried out at least once per week. The areas of inspection shall not be limited to the environmental situation, pollution control and mitigation measures within the site; it should also review the environmental situation outside the works area which is likely to be affected, directly or indirectly, by the site activities. The ET Leader shall make reference to the following information in conducting the inspection:

(i) EIA recommendations on environmental protection and pollution control mitigation measures;

(ii) works progress and programme;

(iii) individual works methodology proposals (which shall include proposal on associated pollution control measures);

(iv) contract specifications on environmental protection;

(v) relevant environmental protection and pollution control laws; and

(vi) previous site inspection results.

The Contractor shall keep the ET Leader updated with all relevant information on the construction contract necessary for him to carry out the site inspections. Inspection results and associated recommendations for improvements to the environmental protection and pollution control works shall be submitted to the IC(E) and the Contractor within 24 hours. The Contractor shall follow the procedures and time-frame as stipulated in the environmental site inspection, and the deficiency and action reporting system formulated by the ET Leader, to report on any remedial measures subsequent to the site inspections.

Ad hoc site inspections shall also be carried out if significant environmental problems are identified. Inspections may also be required subsequent to receipt of an environmental complaint, or as part of the investigation work, as specified in the Action Plan for

(iv) advise the Contractor if mitigation measures are required;

(v) review the Contractor's response to identified mitigation measures, and the updated situation;

(vi) if the complaint is transferred from EPD, submit interim report to EPD on status of the complaint investigation and follow-up action within the time frame assigned by EPD;

(vii) undertake additional monitoring and audit to verify the situation if necessary, and review that circumstances leading to the complaint do not recur;

(vii) report investigation results and subsequent actions to complainant (if the source of complaint is EPD, the results should be reported within the timeframe assigned by EPD); and

(viii) record the complaint, investigation, the subsequent actions and the results in the monthly EM&A reports.

A flow chart of the complaints handling procedure is shown in **Figure 4.1**. During any complaint investigation work, the Contractor and ER shall co-operate with the ET Leader in providing all necessary information and assistance for completion of the investigation. If mitigation measures are identified as being required in the investigation, the Contractor shall promptly carry out the mitigation. The ER shall ensure that all necessary measures have been carried out by the Contractor.

environmental monitoring and audit.

4.2. Compliance with Legal and Contractual Requirements.

There are contractual environmental protection and pollution control requirements as well as environmental protection and pollution control laws in Hong Kong with which construction activities must comply.

In order that the works are in compliance with the contractual requirements, all works method statements submitted by the Contractor to the ER for approval shall be sent to the ET Leader for vetting to see whether sufficient environmental protection and pollution control measures have been included. The implementation schedule of mitigation measures is summarised in **Appendix B**.

The ET Leader shall also review the progress and programme of the works to check that relevant environmental laws have not been violated, and that any foreseeable potential for violating laws can be prevented.

The Contractor shall regularly copy relevant documents to the ET Leader so that work checking can be carried out. The document shall at least include the updated Work Progress Reports, updated Works Programme, any application letters for different licence/permits under the environmental protection laws, and copies of all valid licences/permits. The site diary shall also be available for the ET Leader's inspection upon his request.

After reviewing the document, the ET Leader shall advise the IC(E) and Contractor of any non-compliance with contractual and legislative requirements on environmental protection and pollution control for them to take follow-up actions. If the ET Leader's review concludes that the current status on licence/permit application and any environmental protection and pollution control preparation works may result in potential violation of environmental protection and pollution control requirements, he shall also advise the Contractor and the ER accordingly.

Upon receipt of the advice, the Contractor shall undertake immediate action to correct the situation. The ER shall follow up to ensure that appropriate action has been taken in order to satisfy contractual and legal requirements.

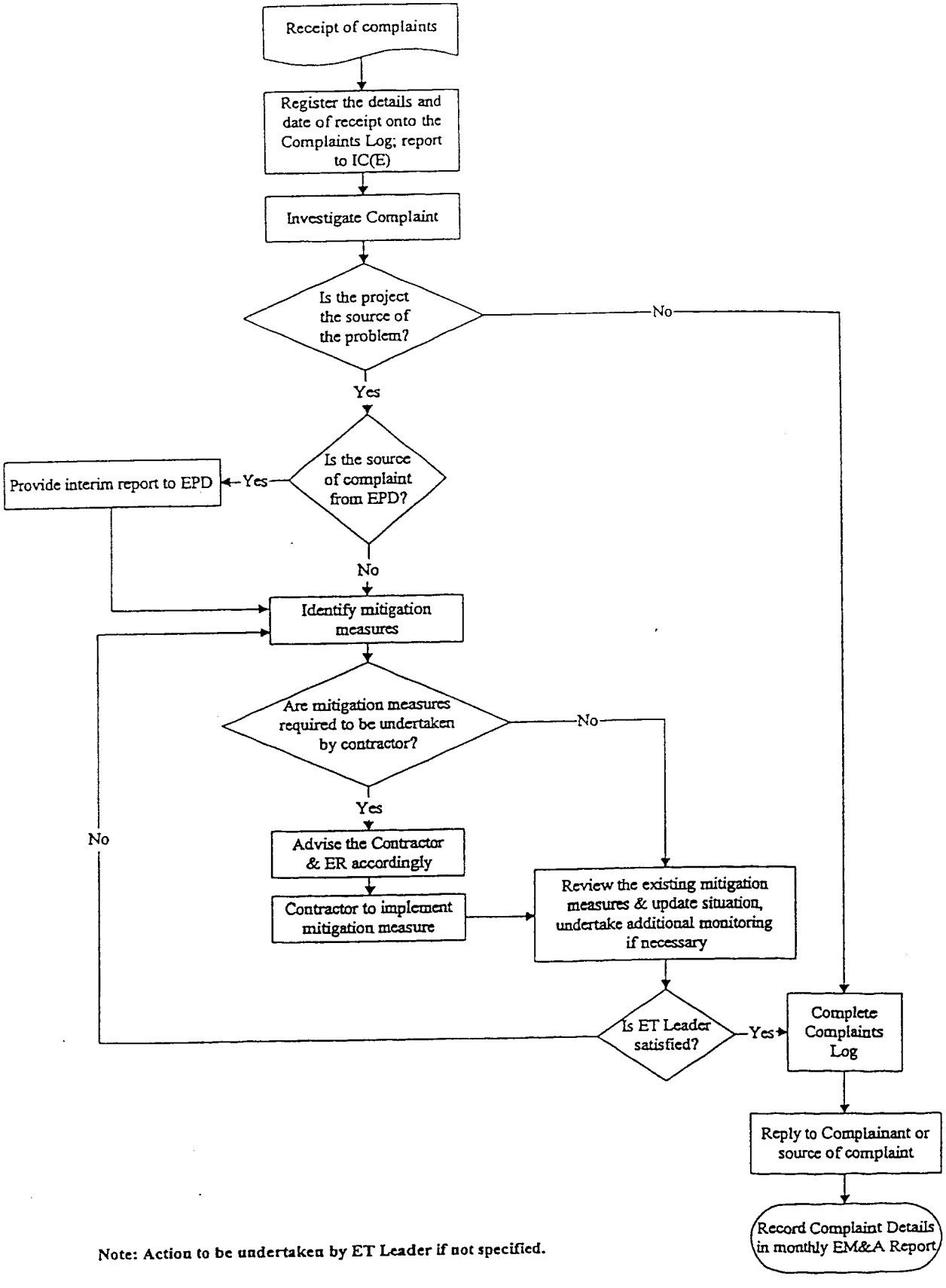
4.3. Environmental Complaints

Complaints shall be referred to the ET Leader for action. The ET Leader shall undertake the following procedures upon receipt of any complaint:

(i) log complaint and date of receipt onto the complaint database and inform the IC(E) immediately;

(ii) investigate the complaint to determine its validity, and assess whether the source of the problem is due to works activities;

(iii) identify mitigation measures in consultation with the IC(E) if a complaint is valid and due to works;



Note: Action to be undertaken by ET Leader if not specified.

FLOW CHART OF THE COMPLAINT RESPONSE PROCEDURE

FIGURE	4.1
SCALE	n/a

5. REPORTING

5.1. General

Reports can be provided in an electronic medium upon agreeing the format with the ER and EPD. This would enable a transition from a paper/historic and reactive approach to an electronic/real time proactive approach. All the monitoring data (baseline and impact) shall also be submitted in diskettes. The format for water quality monitoring data to be submitted in diskette is shown in **Appendix C**.

Types of reports that the ET Leader shall prepare and submit include baseline monitoring report, monthly EM&A report, quarterly EM&A summary report and annual/final EM&A review report. In accordance with Annex 21 of the *TM on Environmental Impact Assessment Process,* a copy of the monthly, quarterly summary and annual/final review EM&A reports shall be made available to the DAF.

5.2. Baseline Monitoring Report

The ET Leader shall prepare and submit a Baseline Environmental Monitoring Report within 10 working days of completion of the baseline monitoring. Copies of the Baseline Environmental Monitoring Report shall be submitted to the Contractor, the IC(E), the ER and EPD. The ET Leader shall liaise with the relevant parties on the exact number of copies they require. The report format and baseline monitoring data format shall be agreed with EPD prior to submission.

The baseline monitoring report shall include at least the following:

(i) up to half a page executive summary;
(ii) brief project background information;
(iii) drawings showing locations of the baseline monitoring stations;
(iv) monitoring results (in both hard and diskette copies) together with the following information:
- monitoring methodology;
- name of laboratory and types of equipment used and calibration details;
- parameters monitored;
- monitoring locations (and depth where applicable);
- monitoring date, time, frequency and duration; and
- QA/QC results and detection limits.

(v) details of influencing factors, including:
- major activities, if any, being carried out on the site during the period;
- weather conditions during the period; and
- other factors which might affect results;

(vi) determination of the Action and Limit Levels for each monitoring parameter and statistical analysis of the baseline data, the analysis shall conclude if there is any significant difference between control and impact stations for the parameters monitored;
(vii) revisions for inclusion in the EM&A Manual; and

(vi) monitoring results (in both hard and diskette copies) together with the following information;
- monitoring methodology;
- name of laboratory and types of equipment used and calibration details;
- parameters monitored;
- monitoring locations (and depth);
- monitoring date, time, frequency, and duration;
- weather conditions during the period;
- any other factors which might affect the monitoring results; and
- QA/QC results and detection limits.

(vii) report on non-compliance, complaints, notifications of summons and successful prosecutions:
- record of all non-compliance (exceedances) of the environmental quality performance limits (Action and Limit levels);
- record of all complaints received (written or verbal) for each media, including locations and nature of complaints investigation, liaison and consultation undertaken, actions and follow-up procedures taken, results and summary;
- record of all notification of summons and successful prosecutions for breaches of current environmental protection/pollution control legislation, including locations and nature of the breaches, investigation, follow-up actions taken, results and summary;
- review of the reasons for and the implications of non-compliance, complaints, summons and prosecutions including review of pollution sources and working procedures; and
- description of the actions taken in the event of non-compliance and deficiency reporting and any follow-up procedures related to earlier non-compliance.

(viii) Others
- an account of the future key issues as reviewed from the works programme and work method statements;
- advice on the solid and liquid waste management status; and
- comments (e.g. effectiveness and efficiency of the mitigation measures), recommendations (e.g. any improvement in the EM&A programme) and conclusions.

Subsequent EM&A Reports

Subsequent monthly EM&A reports shall include the following :

(i) executive summary (1-2 pages):
- breaches of Action and Limit levels;
- complaints log;
- notifications of any summons and successful prosecutions;
- reporting changes; and
- future key issues.

(ii) basic project information:
- project organisation including key personnel contact names and telephone numbers;
- programme;
- management structure, and

(viii) comments, recommendations and conclusions.

5.3. Monthly EM&A Reports

The results and findings of all EM&A work required in the Manual shall be recorded in the monthly EM&A reports prepared by the ET Leader. The EM&A report shall be prepared and submitted within 10 working days of the end of each reporting month, with the first report due the month after construction commences. Each monthly EM&A report shall be submitted to the following parties: the Contractor, the IC(E), the ER and the EPD. Before submission of the first EM&A report, the ET Leader shall liaise with the parties on the required number of copies and format of the monthly reports in both hard copy and electronic medium.

The ET leader shall review the number and location of monitoring stations and parameters every six months, or on as needed basis, in order to cater for any changes in the surrounding environment and the nature of works in progress.

First Monthly EM&A Report

The first monthly EM&A report shall include at least the following :

(i) executive summary (1-2 pages):
- breaches of Action and Limit levels;
- complaint Log;
- notifications of any summons and successful prosecutions;
- reporting Changes; and
- future key issues.

(ii) basic project information:
- project organisation including key personnel contact names and telephone numbers;
- programme;
- management structure, and
- work undertaken during the month;

(iii) environmental status:
- works undertaken during the month with illustrations (such as location of works, daily dredging/filling rates, percentage fines in the fill material used); and
- drawing showing the project area, any environmental sensitive receivers and the locations of the monitoring and control stations (with co-ordinates of the monitoring locations).

(iv) a brief summary of EM&A requirements including:
- all monitoring parameters;
- environmental quality performance limits (Action and Limit levels);
- Event-Action Plans;
- environmental mitigation measures, as recommended in the project EIA study final report; and
- environmental requirements in contract documents;

(v) implementation status:
- advice on the implementation status of environmental protection and pollution control/mitigation measures, as recommended in the project EIA study;

a) major activities being carried out on site during the period;
b) weather conditions during the period; and
c) any other factors which might affect the monitoring results.

- monitoring schedule for the present and next reporting period;
- cumulative statistics on complaints, notifications of summons and successful prosecutions; and
- outstanding issues and deficiencies.

5.4. Quarterly EM&A Summary Reports

A quarterly EM&A summary report of around 5 pages shall be produced and shall contain at least the following information:

(i) executive summary (1-2 pages);
(ii) basic project information including a synopsis of the project organisation, programme, contacts of key management, and a synopsis of work undertaken during the quarter;
(iii) a brief summary of EM&A requirements including:
- monitoring parameters;
- environmental quality performance limits (Action and Limit levels); and
- environmental mitigation measures, as recommended in the project EIA study final report;

(iv) advice on the implementation status of environmental protection and pollution control/ mitigation measures, as recommended in the project EIA study report, summarised in the updated implementation schedule;
(v) drawings showing the project area, any environmental sensitive receivers and the locations of the monitoring and control stations;
(vi) graphical plots of any trends in monitored parameters over the past 4 months (the last month of the previous quarter and the present quarter) for representative monitoring stations annotated against;
- the major activities being carried out on site during the period;
- weather conditions during the period; and
- any other factors which might affect the monitoring results;

(vii) advice on the solid and liquid waste management status;
(viii) a summary of non-compliance (exceedances) of the environmental quality performance limits (Action and Limit levels);
(ix) a brief review of the reasons for and the implications of any non-compliances, including a review of pollution sources and working procedures;
(x) a summary description of actions taken in the event of non-compliance and any follow-up procedures related to any earlier non-compliances;
(xi) a summarized record of all complaints received (written or verbal) for each media, liaison and consultation undertaken, actions and follow-up procedures taken;
(xii) comments (e.g. a review of the effectiveness and efficiency of the mitigation measures and the performance of the environmental management system i.e. of the overall EM&A programme); recommendations (e.g. any improvement in the EM&A programme) and conclusions for the quarter; and
(xiii) proponents' contacts and any hotline telephone number for the public to make enquiries.

- work undertaken during the month;

(iii) environmental status:

- works undertaken during the month with illustrations (such as location of works, daily dredging/filling rates, percentage fines in the fill material used); and
- drawing showing the project area, any environmental sensitive receivers and the locations of the monitoring and control stations.

(iii) implementation status:

- advice on the implementation status of environmental protection and pollution control/mitigation measures, as recommended in the project EIA study;

(iv) monitoring results (in both hard and diskette copies) together with the following information;

- monitoring methodology;
- name of laboratory and types of equipment used and calibration details;
- parameters monitored;
- monitoring locations (and depth);
- monitoring date, time, frequency, and duration;
- weather conditions during the period;
- any other factors which might affect the monitoring results; and
- QA/QC results and detection limits.

(v) report on non-compliance, complaints, notifications of summons and successful prosecutions:

- record of all non-compliance (exceedances) of the environmental quality performance limits (Action and Limit levels);
- record of all complaints received (written or verbal) for each media, including locations and nature of complaints investigation, liaison and consultation undertaken, actions and follow-up procedures taken, results and summary;
- record of all notification of summons and successful prosecutions for breaches of current environmental protection/pollution control legislation, including locations and nature of the breaches, investigation, follow-up actions taken, results and summary;
- review of the reasons for and the implications of non-compliance, complaints, summons and prosecutions including review of pollution sources and working procedures; and
- description of the actions taken in the event of non-compliance and deficiency reporting and any follow-up procedures related to earlier non-compliance.

(vi) others

- an account of the future key issues as reviewed from the works programme and work method statements;
- advice on the solid and liquid waste management status; and
- comments (e.g. effectiveness and efficiency of the mitigation measures), recommendations (e.g. any improvement in the EM&A programme) and conclusions.

(vii) appendix

- Action and Limit levels;
- graphical plots of trends of monitored parameters at key stations over the past four reporting periods for representative monitoring stations annotated against the following:

request. All relevant information shall be clearly and systematically recorded in the document. Monitoring data shall also be recorded in magnetic media form, and the software copy must be available upon request. Data format shall be agreed with EPD. All documents and data shall be kept for at least one year following completion of the construction contract.

5.7. Interim Notifications of Environmental Quality Limit Exceedances

With reference to the Event and Action Plan presented in Table 2.4, when the environmental quality performance limits are exceeded, the ET Leader shall immediately notify the IC(E) and EPD, as appropriate. The notification shall be followed up with advice to IC(E) and EPD on the results of the investigation, proposed actions and success of the actions taken, with any necessary follow-up proposals. A sample template for the interim notifications is presented in **Appendix D**.

5.5. Annual/Final EM&A Review Reports

The annual/final EM&A report should contain at least the following information:

(I) executive summary (1-2 pages);

(ii) drawings showing the project area, any environmental sensitive receivers and the locations of the monitoring and control stations;

(iii) basic project information including a synopsis of the project organization, contacts of key management, and a synopsis of work undertaken during the course of the project or past twelve months;

(iv) a brief summary of EM&A requirements including:
  a) environmental mitigation measures, as recommended in the project EIA study final report;
  b) environmental impact hypotheses tested;
  c) environmental quality performance limits (Action and Limit levels);
  d) all monitoring parameters;
  e) Event-Action Plans.

(v) a summary of the implementation status of environmental protection and pollution control/mitigation measures, as recommended in the project EIA study report, summarised in the updated implementation schedule;

(vi) graphical plots and the statistical analysis of the trends of monitored parameters over the course of the project, including the post-project monitoring (or the past twelve months for annual reports) for all monitoring stations annotated against;
  - the major activities being carried out on site during the period;
  - weather conditions during the period; and
  - any other factors which might affect the monitoring results;

(vii) a summary of non-compliance (exceedances) of the environmental quality performance limits (Action and Limit levels);

(viii) a review of the reasons for and the implications of non-compliance including review of pollution sources and working procedures as appropriate;

(ix) a description of the actions taken in the event of non-compliance;

(x) a summary record of all complaints received (written or verbal) for each media, liaison and consultation undertaken, actions and follow-up procedures taken;

(xi) a summary record of notifications of summons and successful prosecutions for breaches of the current environmental protection/pollution control legislation, locations and nature of the breaches, investigation follow-up actions taken and results;

(xii) a review of the validity of EIA predictions and identification of shortcomings in EIA recommendations; and

(xiii) comments (e.g. a review of the effectiveness and efficiency of the mitigation measures and of the performance of the environmental management system i.e. of the overall EM&A programme);

(xiv) recommendations and conclusions (e.g. a review of success of the overall EM&A programme to cost-effectively identify deterioration and to initiate prompt effective mitigatory action when necessary).

5.6. Data Keeping

No site based documents (such as monitoring field records, laboratory analysis records, site inspection forms, etc.) are required to be included in the monthly EM&A reports. However, any such document shall be well kept by the ET Leader and be ready for inspection upon

APPENDIX A

SAMPLE OF DATA RECORDING SHEET FOR WATER QUALITY MONITORING

Water Quality Monitoring Data Record Sheet

Location							
Date							
Start Time (hh:mm)							
Weather							
Sea Conditions							
Tidal Mode							
Water Depth (m)							
Monitoring Depth		Surface		Middle		Bottom	
Salinity (ppt)							
Temperature (°C)							
DO Saturation (%)							
DO (mg/l)							
Turbidity (NTU)							
SS Sample Identification							
SS (mg/l)							
Observed Construction Activities	< 100 m from location						
	> 100 m from location						
Other Observations							

	Name & Designation	Signature	Date
Recorded By:	_____	_____	
Checked By:	_____	_____	

Note: The SS results are to be filled up once they are available from the laboratory.

APPENDIX B

IMPLEMENTATION SCHEDULE OF MITIGATION MEASURES

Table B.1 Implementation Schedule of Recommended Mitigation Measures

EIA Ref.	Activity	Location	Environmental Protection Measure/ Mitigation Measure	Implementation Agent	Implementation Timing
Marine Water Quality					
EIA S3.8 and EM&A S2.10	Dredging	Works site	Implementation of following methods of working: • Use of not more than two closed grab dredgers or a trailing suction hopper dredger (THD) working at one time; • Maximum total daily dredging rate shall not exceed 9,524 m^3/day i.e. for dredging of both uncontaminated and contaminated sediment; • Maximum daily dredging rate for dredging of contaminated sediment alone shall not exceed 7,143 m^3/day; and • Dredging works and sandfill placement shall not be carried out concurrently (this restriction includes such works for different stages of the breakwater construction at one time).	Contractor	During construction period
	Dredging and dumping	Works site, during transportation and at marine disposal ground	Implementation of following pollution avoidance measures: • Mechanical grabs shall be designed and maintained to avoid spillage and shall seal tightly while being lifted (closed-grab dredgers); • Where THD are in use, overflow from the dredger and the operation of automatic lean mixture overboard (ALMOB) systems shall not be permitted; • All vessels shall be sized such that adequate clearance is maintained between vessels and the sea bed at all states of the tide to ensure that undue turbidity is not generated by turbulence from vessel movement or propeller wash; • All pipe leakages shall be repaired promptly and plant shall not be operated with leaking pipes; • Excess material shall be cleaned from the decks and exposed fittings of barges and hopper dredgers before the vessel is moved; • Adequate freeboard shall be maintained on barges to ensure that decks are not washed by wave action; • All barges and hopper dredgers shall be fitted with tight fitting seals to their bottom openings to prevent leakage of material; and • Loading of barges and hoppers shall be controlled to prevent splashing of dredged material to the surrounding water, and barges or hoppers shall not be filled to a level which will cause the overflow of materials or polluted water during loading or transportation.	Contractor	During construction period & maintenance dredging

EIA Ref.	Activity	Location	Environmental Protection Measure/ Mitigation Measure	Implementation Agent	Implementation Timing
			CED, at any time upon the written request of the DEP, all information and records relevant to the dredging and mud disposal operation. This information shall include, but not be limited to, all data on the plant used by the Contractor, up-to-date periodic data on production rates and record copies of Notification of Dumping which have been sent to the Management Team, etc.		
	Sandfilling	Works site	• Use of a THD, or other suitable vessel to be approved by EPD, with sandfill placement by discharging through a pipeline. This method would require the vessel to hook up to a floating pipeline leading to a diffuser pontoon stationed over the breakwater trench. The diffuser pipe shall enable sandfill to be discharged relatively close to the seabed. The bottom of the diffuser pipe shall generally be kept within a range of 20% of the water depth from the seabed level, however, this will be limited by navigational safety considerations. • Rate of sandfill discharge shall not exceed 2,500 m^3 over 1 hour.	Contractor	During Construction period
	Placement of sediment within DGA	Works site	• Dumping of filling materials within the DGA shall be undertaken after completion of the breakwaters construction (to make up the required 3m thickness of soft material cover at the location of mooring anchorages).	Contractor	During Construction period
EIA S10.2 & EM&A S2	EM&A Programme	Works site and designated monitoring locations	• *Baseline monitoring* : to establish the baseline water quality conditions. For at least 4 weeks prior to the commencement of marine works, 3 days per week, at both mid-flood and mid-ebb tides. Interval between 2 sets of monitoring shall not be less than 36 hours. • *Impact monitoring* : to monitor the nearby water quality to identify any need for additional mitigation measures or modifying methods of work if non-compliance should arise. Monitoring to be carried out during construction of breakwaters, 3 days per week, at both mid-flood and mid-ebb tides. Interval between 2 sets of monitoring shall not be less than 36 hours and one of the weekly monitoring events shall be conducted during night-time hours should there be dredging or sandfilling works at this time. After a period of 2 weeks from completion of all dredging and sandfilling works, monitoring frequency shall be reduced to one day per week (daytime hours). • If impact monitoring results indicate that dredging/sandfilling works have caused an adverse impact on water quality at the sensitive receiver monitoring stations, the construction programme should be carefully reviewed so as to slow down the rate of dredging/sandfilling. • *Post-project monitoring* : 4 weeks monitoring in the same manner as impact monitoring. Details of the water quality parameters to be measured, monitoring equipment, monitoring locations, and water quality criteria (i.e. action & limit levels) are given in the EM&A Manual.	Contractor and Environmental Team	Prior to commencement of marine works During construction period Completion of all marine works

EIA Ref.	Activity	Location	Environmental Protection Measure/ Mitigation Measure	Implementation Agent	Implementation Timing
	Dredging, transportation & disposal of contaminated sediment	Works site, during transportation and at marine disposal ground	Implementation of following special EPD procedures for avoidance of pollution: • The locations and depths of any areas of contaminated marine sediments (as identified in the Sediment Quality Report) shall be indicated in the construction contract. (The stipulation of the sediment contamination details shall be conducted during preparation of the tender documents and is the responsibility of the works department (e.g. CED or their agent); • Contaminated marine sediments shall be dredged, transported and placed in approved special dumping grounds in accordance with the *EPD Technical Circular No. 1-1-92, Works Branch Technical Circular (WBTC) No. 22/92* and *WBTC No. 6/92.* • Contaminated mud shall be placed at a location and in such a manner as directed by the Management Team of CED; • All dumping operations shall be carried out in strict accordance with the method statement agreed by the DEP; • Employ a grab dredger with a closed watertight grab for dredging of contaminated marine mud; • Transport designated contaminated marine mud by split barge of not less than $750m^3$ capacity, well maintained and capable of rapid opening and discharge at the disposal site; • Design properly and maintain carefully all operational plant so as to minimize the risk of sediments or other pollutants being released into the water column and deposited in the seabed other than designated locations; • Fit all barges and hopper dredgers with tight fitting seals to their bottom openings to prevent leakage of material; • Release the mud rapidly and close the hoppers immediately; any material adhering to the sides of the hopper shall not be washed out of the hopper and the hopper shall remain closed until the barge next returns to the disposal site. The dumping vessel shall be stationary throughout the dumping operation; • Size all vessels such that adequate clearance is maintained between the seabed and vessels at all states of the tide, to ensure that undue turbidity is not generated by turbulence from vessel movement or propeller wash. Adequate freeboard shall be maintained on barges to ensure that decks are not washed by wave action; • Employ only barges equipped with automatic self-monitoring devices for the dumping operation, and shall co-operate with and facilitate the DEP to inspect the device and retrieve the record stored in the device on a regular basis; • Provide experienced full time personnel on board all dumping vessels and provide suitable training to ensure that appropriate methods to minimize pollution are implemented. Records shall be maintained to satisfy the DEP that there is no short dumping or dumping outside the designated Dumping Area. The Contractor shall also make available to the DEP and the secretary of Fill Management Committee (S/FMC),	Contractor	During Construction period & maintenance dredging

EIA Ref.	Activity	Location	Environmental Protection Measure/ Mitigation Measure	Implementation Agent	Implementation Timing
	sediments	route & at disposal ground	recommended measures comprise methods of working for dredging, pollution avoidance measures during dredging and dumping, and special EPD procedures for avoidance of pollution during dredging and disposal of contaminated sediment.		maintenance dredging
	All construction activities in general	Works site	• Adopt waste management practices and procedures recommended in Waste Management Section (EIA S7.8) in order to ensure that waste arisings do not enter surrounding marine waters and thereby minimize impacts on *Sousa chinensis* and fisheries in the area. • No underwater blasting of rock on the seabed shall be conducted.	Contractor	During construction period
	Fuel Spillage from vessels using the DGA	Impacted waters & SRs. Also SRs identified to be potentially at risk.	• Implementation of Marine Department's Oil Pollution Contingency Plan so that impacts upon the marine environment and ecologically sensitive receivers shall be minimized as far as possible.	Marine Department	During operational period
Other EM&A Requirements					
EIA S10 and EM&A Manual	Site Environmental Audit	Works site & works vessels/barges	• Site inspections shall be carried out regularly by the Environmental Team to inspect construction activities to ensure that the recommended environmental protection and pollution control mitigation measures are properly implemented. Details of the requirements and procedures in conducting site inspections are given in Section 4.1 of the EM&A Manual. • On the receipt of any complaints, investigation work shall be promptly undertaken by the Environmental Team Leader (including co-operation as required from other parties) and the necessary actions carried out as based on the results of the investigation. Details of the recommended complaints handling procedures and actions are given in Section 4.3 of the EM&A Manual.	Contractor and Environmental Team	During construction period & maintenance dredging

EIA Ref.	Activity	Location	Environmental Protection Measure/ Mitigation Measure	Implementation Agent	Implementation Timing
Waste Management and Mud Disposal					
EIA S7.8 and EM&A S3.2	Transportation and disposal of dredged marine sediment	Along transportation route & at marine disposal ground	• Dispose dredged sediments at designated marine disposal ground depending on level of contamination. • 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 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 DEP.	Contractor	During construction period & maintenance dredging
	All construction activities in general	Works site & along transportation route to disposal location	• Nominate 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. Training of site personnel in proper waste management and handling procedures shall be undertaken. • Separate chemical wastes for special handling and appropriate treatment at the Chemical Waste Treatment Centre located at Tsing Yi. • General refuse generated on the vessels shall be stored and collected separately from other construction and chemical wastes.	Contractor	During construction period
EIA S10.2 & EM&A S3	EM&A Programme	Works site & works vessels/barges	• Monitoring and audit of the procedures for storage, handling, transportation & disposal of all waste arisings to ensure that proper waste management practices are being implemented. • Details of the control measures and auditing procedures are given in the EM&A Manual.	Contractor and Environmental Team	During construction period & maintenance dredging
Fuel Spillage					
EIA S4.7	Fuel spillage from vessels using DGA	Impacted waters & sensitive receivers (SRs). Also SRs identified to be potentially at risk.	• Immediate implementation of procedures and actions stipulated in Marine Department's Oil Pollution Contingency Plan. (This Plan sets out the responsibilities, operational procedures and actions for responding to an oil spill in Hong Kong waters).	Marine Department	During operational period
Ecology					
EIA S9.8	Dredging and disposal of marine	Works site, along transportation	• Implement mitigation measures recommended in Water Quality Section (EIA S3.8) so as to minimize adverse impacts on fisheries and Chinese White Dolphin (*Sousa chinensis)* through sediment resuspension and associated direct and indirect physical effects. These	Contractor	During construction period &

APPENDIX C

SAMPLE DATA FORMAT FOR WATER QUALITY MONITORING

Data Format for Water Quality Monitoring

A. The following is the database structure for water quality monitoring:
(Source: Generic EM&A Manual, EPD)

	Field Name	Type	Width	Dec	Remark/ Units of Measurement
1	Project/Contract ID	C	3		Given by EPD
2	WorkArea ID	C	2		Given by EPD
3	Stn	C	3		Sampling station e.g. M1, M2, C1, C2
4	Weather	C	10		Sunny, Rain, Cloudy
5	Tidestatus	C	10		Tidal status e.g. Mid-ebb, Mid-flood
6	Amb Temp	N	4	1	Ambient temperature (°C)
7	Date	D	8		Sampling date
8	Time	C	5		Sampling time e.g. 0935
9	WDepth	N	4	1	Depth of water column (m)
10	Sno	C	1		Sample number: 1=first sample; 2=duplicated sample
11	Sdepth	C	1		Depth of sample taken (S=surface, M=middle, B=Bottom)
12	Temp	N	4	1	Water temperature (°C)
13	Sal	N	6	2	Salinity (ppt)
14	DO	N	6	2	Dissolved oxygen (mg/L)
15	DOS	N	6	2	Dissolved oxygen in % saturation
16	Tub	N	6	2	Turbidity (NTU)
17	SS	N	6	2	Suspended Solids (mg/L)

(Remark: Enter 999.99 to any numeric field that have no reading. 'Zero' is also a valid data. Remove 999.99 prior to statistical analysis of data. All data must be read on PC platform.)

B: Apart from the above, the following information should also be provided:

1. Project name, contract number, consultant name and telephone, contractor name, contact person and telephone number, site staff and telephone;

2. Project work nature e.g. dumping or reclamation, project commencement date and proposed completion date, frequency of sampling i.e. twice per week or something else;

3. Nature of stations i.e. monitoring or control stations, position of stations i.e. easting, northing and latitude, longitude; and

4. List of site instrument of water quality monitoring.

APPENDIX D

SAMPLE TEMPLATE FOR INTERIM NOTIFICATIONS OF ENVIRONMENTAL QUALITY PERFORMANCE LIMITS EXCEEDANCES

Incident Report on Action Level or Limit Level Non-compliance

Project	
Date	
Time & Tidal status if relevant	
Monitoring Location	
Parameter	
Action & Limit Levels	
Measured Level	
Possible reason for Action or Limit Level Non-compliance	
Actions taken/ to be taken	
Remarks	

Prepared by: _____

Designation: _____

Signature: _____

Date: _____

APPENDIX E

IMPACT PREDICTION REVIEW FOR MARINE WATER QUALITY

Impact Prediction Review for Marine Water Quality at the Sensitive Receiver Monitoring Stations

Table E1 **Predicted Maximum Elevations in Suspended Solids Concentrations* at Water Quality Sensitive Receiver Monitoring Stations (mg/L) – Unmitigated Works**

Sensitive Receiver Monitoring Station	Dry Season Spring Tide	Wet Season Neap Tide
Dredging		
Tung Wan Tsai	14 (8.6)	6 (2.4)
Ma Wan fish culture zone	4.5 (2.9)	3.5 (2.0)
Sandfilling		
Tung Wan Tsai	802 (493)	344
Ma Wan fish culture zone	258 (166)	201

The above SS concentrations are predicted maximum elevations above ambient levels.
Values given in brackets indicate the predicted depth-averaged SS concentrations.

Table E2 **Predicted Maximum Elevations in Suspended Solids Concentrations* at Water Quality Sensitive Receiver Monitoring Stations (mg/L) – Mitigated Works**

Sensitive Receiver Monitoring Station	Dry Season Spring Tide	Wet Season Neap Tide
Dredging		
Tung Wan Tsai	4.4 (2.7)	1.9 (0.7)
Ma Wan fish culture zone	1.4 (0.9)	1.1 (0.6)
Sandfilling		
Tung Wan Tsai	4.3 (2.6)	1.9 (0.7)
Ma Wan fish culture zone	1.4 (0.9)	1.1 (0.6)

The above SS concentrations are predicted maximum elevations above ambient levels.
Values given in brackets indicate the predicted depth-averaged SS concentrations.