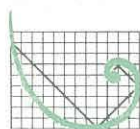


Civil Engineering Department

Backfilling of South Tsing Yi and
North of Lantau MBAs:
*Environmental Monitoring and Audit
Manual*

6 November 1995

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ERM

Civil Engineering Department

Backfilling of South Tsing Yi and
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Manual*

6 November 1995

Reference c1428

For and on behalf of ERM-Hong Kong, Ltd

Approved by: *SM Lau*

Position: *Deputy Managing Director*

Date: *6th November 1995*

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1.1

BACKGROUND TO STUDY

Sand from Marine Borrow Areas (MBAs) south of Tsing Yi and north of Lantau has been excavated for various projects, including the North Lantau Expressway – Tai Ho Section. Since these sand resources have now been exhausted, in accordance with the policy of the Fill Management Committee (FMC), it is proposed to backfill the MBAs and restore the seabed as close as possible to its pre-dredging condition without causing any unacceptable environmental impacts. This restoration is expected to produce several benefits including the potential reinstatement of the natural hydrodynamic regime, recolonization by a benthic community similar to that which existed prior to sand dredging, and provision of routine and emergency ship anchorage. Backfilling also provides additional disposal capacity, above the capacity supplied by marine disposal sites at East of Ninepins and South Cheung Chau, for uncontaminated (Class A and B) fine marine sediments dredged from reclamation areas. The two MBAs proposed for backfilling are shown on *Figure 1.1a*.

An Operations Plan and Environmental Monitoring and Audit (EM&A) requirements, necessary to ensure the implementation and effectiveness of the recommended general mitigation measures and operational controls, have been developed within the Environmental Impact Assessment (EIA) Study. This Manual presents details of the Operations Plan and EM&A programme including water quality EM&A requirements associated with backfilling at both MBAs and noise EM&A requirements associated with backfilling at the North of Lantau MBA.

It should be noted that the base monitoring, audit and mitigation programme described in this Manual refers specifically to activities and impacts arising from the backfilling of the South Tsing Yi and North Lantau MBAs alone. Supplementary monitoring, audit and mitigation issues relating to adjacent dredging/disposal projects are presented in the Cumulative Effects Assessment Manual (CEAM).

The Initial Assessment Report (IAR) for Backfilling of South Tsing Yi and North of Lantau Marine Borrow Areas (MBAs) was released in December 1994. In January 1995, the Study Management Group approved the IAR and authorized preparation of a detailed EIA. The draft EIA, released in April 1995, assessed key issues and evaluated the environmental impacts predicted to result from various operational scenarios. Using the results of these evaluations, an Operations Plan for backfilling at the South Tsing Yi and North of Lantau MBAs which minimises environmental impacts through project design constraints was developed and presented as part of the draft EIA. The draft EIA also provided general mitigation measures, in the form of plant maintenance and working methods, to further improve environmental compliance.

1.2

OBJECTIVES OF ENVIRONMENTAL MONITORING

The Operations Plan and EM&A programme, including the application of specified procedures and actions through Action/Event Plans (AEPs), will

manage the Project's response to any identified unacceptable environmental impacts.

Specifically, the EM&A programme objectives include:

- Providing a set of data which can be used to determine any short or long term environmental impacts of the backfilling operations, as described in *Section 4.2 and 4.3*;
- Auditing the environmental consequences of the backfilling operations through collection and interpretation of monitoring data;
- Verifying the environmental impacts predicted in the EIA Study;
- Monitoring the performance and effectiveness of mitigation measures;
- Determining project compliance with regulatory requirements, standards and Government policies;
- Providing an early indication and suggesting appropriate remedial action should any of the environmental control measures or practices fail to achieve acceptable standards.

1.3

THE ENVIRONMENTAL MONITORING & AUDIT MANUAL

The EM&A Manual is designed to provide information, guidance and instruction to those site staff with responsibilities for limiting environmental impacts and those undertaking environmental monitoring and audit work. It presents the Operations Plan and mitigation measures as defined by the EIA and provides a base monitoring and audit programme for effects predicted from backfilling activities alone. During backfilling operations, the EM&A programme and Manual will be used to determine any residual impacts remaining after the implementation of the recommended mitigation measures. Should unacceptable residual impacts occur, additional requirements will be identified, the EM&A Manual will be updated as necessary, and additional mitigation measures will be implemented in accordance with the Action/Event Plan.

The base mitigation, monitoring and audit programme defined in this manual considers only activities and impacts relating to the backfilling of the South Tsing Yi and North Lantau MBAs (hence the term "base"). The programme shall be modified and/or supplemented by additional measures in the event that other dredging/disposal activities occur concurrently and have the potential to cumulatively impact sensitive receivers identified in the EIA. Cumulative effects relating to suspended sediment will be evaluated and adjustments made to the base mitigation, monitoring and audit programme by the Cumulative Effects Assessment Manual (CEAM) which is issued in conjunction with this EM&A Manual. The relationship between the base mitigation programme and the CEAM mitigation programme is illustrated in *Figure 1.3a*.

This EM&A Manual discusses the various components of the EM&A programme (*Section 2*) and the environmental management of backfilling operations including details of the roles and responsibilities of the relevant parties with respect to environmental compliance (*Section 3*). In addition,

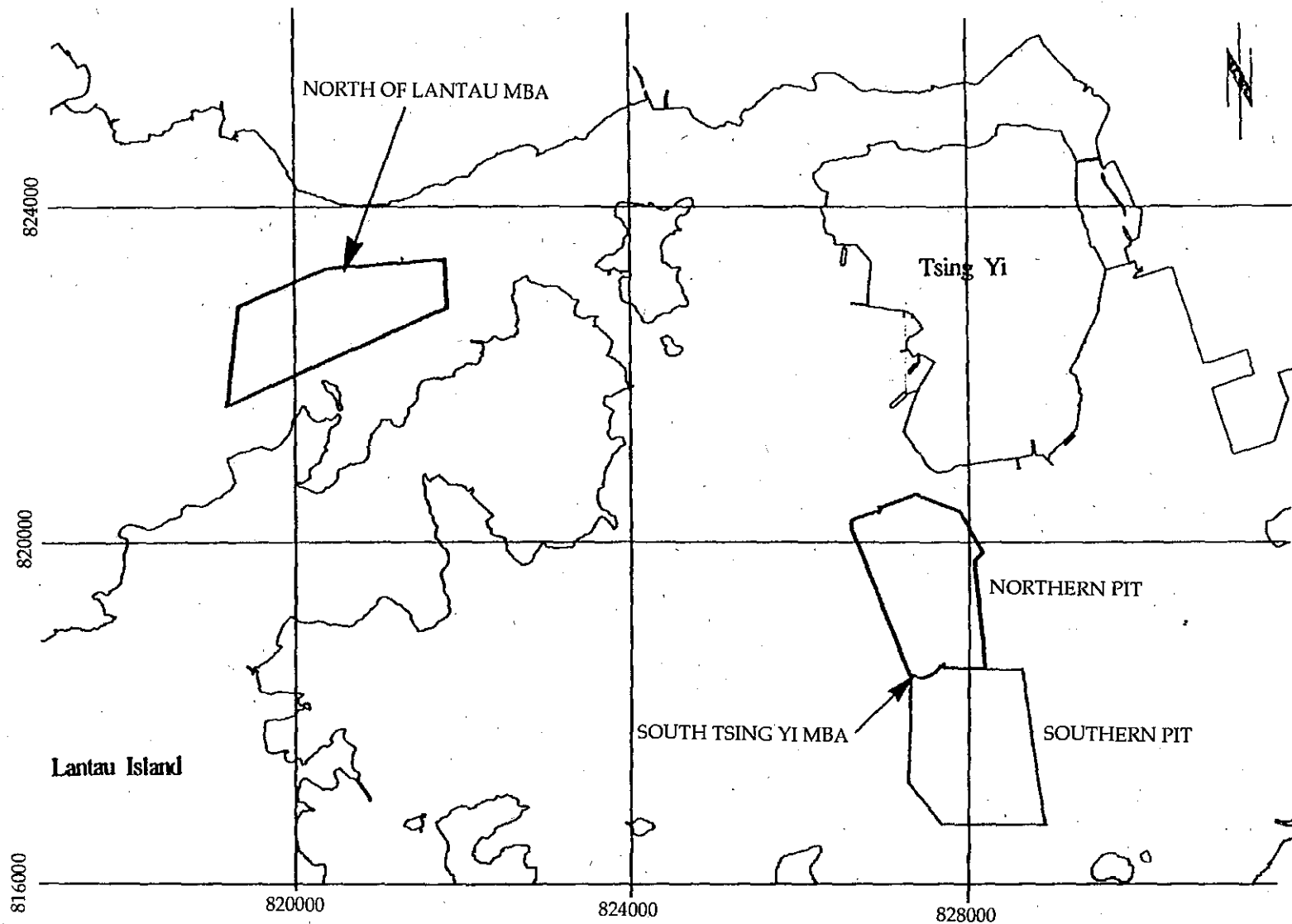


FIGURE 1.1a - LOCATION OF THE SOUTH TSING YI AND NORTH OF LANTAU MARINE BORROW AREAS (MBAs)

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BASE MITIGATION PROGRAMME

GENERAL MITIGATION MEASURES

- PLANT MAINTENANCE
- WORKING METHODS

OPERATIONS PLAN (MITIGATION MEASURES)

- BACKFILLING RATE & VOLUME
- BACKFILLING HEIGHT
- SPATIAL RESTRICTIONS
- TEMPORAL RESTRICTIONS
- TRAFFIC RESTRICTIONS
- MATERIAL REQUIREMENTS



CEAM MITIGATION MEASURES
IN THE EVENT OF CUMULATIVE
IMPACTS

FIGURE 1.3a - COMPONENTS OF THE EM&A PROGRAMME

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recommendations for environmental complaint procedures are given (*Section 5*) and reporting and audit requirements for the backfilling operations are presented (*Sections 6 and 7*). The reporting structure will include the methodology for recording data, the treatment of exceedances and the format of the monthly and quarterly progress reports. The environmental audit requirements ensure the environmental monitoring programme is being effectively implemented.

2.1 INTRODUCTION

As noted in *Section 1.1*, the focus of the EM&A programme is on water quality impacts from backfilling of both MBAs and noise impacts for backfilling of the North of Lantau MBA. The following sections present a summary of the Operations Plan and general mitigation measures for potential water quality and noise impacts.

Mitigation measures for ecology and air quality are not recommended as part of this Manual. Although potential impacts to ecological sensitive receivers may occur as a result of the proposed backfilling operations through changes in suspended sediment loads and dissolved oxygen, environmental mitigation of water quality impacts will effectively mitigate these potential impacts. Therefore, specific mitigation measures for ecological impacts are not required. *Section 6 Air Quality* of the draft EIA identified no unacceptable impacts to air quality arising from the Project, therefore no mitigation measures are necessary.

2.2 OPERATIONS PLAN

The Operations Plan outlined below at South Tsing Yi and North of Lantau MBAs defines backfilling operations in terms of rates and volumes of disposal, backfill level, and spatial, temporal and marine traffic restrictions and material requirements.

2.2.1 South Tsing Yi MBA

Rates and Volumes of Disposal

As described in *Sections 3 and 4* of the EIA, it is considered acceptable to backfill at rates which are equal to or lower than 100,000 m³/day. This rate is not likely to restrict disposal operations as it represents a generous estimate of the maximum amount which could be practically disposed at the South Tsing Yi MBA. Total capacity at the site is estimated as 41.9 Mm³. Backfilling from -34mPD to -25mPD in the northern portion of the MBA is expected to require 15.7 Mm³ of which at least 50% will probably be grab-dredged material. Backfilling of the southern portion of the MBA from -34mPD to -25mPD is estimated to require 26.2 Mm³ of either grab- or trailer-dredged material. Actual volumes and rates of disposal for individual projects will be regulated by the Fill Management Committee (FMC) and the Environmental Protection Department (EPD) through the allocation and permitting processes.

Backfill Level

A backfilling level of -25mPD has been deemed acceptable for the South Tsing Yi MBA since both trailer- and grab-dredged material will be stable (ie. will not erode) under wave and current action at this level.

Spatial Restrictions

If sand in the southern pit of the MBA has not been extracted prior to the commencement of backfilling, it will be necessary to reserve an area at approximately Hong Kong metric grid coordinates 819000N for grab-dredged material. This material will be used to form a slope of approximately 1:20 of cohesive material which will prevent trailer-dredged material from migrating into the southern pit. Once this material has been placed, backfilling can proceed in the northern portion of the MBA using either grab- or trailer-dredged material without impacting remaining sand resources in the southern MBA.

It will also be necessary to construct, from mechanically dredged uncontaminated (Classes A and B) material, a separate small area of mechanically dredged material at the northern end of the northern MBA to prevent movement of disposed material northward toward the Ma Wan channel. In order to accomplish placement of these areas of grab-dredged material, a staged approach is recommended whereby barge-dumping areas are maintained at higher backfill levels than trailer-dumping areas, thus permitting both types of material to be dumped at the same time, after the initial raising of levels in the barge-dumping areas.

A contractor identified by the Civil Engineering Department Geotechnical Engineering Office (CED GEO) will conduct bathymetric surveys every two months during backfilling operations to verify the effectiveness of the slope structure. If the surveys show that the required slopes are not being formed or maintained, then the 'design' slope and, consequently, the management of the dumping operations will be modified to reduce material losses. Such modifications are anticipated to comprise limiting backfilling operations to grab-dredged materials only until sand dredging has been completed in the southern portion of the South Tsing Yi MBA and/or modifying the allowable backfill material types and rates.

Temporal Restrictions

Backfilling operations will be prohibited at the South Tsing Yi MBA during the dredging of surface marine sands from the southern pit of the South Tsing Yi MBA.

Marine Department have indicated that operations will be limited to no more than 2 trailers or barges operating at any one time within the MBA (ie including possible future sand dredging operations in the southern pit of the MBA.) In addition, only one dredging or dumping vessel will be permitted to work in the fairway at any one time. No special daytime or night-time restrictions have been identified beyond the requirements of *General Allocation Conditions for Marine Borrow Areas and Mud Disposal Sites*. Details of temporal restrictions will be the subject of further discussions between CED GEO and Marine Department.

Marine Traffic Restrictions

Marine Department has stated that vessels participating in backfilling operations at the South Tsing Yi MBA must be highly-maneuvrable, self-propelled vessels and that all disposal vessels remain in motion during disposal. Exact specifications resulting from these requirements will be the subject of further discussions between CED GEO and Marine Department.

Material Requirements

There are no special material restrictions for the South Tsing Yi MBA other than those which will arise from the issues described above.

2.2.2 North of Lantau MBA

Rates and Volumes of Disposal

As described in Sections 3 and 4 of the EIA, it is considered acceptable to backfill at rates which are equal to or lower than 10,000 m³/day. This rate is not likely to restrict disposal operations as it represents a generous estimate of the maximum amount which could be practically disposed at the North of Lantau MBA. Total capacity at the site is estimated as 7.0 Mm³ and approximately 2 years and 8 months will be required to complete the backfilling operations.

The North of Lantau MBA will be backfilled in phases, with backfilling initially confined to an area covering approximately 20% of the western portion of the site (*Figure 2.2a*). It is estimated that 2.2 Mm³ of grab spoil will be required to achieve the proposed initial backfill profile in the western part of the site. Assuming a dumping rate of 50,000 m³ per week, this initial phase of operation will require approximately 11 months. After completion of the initial phase, backfilling will proceed sequentially to the east, allowing progressive recolonisation from the west (*Figure 2.2b*). No more than 20% of the gazetted area will be affected by backfilling operations at any one time.

Backfill Level

It is considered that the original seabed profile should be reinstated through the backfilling operation. If a specific backfill level is required, a maximum backfilling level of -25mPD is recommended for the North of Lantau MBA based on the stability of surface-derived material at and below this backfill level under typical wave and current conditions, and the 0.1, 1 and 10 year storm events.

Spatial and Temporal Restrictions

Significant exceedances (up to 7 dB(A)) of the Noise Control Ordinance (NCO) night-time (2300-0700) criteria have been predicted for unmitigated night-time spoil dumping operations at the North of Lantau MBA. Mitigation will therefore be required to reduce night-time noise impacts from dumping operations at nearby Noise Sensitive Receivers to levels in compliance with those specified under the NCO. As a result, spatial and temporal restrictions have been proposed in the Operations Plan for the North of Lantau MBA should night-time dumping operations be carried out.

The Operations Plan proposes to restrict backfilling operations to daytime hours (0700-2300) in areas north of Hong Kong grid reference line 823000N (approximately 400 m south of the northern MBA boundary, see *Figure 4.3a*). No night-time operations (2300-0700) will be authorized in MBA areas north of this line. Backfilling in areas south of 823000N may take place at night, but will be restricted to the operation of no more than two barge/tug

boat combinations in any 5 minute period. No spatial restrictions are necessary for daytime operations (0700–2300). A night-time noise monitoring and audit programme will be carried out at nearby NSRs during night-time backfilling activities to verify whether noise levels are sufficiently mitigated by operational restrictions and are in compliance with

NCO criteria. Details of EM&A requirements for noise are presented in Section 4.3.

Marine Traffic Restrictions

No special marine traffic considerations have been identified for the North of Lantau MBA. However, backfilling operations must comply with the *General Allocation Conditions for Marine Borrow Areas and Mud Disposal Sites* and any other special conditions required by Marine Department.

Material Requirements

CED GEO has indicated that due to the naturally sloping bathymetric profile in the area, the North of Lantau MBA is expected to be backfilled with grab-dredged material only.

2.3

GENERAL MITIGATION MEASURES

General mitigation measures are plant maintenance and working method requirements which supplement the Operations Plan by further reducing the potential for unacceptable environmental impacts. The following sections describe general mitigation measures for water quality/sediment transport and noise which are applicable to both the South Tsing Yi and North of Lantau MBAs.

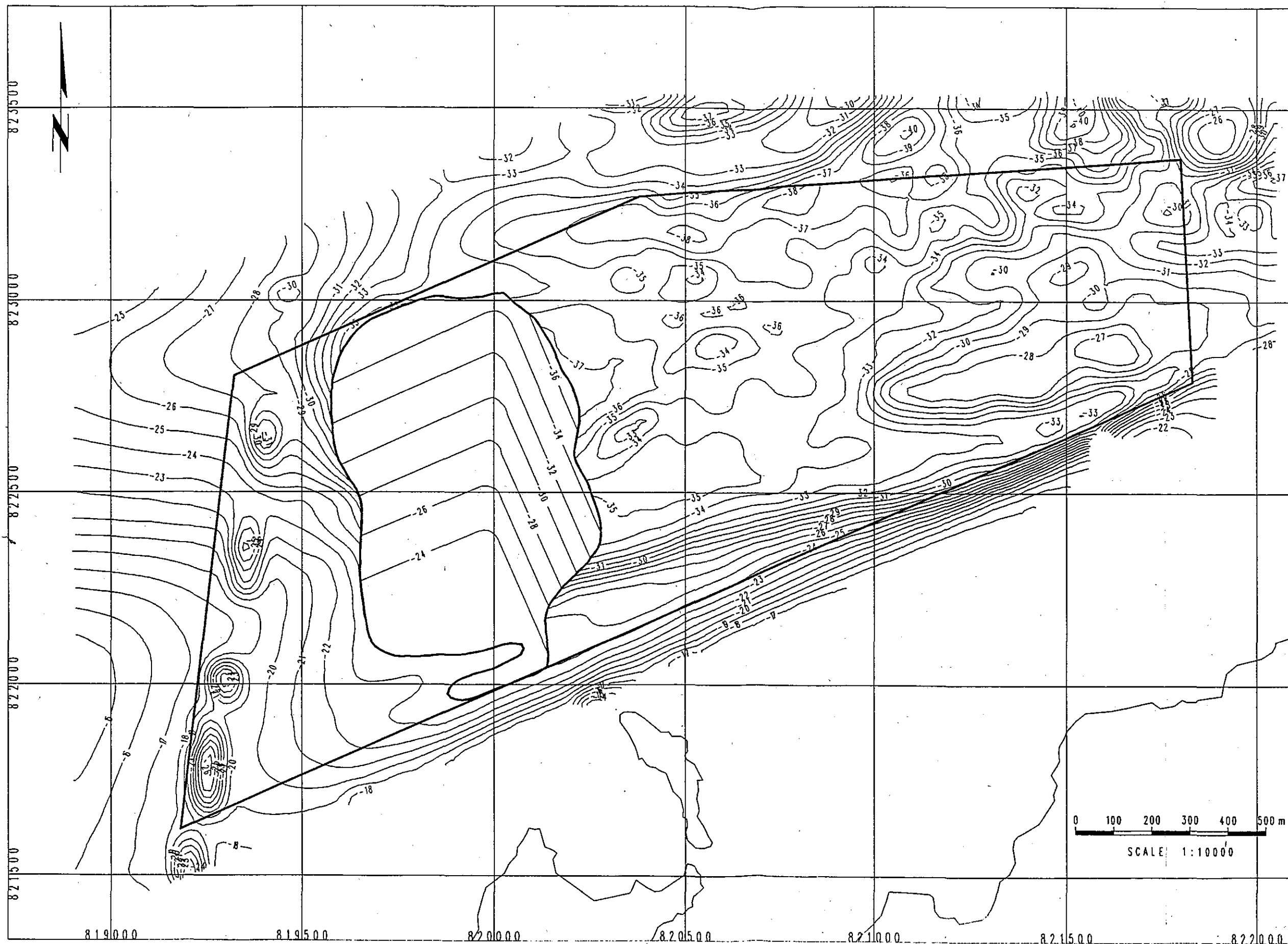
2.3.1

Water Quality and Sediment Transport

The general mitigation measures are designed to supplement the Operations Plan by further controlling spoil loss to the water column and to minimising disturbance to the seabed. The Operations Plan, in conjunction with the general mitigation measures described herein will be implemented to ensure that any residual impacts associated with backfilling will not breach the Water Quality Objectives (WQO), and other specified SS criteria.

The following standard plant maintenance and working method mitigation measures should be applied at all times to backfilling operations.

- Dumping should take place in strict accordance with EPD Marine Dumping Permits;
- All barges and hoppers should be fitted with tight seals to their bottom openings to prevent leakage of fill material during transport;
- Mechanical grabs should be designed and maintained to avoid spillage of fill material and should seal tightly while being lowered and lifted;
- After dumping, excess material should be cleaned from the decks and exposed fittings of barges and hopper dredgers before the vessel is moved;



TITLE FIGURE 2.2a

NORTH OF LANTAU -
PROPOSED INITIAL
BACKFILL PROFILE

DATE 8-JUNE-1995

FILE NO.

COMPILED BY

N. Evans

DRAWN BY

W.C. Yeung

DRAWING NO.

FMC/302/3

SCALE

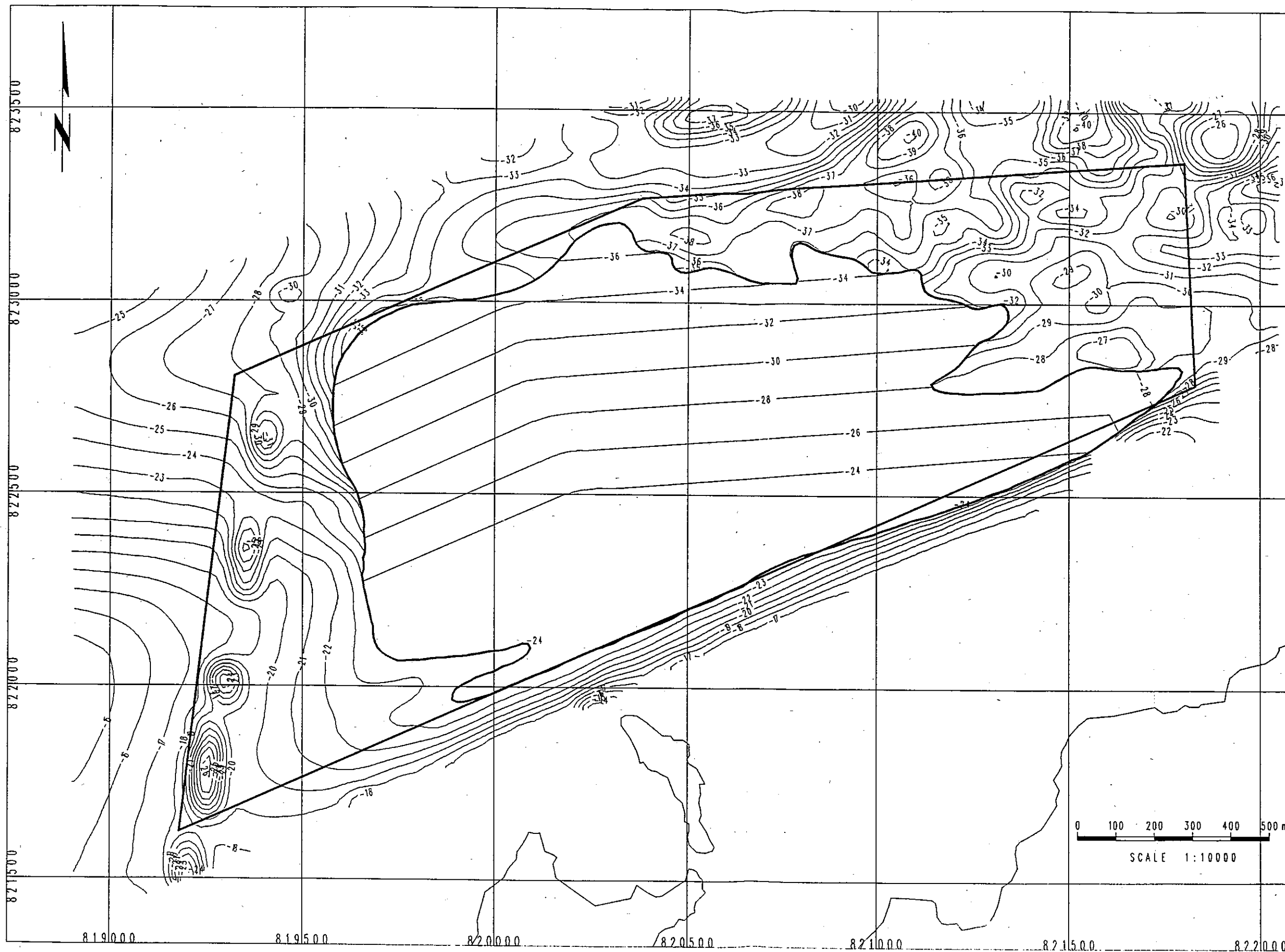
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OFFICE

FILL MANAGEMENT DIVISION
Geotechnical Engineering Office



Civil Engineering
Department
HONG KONG



TITLE		FIGURE 2.2b
		NORTH OF LANTAU - PROPOSED FINAL BACKFILL PROFILE
DATE		8-JUNE-1995
FILE NO.		
COMPILED BY		N. Evans
DRAWN BY		M.C. Yeung
DRAWING NO.	SCALE	
FMC/302/2	1:10000	
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FILL MANAGEMENT DIVISION Geotechnical Engineering Office		
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- Adequate freeboard will be maintained on barges to ensure that decks are not washed by wave action;
- All vessels should 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;
- The Contractor should ensure that the Works cause no visible foam, oil, grease, litter or other objectionable matter to be present in the water within and adjacent to the MBAs.

2.3.2

Noise

In order to minimise noise disturbance to *Sousa chinensis*, all North of Lantau MBA backfilling activities should be as short in duration as possible and 'quiet' plant used where practicable. The Contractor should ensure plant and equipment are well-maintained to minimise noise levels.

3.1 INTRODUCTION

The environmental management roles and responsibilities for backfilling operations and the interaction between various components of the EM&A programme are illustrated in *Figure 3.1a*.

3.2 ROLES OF KEY PARTIES

The roles of key parties in the environmental management process are discussed below.

Site Manager

The Site Manager will play the pivotal role in managing backfilling operations by overseeing the Environmental Consultant and liaising with both the Environmental Protection Department (EPD) and the Project Team. Specific duties of the Site Manager include reviewing the monthly and quarterly EM&A reports prepared by the Environmental Consultant, informing parties of exceedances, and identifying and imposing corrective actions where necessary. The Site Manager maintains the overall responsibility for controlling backfilling operations to ensure that environmental compliance is maintained and appropriate actions are taken in the event of any documented exceedances. The Site Manager will also have the authority to re-direct any project to another site at any time, enabling appropriate management of the site within the requirements of the EM&A Manual to be achieved.

EPD Monitoring and Audit Section

EPD's role involves ensuring that site management practices are in compliance with all environmental regulatory criteria, that appropriate conditions are specified in the dumping licence, and that these conditions are met. This will be accomplished through liaison with the Site Manager and periodic auditing of EM&A data submitted by the Site Manager and Environmental Consultant in monthly and quarterly reports. It is anticipated that the EPD Monitoring and Audit Section will take the lead in these activities.

Project Team

The Project Team may consist of the project manager (a government or private party depending on the project proponent), the engineer's representative, and/or the contractor. The exact assignment of responsibilities to members of the Project Team will vary based on the management structure of individual projects contributing to backfilling. The point of contact within the Project Team for EM&A matters should be specified in the EPD dumping license. It is the responsibility of this point of contact to ensure that backfilling operations are conducted in compliance with the dumping license and the EM&A programme. Any corrective actions imposed by the Site Manager will be communicated to

the Project Team's point of contact. The Project Team point of contact is responsible for ensuring that these corrective actions are implemented.

Environmental Consultant

The Environmental Consultant is responsible for conducting the EM&A programme and preparing monthly and quarterly reports for the Site Manager. The key task for the Environmental Consultant is to perform an independent review of data collected by the Laboratory/Environmental Contractor. This will involve identifying any exceedances as defined by the EM&A Manual, particularly the Trigger, Action and Target levels and Action/ Event Plan for water quality and noise monitoring and to notify the Site Manager. It will also include a general review to verify the accuracy of the EIA predictions and assess the effectiveness of mitigation measures. The Environmental Consultant shall assist the Site Manager, as directed, in formulating corrective actions and liaison with government departments and the Project Team.

Laboratory/Environmental Contractor

The Laboratory/Environmental Contractor shall collect and analyze field samples (eg suspended solids concentration), and notify the Environmental Consultant of any observed exceedances. All data shall be provided in the approved formats to the Environmental Consultant for inclusion in the monthly and quarterly monitoring reports. Suggested formats for water quality and noise monitoring data, which are currently used for other EM&A programmes, are provided in *Annex A*.

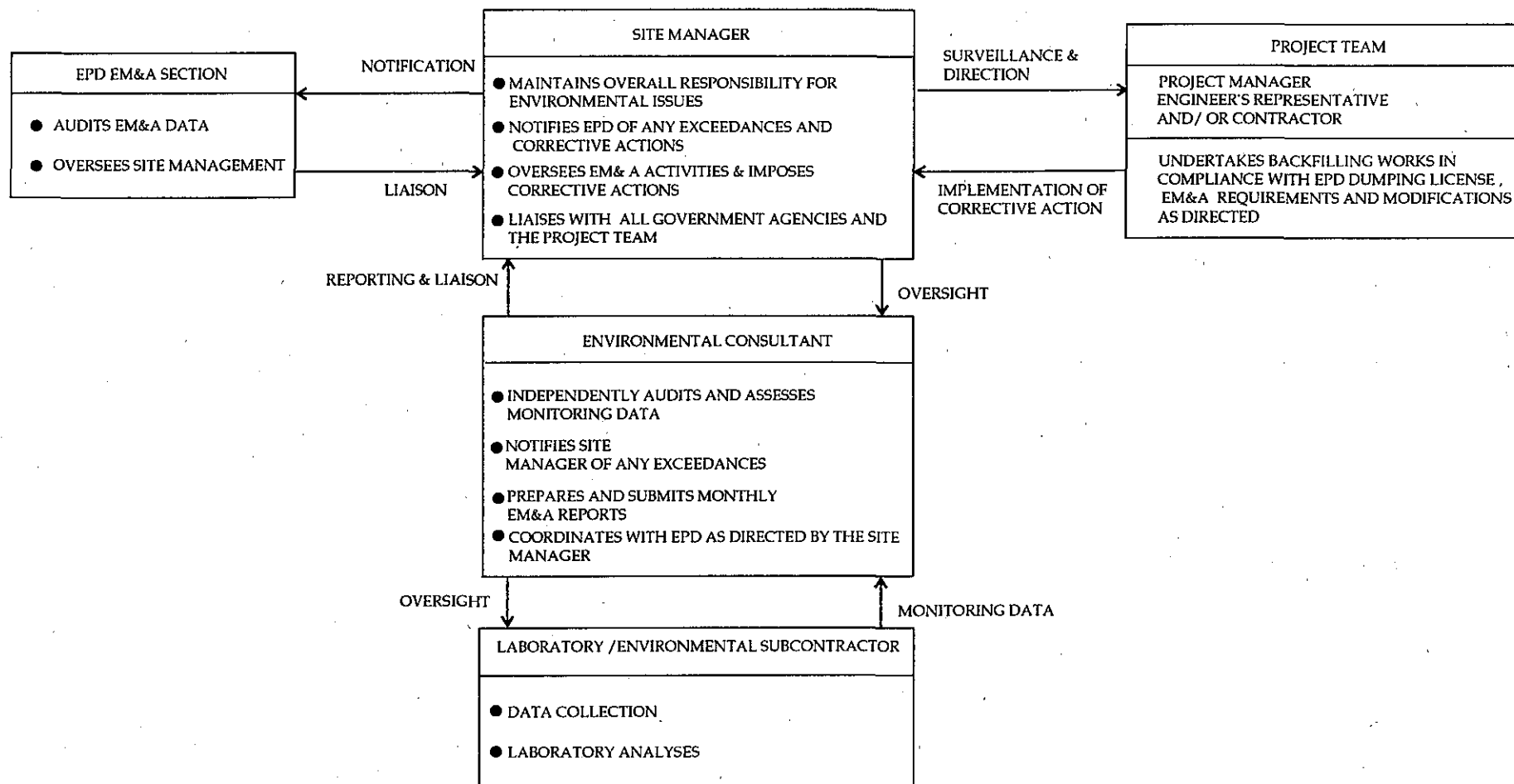


FIGURE 3.1a - ENVIRONMENTAL MONITORING AND AUDIT PROGRAMME ROLES AND RESPONSIBILITIES

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4.1

INTRODUCTION

This section introduces the structure of the environmental monitoring programme and provides technical requirements for monitoring water quality and noise impacts.

Figure 4.1a illustrates the relationship between the Operations Plan and general mitigation measures, the EM&A programme and the Action/Event Plans. The roles of each of these respective elements is further discussed below:

- *Operations Plan and General Mitigation Measures:* The Operations Plan and general mitigation measures have been determined during the EIA, and are described in Section 2.0.
- *EM&A Programme:* The monitoring of environmental impacts will comprise water quality monitoring at specified water quality monitoring stations, and noise monitoring at specified noise sensitive receivers as detailed in Sections 4.2 and 4.3.
- *Action/Event Plans (AEPs):* The purpose of AEPs is to provide procedures for ensuring that if any significant exceedances (either accidental or through inadequate implementation of mitigation measures on the part of the contractor) occur, that the cause is quickly identified and remedied, and that the risk of a similar event occurring is reduced. AEPs for water quality and noise are presented in Sections 4.2.7 and 4.3.6, respectively.

The AEPs are based on trigger, action and target levels which categorize the site monitoring data for suspended sediments, turbidity, and dissolved oxygen in terms of comparison to baseline and control station data. These defined levels of impact are:

- **Trigger Levels:** beyond which there is an indication of a deteriorating ambient environment. Exceedance of Trigger Levels often results in an increase in the frequency of environmental monitoring.
- **Action Limits:** beyond which appropriate remedial actions may be necessary to prevent environmental quality from going beyond the Target Limits, which would be unacceptable.
- **Target Limits:** Statutory limits stipulated in the relevant pollution control ordinances, HKPSG or Environmental Quality Objectives established by EPD. If these are exceeded, works shall not proceed without appropriate remedial action, including a critical review of plant and working methods.

Details of the requirements for the EM&A of water quality impacts during the backfilling operations at South Tsing Yi and North of Lantau MBAs are presented below.

4.2.1 *Compliance with Water Quality Objectives and Criteria*

The objective of the water quality monitoring programme can be summarised as follows:

- to check compliance with relevant Water Quality Objectives (WQOs);
- to verify the predictions of the sediment plume modelling;
- to determine the effectiveness of the operational controls and mitigation measures employed;
- to determine the need for supplemental mitigation measures.

The water quality monitoring results shall be assessed with respect to the relevant Western Buffer and North Western Waters Water Control Zone WQOs for South Tsing Yi and North of Lantau MBAs respectively. These WQOs are:

- Suspended Solids (SS): Human activities must not raise the natural ambient SS level by 30% nor cause an accumulation of SS which may adversely affect aquatic communities; and
- Dissolved Oxygen (DO): DO within 2 m of the bottom should not be less than 2 mg l⁻¹ for 90% of the samples. Depth averaged DO should not be less than 4 mg l⁻¹ for 90% of the samples (not less than 5 mg l⁻¹ for fish culture subzones).

Guidance from EPD, provided at the 2nd Study Management Group meeting on 26 May 1995, indicated that ambient values are approximated by the 90th percentile value of the EPD routine water quality monitoring data set. Given the high volume of water exchange between the two MBA areas, EPD agreed that data from all EPD routine water quality monitoring stations in the area (ie, stations VM8, VM12, WM2, WM3, WM4, NM1, NM2, NM3) can be pooled to derive a single ambient value for compliance purposes. Using this methodology, the ambient value for the area is 25.0 mg l⁻¹ and thus the Water Quality Objective is 32.5 mg l⁻¹. This ambient value is applied to all sensitive receivers except for the Kennedy Town WSD Intake (*see below*).

Many of the Sensitive Receivers (SRs) have their own individual specified SS criteria (*see Table 4.2a*). Where there is an individual specified criterion, it is EPD's policy to take the more conservative of the specific criterion or the general WQO to determine compliance. All but one of the SRs in the study area have criteria which are higher than EPD's Water Quality Objective. Thus, the WQO of 32.5 mg l⁻¹ was used for all SRs except Kennedy Town WSD, where the specified criterion of 20 mg l⁻¹ was employed.

Bathing Beaches

A number of gazetted bathing beaches which may be affected by the backfilling of the South Tsing Yi and North of Lantau MBAs are located along the Tsuen Wan and Tuen Mun coastline. The results of sediment plume modelling for the backfilling rate specified in the Operations Plan

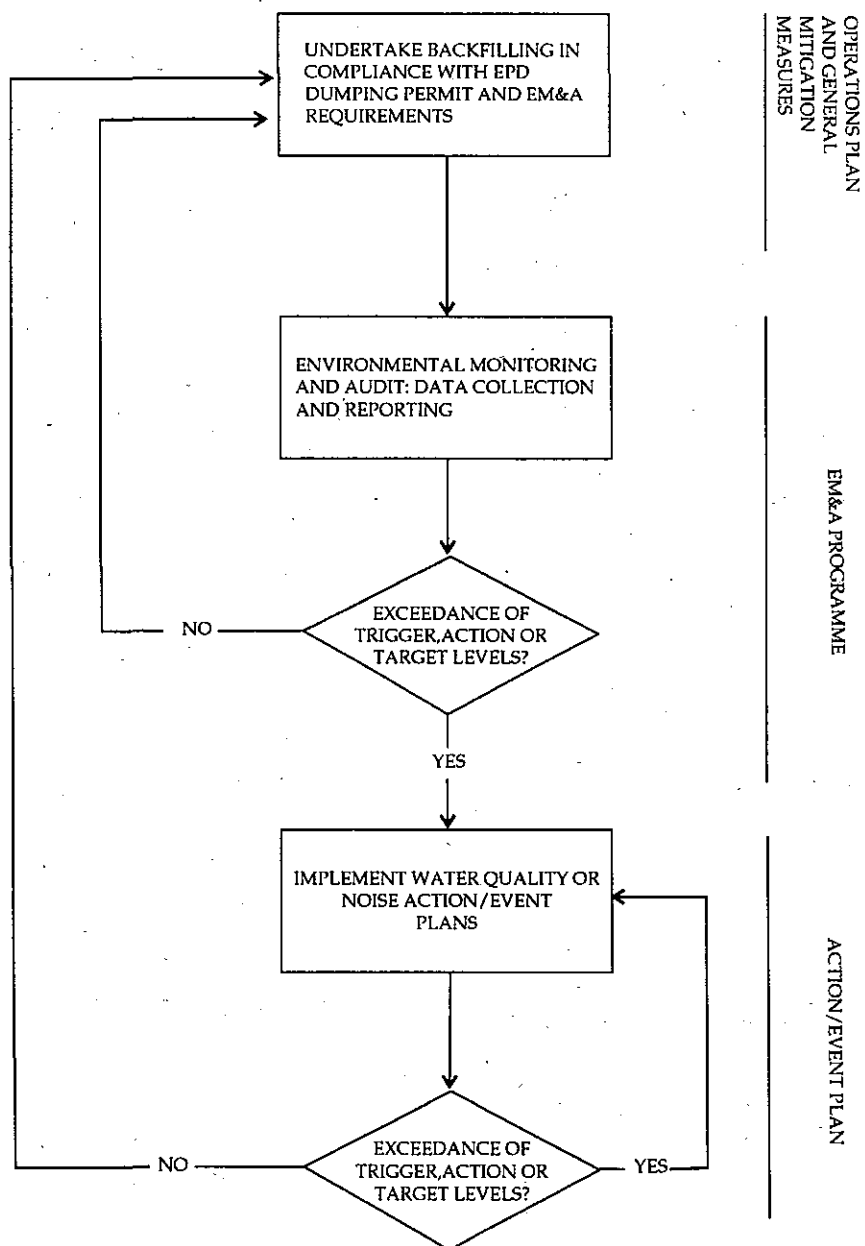


FIGURE 4.1a - IMPLEMENTATION OF OPERATIONS PLAN AND GENERAL MITIGATION MEASURES, THE EM&A PROGRAMME AND THE ACTION/EVENT PLAN

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(Scenario 4e in the EIA) indicated peak surface and bed layer SS concentrations of 5 mg l^{-1} above background at Angler's and Gemini Beaches, and 4 mg l^{-1} and 3 mg l^{-1} at Casam Beach and Hoi Mei Wan respectively. At the other affected beaches (Lido and Butterfly Beaches), peak SS elevations above background did not exceed 2 mg l^{-1} . When evaluated against an ambient value of 25 mg l^{-1} and a WQO of 32.5 mg l^{-1} , these predicted SS concentrations are compliant and do not indicate any environmentally unacceptable impacts.

Power Stations

Power stations in the area have criteria for SS levels in cooling water intakes since increased particulate matter in the seawater supply could block filters and damage cooling water intake pumps. The Castle Peak Power Station has a 5 km radius within which the water quality must be maintained below 150 mg l^{-1} of SS. The Black Point Power Station which is scheduled to be commissioned in 1996 is expected to have similar requirements. The Lamma Power Station cooling water intake criteria is 140 mg l^{-1} , as is that of the Tsing Yi Power Station, which is currently in standby mode. Modelling for the backfilling rate specified in the Operations Plan (Scenario 4e in the EIA) indicated that elevations in SS concentrations will only be detectable at the Tsing Yi intake. The predicted peak surface layer concentrations ($<2 \text{ mg l}^{-1}$) in combination with ambient suspended sediment concentrations (25 mg l^{-1}) will not exceed the specified SS criteria for the Tsing Yi Power Station.

Other Cooling & Flushing Water Intakes

There are a number of additional cooling water and flushing water intakes in the vicinity of the study area. Each of these have specific SS criteria with which the backfilling operations must comply, namely Kennedy Town WSD Intake (20 mg l^{-1}), Queen Mary Hospital Intake (140 mg l^{-1}) and Wah Fu Estate Intake (140 mg l^{-1}). Modelling for the backfilling rate specified in the Operations Plan, undertaken in Scenario 4e of the EIA, predicted peak surface layer concentrations of 4 mg l^{-1} at the Kennedy Town WSD Intake, the Queen Mary Hospital Intake and the Wah Fu Estate Intake. These increases are acceptable at the Queen Mary Hospital Intake and Wah Fu Estate Intake; compliance assessment at the Kennedy Town WSD Intake is more complex.

At the 2nd SMG meeting on 26 May 1995, EPD stated that ambient suspended sediment concentrations at the Kennedy Town WSD should be derived from recent EPD routine water quality monitoring data at Station VM8. The average ambient concentration of SS at Station VM8 is 16.9. The predicted elevation in SS of 4 mg l^{-1} resulting from backfilling, combined with the ambient value of 16.9, resulted in a total predicted concentration of 20.9 mg l^{-1} . Although this represents a transitory (less than 4 hours of the tidal cycle) worst case scenario which is expected to occur only on the worst case tide, it does slightly exceed the WSD criterion of 20 mg l^{-1} . However, this worst-case predicted impact is compliant with the WQO of 21.9 mg l^{-1} . Due to the project's slight exceedance of the WSD criterion and compliance with the WQO, no special mitigation measures are recommended as part of the base mitigation programme. However, should exceedance of either the WSD criterion or the WQO be demonstrated during monitoring at the Kennedy Town WSD Intake, supplemental mitigation measures to reduce the impacts of SS concentration shall be adopted.

Several fisheries and fish culture zones in the vicinity of the study area were identified as sensitive receivers in the EIA and have SS criteria. These are Tung Wan Tsai, Ma Wan Fishery, Kau Yi Chau Fishery, Penny's Bay Fishery, Tai Pak Wan Fishery, Silvermine Bay Fishery, Ma Wan Fish Culture Zone (FCZ), Lo Tik Wan FCZ and Sok Kwu Wan FCZ. Although each fisheries and mariculture area may have its own requirements in terms of *ex-gratia* arrangements, at the 2nd SMG meeting on 26 May 1995, AFD confirmed that a criterion of 50 mg l⁻¹ could be used for all fisheries and fish culture zones.

At all affected fisheries or fish culture zones, transitory peak concentrations of less than 7 mg l⁻¹ above background were predicted by Scenario 4e. Predicted concentrations were highest at the Ma Wan Fishery (7 mg l⁻¹), Tung Wan Tsai (6 mg l⁻¹), Kau Yi Chau Fishery (4 mg l⁻¹) and the Ma Wan Mariculture area (3 mg l⁻¹). All other fisheries and fish culture zones were predicted to experience above ambient concentrations of less than 1 mg l⁻¹. These concentrations, in conjunction with ambient levels (25 mg l⁻¹), do not exceed either the WQOs or the specified water quality criteria and are thus considered acceptable.

Dissolved oxygen (DO) is of critical importance for fisheries and should never fall below a concentration of 5 mg l⁻¹ (depth average). No unacceptable impacts associated with the dissolved oxygen or nutrients were predicted in the EIA for backfilling operations at the North of Lantau and South Tsing Yi which conform to the Operations plan.

In summary, the EIA concluded that suspended sediment loads generated by backfilling activities alone are considered acceptable. However, compliance monitoring is recommended to ensure that SS concentrations do not exceed the specified criteria and WQOs, and to determine the need for additional mitigation measures should exceedances be recorded. The water sensitive receivers at which water quality monitoring is proposed are given in *Section 4.2.5*.

4.2.2

Baseline Conditions

A month-long baseline monitoring programme for all EM&A parameters consisting of thrice weekly measurements on both mid-ebb and mid-flood tides at all perimeter, control and sensitive receiver monitoring stations will be conducted. However, as this sampling period will be insufficient to characterize variation on a longer time scale (ie, monthly, yearly), EPD routine water quality monitoring data will be used to supplement the baseline monitoring programme. Both data sets will be used to determine the validity of the proposed control stations. Although every attempt will be made to avoid sampling during other dredging or disposal projects, it may not be possible to control for all other project-related effects during the baseline monitoring programme.

The monitoring programme outlined in this EM&A Manual will be modified and/or supplemented by additional measures contained in the Cumulative Effects Assessment Manual (CEAM) when other dredging/disposal activities occur concurrently and have the potential to cumulatively impact sensitive receivers identified in the EIA. The CEAM contains suggested measures and implementation guidance for both additional mitigation measures, and

modifications to the EM&A programme in the event of predicted cumulative impacts.

4.2.3

Monitoring Methodology

The values of turbidity, dissolved oxygen (DO) and suspended solids (SS) shall be determined at each designated control and monitoring station. Two measurements of DO concentration (mg l^{-1}) and DO saturation (%) shall be taken *in situ* at water depths of 1 metre below water surface, mid-water depth and 1 metre above sea bed. The monitoring probes must be removed from the water after the first measurement and redeployed for the second measurement. Two samples for turbidity (NTU) and suspended solids (mg l^{-1}) measurements shall be taken at the same three depths and the SS concentration shall be ascertained by gravimetric determination in the laboratory. Where the difference in value between the first and second measurement of the DO and turbidity parameters are more than 25% of the value of the first reading, the readings shall be discarded and further readings shall be taken. For the purpose of evaluating water quality, the values obtained from individual water depths (ie. surface, middle, bottom) shall be assessed individually against the specified WQOs and SS criteria. Water quality monitoring data should be recorded in the format given in Annex A.

4.2.4

Equipment

The following equipment shall be used to conduct the environmental monitoring programme:

(a) Dissolved Oxygen and Temperature Measuring Equipment

The instrument shall be portable and weatherproof, complete with cable, sensor, operation manual, and be operable from a DC power source. It shall be capable of measuring:

- (i) dissolved oxygen level in the range of $0\text{--}20 \text{ mg l}^{-1}$ and $0\text{--}200\%$ saturation; and
- (ii) temperature in the range of $0\text{--}45^\circ\text{C}$.

It shall have a membrane electrode with automatic temperature compensation, and a cable of not less than 25 m in length. Sufficient stocks of spare electrodes and cable shall be maintained for replacement where necessary (YSI 58 or YSI 59 Meter, YSI 5795A submersible stirrer with reel and cable or similar approved models).

(b) Turbidity Measurement Equipment

Turbidity shall be measured on the monitoring vessel, immediately after collection of the water sample. The instrument shall be a portable turbidity-measuring instrument (Hach 2100P Turbidimeter or similar approved model) complete with standard formazine concentrations for calibration and cuvettes for holding the water sample. It shall be capable of measuring turbidity between $0\text{--}1000$ NTU.

(c) Suspended Solids Measurement Equipment

A 'Van Dorn' type sampler, which is a transparent PVC or glass cylinder (capacity not less than 2 litres) which can be effectively sealed with cups at both ends, shall be used for sampling. The sampler has a positive latching system which keeps it open and prevents premature closure until released by a weight system (messenger) when the sampler is at the selected water depth (Kahlsico Water Sampler 135WB203 or similar approved). Samples shall be collected in high density polythene bottles, packed in ice (cooled to 4°C without being frozen), and delivered to the laboratory as soon as possible after collection. Upon arrival at the laboratory, Method 2540D Standard Methods for the Examination of Water and Wastewater (17th ed. APHA, AWWA, WPCF), should be used to analyse the samples.

(d) Thermometer

A laboratory standard certified mercury thermometer with an accuracy of at least 0.5 degrees Celsius and capable of measuring both ambient and water temperature shall be used. Sensors shall be calibrated against a mercury thermometer of 0.1°C scale. This thermometer should be used to measure the temperature of the cooling box in which the suspended solids samples are stored.

(e) Water Depth Measurement Equipment

A portable, battery-operated Echo Sounder shall be used for the determination of water depth within the MBA and at each designated monitoring station. This unit (Seafarer 701 or similar approved models) can either be handheld or affixed to the bottom of the work boat if the same vessel is to be used throughout the monitoring programme.

(f) Positioning Device

A self-positioning device (Global Positioning System with an accuracy of $\pm 10\text{m}$) shall be used to ensure that the vessel is at the correct position before taking measurements. Positioning equipment must be approved by the Site Manager prior to use in monitoring operations.

All monitoring instruments shall be checked, calibrated and certified by an approved accredited laboratory before use on the Works and subsequently returned to the laboratory for re-calibration at 3-month intervals throughout the water quality monitoring programme. Responses of sensors and electrodes shall be checked with certified standard solutions before each use. The turbidity meter shall be calibrated to establish the relationship between turbidity readings (in NTU) and levels of suspended solids (in mg l^{-1}), where possible.

A set of backup equipment (DO meter, turbidimeter, sampler, echo sounder etc) should be available on the vessel, so that monitoring can proceed uninterrupted in the case of equipment failure or unavailability due to re-calibration.

For the purpose of the EM&A programme, water quality monitoring stations are proposed in two zones:

- the perimeter of the South Tsing Yi and North of Lantau MBAs; and
- at sensitive receivers which may experience elevations in SS concentrations, as predicted in the EIA.

Monitoring shall be carried out at all stations three times per week. Although there are no further specific guidelines for the timing of monitoring, both daytime and nighttime backfilling operations shall be monitored.

MBA Perimeter Monitoring Stations

The purpose of the perimeter monitoring stations is to indicate the magnitude of sediment loss through the water column during initial dispersion after disposal at the MBAs. The designated perimeter monitoring stations at the South Tsing Yi and North of Lantau MBAs are indicated on *Figure 4.2a*. At the South Tsing Yi MBA, 8 monitoring stations (T1 – T8) will be located equidistantly around the perimeter of the MBA at a distance of approximately 200 m from the MBA boundary. Similarly at the North of Lantau MBA, 8 monitoring stations (N1 – N8) will be placed at a distance of approximately 200 m from the boundary of the MBA. Perimeter monitoring stations shall be sampled three times per week. Perimeter sampling shall be programmed to coincide (ie, same date and tide) with sampling of sensitive receiver and control monitoring stations.

Both pits have been assigned equal numbers of perimeter monitoring stations in order to indicate the magnitude, dispersion and direction of sediment flows. Greater potential impacts resulting from the greater volume proposed for the South Tsing Yi MBA are accounted for through allocation of sensitive receiver monitoring stations, as described below.

Sensitive Receiver Monitoring Stations

The proposed locations for the water quality monitoring stations represent the sensitive receivers which were predicted to be affected by the worst-case non-cumulative modelling scenario (Scenario 4a). This scenario modelled backfilling rates of 200,000 m³/day of trailer-dredged material at the South Tsing Yi MBA and backfilling of 10,000 m³/day of mechanically dredged material at the North of Lantau MBA. The extent of the suspended sediment plume (>1 mg l⁻¹ in the surface layer) resulting from this backfilling scenario is illustrated on *Figure 4.2b*.

Since the Operations Plan presented in the EIA will restrict backfilling rates at the South Tsing Yi MBA to half of the rate modelled in Scenario 4a, sensitive receiver monitoring locations, also shown in *Figure 4.2b*, represent a conservative estimate of potentially impacted areas. Compliance monitoring should be undertaken at these sensitive receivers to act as a check on whether SS concentrations generated during backfilling operations alone exceed the relevant WQOs and specified SS criteria. This monitoring will assist in determining the need for additional mitigation measures should exceedances of the specified criteria and WQOs be recorded.

Based on comments received from EPD on the Draft EM&A Manual, all SR monitoring stations will be monitored on a thrice weekly basis. Those SRs at which the predicted elevation in SS concentrations under the worst case non-cumulative scenario (Scenario 4a) exceeds 10 mg l^{-1} are shown in Figure 4.2b with triangle. SR monitoring stations expected to experience SS concentration elevations of less than 10 mg l^{-1} are designated by a circle. A summary of water quality monitoring at sensitive receiver monitoring stations is provided in Table 4.2a.

Control Stations

The water quality monitoring control stations are recommended to be placed upstream and downstream of the South Tsing Yi and North of Lantau MBAs and should reflect true ambient conditions. The location of the proposed control stations (C1 – C5, Figure 4.2b) shall be adjusted at the discretion of the Site Manager, based on the location of dredging/disposal projects proceeding concurrently with the backfilling operations. Only control stations which provide a true indication of background water quality, unaffected by concurrent projects in the surrounding area shall be used. Frequency of water quality monitoring at the control stations is three times per week as indicated in Table 4.2a.

Table 4.2a Proposed Perimeter, Control and Sensitive Receiver Monitoring Stations

Monitoring Location	Monitoring Stations (Fig. 4.2b)	WQO	Specified SS Criteria	Proposed Monitoring Frequency
<i>Perimeter Stations:</i>				
North of Lantau MBA	N1-N8	NA	NA	3 times per week
South Tsing Yi MBA	T1-T8	NA	NA	3 times per week
<i>Control Stations:</i>				
W. Victoria Harbour	C1	NA	NA	3 times per week
East Kau Yi Chau	C2	NA	NA	3 times per week
West Tsing Yi	C3	NA	NA	3 times per week
West Ma Wan	C4	NA	NA	3 times per week
East Brothers Islands	C5	NA	NA	3 times per week
<i>Fisheries & Mariculture:</i>				
Ma Wan Fishery	S1	32.5 mg l^{-1}	50 mg l^{-1}	3 times per week
Ma Wan FCZ	S3	32.5 mg l^{-1}	50 mg l^{-1}	3 times per week
Kau Yi Chau Fishery	S5	32.5 mg l^{-1}	50 mg l^{-1}	3 times per week
<i>Bathing Beaches:</i>				
Tung Wan Tsai	S1	32.5 mg l^{-1}	NA	3 times per week
Anglers Beach	S4	32.5 mg l^{-1}	NA	3 times per week
Gemini Beach	S2	32.5 mg l^{-1}	NA	3 times per week
Hoi Mei Wan	S2	32.5 mg l^{-1}	NA	3 times per week
Casam Beach	S2	32.5 mg l^{-1}	NA	3 times per week
Lido Beach	S2	32.5 mg l^{-1}	NA	3 times per week
<i>Water Intakes:</i>				
Kennedy Town	S7	21.9 mg l^{-1}	20 mg l^{-1}	3 times per week
Queen Mary Hospital	S8	32.5 mg l^{-1}	140 mg l^{-1}	3 times per week
Wah Fu Estate	S9	32.5 mg l^{-1}	140 mg l^{-1}	3 times per week
Tsing Yi Power Station	S6	32.5 mg l^{-1}	140 mg l^{-1}	3 times per week

Note: Suspended Solids concentration lists specific criteria applicable to sensitive receivers or the water quality objective where specific criteria do not exist.

STATION	N	E
N1	822200	818750
N2	823280	819500
N3	823610	820300
N4	823620	821400
N5	823200	822160
N6	822310	822160
N7	822030	821240
N8	821500	819420
T1	820600	827300
T2	819780	828160
T3	818600	828220
T4	817250	828850
T5	816580	828260
T6	817690	829220
T7	818660	827130
T8	819830	826660

KEY

⊗ PERIMETER MONITORING STATIONS

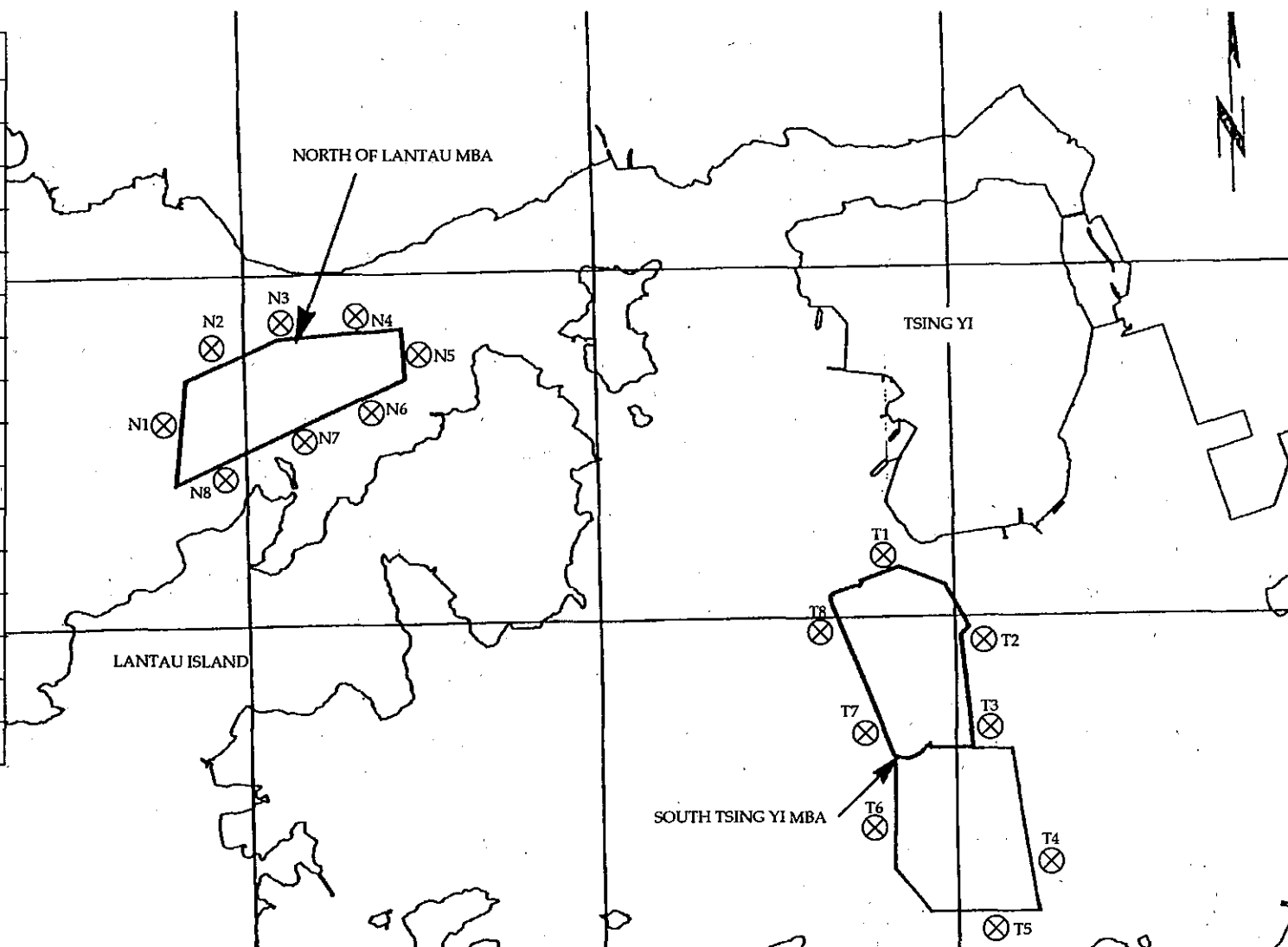
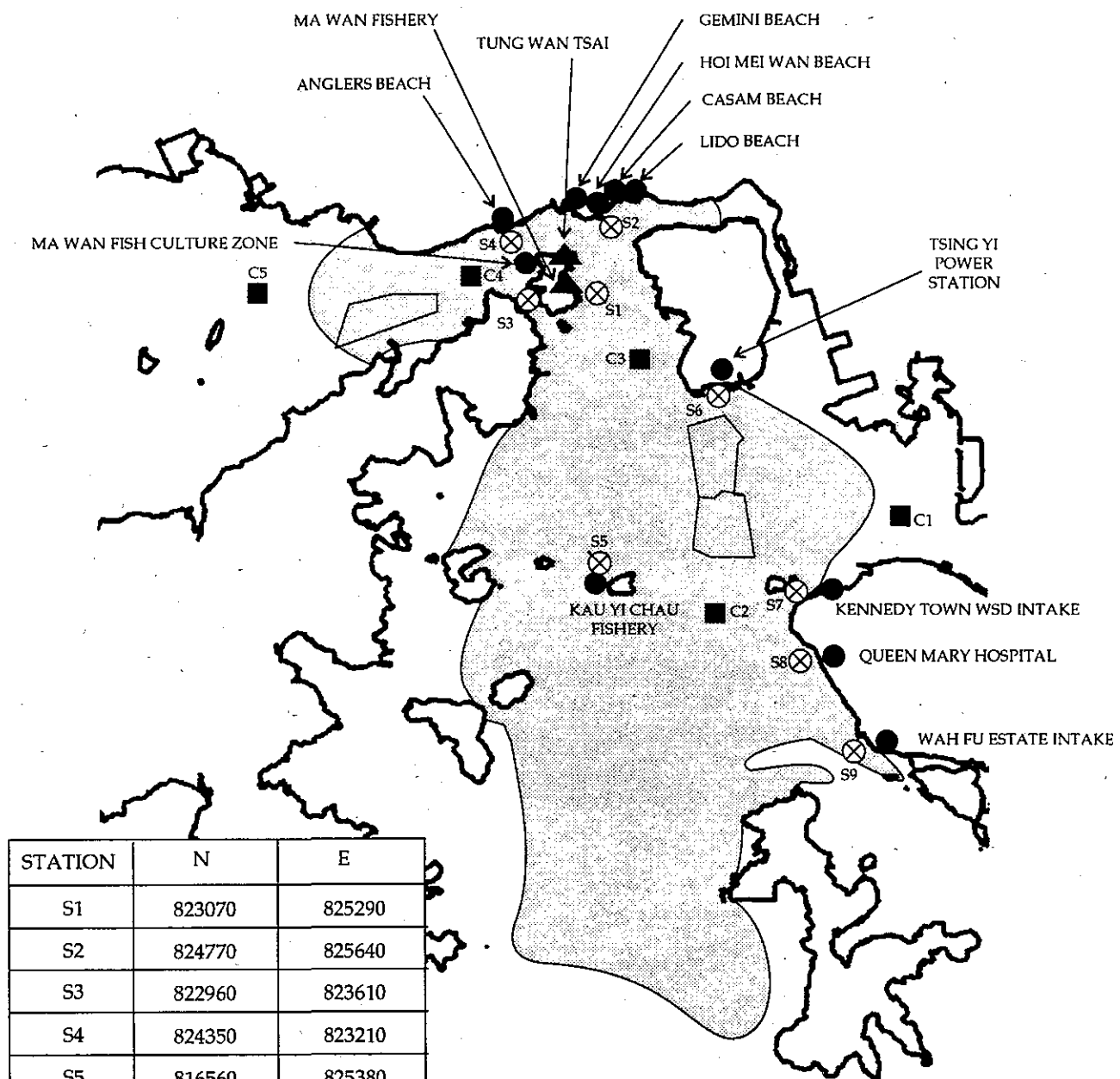


FIGURE 4.2a - PROPOSED MBA PERIMETER WATER QUALITY MONITORING STATIONS

ERM Hong Kong
6th Floor
Hecny Tower
9 Chatham Road
Tsimshatsui, Kowloon
Hong Kong





STATION	N	E
S1	823070	825290
S2	824770	825640
S3	822960	823610
S4	824350	823210
S5	816560	825380
S6	820640	828290
S7	815900	830140
S8	814190	830250
S9	812010	831510
C1	817710	832700
C2	815340	828220
C3	821510	826350
C4	823470	822240
C5	823100	817030

KEY

- SUSPENDED SEDIMENT PLUME (SS > 1 PPM IN SURFACE LAYER)
- AFFECTED WSR (SS < 10 PPM)
- AFFECTED WSR (SS > 10 PPM)
- MONITORING STATION (SENSITIVE RECEIVER)
- CONTROL STATION

FIGURE 4.2b - POTENTIALLY AFFECTED WATER SENSITIVE RECEIVERS (WSR) [MAXIMUM BACKFILLING SCENARIO (NON-CUMULATIVE)] AND PROPOSED WATER QUALITY MONITORING STATIONS

ERM Hong Kong

6th Floor
Hecny Tower
9 Chatham Road
Tsimshatsui, Kowloon
Hong Kong



The proposed Trigger, Action and Target (TAT) levels for the water quality monitoring are shown in *Tables 4.2b-e*.

Table 4.2b *TAT levels for All Marine Waters in the Study Area except Fish Culture Zones and Water Intakes*

Parameters	Trigger	Action	Target
Dissolved Oxygen, DO mg/L (depth averaged of Surface, Middle & Bottom layer)	DO < the lowest value of either 5%-ile of baseline value or 80% of the depth averaged reading from upstream control station at the same tide on the same day	Midway between Trigger and Target levels	<4 mg/L
Dissolved Oxygen, DO mg/L (Bottom)	DO < the lowest value of either 5%-ile of baseline value or 80% of the reading from upstream control station at the same tide on the same day	Midway between Trigger and Target levels	<2 mg/L
Suspended Solid Content, SS mg/L (depth-averaged)	SS > the highest value of either 90%-ile of baseline data or 110% depth averaged SS from upstream control station at the same tide on the same day	Midway between Trigger and Target levels	SS > the lowest value of either 32.5 mg l ⁻¹ or 130% depth averaged SS from upstream control station's SS at the same tide on the same day
Turbidity, Tby, NTU (depth-averaged)	Tby > 90%-ile of baseline data and Tby > 110% depth averaged reading from upstream control station's Tby at the same tide on the same day	Midway between Trigger and Target levels	Tby > 99%-ile of baseline data and Tby > 130% depth averaged reading from upstream control station's Tby at the same tide on the same day

Table 4.2c TAT levels for Fish Culture Zones

Parameters	Trigger	Action	Target
Dissolved Oxygen, DO mg/L (depth average of Surface, Middle & Bottom layer)	DO < the lowest value of either 5%-ile of baseline value or 80% of the depth average reading from upstream control station at the same tide of the same day	Midway between Trigger and Target levels	<5 mg/L
Dissolved Oxygen, DO mg/L (Bottom)	DO < the lowest value of either 5%-ile of baseline value or 80% of the reading from upstream control station at the same tide of the same day	Midway between Trigger and Target levels	<2 mg/L
Suspended Solid Content, SS mg/L (depth-averaged)	SS > the highest value of either 90%-ile of baseline data or 110% depth average SS from upstream control station at the same tide of the same day	Midway between Trigger and Target levels	SS > the lowest value of either 50 mg/L or 130% depth average SS from upstream control station's SS at the same tide of the same day
Turbidity, Tby, NTU (depth-averaged)	Tby > 90%-ile of baseline data and Tby > 110% depth average reading from upstream control station's Tby at the same tide of the same day	Midway between Trigger and Target levels	Tby > 99%-ile of baseline data and Tby > 130% depth average reading from upstream control station's Tby at the same tide of the same day

("depth averaged" is calculated by taking the arithmetic means of reading of all three depths)

Table 4.2d TAT levels for Kennedy Town Water Intake.

Parameters	Trigger	Action	Target
Suspended Solid Content, SS mg/L (depth-averaged)	SS>the highest value of either 90%-ile of baseline data or 110% depth averaged SS from upstream control station at the same tide on the same day	Midway between Trigger and Target levels	SS>the lowest value of either 20 mg/L or 130% depth averaged SS from upstream control station's SS at the same tide on the same day
Turbidity, Tby, NTU (depth-averaged)	Tby>90%-ile of baseline data and Tby>110% depth averaged reading from upstream control station's Tby at the same tide on the same day	Midway between Trigger and Target levels	Tby>99%-ile of baseline data and Tby>130% depth averaged reading from upstream control station's Tby at the same tide on the same day

Table 4.2e TAT levels for Queen Mary Hospital, Wah Fu Estate and Tsing Yi Power Station Water Intake.

Parameters	Trigger	Action	Target
Suspended Solid Content, SS mg/L (depth-averaged)	SS>the highest value of either 90%-ile of baseline data or 110% depth averaged SS from upstream control station at the same tide on the same day	Midway between Trigger and Target levels	SS>the lowest value of either 140 mg/L or 130% depth averaged SS from upstream control station's SS at the same tide on the same day

("depth averaged" is calculated by taking the arithmetic means of reading of all three depths)

In the event of an exceedance of any one of the TAT levels as defined in *Tables 4.2b-e*, a review of backfilling activities should be carried out by the Site Manager. This may include a combination of the following:

- a) a review of operational controls as defined under the Operations Plan;
- b) a review of general mitigation measures such as working methods and practices; and
- c) inspection of any marine plant or equipment suspected of contributing to the exceedance.

The Site Manager should inform EPD of any actions taken in response to an action/target level exceedance. In addition, a record of all actions taken during the current month should be kept and forwarded to the Environmental Consultant, for inclusion in the EM&A monthly report.

A water quality AEP has been established to show the responsibilities of the relevant parties in the event of an exceedance in the TAT levels (*Table 4.2f*).

Table 4.2f Action/Event Plan for Water Quality

Exceedance	Environmental Team (Environmental Consultant & Laboratory/Environmental Contractor)	Project Team(s)	Site Manager
Trigger level being exceeded by one sampling day	Inform Site Manager	Rectify unacceptable practice.	
Trigger level being exceeded by more than two consecutive sampling days	Repeat <i>in-situ</i> measurement to confirm findings; Identify source(s) of impact; Inform Site Manager; Check monitoring data, all plant, equipment and Project Team's working methods; Discuss mitigation measures with the Site Manager and Project Team(s);	Rectify unacceptable practice; Check all plant and equipment; Consider changes of working methods; Propose mitigation measures to Site Manager and discuss with Environmental Team and the Site Manager; Implement mitigation measures.	Inform Project Team(s); Discuss with Environmental Team and the Project Team(s) on the proposed mitigation measures; Make agreement on the mitigation measures to be implemented; Assess the effectiveness of the implemented mitigation measures
Action level being exceeded by one sampling day	Repeat <i>in-situ</i> measurement to confirm findings; Identify source(s) of impact; Inform Site Manager; Check monitoring data, all plant, equipment and Project Team(s) working methods; Discuss mitigation measures with the Site Manager and Project Team(s); Repeat measurement on the next day of exceedance.	Confirm notification of exceedance in writing; Rectify unacceptable practice; Check all plant and equipment; Consider changes of working methods; Propose mitigation measures to Site Manager and discuss with Environmental Team and the Site Manager; Implement the agreed mitigation measures.	Inform Project Team(s); Discuss with Environmental Team and the Project Team(s) the proposed mitigation measures; Make agreement on the mitigation measures to be implemented; Assess the effectiveness of the implemented mitigation measures.

Table 4.2f Action/Event Plan for Water Quality (cont.)

Exceedance	Environmental Team (Environmental Consultant & Laboratory/Environmental Contractor)	Project Team(s)	Site Manager
Action level being exceeded by more than two consecutive sampling days	Repeat <i>in-situ</i> measurement to confirm findings; Identify source of impact; Inform Site Manager; Check monitoring data, all plant, equipment and Project Team(s) working methods; Discuss mitigation measures with the Site Manager and Project Team(s); Ensure mitigation measures are implemented; Prepare to increase the monitoring frequency to daily; Repeat measurement on the next day of exceedance.	Confirm notification of exceedance in writing; Rectify unacceptable practice; Check all plant and equipment; Consider changes of working methods; Propose mitigation measures to the Site Manager within 3 working days upon the notification and discuss with Environmental Team and the Site Manager; Implement the agreed mitigation measures;	Inform the Project Team(s); Discuss with Environmental Team and the Project Team(s) on the proposed mitigation measures; Make agreement on the mitigation measures to be implemented; Assess the effectiveness of the implemented mitigation measures.
Target level being exceeded by one sampling day	Repeat <i>in-situ</i> measurement to confirm findings; Identify source(s) of impact; Inform Site Manager; Check monitoring data, all plant, equipment and Project Team(s) working methods; Discuss mitigation measures with the Site Manager and Project Team(s); Ensure mitigation measures are implemented; Increase the monitoring frequency to daily until no exceedance of Target level.	Confirm notification of exceedance in writing; Rectify unacceptable practice; Check all plant and equipment; Review critically the working methods; Propose mitigation measures to the Site Manager within 3 working days upon the notification and discuss with Environmental Team and the Site Manager; Implement the agreed mitigation measures.	Inform Project Team(s) and EPD; Discuss with Environmental Team and the Project Team(s) on the proposed mitigation measures; Request Project Team(s) to critically review the working methods; Make agreement on the mitigation measures to be implemented; Assess the effectiveness of the implemented mitigation measures.

Table 4.2f Action/Event Plan for Water Quality (cont.)

Exceedance	Environmental Team (Environmental Consultant & Laboratory/Environmental Contractor)	Project Team(s)	Site Manager
Target level being exceeded by more than two consecutive sampling days	Repeat <i>in-situ</i> measurement to confirm findings; Identify source(s) of impact; Inform Site Manager; Check monitoring data, all plant, equipment and Project Team's working methods; Discuss mitigation measures with the Site Manager and Project Team(s); Ensure mitigation measures are implemented; Increase the monitoring frequency to daily until no exceedance of Target level for two consecutive days.	Confirm notification of exceedance in writing Rectify unacceptable practice; Check all plant and equipment; Review critically the working methods; Propose mitigation measures to Site Manager within 3 working days upon the notification and discuss with Environmental Team and the Site Manager; Implement the agreed mitigation measures; As directed by the Site Manager, to slow down or to STOP all or part of the marine work.	Inform Project Team(s) and EPD; Discuss with Environmental Team and the Project Team(s) on the proposed mitigation measures; Request Project Team(s) to critically review the working methods; Make agreement on the mitigation measures to be implemented; Assess the effectiveness of the implemented mitigation measures; Consider and instruct, if necessary, the Project Team(s) to slow down or to STOP the backfilling operation until no exceedance of Target level.

Details of the requirements for the EM&A of noise impacts during night-time backfilling operations at the North of Lantau MBA are presented below.

4.3.1

Objectives and Criteria

The objectives of the noise monitoring programme include the following:

- to establish the pre-existing and on-going baseline noise climate at Noise Sensitive Receivers (NSRs), against which any short or long term noise impacts can be judged;
- to provide an early indication if the operational restrictions proposed in the Operations Plan are failing to reduce night-time noise impacts from dumping operations, at nearby NSRs, to levels in compliance with those specified under the NCO; and
- to provide data to enable an environmental audit of the night-time backfilling operations at the North of Lantau MBA.

The criteria against which the noise monitoring shall be assessed refer to the noise level at 1 meter from the NSR facade and are as follows:

- for daytime (0700–1900) working, Monday to Saturday, the generally agreed, non-statutory, level of $L_{Aeq, 30 \text{ min}}$ 75 dB(A); and
- for restricted hours ie. all other times (1900–0700) Monday to Saturday, and all day on Public Holidays (including Sundays), the Basic Noise Levels (BNLs) specified in the *Technical Memorandum on Noise from Construction Work other than Percussive Piling*, these are shown in Table 4.3a below.

Table 4.3a *Basic Noise Levels for Restricted Hours ($L_{Aeq, 5 \text{ min}}$ dB)*

Time Period	Area Sensitivity Rating - A	Area Sensitivity Rating - B	Area Sensitivity Rating - C
All days during the evening (1900–2300) and public holidays (including Sundays) during the day and evening (0700–2300)	60	65	70
All days during the night-time (2300–0700)	45	50	55

The appropriate limit is determined by the type of area in which the NSR lies. Table 4.3b shows the criteria for the various Area Sensitivity Ratings (ASRs).

Table 4.3b Area Sensitivity Rating Criteria

Type of area containing NSR	Not Affected ⁽¹⁾	Indirectly Affected ⁽²⁾	Directly Affected ⁽³⁾
(i) Rural area, including country parks or village type developments	A	B	B
(ii) Low density residential area consisting of low-rise or isolated high-rise developments	A	B	C
(iii) Urban area	B	C	C
(iv) Area other than those above	B	B	C

Note:

(1) Not Affected means that the NSR is at such a location that the noise generated by the influencing factors⁽⁴⁾ (IF) is not noticeable at the NSR.

(2) Indirectly Affected means that the NSR is at such a location that the noise generated by the IF, whilst noticeable at the NSR, is not a dominant feature of the noise climate of the NSR.

(3) Directly Affected means that the NSR is in such a location that the noise generated by the IF is readily noticeable at the NSR and is a dominant feature of the noise climate of the NSR.

(4) Influencing Factors are defined as industrial areas, major roads or the area within the boundary of Hong Kong International Airport.

Source: Technical Memorandum on Noise from Construction Work other than Percussive Piling.

4.3.2 Monitoring Locations

A discussion of predicted noise impacts on NSRs is provided in the EIA. For the purposes of the EM&A programme, noise monitoring is recommended to be undertaken at the following locations, as shown on Figure 4.3a.

- Wu Uk Village (ASR = A);
- Ka Loon Tsuen (ASR = B);
- Ma Kok Tsui (ASR = A); and
- Hong Kong Garden (ASR = B).

Monitoring stations shall be set up at these locations. The exact location and orientation of monitoring equipment shall be proposed by the Environmental Consultant and approved by the Site Manager.

4.3.3 Noise Measurement Methodology

The following procedures shall be adopted for all noise monitoring, either of baseline noise levels or of construction noise.

Noise levels will be determined by carrying out measurements at the monitoring locations. Noise measurements will be made in terms of the A-weighted equivalent continuous sound pressure level (L_{Aeq}) measured with an integrating sound level meter set to "fast" response. Such measurements will be made over a 30 minute period comprising six consecutive $L_{Aeq, 5 \text{ min}}$ readings. The $L_{Aeq, 30 \text{ min}}$ value will be calculated from the $L_{Aeq, 5 \text{ min}}$ readings.

Where a measurement is to be carried out at a building, the assessment point would normally be at a position 1 m from the exterior of the building facade but may be at any other point considered appropriate by EPD. Where a measurement is to be made of noise being received at a place other than a building, the assessment point would be at a position 1.2 m above the

ground in free-field and a +3 dB correction shall be added to the results to give the equivalent of a facade noise level.

Immediately prior to and following each set of measurements at any NSR the accuracy of the sound level meter shall be checked using an acoustic calibrator generating a known sound pressure level at a known frequency. If the calibration levels before and after the measurement differ by more than 1.0 dB, the measurement shall be repeated to obtain a reliable result. Periods of prolonged or repeated overloading of the sound level meter detector shall be avoided by setting the meter with adequate headroom prior to commencing measurements. Measurements shall be recorded to the nearest 0.1 dB, with values of 0.05 being rounded up.

General meteorological and weather conditions, including a measurement of wind speed, shall be recorded for each measurement. Where the steady wind speed exceeds 5 m s^{-1} or gusts above 10 m s^{-1} , or in the presence of fog or rain, measurements shall be treated as invalid and repeated in more appropriate conditions.

Noise monitoring data should be recorded in the format given in *Annex A*.

Baseline Monitoring

Initial baseline ambient noise levels shall be measured over one continuous 24 hour, weekday period at each monitoring location prior to the commencement of backfilling operations. The survey period shall be selected so as to avoid any unusual or infrequent activity in the area. Measurements of the L_{Aeq} , L_{A90} and L_{A10} noise levels shall be made, over 30 minute periods, for the whole of the 24 hour period. Additionally, during the survey period, octave band spectra, covering the frequency range 63 Hz – 8 kHz, shall be measured over two typical daytime and two typical night-time, 5 minute periods. In order to confirm that typical conditions prevail throughout the survey period, observations of noise sources and weather conditions shall be made and reported on field data forms for two typical daytime and two typical night-time occasions. Initial baseline monitoring results will be taken by a logging sound level meter. All baseline measurements may be carried out during a single 24 hour period.

The baseline monitoring results will be used in conjunction with the Trigger/ Action/Target (TAT) levels (described below) to determine the validity of complaints, the significance of impact monitoring results, and the requirements for action under the Action/Event Plan.

Impact Monitoring

During night time construction working hours (ie 2300–0700), monitoring of $L_{Aeq, 5min}$ noise levels shall be carried out at the listed NSRs, for three consecutive 5 minute periods. Where a measurement includes a period of atypical background noise it shall be considered invalid, discarded and the measurement repeated. Measurements should be carried out once per week when backfilling operations are taking place.

4.3.4

Equipment

Prior to the commencement of the construction works, a calibrated sound level meter and pistonphone calibrator shall be prepared for use in

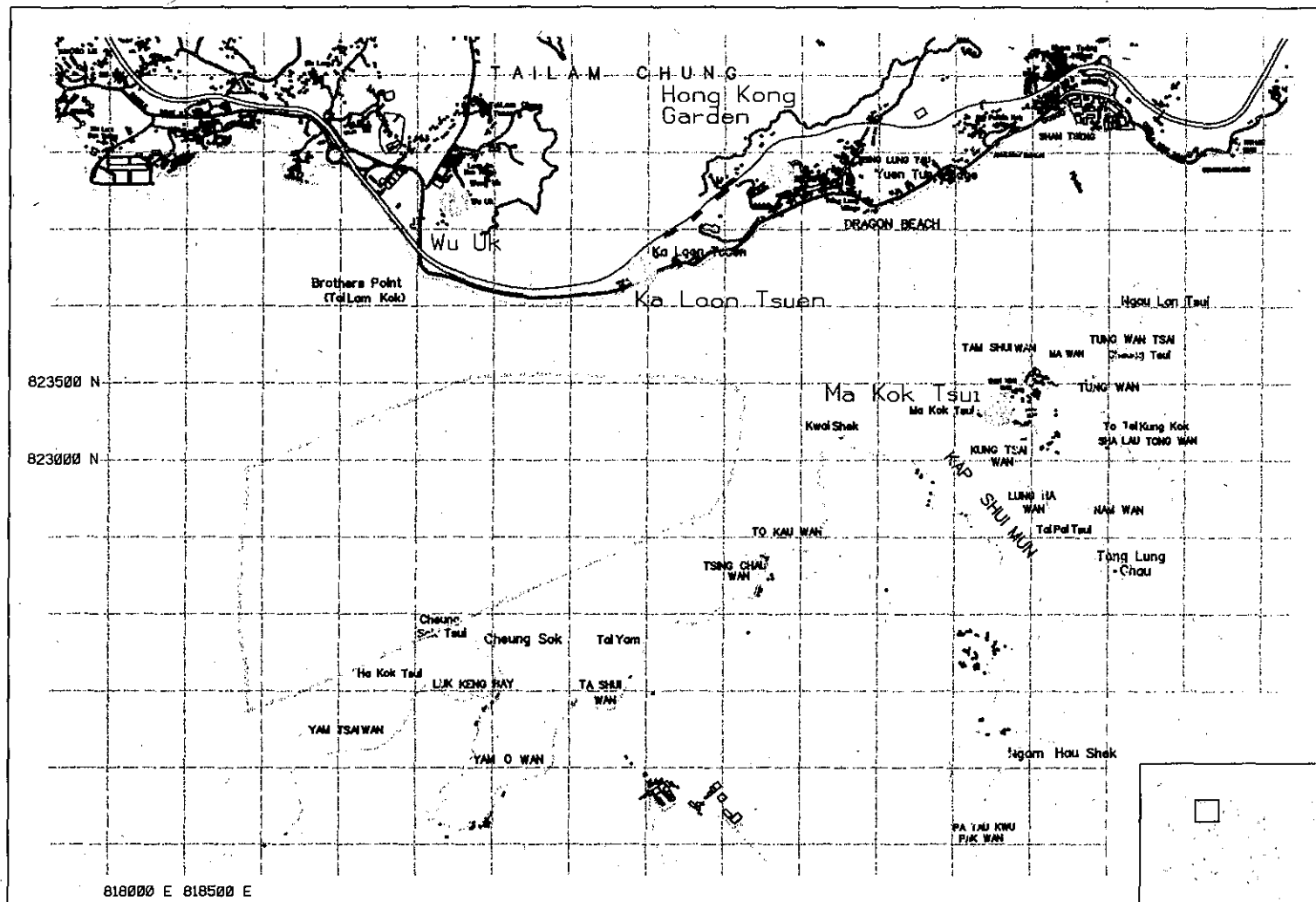


FIGURE 4.3a Proposed noise monitoring stations near the North Lantau MBA

Date : 1 July 1995

Project No.: C 1280

Map drawn by GIS and Mapping, ERM

Base map from LANDS DEPT. 1:20k topo

KEY

NSR Location

MBA Site

ERM Hong Kong

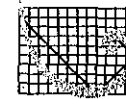
6th Floor

Hecny Tower

9 Chatham Road

Tsimshatsui, Kowloon

Hong Kong



ERM

monitoring. The meter and pistonphone calibrator shall comply with the International Electrotechnical Commission (IEC) Publication 651:1979 (Type 1) and 804:1985 (Type 1) specification as referred to in the Technical Memoranda to the NCO. The sound level meter shall be supplied and used with the manufacturers recommended wind shield, and a suitable tripod. The equipment shall be maintained in proper working order with sufficient spare equipment available in the event of breakdown. The sound level meters/analysers including the calibrators shall be verified by the manufacturers once every two years to ensure they perform to the same level of accuracy as stated in the manufacturers specifications. At the time of measurements, the equipment shall have been verified within the previous two years.

A calibrated anemometer shall also be supplied for the measurement of wind speeds during noise monitoring periods. The equipment shall be maintained in accordance with the manufacturer's recommendations.

4.3.5 Compliance Check

The noise monitoring data shall be checked against the agreed TAT levels as defined below.

The *Trigger* and *Action* levels for construction noise monitoring are defined not only on a scale of noise levels, but also in terms of complaints that might be received from the local NSRs, as follows:

- *Trigger* level – Receipt of a single documented complaint of construction noise or a single measured exceedance of the noise criteria (*Section 4.4.1*).
- *Action* level – Receipt of more than one documented complaint of construction noise in any one week period or more than one measured exceedance of the noise criteria (*Section 4.3.1*) in a given week.

The *target levels* for construction noise, measured at the facade of any NSR, are as shown below in *Table 4.3c*.

Table 4.3c Construction Noise Target Levels

Time Period	Target Level ASR – A	Target Level ASR – B
Daytime (0700–1900), any days other than public holidays including Sundays ($L_{Aeq, 30 \text{ min}}$ dB)	75	75
All days during the evening (1900–2300) and public holidays (including all Sundays) during the daytime and evening (0700–2300) ($L_{Aeq, 5 \text{ min}}$ dB)	60	65
All night periods (2300–0700) ($L_{Aeq, 5 \text{ min}}$ dB)	45	50

The situation does arise, however, where the existing background noise level is already approaching or greater than the target, particularly where the receiver is beside a busy road or industrial area where there are many other dominant noise sources. In such situations, there is a procedure to calculate the noise emanating from a single source, ie the construction site, given the prevailing ambient noise levels (ie Baseline Levels).

A measured impact noise level which exceeds the Baseline Level and is

above the Target 75 dB(A) Level, may in fact result from a construction noise level below the Target Level (75 dB(A)) and this would not constitute an exceedance. This is illustrated by an example shown in *Table 4.3d*.

Table 4.3d *Determination of an Exceedance for an example NSR with Baseline Noise Level above Target (75 dB(A))*

Baseline Level	Measured Noise Impact Level	Calculated Construction Noise Level	Exceedance
76	77	70.1	N
76	78	73.7	N
76	79	76.0	Y
76	80	77.8	Y
76	81	79.3	Y

For the purposes of reporting the noise monitoring results, an exceedance is considered to have occurred if all the following conditions are met:

- 1) The measured impact noise level is above the Target Level;
- 2) The measured impact level is above the Baseline Level;
- 3) The construction noise level, as calculated by logarithmical subtracting the Baseline Level from the measured impact level, is above the Target Level.

4.3.6 *Action/Event Plan (AEP)*

In the event of an exceedance of any one of the TAT levels as defined above in *Section 4.3.5*, a review of backfilling activities should be carried out by the Site Manager. This may include a combination of the following:

- a) a review of operational controls as defined under the Operations Plan;
- b) a review of general mitigation measures such as working methods and practices; and
- c) inspection and maintenance or replacement of any marine plant or equipment contributing to the deterioration.

The Site Manager shall immediately inform EPD of any target level exceedances and subsequent actions. A record of all actions taken during the relevant month should be kept and forwarded to the Environmental Consultant, for inclusion in the EM&A monthly report.

An AEP which outlines details of responsibilities by relevant parties in the event of exceedance of the recommended TAT levels is given in *Table 4.3e*. Additional noise measurements will be required on an *ad hoc* basis as indicated.

Table 4.3e Noise Action/Event Plan

Event	Environmental Consultant	Site Manager	Project Team
Trigger Limit Exceedance	<ul style="list-style-type: none"> Identify main noise source if possible; Inform Site Manager; Discuss potential remedial actions with Site Manager; Repeat noise measurement to confirm findings. 	<ul style="list-style-type: none"> Review noise monitoring data; Assess the effectiveness of mitigation measures; Discuss potential remedial actions with the Environmental Consultant; Impose additional mitigation and monitoring requirements as necessary. 	<ul style="list-style-type: none"> Rectify any unacceptable practice to the approval of the Site Manager; Implement any additional mitigation and monitoring requirements imposed by the Site Manager.
Action Limit Exceedance	<p><i>As above for Trigger Level Exceedance, plus:</i></p> <ul style="list-style-type: none"> If findings confirmed, increase noise monitoring frequency; Report findings of additional monitoring to the Site Manager and assess efficacy of remedial actions. 	<p><i>As above for Trigger Level Exceedance, plus:</i></p> <ul style="list-style-type: none"> Direct Environmental Consultant to increase monitoring frequency; Assess results of additional monitoring from Environmental Consultant. 	<ul style="list-style-type: none"> Submit proposals within 3 working days to the Site Manager to reduce noise impacts; Amend proposals, if required, and implement agreed proposals immediately.
Target Limit Exceedance	<p><i>As above for Action Level Exceedance, plus:</i></p> <ul style="list-style-type: none"> Detailed investigation of the cause of exceedance, as directed by the Site Manager. 	<p><i>As above for Action Level Exceedance, plus:</i></p> <ul style="list-style-type: none"> Direct project team to critically review working methods; Notify EPD. 	<p><i>As above for Trigger Level Exceedance, plus:</i></p> <ul style="list-style-type: none"> Resubmit proposals if problem still not solved.

In the event that a complaint whether direct or indirect is received, an assessment of the validity and relevance of the complaint will first be made by the party receiving the complaint and/or by the Site Manager. Following this step, the Site Manager shall immediately take any necessary and appropriate action.

The Site Manager should consider implementing the following steps to rectify the situation:

- identifying the source of impacts;
- taking necessary action to mitigate the situation;
- increasing monitoring with respect to water quality or noise;
- checking compliance with TAT levels and environmental regulations;
- if monitoring results show exceedances, repeat review procedures, identifying possible areas of improvement and checking procedures;
- documenting all complaints in the monthly EM&A report to EPD including details of remedial measures taken, and the additional monitoring results for the period; and
- where possible, preparing a formal reply to complaints to notify the concerned person(s) that action has or will be taken, within two weeks of receipt of the complaint.

Figure 5.0a is an illustration of the procedures to be undertaken in the event of complaints.

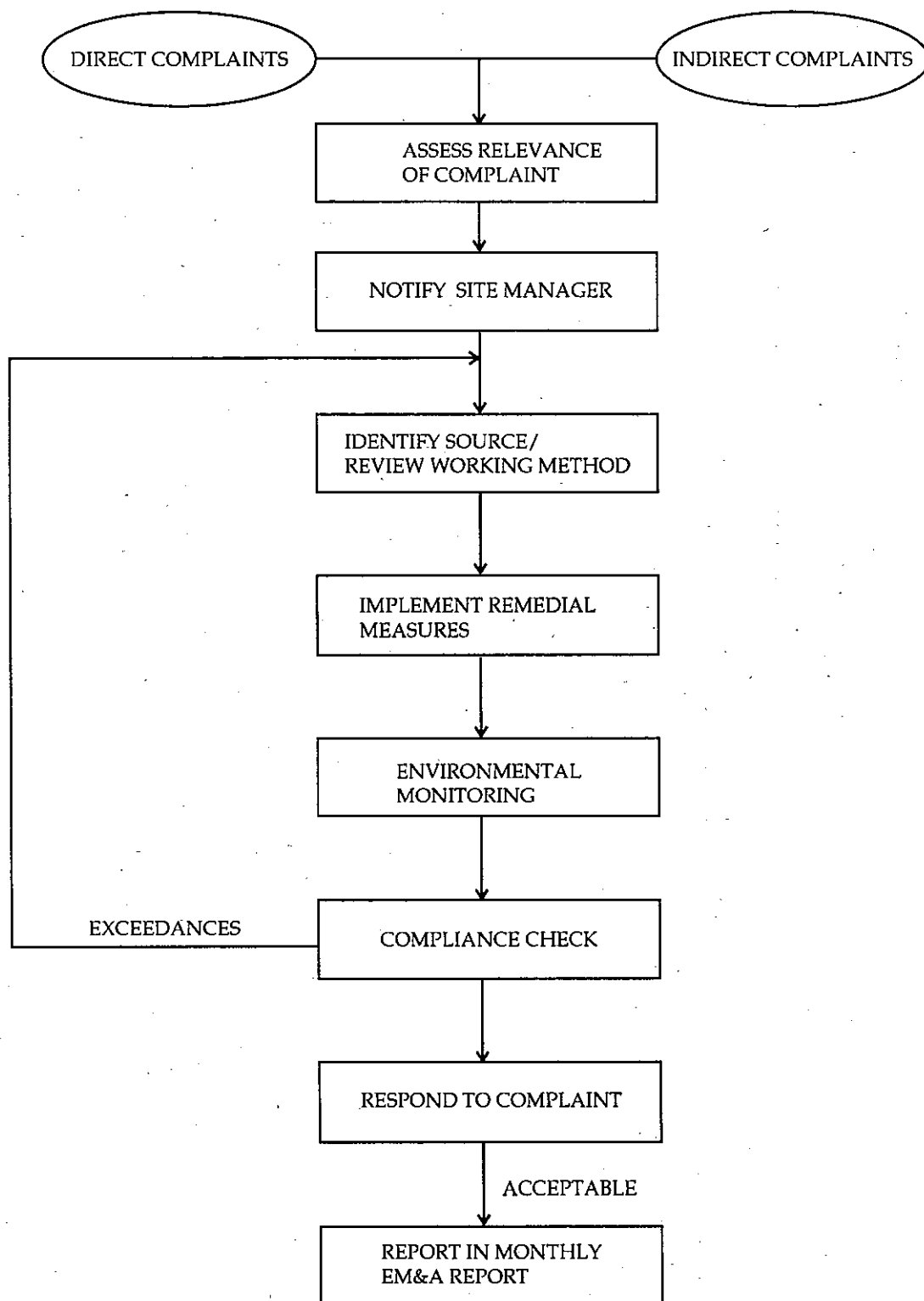


FIGURE 5.0a - COMPLAINT HANDLING PROCEDURE

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6.1

INTRODUCTION

The proposed reporting requirements for the backfilling operations are discussed below. This reporting structure includes the methodology for recording data, the treatment of exceedances and the format of the monthly and quarterly (3-monthly) progress reports. The audit requirements set out the procedures to be used to ensure the efficacy of the environmental management and monitoring systems.

6.2

MONITORING RESULTS

Monitoring data shall be reported on standardised record sheets and shall contain the following information, as appropriate:

- sampling point(s);
- sampling depth(s);
- sampling parameter(s);
- number of measurements;
- weather conditions;
- brief description of the backfilling activities (eg. location of dumping operations, rates of disposal, backfill level, operational restrictions);
- trigger/action/target levels; and
- checks on compliances.

A sample record sheet for water quality and noise monitoring is illustrated in *Annex A*.

6.3

ENVIRONMENTAL EXCEEDANCES

In the event of environmental exceedances, the appropriate AEP should be adopted. The Environmental Consultant should notify the Site Manager immediately if any exceedances occur. In addition, in the event of target level exceedances, the Site Manager should inform EPD by fax. Action(s) taken should be reported immediately to the EPD, as well as reported in the monthly progress report. If any of the TAT levels are exceeded on more than two consecutive days, EPD shall be informed by a report which summarizes the monitoring data, describes implemented mitigation measures and proposes actions to avoid further occurrences of non-compliance.

6.4

MONTHLY EM&A PROGRESS REPORT

A monthly EM&A progress report should be prepared and submitted to the Site Manager on the tenth working day of each month in an agreed format (printed and/or magnetic media form). The report should include the following:

- summary of major points and the month's backfilling activities;

- monitoring data and audit/review of these monitoring results;
- compliance check and report on exceedances;
- remedial measures adopted to mitigate any adverse impacts;
- record of complaints and remedial measures;
- forecast of work programme and monitoring schedule;
- proposal for changes to monitoring requirements, as appropriate; and,
- comments and conclusions.

6.5 *QUARTERLY EM&A PROGRESS REPORT*

A quarterly EM&A Report should also be prepared and submitted to the Site Manager on the tenth working day following the subject 3 month period, in an agreed format. The report should include:

- past 3 months data;
- trend analysis of environmental conditions over the monitoring period;
- annotated figures of events (environmental conditions, TAT level exceedances, etc); and
- remedial measures undertaken and the efficacy of these measures.

This quarterly report will be made publicly available, in accordance with the draft Technical Circular on EM&A currently being assessed by SPEL, which will be in line with PELB's General Circular No. 2/94 on the Public Access to Environmental Impact Assessment (EIA) Reports.

Environmental auditing is recommended to test the adequacy and effectiveness of the environmental monitoring programme.

These audits should be carried out by an independent body on a regular basis, for example at monthly intervals. The audit should cover the following:

- Review and verification of information available in records generated through the monitoring programme;
- Identification of specific issues of non-compliance and recommendations to meet them; and
- Checking the effectiveness of operational controls and mitigation measures and reviewing the need for further mitigatory measures.

In addition, an audit of the environmental complaints handling procedures should be carried out to verify that complaints are properly channelled and addressed. The results of the environmental auditing shall be reported in the subsequent monthly EM&A Report.

Annex A

Examples of Monitoring
Record Sheets

Table A1

Water Quality Monitoring Record Sheet - Suspended Solids Level

Monitoring Station		Water Depth					
		S		M		B	
S							
S							
S							
S							
S							
S							
Mean							
Maximum							
Control Station	C						
	C						
	Mean						
	Maximum						
Trigger level (mg/l) (>90%ile of EPD routine monitoring results and >20% above mean same day upstream control station)							
Exceedances ¹							
Action Level (mg/l) (>30% above mean same day upstream control station)							
Exceedances ²							
Target Level (mg/l) (persistently (3 times) >30% above maximum same day upstream control station)							
Exceedances ³							
<p>Note : S = 1 meter below surface M = middepth B = 1 meter above seabed</p> <p>*1 = Trigger Level - Compare measured result with daily mean of the control station and EPD routine monitoring results *2 = Action Level - Compare measured result with daily mean of the control station *3 = Target Level - Compare measured result with the daily maximum of the control station</p>							

Ambient Temperature :

Weather :

High Tide Time :

Height:

Low Tide Time :

Height:

Remarks :

Name & Designation

Signature

Date

Field Operator :

Lab Staff :

Checked by :

Table A2 Noise Monitoring Record Sheet

Monitoring Location and reference

Date and day

Personnel reference

Weather conditions (general)

Wind Speed - average/peak (m/s)

Calibration before measurement

Calibration after measurement

Start and finish time of measurement

Duration of measurement

L_{90} level

L_{10} level

L_{eq} level

Principal Noise Sources

Other comments

	Name & Designation	Signature	Date
--	--------------------	-----------	------

Field Operation :			
-------------------	--	--	--

Lab. Staff :			
--------------	--	--	--

Checked by :			
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