# Appendix A

## ENVIRONMENTAL MONITORING AND AUDIT MANUAL

FOR

## LANTAU PORT DEVELOPMENT STAGE 1 Container Terminal 10 & 11

# TABLE OF CONTENTS

## LIST OF TABLES



## LIST OF FIGURES



## APPENDICES

# 1 INTRODUCTION

## 1.1 Purpose of this Document

This Manual outlines the monitoring and audit programme to be undertaken for the construction of Container Terminal (CT) No.10 and 11, as part of the Lantau Port Development (LPD). It aims to provide systematic procedures for environmental monitoring and auditing of the construction and operation impact of the development.

Environmental monitoring schedules and audit procedures are used to ensure that the environmental impacts of the construction and operation of CT development are maintained within specified limits. An Action Plan provides for appropriate corrective measures to minimise the impact of pollution events and periodic audits check compliance, review monitoring schedules, record anomalies and identify areas for remedial action.

Hong Kong environmental legislation for air quality, noise and water quality and the Hong Kong Planning Standards and Guidelines have been used for the preparation of this Manual.

## 1.2 Project Background

A principal recommendation of the Port and Airport Development Strategy (PADS) was that the majority of Hong Kong's future port requirements will be accommodated by new Container Terminals at northeast Lantau.

The Lantau Port and Western Harbour Development (LAPH) Studies, were completed in early 1993 and investigated the feasibility of development of land and marine based port facilities on the north-eastern coast of Lantau and the Western Harbour.

The study recommended that LPD comprise of 4 Phases :

Phase I/II : Container Terminal no.10 and 11 (CT10 & CT11) and Backup Areas;
Phase III/IV : CT 12 & 13 and Backup Areas.

This Study represents Stage 1, Preliminary Design of Phase I/II a study involving investigation, preliminary design and environmental assessment of LPD, CT 10 & 11 and Tsing Chau Tsai (TCT) borrow area development. A concurrent Ancillary Works Study is investigating back-up areas, port breakwater, approach channel, serviced land, road link to the terminals, internal roads for the serviced land, as well as other associated services. Construction of critical components of the first stage of the LPD should commence during early 1995. Figure 1.1 shows the key elements of Lantau Port Developments.

## 1.3 Project Site

CT10 and CT11 will be built immediately adjacent to each other on reclaimed land formed south of the TCT peninsula and immediately to the south and east of Pennys Bay, shown in Figure 1.2.

## 1.4 Project Construction

The construction of CT10 and CT11 will involve reclamation from the sea and subsequent construction of port structures and container berths. The fill material required for the reclamation is assumed to be sourced from a marine borrow area, which has still to be defined. Figure 1.2 shows the major activity areas associated with the construction of the port.

Marine mud beneath the reclamation will, for the most part, be left in-situ and its consolidation will be accelerated using wick drains. The exception is a dredged trench required to form the southern seawall foundations. The terminals will be 620 metres front to back measured from the cope line to the northern boundary fence along the southern edge of the main port road. Initial investigation has identified the presence of contaminated material. Additional investigation is being undertaken to confirm and define extent of this material. Both CT10 and CT11 are planned to have four berths, each berth being 320 metres in length. These will be 20 ha of container storage available for each berth. It is proposed that the eastern terminal would be started first with the western terminal following, though there is likely to be concurrent construction activity. Each terminal will incorporate a 25m high bund at its western end to provide noise attenuation from port activities and mitigate noise impact on receivers to the west.

## 1.5 Interface with Other Projects

Operations within the Ancillary Works reclamations and associated infrastructure projects, construction of North Lantau Expressway and Tsing Ma Bridge will all contribute to the environment of Northeast Lantau. The air, noise and water quality of the area around the site will be affected by more than one construction activity and a number of different contractors operating under different contracts.

## 1.6 Integrated Monitoring Programme

It is likely that it will be problematic to monitor and assess the environmental impact caused by a single contractor or particular operation in isolation. Therefore, it is recommended that monitoring would be best carried out as a focused programme with project specific monitoring and an area-wide assessment of cumulative impact. The impacts of specific projects can then be identified, while cumulative assessment of all activities in the area will provide a mechanism to institute area-wide control and mitigation. It is proposed that an independent environmental office is set up, in an arrangement similar to the one adopted on the West Kowloon reclamation (Environmental Protection Office - ENPO).

Data would be collected from a number of locations, chosen for their ability to identify impact; that is either close to potentially environmentally detrimental activity or close to sensitive uses. The environmental office would monitor site activity on a daily basis, recording where construction activity was concentrated, time of activity, type of activity, plant involved, and a qualitative assessment/description of the activity. In the event of the monitoring programme detecting an exceedance records could be reviewed to identify the potential source of impact. The activities would then be assessed to determine whether a "one off" situation or a general deterioration due to cumulative impact had developed. Focused monitoring could then be investigated to quantify levels of impact from particular activities. This information could be forwarded to EPD and could be used when

formulating requirements for Construction Noise Permits (CNP) issue or renewal or when assessing implications of dust producing or water polluting activity.

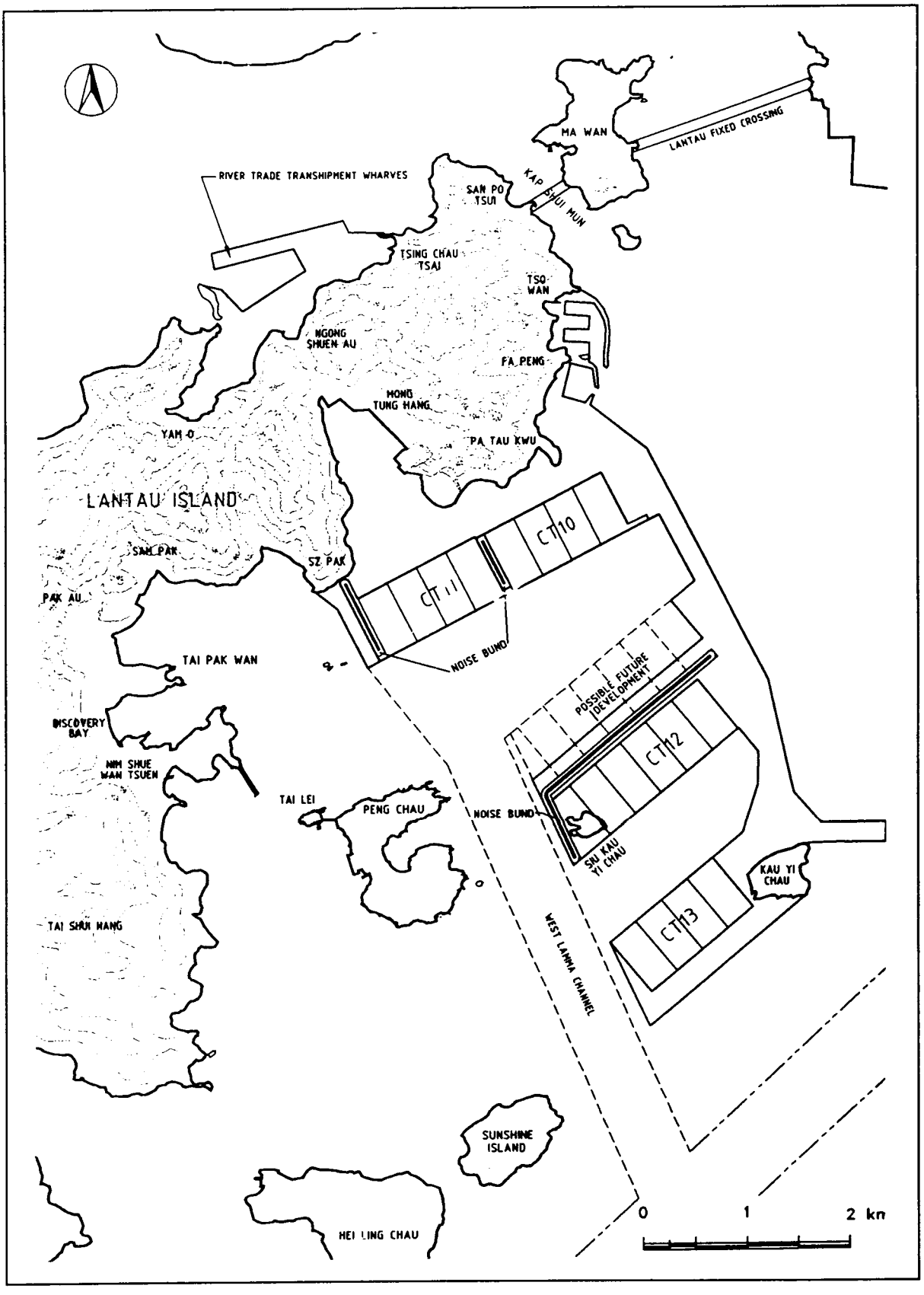


**Figure 1.1 Lantau Port Development**

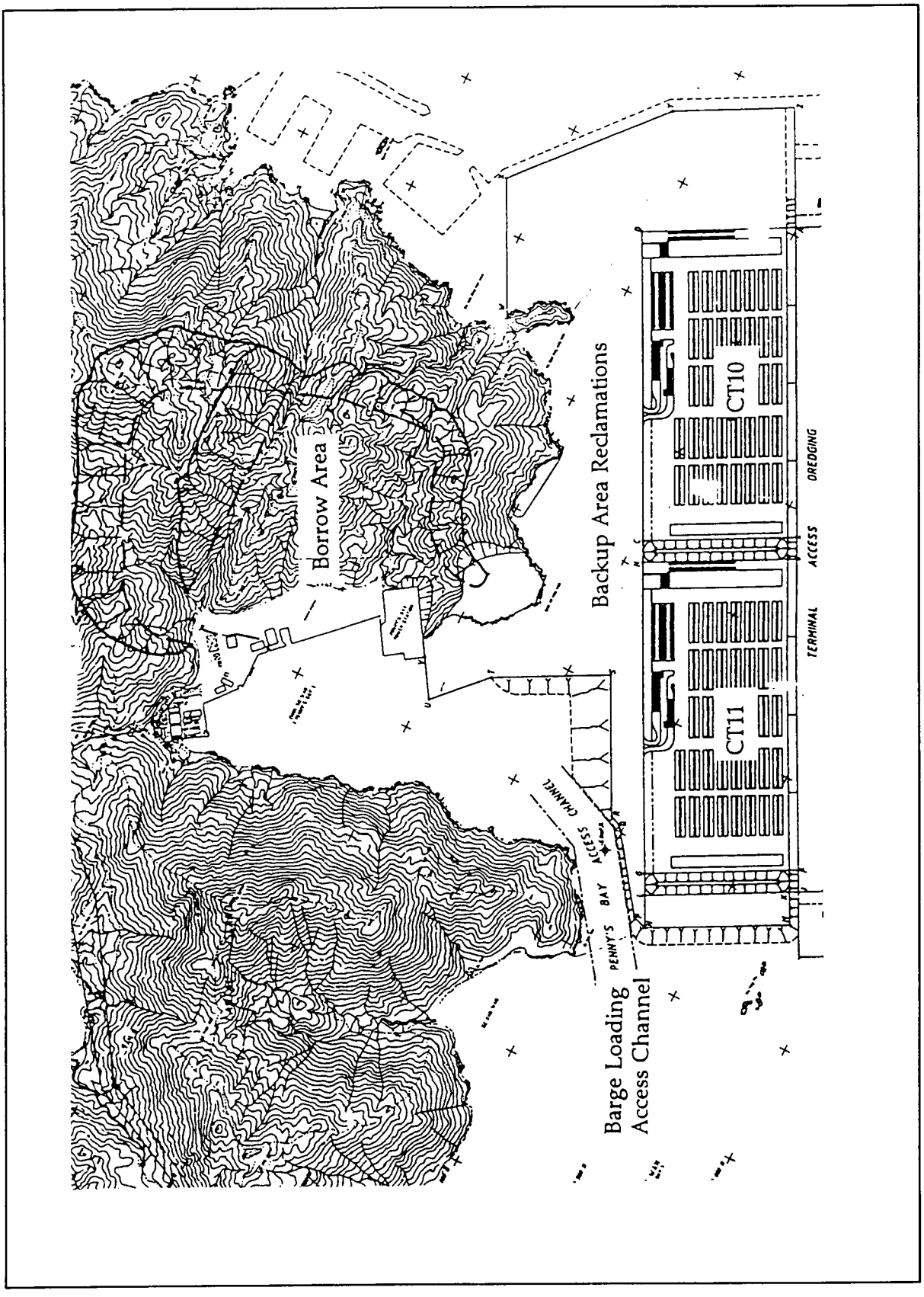


**Figure 1.2 Activity Areas**

# 2 ENVIRONMENTAL ASSESSMENT STUDIES

## 2.1 Environmental Context

The area around the site is essentially rural in character and includes many scenic and important amenity locations. There are also several major residential areas and small villages near to the project which have potential to be affected by construction activity impacting on the local noise, air and marine environment. An Area Sensitive rating (ASR) of "A" has been assigned as the appropriate noise criteria for the CT10 & 11 construction phase. Sensitive receivers with potential to be affected by the LPD project are shown in Figure 2.1.

The limited industry in the area includes Cheoy Lee Shipyard and Penny's Bay Power Station. Cheoy Lee Shipyard is likely to be relocated during the CT 10 & 11 project when reclamation of Pennys Bay is carried out. In the future the reclamation will be developed as a commercial/industrial zone.

The marine areas around the site are used by shipping and for marine commercial activities, including fishing and mariculture (Figure 2.2). The area around the site falls within the gazetted Southern Water Control Zone and the Western Buffer Control Zone. The relevant Water Quality Objectives for these WCZs will need to be complied with during the construction of CT10 & 11.

## 2.2 Environmental Assessment

Environmental Assessments (EA) have been carried out as part of this project and in the earlier Lantau Port and Western Harbour Studies, (LAPH).

The principal findings of these EAs are summarised in the following sections:

### 2.2.1 Air Quality

- Dust emissions may occur from both stationary sources (construction activities) and mobile sources (haulage).
- The key potential sources of dust emissions are identified as: transportation of reclamation material, reclamation, surcharge handling and wind erosion of stockpiles and exposed site areas.
- Modelling results indicate that without dust suppression measures there may be exceedance of AQO's from cumulative construction activity.

### 2.2.2 Noise

- It is assumed that only daytime and evening activity will be required, there will be no night-time work.
- Noise from container port construction is predicted to cause adverse noise impact on isolated NSRs at Fa Peng/Tso Wan and the headland of Peng Chau.

- Dominant noise source during construction phase will be from the fleet of dump trucks which will move surcharge material across the completed berths to form new reclamation.

2.2.3 Water Quality

- The most significant activity which may impact on the marine environment is from dredging and reclamation activities.

- Contaminated sediments have been identified in the initial sampling programme. Confirmation of the presence and extent of contamination will be required in advance of an agreed construction programme. Strict precautions, including special dredging and disposal conditions, are required for contaminated material.

- Sewage disposal, stormwater discharges and the accidental spillage of materials which may enter the marine environment represent the main impact areas. There is no space on the reclamations for treatment facilities. Sewage generated within CT 10 & 11 projects will be directed to a treatment facility in the back-up area. Any discharge should be directed east into the deeper faster flowing waters with greatest dispersive capacity.

## 2.3 Mitigation Measures

Recommendations for mitigating impacts are identified in the following section:

2.3.1 Air Quality

- Early paving of individual berths and access roads to reduce site erosion and dust generation.

- Reduction of dust emission from exposed site surfaces paved and unpaved roads by regular watering. Treatment of aggregate or particulate material storage piles by enclosure or covering.

- Use of wheel wash facilities and hosing down of vehicles.

- Wind shields, water sprinklers and dust extractors should be provided at material loading and unloading areas.

- Speed controls for on-site vehicles. (A maximum speed of 15km/h on unpaved surfaces was assumed in the EIA conducted for this project).

2.3.2 Noise

- Plant and equipment should be routinely maintained in good working condition and 'sound-reduced' as far as practicable by means of silencers, mufflers or acoustic linings.

- Use of noise barriers both temporary and permanent (noise bunds) to shield activities from NSRs.

- Sympathetic grouping of equipment to maximise shielding efficiency.
- Phasing of activities to reduce the individual impact levels. Early establishment of the noise bunds to shield construction activity.

### 2.3.3 Water Quality

- Careful selection of the method and type of dredging equipment employed, timing and procedures used.
- Filling to +2.6m PD quickly and in a controlled manner.
- Provision of a bund around the perimeter of the reclamation with drainage collection ditches leading rainwater run-off to trapped settlement pits before discharge. Oil and grease interceptors should be provided to trap oil and grease generated within the project area.

## 2.4 Recent Monitoring Programme

Sampling and monitoring surveys to determine the existing environmental conditions within the study area were carried out as part of this study and in the LAPH Studies but will need to be supplemented by additional monitoring specific to this site.

CES (Asia) Ltd carried out water quality monitoring around Penny's Bay in December, 1993. Dissolved Oxygen, salinity and current velocities were measured.

Surveys in the LAPH Studies were carried out for the following:

- air quality (particulates and gaseous pollutants);
- noise levels;
- marine ecology (sealed grab sampling for biological and sediment analysis).

A description of the surveys and the results obtained is given in the "Environmental Data Surveys Report, October 1992".

Hydrodynamic data of the study area was obtained by the WAHMO modelling undertaken as part of the LAPH Studies, Final EIA report.

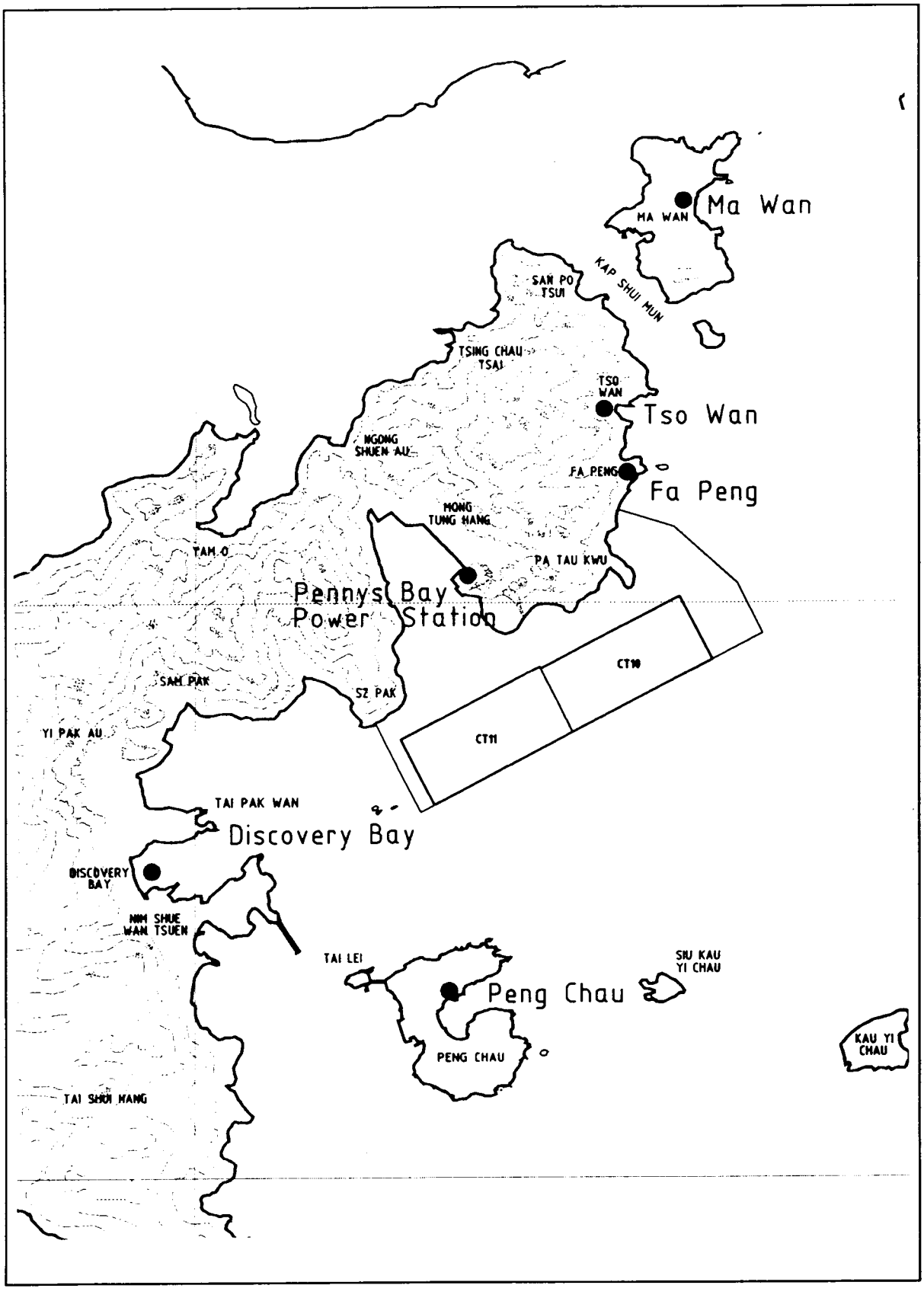


**Figure 2.1 Land Based Sensitive Receivers**

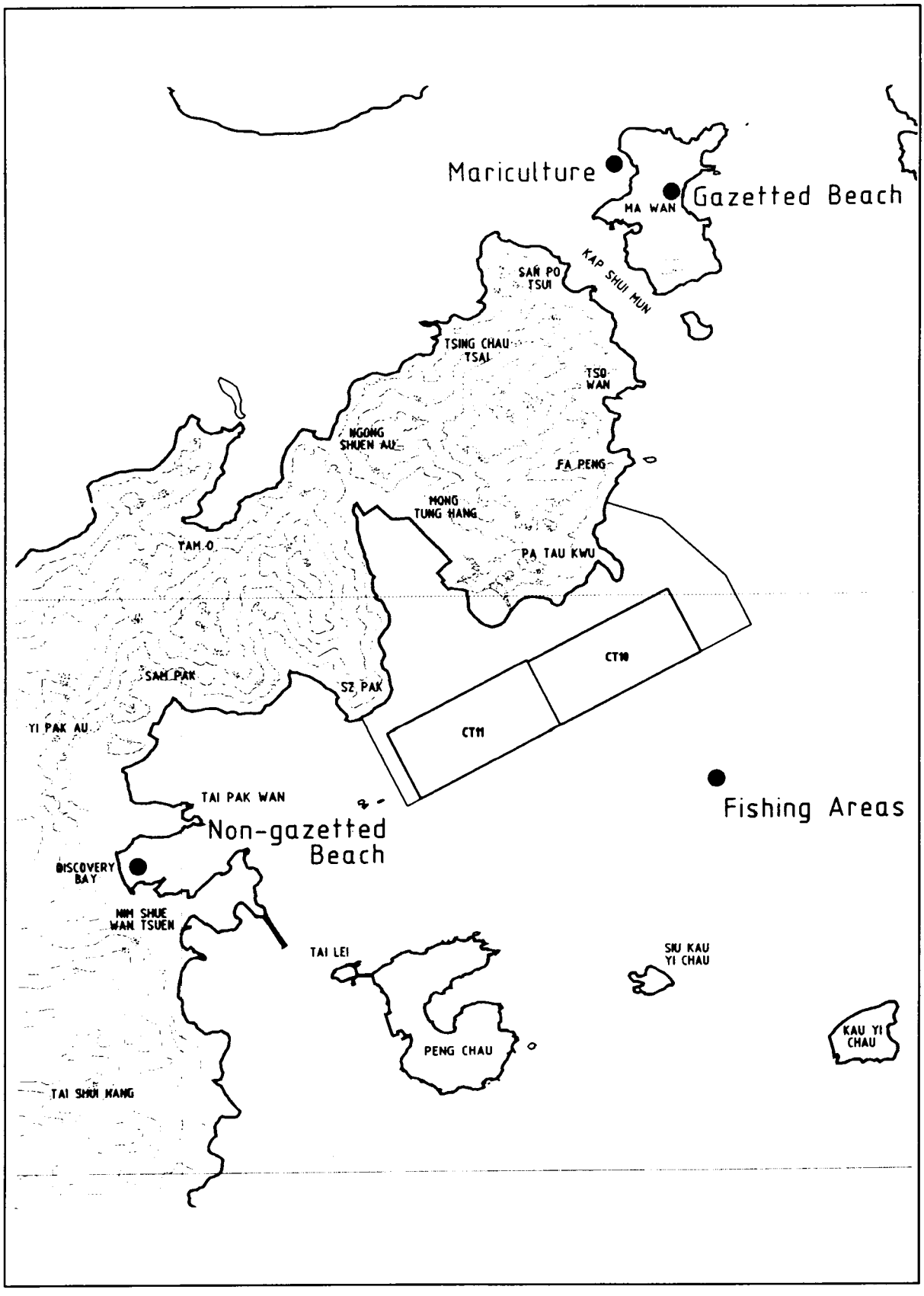


**Figure 2.2 Water Based Sensitive Receivers**

# 3 PROJECT ORGANISATION

## 3.1 Internal Organisation of the Project Team

The monitoring and audit work should be carried out by an Environmental Office (EO) and contracted to an independent organisation not directly responsible for cost and programme considerations. It is recognised that this adds a degree of complication to the contractual arrangements. However, it is considered that separation of the environmental issues from direct control by the project manager is essential if the EO is to be fully effective. This will ensure that the environmental monitoring and auditing programme is not constrained by conflict of responsibilities.

The administration is organised such that the Environmental Office (EO) supervisor reports directly to the Client Department, for example CED, who will in turn circulate reports to EPD and the Project Manager. The Client Department instructs the Project Manager who can in turn instruct / advise the contractor on environmental issues. Figure 3.1 illustrates a suggested structure for the project and the way in which the EO fits into this structure. It is not envisaged that the EO would liaise directly with the contractor, though an informal contact should be maintained to allow a channel for early advice of deteriorating environmental conditions. The internal structure of the Environmental Office should be agreed at a later stage. The EO should comprise suitably qualified and experienced personnel.

## 3.2 Lines of External Communication regarding Environmental Issues

The existing EPD complaint hotline could be utilized, with complaints received passed on to the EO who would investigate and report to the Client Department who would instruct the Project Manager. An alternative method would be to provide a *hotline* direct to the site. This could be into the contractors office, as is the case on the Western Harbour Crossing Project, or to a dedicated environmental monitoring office.

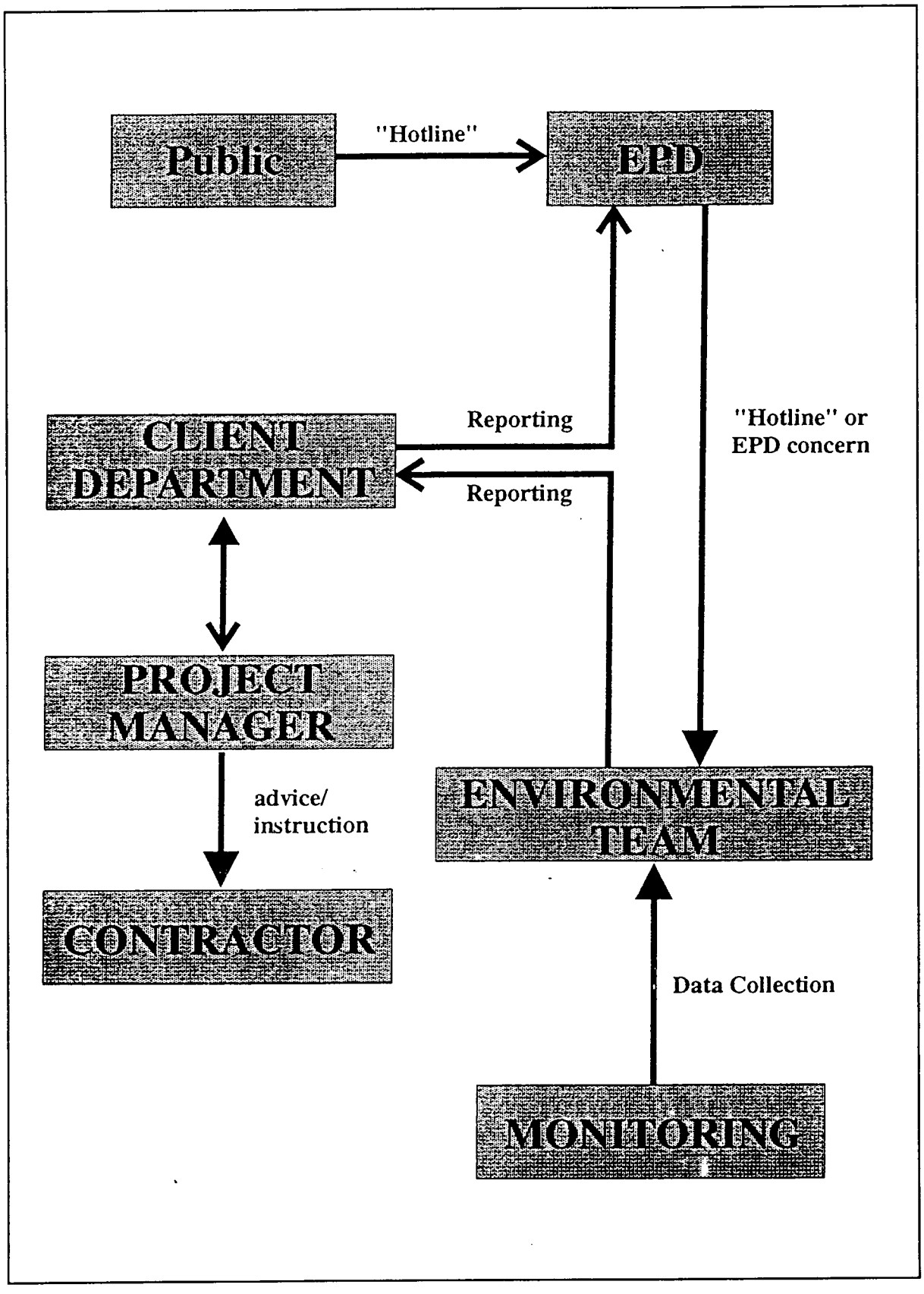


**Figure 3.1 Organisation of Project Team**

# 4 PROJECT PROGRAMME

The proposed implementation programme for Stage 1 commences with the advance works contract assumed to last 18 months. CT10 and CT11 developments are envisaged to start in April 1996 subject to the completion of the necessary government and statutory procedures. Reclamation works and construction of the quay will proceed concurrently.

Commissioning of the first CT10 berth is expected in October 1998 with the other berths following at 6 month intervals. CT10 would be fully operational at the end of the year 2000. The first of the CT11 berths would be completed in June 1999, assuming that CT10 and CT11 are constructed in parallel. CT11 would be completed in June 2001.

The programme is subject to change and should be reviewed at the commencement of construction activities.

# 5 ENVIRONMENTAL MONITORING AND AUDIT REQUIREMENTS

## 5.1 Trigger, Action and Target Levels

The basic method of recording any changes in environmental conditions is through monitoring of air, noise and water quality. It has become a common practice to apply a range of environmental limits termed Trigger, Action and Target (TAT) levels to provide a framework for the interpretation of monitoring results. These levels are defined as follows:

*Trigger* — Trigger levels provide an indication of deteriorating ambient environmental quality.

*Action* — Action levels indicate the necessity to adopt appropriate remedial actions to prevent the environmental quality from going beyond the target limits. If levels go above target, appropriate remedial action, including critical review of plant and work methods would be required.

*Target* — Target levels are stipulated in relevant pollution control ordinances, or HKPSG, or established by EPD for a particular project. These are the maximum levels at which the works should proceed.

TAT levels should be established after the completion of baseline monitoring to provide effective environmental management of the project.

Trigger, action and target levels must be realistic and related to existing conditions as well as statutory requirements and guidelines. Levels should not be set too low. If levels are set too low a continuous series of exceedances will diminish the effectiveness of monitoring. In cases where exceedances of guidelines and statutory standards already exist, levels must take account of this. Alternatively, if levels are set too high, they will not be useful in indicating deteriorating conditions which could be controlled by mitigation measures.

Table 5.1 below summarises the proposed event and action plans for various levels of exceedance of TAT levels.

## Table 5.1 Action Plans for Exceedance of TAT Levels[1]

| Event | Action by Environmental Office (EO) | Action by Contractor |
|---|---|---|
| Trigger exceeded for one sample | • Repeat measurement<br>• Notify Contractor | • Identify source |
| Trigger exceeded for more than one consecutive sample | • Repeat measurement<br>• Notify Contractor and EPD and Client Department immediately | • Identify source and impose necessary mitigation |
| Action Level exceeded for one sample | • Repeat measurement<br>• Notify Contractor and EPD and Client Department immediately | • Identify source and impose necessary mitigation |
| Action Level exceeded for more than one consecutive sample | • Daily monitoring imposed<br>• Notify Contractor and EPD and Client Department immediately<br>• Contractor to make additional mitigation proposals | • Identify source<br>• Review plant, equipment and working procedures<br>• Submit mitigation proposals to EO<br>• Implement remedial action<br>• Notify engineer of action taken |
| Target Level exceeded for one sample | • Daily monitoring imposed<br>• Notify Contractor and EPD and Client Department immediately<br>• Contractor to make additional mitigation proposals<br>• Provide investigation report for EPD and Client Department | • Identify source<br>• Review plant, equipment and working procedures<br>• Submit mitigation proposals to EO<br>• Implement remedial action<br>• Notify engineer of action taken<br>• Provide investigation report |
| Target Level exceeded for more than one consecutive sample | • Daily monitoring imposed immediately<br>• Notify Contractor and EPD and Client Department immediately<br>• Contractor to make additional mitigation proposals and take immediate steps to reduce impact<br>• Provide investigation report for EPD and Client Department | • Identify source<br>• Review plant, equipment and working procedures<br>• Submit mitigation proposals to EO<br>• Implement mitigation to reduce impact immediately<br>• Notify engineer of action taken<br>• Provide investigation report which should include findings and suggestions to prevent situation recurring |

1 Source : Correspondence from Environmental Protection Department as ( ) in EP 2/N9/42 VIII dated 10 September 1994

## 5.2 Equipment

To facilitate the efficient collection and processing of monitoring data it is proposed that simple calibration exercises and dust monitoring filters are processed at a small dedicated laboratory on site. To carry out a monitoring programme, the following equipment is suggested.

### 5.2.1 Air Quality

For air quality monitoring, the following or similar equipment should be used:

- High Volume Air Sampling System
- Wind Speed and Direction Sensor connected to a Data Logger will be used to collect meteorological data in accordance with the monitoring programme.

The TSP monitor should be a high volume sampler as referenced in the USEPA Standard Method 40, CFR Part 50, Appendix B.

Portable Dust Meters should be available to perform ad-hoc air sampling when sources of dust are in doubt, but should not replace high volume sampling in the monitoring programme.

### 5.2.2 Noise

The sound level meter used should comply with International Electrotechnical Commission Publications 651:1979 (Type 1) and 804:1985 (Type 1). Any other noise measuring and analysis instrumentation used should be of a comparable professional quality. Noise measurement procedures should comply with the requirements in the Technical Memorandum on Noise from Construction Work other than Percussive Piling. Standard acoustical principles and practices should be followed in the analysis of the noise under investigation.

### 5.2.3 Water Quality

For water quality monitoring equipment capable of measuring the following parameters is required :

- Turbidity;
- Dissolved Oxygen;
- Suspended Solids; and
- Salinity.

In addition the following are required on the monitoring vessel :

- Depth finding system ; and
- navigation and positioning system.

## 5.3 Methodology

### 5.3.1 Air (TSP) Monitoring

TSP is sampled by drawing air through a conditioned, pre-weighed filter paper inside the high volume sampler at a controlled flow rate. After 24 hours of sampling the filter paper with retained particulates would be collected and returned to the laboratory for drying in a desiccator followed by accurate weighing. TSP levels are calculated from the ratio of mass of particulates retained on the filter paper to the total volume of air sampled. The analysis process normally takes approximately two days. All procedures should be done following the USEPA Standard Method 40, CFR, Part 58, Appendix B.

Sample collection filters should comprise of glass fibre, quartz fibre or teflon fibres in order to minimise sample degradation.

### 5.3.2 Noise Monitoring

Noise levels should be determined by carrying out measurements at the monitoring locations. 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.

Noise measurements should be made in terms of the A-weighted equivalent continuous sound pressure level ($L_{eq}$) measured with an integrating sound level meter. Such measurements should be made over a 30 minute period to give 6 consecutive $L_{eq}$(5 min) readings. The $L_{eq}$(30 minute) reading should be calculated from the $L_{eq}$(5 minute) readings within the noise meter.

### 5.3.3 Water Monitoring

Two consecutive readings of DO concentration, DO % saturation, temperature and turbidity will be taken at each location at 1 m below surface, mid-depth and 1 m above bottom in the field. If they do not agree to within 25%, the readings should be discarded and repeated.

Water samples collected for laboratory analysis of SS, $NO_2^-$(N), $NO_3^-$(N), $NH_3$(N), Total Kjeldahl Nitrogen (TKN) and Total Phosphorus (TP) should be stored in a cold box and returned for analysis within 24 hours. Water samples collected for analysis of *E.coli* should be kept at 4°C and sent for analysis within 6 hours. The sampling bottles used for *E.coli* must be sterilised by methods such as autoclaving. All samples should be collected in duplicates for analysis. SS, $NO_2^-$(N), $NO_3^-$(N) and $NH_3$(N) determinations should be carried out according to APHA Standard Methods for the Examination of Water and Wastewater, 17 Edition, 1989 analysis no. 2540D, 4500- $NO_2^-$4500-$NO_3^-$ and 4500-$NH_3$ respectively. *E.coli* determination should be carried out according to DoE (1983): The Bacteriological Examination of Drinking Water Supplies 1982, Section 7.8 and 7.9. TKN and TP determinations should be carried out according to ASTM D 3590-89 and 515-88 respectively.

In the field each water sample taken for subsequent laboratory analysis should be given a unique sampling number, which is recorded on the sample label and the data form.

In addition to the sampling method mentioned above, it is suggested that continuous monitoring of the parameters DO, SS, temperature and current flow should be taken at the Discovery Bay monitoring station. Continuous water monitoring equipment together with a current meter should be installed at the monitoring station for this purpose. The information should be down loaded on a weekly basis and equipment checked once a month.

## 5.4 Calibration

### 5.4.1 Introduction

Equipment should be maintained in calibration at all times and re-calibration should be carried out in accordance with requirements stated in this Manual or that recommended by the manufacturers, whichever is more stringent.

### 5.4.2 Air (TSP) Monitoring

The flow rate of each high volume sampler with mass flow controller should be calibrated using an orifice calibrator. Initial five point calibration should be conducted upon installation and prior to commissioning. One point flow rate calibration should be carried out every two months. Five point calibration should be carried out initially and every six months thereafter.

The portable dust meters should be calibrated every time against gravimetric standards every 2 months. A calibration check against a known standard should be carried out on each occasion the meter is used. Calibration records should be included in the monthly reports.

### 5.4.3 Noise Monitoring

The sound level meters should be calibrated using the manufacturer's recommended sound level calibrator prior to and after each set of measurements. The results of the calibration should be recorded on the field data form. The measurement is discarded if the calibrations before and after do not agree to within 1 dB(A), then repeated until the calibrations before and after agree to within 1 dB(A).

An annual calibration check should be carried out by the manufacturer.

### 5.4.4 Water Monitoring

*DO Meter* The DO meter should be calibrated against the results of standard Winkler titration every 2 months. The temperature sensor should be calibrated using a standard certified reference thermometer with an accuracy of 0.5 degrees Celsius.

*Turbidimeter* The Turbidimeter should be calibrated every two months using standard formazin solutions. It should be standardised with reference formazin gel solutions every time before use.

*Balance* The balance should be calibrated against an internationally traceable standard at intervals recommended by the manufacturer.

*Current meter* The current meter should be calibrated against an international standard at intervals recommended by the manufacturer.

*Seacat Profiler* All sensors should be calibrated to laboratory standards at intervals recommended by the manufacturer.

## 5.5 Monitoring Locations and Parameters

Monitoring at various locations will be applied as a means of quantifying and controlling the environmental impacts of this project.

### 5.5.1 Water quality

Suggested locations of water quality monitoring stations are shown in Figure 5.1. These stations will be used for both baseline monitoring and compliance monitoring. Station 7 is set up as the control station. The station marked by the letter E is the existing monitoring station, SM10, sampled by EPD.

The parameters to be monitored will be:

SetA: DO, DO% sat, Turbidity/Suspended Solids, Temperature, water depth.

SetB: $NH_3(N)$, $NO_2^-(N)$, $NO_3^-(N)$, Total Kjeldahl Nitrogen (TKN), *E. coli* and Total Phosphorus (TP), water depth.

Both Set A and Set B parameters will be monitored during baseline monitoring and dredging. After dredging, monitoring of Set A parameters 3 times a week and Set B on a monthly basis will be sufficient.

Surface, mid-length, bottom and depth averaged values should be obtained at both Mid Ebb and Mid Flood. Duplicated measurements should be performed.

It is suggested that continuous monitoring of the parameters DO, SS, Temperature, Salinity and current speed & direction should be performed at Station 1 since it is situated close to Discovery Bay and the beach. The data obtained can be used to judge if any deterioration of water quality at Discovery Bay is due to the Port development or other source. To prevent theft of the equipment, it is suggested that a monitoring station should be set up by the Marine Department at that location so that the equipment can be installed there.

### 5.5.2 Air and Noise

Suggested locations for three air and four noise monitoring stations are shown in Figure 5.2.

Air monitoring Station 1 on the headland at Hai Kam Tsui is suggested as the majority of sensitive receivers are situated in Discovery Bay. Station 3 would provide monitoring of the closest SR Fa Peng village, and air station 2 is located adjacent to the Pennys Bay

Power Station to monitor air quality impact from both the Container Terminals and Ancillary Works Areas, depending on the wind direction.

Noise monitoring station A is located at Discovery Bay to quantify noise impact for NSR with direct line of sight to the CT. Station B at Fa Peng village monitors the impact at the closest NSR. Station C on the northern promontory of Peng Chau monitors impacts on isolated SR with direct line of sight to the Terminals from the south. A control station D is located on the nearest existing land spur to the CT at Pa Tau Kwu.

Parameters monitored will be TSP (24 hrs) for air and 6 consecutive $L_{eq}$ (5min) readings for noise

## 5.6 Initial Baseline Monitoring

Initial baseline monitoring before the project starts is required to obtain baseline conditions of the area and for setting the TAT levels. The monitoring should be carried out at all identified monitoring points. The following frequencies and durations are suggested in the following table:

**Table 5.2 Baseline Monitoring**

| Parameter | Frequency | Duration | Notes |
|---|---|---|---|
| Water Set A | 4 / week | 4 weeks | |
| Water Set B | 1 / week | 4 weeks | |
| Air | 7 / week | 2 weeks | 1 hr TSP monitoring should be carried out 3 times per day to coincide with the predicted peak dusty periods |
| Noise | 7 / week | 2 weeks | Monitoring required during day-time, evening and night-time periods |

## 5.7 Compliance Monitoring Frequency

Compliance monitoring from the start to finish of the project is required for auditing the environmental impacts caused by the project and facilitate immediate action when problems arise. The frequencies suggested are listed below:

## Table 5.3 Compliance Monitoring Frequency

| Parameters | Frequency | Notes |
|---|---|---|
| Water Set A | three times / week | |
| Water Set B | once / month | 3 times /week - during dredging |
| Air (1) | once / 6 days | 1 hr TSP monitoring should be carried out 3 times per day to coincide with the predicted peak dusty periods |
| Noise | once / day | measurement at each monitoring station in day-time, evening and night-time period when there is construction activity associated with LPD |

Note

(1) Ad-hoc sampling using a portable dust meter can be performed if sources are in doubt, but should not replace monitoring by high volume sampler.

Table 5.4 gives a summary of the monitoring programme.

## Table 5.4 Summary of Monitoring Programme

| Item | Air | Noise | Water |
|---|---|---|---|
| Parameter(s) | TSP (24 Hour) and *ad hoc* (1 hour) sampling | 6 consecutive readings of $L_{eq}$ (5 mins) | 2 consecutive readings of Set A Turb, Temp. DO and DO (%sat) & SS. and Set B |
| No of locations | 3 | 4 | 7 stations |
| Baseline Frequency and Duration | 2 weeks prior to construction<br><br>7 times per week | 2 weeks prior to construction<br><br>7 times per week [in each day, evening and night period] | 4 weeks prior to construction<br><br>Station 1- Continuous<br>Set A - 4 times/week<br>Set B - once/week |
| Compliance | every 6 days | every working day | Station 1- Continuous<br>Set A - 3 times/week<br>Set B - once/month |
| Scheduling Plan | Schedule of locations and times to be submitted monthly 2 weeks before start of monitoring for air, noise and water | | |
| Scheduling Requirements | None | None | On mid-flood and mid-ebb. Gaps between sampling > 36 hours |
| Additional Requirements | Occasional *ad hoc* monitoring using portable dust meter | Spot checks for compliance in restricted hours where permits apply | Daily monitoring if levels are above trigger until quality is 'improving and acceptable'<br><br>Duplicate samples required for SS. If the difference between the samples is greater than 25% the sample will be rejected |

## 5.8 Contingency Planning

Contingency plans should be made for the following eventualities:

- delay in equipment delivery or set-up;
- prolonged non-availability of key personnel;
- failure or theft of equipment; and
- adverse weather conditions.

All efforts should be made to acquire, prepare and install the equipment to meet the start date of the programme. Should there be a delay in installation, the client and EPD should be informed of the revised start date for that environmental parameter. The monitoring programme for those environmental parameters not affected will proceed as scheduled.

In the absence of any key monitoring personnel for longer than 2 weeks, a suitable replacement should be found within 1 week of the commencement of the period of non-availability. In the interim period, the responsibilities of the individual in question should be assumed by another member of the monitoring team who is experienced in the monitoring procedures.

Provisions should be made for the case of equipment failure or theft. The contractor should have access to back-up equipment, which can be made available within 1 week of equipment failure or theft. This is to assure that the monitoring programmes will not be interrupted for an extended time period due to equipment failure or loss.

Should there be any changes in the schedule due to any of the above, the client and EPD should be notified as soon as possible about the inability to sample according to the original schedule. The monitoring should be rescheduled as soon as practicable.

## 5.9 Data Recording

Standard pro-forma should be used for recording field data. Sample data forms are included in Appendix 1. The data should then be input into a computerised database. These will serve as a systematic method of recording and storing data. In the event of complaints or evidence of unacceptable environmental impacts being obtained from the monitoring results, these data should be easy to reference.

Monitoring staff should record observations and events on the data forms to allow later interpretation of the results obtained.

## 5.10 Reporting

Monthly EM & A reports and summary quarterly reports should be submitted for water, air, noise and chemical waste arisings.

The EM&A team shall prepare an EM&A report and submit it to the Strategic Assessment Group/EPD for review.

Monthly EM&A reports shall include at least the following[2]:

a. 1-2 page executive summary;

b. brief project background information including a synopsis of the project organisation, programme and management structure;

c. summary of EM&A requirements including:
- All monitoring parameters
- Environmental quality performance limits (trigger/action/target levels)
- Event/Action plans
- Environmental requirements in contract documents

d. drawings showing SRs and locations of the monitoring stations;

e. monitoring results (hard and diskette copies) together with the following:
- Monitoring methodology
- Equipment used and calibration details
- Parameters monitored
- Monitoring locations (and depth)
- Monitoring time, frequency, duration, and period

f. graphical plots of trends of monitored parameters over the past four reporting periods for representative monitoring stations annotated against the following:
- Weather conditions during the period
- Major activities being carried out on site during the period
- Other factors that may effect the monitoring results

g. advise on the solid and liquid waste management status;

h. advise on the implementation status of environmental protection and pollution control measures as recommended in the EIA study report;

i. summary of noncompliance (exceedances) of the environmental quality performance limits (trigger/action/target levels)

j. review the reasons for the noncompliance including review of pollution sources and working procedures;

k. description of the actions taken in the event of noncompliance and any follow-up procedures related to earlier noncompliance;

l. record of all complaints (written or verbal) received including locations and nature of complains, liaison and consultation undertaken, actions and follow-up procedures taken and summary of complaints;

m. forecast of the works programme and monitoring schedule for the next month;

2 Source : Airport Core Programme, Procedures 312, Environmental Coordination, Attachment 312-2 - par 9

n. comments and conclusions for the month.

Quarterly EM&A Summary reports shall include at least the following[3]:

a. 1-2 page executive summary;

b. basic project information including a synopsis of the project organisation, programme and management structure;

c. a brief summary of EM&A requirements including:
- monitoring parameters
- environmental quality performance limits (trigger/action/target levels)
- environmental mitigation measures, as recommended in the project EIA study report

d advise on the implementation status of environmental protection and pollution control (mitigation) measures as recommended in the project EIA study report;

e. sketches showing the project area, environmental sensitive receivers and locations of the monitoring and control stations;

f. graphical plots of the trends of monitored parameters over the past four reporting periods 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 that may effect the monitoring results.

g. summary of compliance or exceedance of the environmental quality performance limits (trigger/action/target levels).

h. review of the reasons for and the implications of noncompliance including review of pollution sources and working procedures;

i. a summary description of the actions taken in the event of noncompliance and any follow-up procedures related to earlier noncompliance;

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

k. comments and conclusions for the quarter.

## 5.11 Setting of Levels

Water Quality

TAT levels for Water Quality monitoring should be established from WQO and baseline data. The target levels would be set at the WQO requirements. Trigger and Action levels for dissolved oxygen should be derived from baseline data. If the value of the mean of

3 Source : EPD letter ref ( ) EP2/N9/42 VIII dated 10 September 1994

the baseline minus 3 standard deviations does not fail the WQO, a percentile approach should be adopted, with Trigger and Action levels set at the 95%ile and 99%ile respectively. If the value of the mean of the baseline minus 3 standard deviations does fail the WQO (ie the background DO already fails the WQO from time to time), the difference between baseline and WQO would be taken as a range, with Trigger level set at 2/3 range and Action Level set at 4/5 range.

For suspended solids the WQO/Target level is set at 30% above ambient and Trigger and Action levels should be set at 20% and 25% respectively. In order to take account of seasonal changes, it is proposed that the EPD monitoring Station (SM10) within Discovery Bay is used as a Control Station, forming a moving baseline against which the TAT levels are adjusted.

**Table 5.6 Target levels for Dissolved Oxygen and Suspended Solids Concentration**

| Parameter | Target Level |
|---|---|
| Dissolved Oxygen, mg/l | Depth average DO of 4.0 mg/l for 90% of samples |
| Suspended Solids, mg/l (depth average) | Not to raise ambient level by 30% |

Air Quality

The existing air quality in the area needs to be confirmed by baseline monitoring. The Trigger level would be set at 30% above the baseline. Target level would be set at the HK Air Quality Objective and the action level set at the average of Trigger and Target levels. The Target level is identified in Table 5.5.

**Table 5.7 Target Construction Air Quality**

| Parameter | Maximum Average Concentration ($\mu g/m^3$) |
|---|---|
| 24 - hour TSP | 260 |
| 1 - hour TSP | 500 |

Noise

For noise impact, the application air/water approach would be somewhat difficult to control due to rapidly varying levels and the subjective nature of noise nuisance. Therefore, TAT levels for noise would be based on the number of complaints received upto the legislative or guideline limit:

Trigger - one noise complaint received.
Action - more than one independent noise complaints received about a similar source in one week.

Target - noise level from construction exceeds legislative/ guideline requirement.

The sensitive receivers in the vicinity of the site area will be assigned as ASR of 'A' in accordance with the Technical Memorandum on Noise from Construction Work other than Percussive Piling. There are no statutory requirements for daytime construction noise, though EPD recommend a daytime criteria of 75 dB(A) in the urban area. However, in earlier studies a more stringent criteria was adopted, limiting construction noise impact at NSR to 10 dB(A) above the background, giving a noise criteria of 60 dB(A) which has been adopted in the assessment. The level for evenings (1900 - 2300) and holidays is based on the statutory limit set at 60 dB(A). The construction noise target level for night-time (2300 - 0700) should be based on the statutory limit set at 45 dB(A). The construction noise Target levels are given in Table 5.6.

**Table 5.8 Target Construction Noise Levels**

| Time Period | Target Construction Noise Level (dB(A)) |
|---|---|
| 0700-1900 weekdays | 60 |
| 1900-2300 weekdays and all day on general holidays including Sunday | 60 |
| 2300-0700 all days | 45 |

## 5.12 Post Project Monitoring and Audit

This EM&A manual has been focused on procedures proposed for the construction phase. However the monitoring programmes, equipment and reporting requirements will be broadly similar for the Operation Phase of the terminals, the Post Project phase. The object of Post Project Monitoring and Audit will be to confirm that mitigation identified for incorporation into the terminal is effective. In addition it will give early identification of any unforseen impacts allowing remedial action to be instituted in advance of significant deterioration. The Operation Phase monitoring programme would follow on from the construction phase. Audit of monitoring results and procedures would be carried out after a sufficient time period had elapsed, allowing conditions to stabilise. The particular conditions that the Monitoring and Audit Programme is designed to address are outlined in the following paragraphs.

Noise

The key objective is to confirm effectiveness of mitigation measures, particularly the noise bund and quietened equipment. Noise monitoring stations are proposed for Discovery Bay over a 24 hour period every month. Requirements for ongoing monitoring and additional stations should be reviewed in the audit procedures. If monitoring identifies deterioration the monitoring should be increased to identify the source of deterioration. One of the main problems of the post project noise monitoring programme will be the identification of the principal noise sources. The ongoing construction activity, concurrent terminal operation and other sources will crate a blanket of sound. It is therefore

proposed that operators be required to supply details of the plant items operating within their terminal. This information should include total numbers of plant, activity levels, and sound power levels in appropriate frequency spectra for individual equipment items. The sampling methodology for the SWL will be proposed by the terminal operator and agreed by EPD. From this information and details of any noise mitigation elements within the terminal, it will be possible to compare the actual operation impact with the base-case identified in the noise impact assessment and identify any deficiencies requiringadditonal mitigation.

Air Quality

A low impact is anticipated from terminal activities. Monitoring was proposed for Discovery Bay in the LAPH Studies which noted that a permanent EPD monitoring station may be established in the area. A monitoring station at Discovery Bay would serve as an indicative receiver for all monitoring points in Discovery Bay including Peng Chau. Monitoring parameters would be those routinely carried out at other permanent EPD stations in the Territory and include $SO_2$, $NO_2$, CO, $O_3$, TSP and RSP. An alternative site for a permanent monitoring station would be within Pennys Bay to monitor the conditions within the commercial/industrial zone.

Water Quality

The objective is to identify any deterioration in water quality within Discovery Bay, particularly from storm and sewage discharges. Stations proposed for monitoring are the EPD station (SM10), a point within Discovery Bay west of the terminals, and a point to the south of terminals CT10 & 11. All points form part of the construction monitoring network.

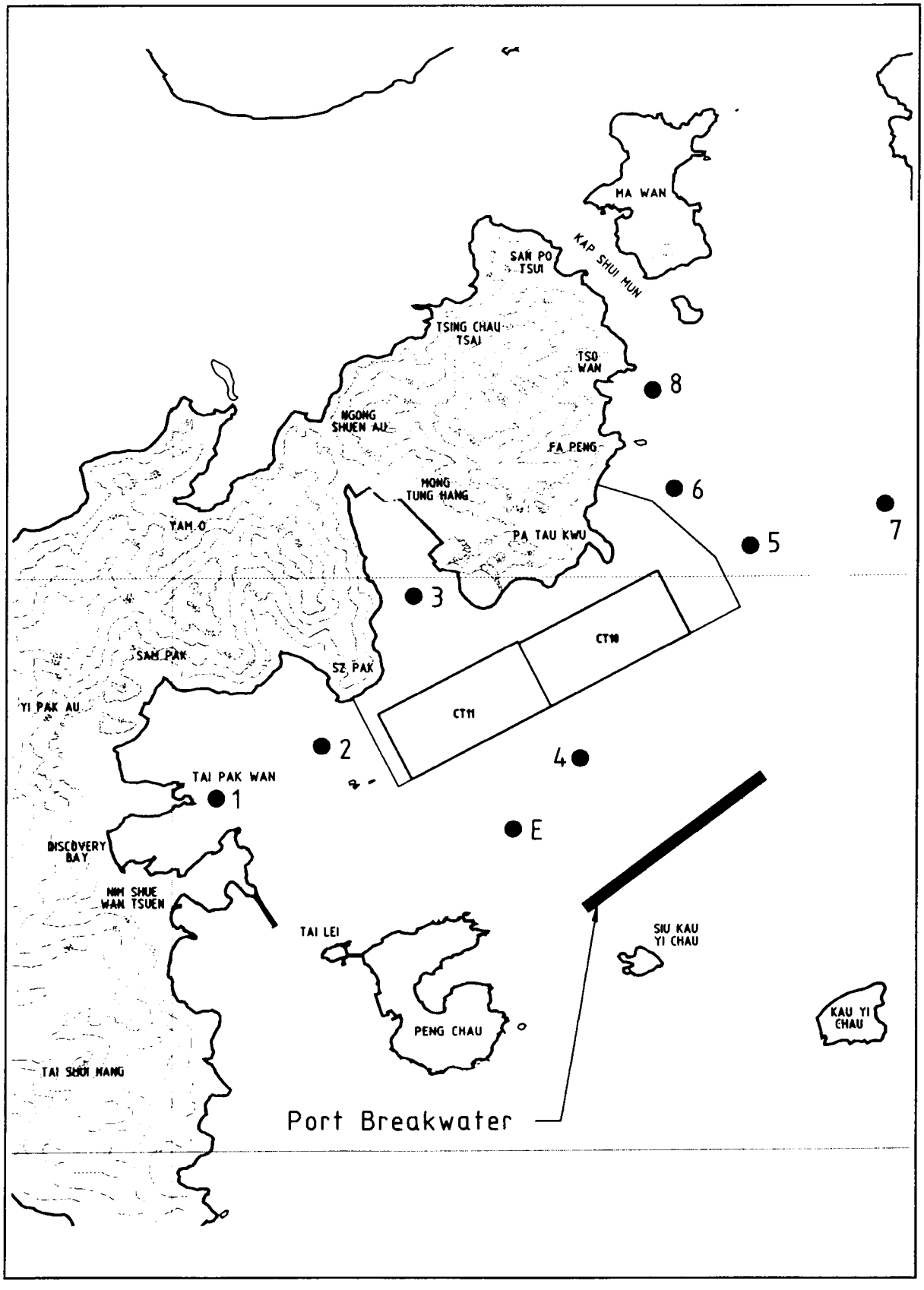


**Figure 5.1 Water Quality Monitoring Stations**

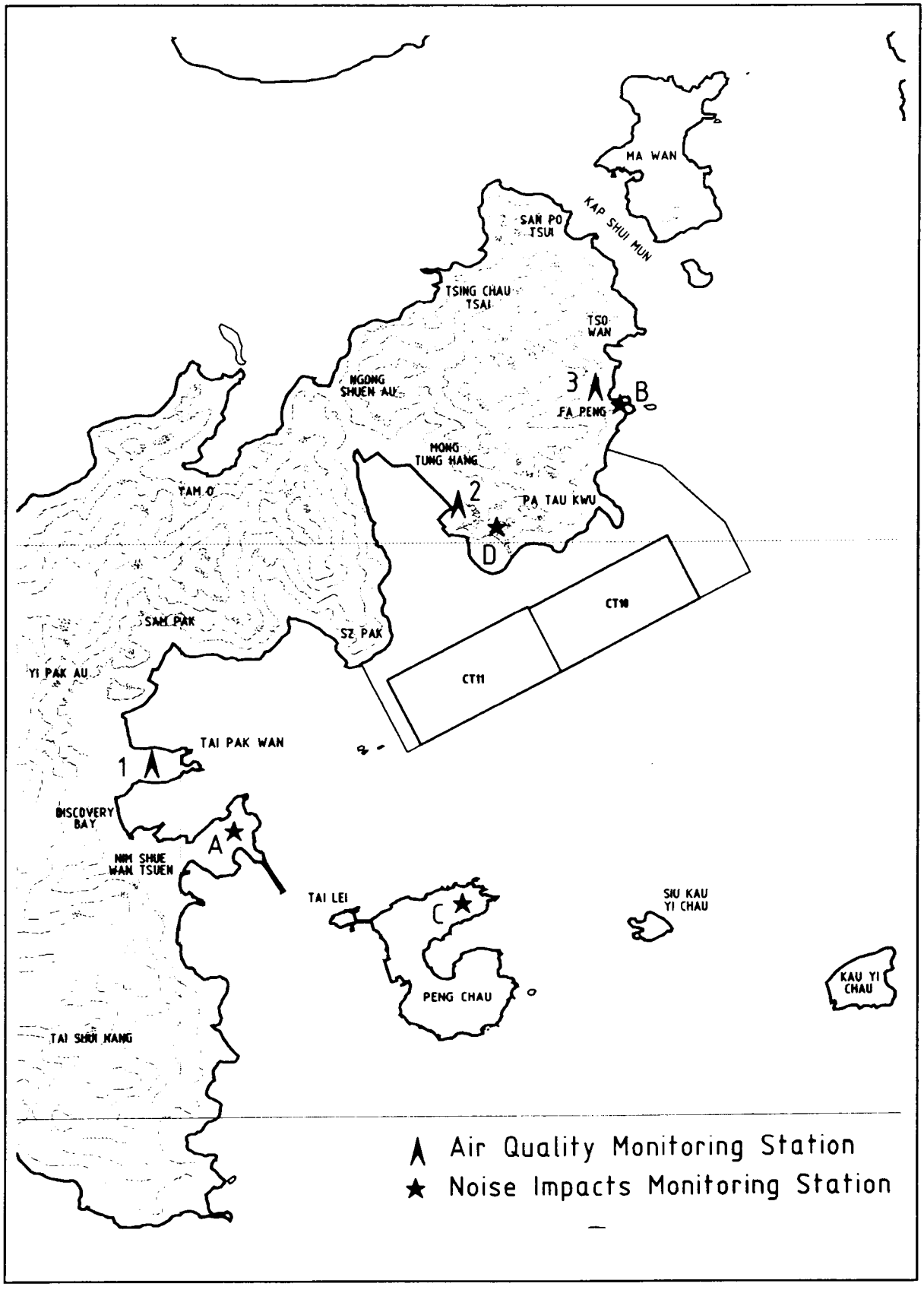


**Figure 5.2 Air and Noise Monitoring Stations**

# 6 ENVIRONMENTAL COMPLAINTS PROCEDURES

The following complaints procedures are recommended:

- Complaints from the public should be made to EPD through the EPD hotline number or direct to site if a hotline can be established in the contractors or a dedicated environmental monitoring office.

- EPD should then inform the environmental team or the relevant representative of the complaint. Or, if a site hotline is involved the monitoring office should then inform EPD of the complaint.

- Investigation of complaint to determine the validity of the complaint. Environmental team investigation may require monitoring at the complainant's premises to assess whether the source of the problem is a one-off complaint or the product of recurring works activities.

- Environmental team to inform the complainant, the client EPD and the Project Manager of the results of the investigation. The investigation will be carried out within a 2-week time frame. The complain report to the complainant shall include:

  - assessment of the complaint;
  - proposals on mitigation measures that may need to be taken; and
  - proposals concerning additional monitoring and audit where necessary.

# ENVIRONMENTAL MONITORING AND AUDIT MANUAL

FOR

## LANTAU PORT DEVELOPMENT
## STAGE 1
## Container Terminal 10 & 11

# Appendix 1

## Field Survey Proforma for :

AirQuality (Dust)
Water Quality
Noise

# DUST MONITORING

| | | | |
|---|---|---|---|
| Date Started | | Time Started | |
| Station ID | | Location | Refer to drawing |
| Sampler Type | TSP Hi-Vol | Serial No. | |

## SAMPLING RESULT

| | Start | Finish |
|---|---|---|
| Timer Reading | | |
| Manometer Reading | | |
| Filter Paper Weight (g) | | |
| Observations (site activities, possible dust sources, etc) | | |

## WEATHER SUMMARY

| Rainfall | Nil / Trace / mm (Data from RO / Weather Station on site*) | | | | |
|---|---|---|---|---|---|
| Wind Data Summary , Hour Started ( ) | | | | | |
| Hour | Wind Speed ($ms^{-1}$) | Wind Direction (°) | Hour | Wind Speed ($ms^{-1}$) | Wind Direction (°) |
| 1 | | | 13 | | |
| 2 | | | 14 | | |
| 3 | | | 15 | | |
| 4 | | | 16 | | |
| 5 | | | 17 | | |
| 6 | | | 18 | | |
| 7 | | | 19 | | |
| 8 | | | 20 | | |
| 9 | | | 21 | | |
| 10 | | | 22 | | |
| 11 | | | 23 | | |
| 12 | | | 24 | | |

* Select one

Prepared By : _____ Checked By : _____

Date : _____ Date : _____

# NOISE MONITORING

| | | | | | |
|---|---|---|---|---|---|
| Type of Sound Level Meter | | | | Serial No. | |
| Location | | | | | |
| Details of Location | | | | | |
| Weather Conditions | | | | | |
| Site Conditions | | | | | |
| Date and time of monitoring | Start | | | | |
| | Finish | | | | |
| Measurement of $L_{eq\ (5\ min)}$, dB(A) | 1 | | | | |
| | 2 | | | | |
| | 3 | | | | |
| | 4 | | | | |
| | 5 | | | | |
| | 6 | | | | |
| | Average | | | | |
| Evaluation of $L_{eq\ (30\ min)}$, dB(A) | | | | | |
| Calibration | | Type of Calibrator | Noise Level of Calibrator | Frequency of Signal (KHz) | Measurement (dB) |
| | Before | | | | |
| | After | | | | |

Please list any significant noise sources nearby on the back of this form stating activity and approximate location.

Tested by : _____ Checked by : _____

Date : _____ Date : _____

# WATER QUALITY MONITORING

Date: _____ Weather: _____ Field Staff _____ Tide State _____ Test No. _____

| Location | Sampling Time | Depth of Water (m) | Depth Sampled (m) | | Sample No. | Temp. °C | | DO (mg/l) | | DOS (%) | | Turbidity NTU | | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | |
| 1 | Start | | S | 1.0 | | | | | | | | | | |
| | | | M | | | | | | | | | | | |
| | Finish | | B | | | | | | | | | | | |
| 2 | Start | | S | 1.0 | | | | | | | | | | |
| | | | M | | | | | | | | | | | |
| | Finish | | B | | | | | | | | | | | |
| 3 | Start | | S | 1.0 | | | | | | | | | | |
| | | | M | | | | | | | | | | | |
| | Finish | | B | | | | | | | | | | | |
| 4 | Start | | S | 1.0 | | | | | | | | | | |
| | | | M | | | | | | | | | | | |
| | Finish | | B | | | | | | | | | | | |
| 5 | Start | | S | 1.0 | | | | | | | | | | |
| | | | M | | | | | | | | | | | |
| | Finish | | B | | | | | | | | | | | |

Any dredgers nearby? Y/N If yes, mark locations on map on reverse and indicate whether working or not

Name of dredgers : _____ (Please number and show the numbers on the map).

Any visible discoloration of the water? Y/N If yes, please mark on map with remarks on appearance

Other observations _____

Prepared by _____ Checked by _____ Date _____