



Hong Kong Government  
Territory Development Department  
Urban Area Development Office

## Central and Wan Chai Reclamation Development

Focussed Study for the Proposed  
Extension to the Hong Kong  
Convention and Exhibition Centre

Environmental Monitoring and Audit Manual  
Final Report

Maunsell Consultants Asia Ltd

in association with

Balfours International (Asia)

MVA Asia Ltd · Urbis Travers Morgan Ltd

CES Consultants in Environmental Sciences (Asia) Ltd

EIA-030.1/BC

Hong Kong Government  
Territory Development Department  
Urban Area Development Office  
Agreement CE 12/93

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## INTRODUCTION

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## **1 INTRODUCTION**

### **1.1 Purpose and structure of this document**

This Manual outlines the monitoring and audit programme to be undertaken for the construction of the extension to the Hong Kong Convention and Exhibition Centre. It aims to provide systematic procedures for environmental monitoring and checking of the construction impact of the HKCEC extension.

Hong Kong environmental regulations for air quality, noise and water quality and the Planning Standards and Guidelines have served as environmental standards and guidelines in the preparation of this Manual.

### **1.2 Project Background**

The Project concerns the construction of an extension facility to the Hong Kong Convention and Exhibition Centre on a reclaimed island to the north of the existing HKCEC. This project forms the Exhibition Development Cell of the Central and Wanchai Reclamation, the other two development cells being Central and Tamar. The extension was proposed by the Hong Kong Trade Development Council, and was considered in the Central and Wanchai Reclamation Feasibility (CWRFS, 1989).

To properly address the areas of concern, a multi-disciplinary focused study was commissioned in two sequential stages. The decision to proceed with Stage 2 was contingent on in-principle approval for the Scheme after the Stage 1 Report. The Stage 1 assessment included an initial assessment of potential water quality problems during operation as well as examination of traffic and engineering issues. This Report recommended that the Island Scheme should proceed, provided certain environmental mitigation measures, plus road and other infrastructure improvements are carried out. The Stage 1 Report was endorsed at the Steering Group meeting held on 13 August 1993. The Stage 2 Study was then instructed. Mitigation measures required to minimise the environmental and traffic impacts of the Island scheme have been studied in more detail during this stage and necessary measures for improvements or mitigation proposed. This manual supplements the Stage 2 Report.

### **1.3 Project Construction**

The reclamation for the HKCEC Extension is known as the 'Island Scheme' and covers an area of approximately 9.0 hectares. Approximately 1200 linear metres of new seawall will be constructed. A 75 metre-wide waterway separates the new island reclamation from the existing seawall. Access to the island will be by two piled deck structures which will provide both road and rail service links. The present cooling water and stormwater culverts will not be affected by the reclamation although relocation of these will be required during future reclamation works. The Wanchai ferry pier will not require relocation at this stage but reprovision will be required for

the stub pier, which presently berths the Hong Kong and Yaumati Ferry Company (HYF) nightclub and restaurant vessels.

The Extension will house an Exhibition Park which will be located to the west of the Extension and a waterfront pedestrian promenade will be constructed to the north of the Extension. A ferry pier and commercial development will eventually be built to the east of the Extension. Services are planned for the island reclamation area. These include extension of storm drainage to the new seawall, sewerage interceptors to link with the main sewage scheme, and sea water pumping stations on the new waterfront.

The Project is being undertaken by the Urban Area Development Office. A schedule for the construction and details on the management structure of the project are given in Chapter 3 and Chapter 4 respectively.

#### **1.4 Project Site**

The reclamation site for the HKCEC Extension is located in Victoria Harbour and extends from Fenwick Street to Fleming Road on the north seafront of Hong Kong Island as shown in Figure 1.1.

#### **1.5 Existing Monitoring Programme**

A brief water monitoring survey was carried out between 14-18 May, 1993 to provide verification data for the hydraulic modelling studies for the focused study of this project. However, no monitoring programme is being carried out at present. It is recommended that baseline monitoring for noise, water and air quality be carried out before construction begins.

Environmental Protection Department (EPD) has a number of water monitoring stations in the Victoria Harbour as does the West Kowloon Project Area (WKPA) Environmental Project Office (ENPO). Account of these results will need to be taken in setting the Trigger, Action and Target (TAT) levels.

#### **1.6 Interface with Other Projects**

There will be other reclamation works taking place in close proximity to the site such as Central reclamation and probably Tamar reclamation. The water and air quality of the area around the HKCEC extension site will be affected by these projects and it will be difficult to try to monitor and assess the environmental impact caused by one project alone. Therefore, it is suggested that the monitoring would be best carried out on an area-wide basis. In this way, cumulative impacts can be assessed instead of project specific impact. Area-wide mitigation measures would then be much easier to implement.



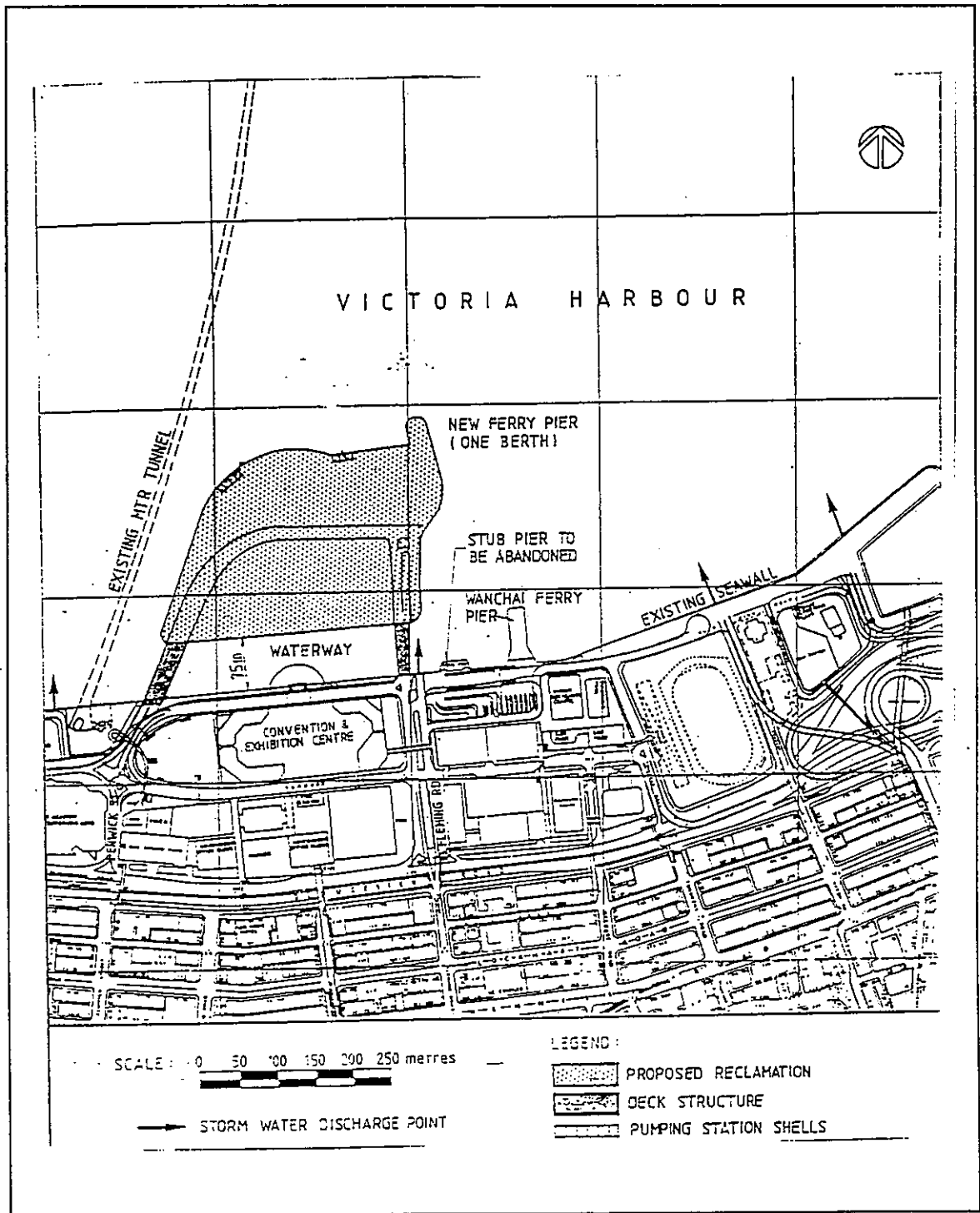


Figure 1.1 Site Location

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ENVIRONMENTAL ASSESSMENT  
STUDIES

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## 2 ENVIRONMENTAL ASSESSMENT STUDIES

### 2.1 Environmental Setting

Water quality in Victoria Harbour is generally acknowledged to have deteriorated steadily since full records began in 1972. The area suffers from relatively low dissolved oxygen saturation (DOS) and high bacteria counts. Although the declining trend has now been slowed, a major improvement in water quality is not expected until major sewerage works are undertaken as part of the Strategic Sewage Disposal Scheme (SSDS). Sediments in the study area are also known to have high concentrations of contaminants.

Victoria Harbour has not yet been gazetted as a Water Control Zone (WCZ) and therefore there are no statutory Water Quality Objectives (WQOs) published at this time. However, assuming that the minimum standards for pH, dissolved oxygen, ammoniacal nitrogen and nutrients will be similar to gazetted WCZs, then the present water quality in the Harbour would exceed all these WQOs on some occasions during each year.

There are hotels and commercial buildings along the waterfront which are the potential concerns for noise and air impact during construction, although all of these buildings are protected by high quality glazing and central air conditioning. Sensitive receivers for air and noise impacts identified in the Stage 2 Report of the focused study are listed below in Table 2.1 and Table 2.2 and shown in Figure 2.1 and Figure 2.2 respectively.

### 2.2 Previous Environmental Assessment

Previous studies of the HKCEC Extension include a preliminary environmental appraisal (Environmental Protection Department, September 1992) as part of an assessment of the entire Central Wanchai Reclamation. In respect of the Island Scheme, this EPD initial assessment concluded that some deterioration in local water was expected to occur but the change in conditions will not be as great as in the case of the original full scale reclamation proposed.

A Focused Environmental Impact Assessment of the Island Scheme was conducted in 1993. It consisted of a two stage study with Stage 1 providing an initial assessment and Stage 2 a more detailed examination. The findings are summarised below:

- A sediment plume modelling was carried out and showed that during construction a narrow plume extending for 7 km just offshore of Central and Wan Chai would be formed and would experience increases in suspended sediment loads of 0.1 to 0.5 mg/l. This was based on a volume of dredged mud of 500,000 m<sup>3</sup>. The actual volume to be removed is now understood to be only 50,000 m<sup>3</sup>.

Table 2.1 Air Sensitive Receivers (ASR) for HKCEC extension

Receiver	Location
ASR1	Hong Kong Convention & Extension Centre
ASR2	Grand Hyatt Hotel
ASR3	New World Harbour View Hotel
ASR4	Servicemen's Guides Association
ASR5	Hong Kong Academy for Performing Art
ASR6	Hong Kong Arts Centre
ASR7	YMCA Hotel
ASR8	Shui On Centre
ASR9	Wan Chai Tower
ASR10	Kwong Wan Fire Station
ASR11	Central Plaza
ASR12	Great Eagle Centre
ASR13	Harbour Centre
ASR14	Hong Kong Exhibition Centre
ASR15	China Resources Building
ASR16	Causeway Centre
ASR17	Sun Hung Kai Centre

- The existing sewer reticulation within the Wan Chai area will not be directly affected by the proposed Island Scheme. Additional sewage from HKCEC extension would represent 2% of the present load.
- Existing seawater pumping stations will not be physically affected by the Island Scheme
- Marine sediments in the area have been classified as Class C.



**Table 2.2 Noise Sensitive Receivers (NSR) for HKCEC extension**

Receiver	Location
NSR1	Gloucester Road No. 169-170
NSR2	Sun Hung Kai Centre
NSR3	Causeway Centre
NSR4	Harbour Centre
NSR5	Great Eagle Centre
NSR6	New World Harbour View Hotel
NSR7	HK Convention and Exhibition Centre
NSR8	Grand Hyatt Hotel
NSR9	Central Plaza
NSR10	Wan Chai Magistracy
NSR11	Shui On Centre
NSR12	YMCA Hotel
NSR13	HK Arts Centre
NSR14	HK Academy for Performing Arts

- Total Suspended Particulates (TSP) concentration may exceed the acceptable limits by up to 35%.
- Most of the NSR's assessed may be exposed to maximum noise levels which exceed the 75 dB(A) non-statutory day-time limit during construction phase. However, all NSR's except Causeway Centre are fitted with high quality glazing and central air conditioning which will attenuate the noise levels.

Recommendations regarding mitigation measures were made for water, air and noise and it was concluded that the Island Scheme is environmentally acceptable, with these mitigation measures.

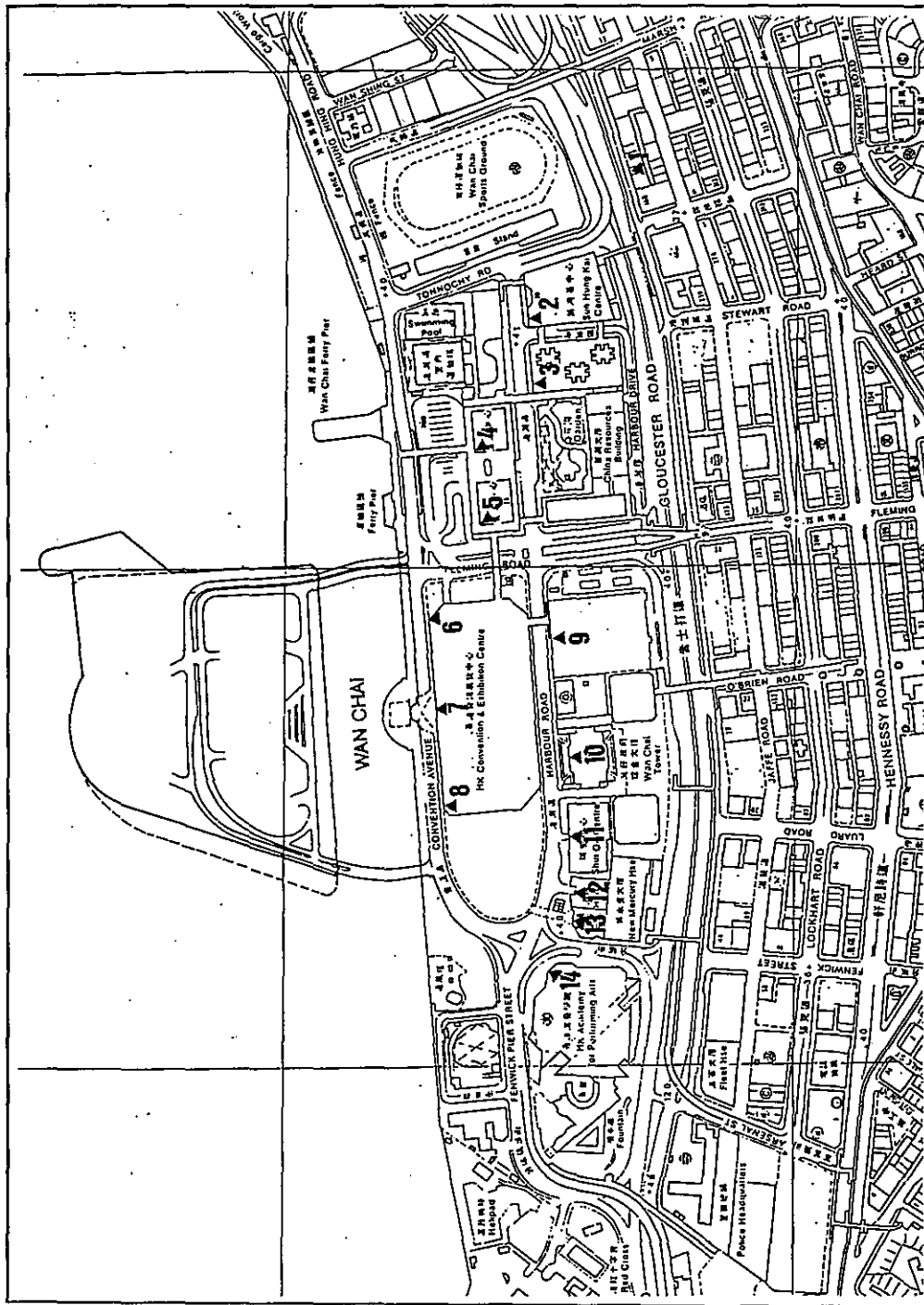


Figure 2.2 NSRs identified for HKCEC extension project

### 2.3 Summary of Recommendations and Mitigation Measures for Minimising Environmental Impacts

The contract is not yet finalised. Contract requirements are expected to be based on the recommendations of this study, reviewed and endorsed by EPD.

The following summary of measures are based on findings from the Stage 2 Report and standard contract conditions:

#### *Water*

- o Rate of dredging not to exceed 1700 m<sup>3</sup> per day.
- o Dredgers should use close-fitting grabs.
- o Stormwater outfall from Catchment 'M' to be reduced by 50%.
- o All other stormwater outfalls in the area to be reduced by 25%.
- o Sewage to be incorporated into the Wanchai reticulation.
- o Floating debris should be collected by water-witch or similar vessel.
- o Contaminated sediments must be disposed of in accordance with licence conditions.

#### *Air*

- o Use of regular watering to reduce dust emissions from exposed site surfaces and unpaved roads. Up to 50% reduction in dry dust emissions can be achieved by twice daily watering with complete coverage.
- o Use of frequent watering for particularly dusty static construction areas and areas on the southern side of the site.
- o Side enclosure and covering of any aggregate or dusty material storage piles to reduce emissions. Where this is not practicable owing to frequent usage, watering should be employed to aggregate fines.
- o Where possible, prevent placing dusty material storage piles on the southern side of the site.
- o Paving of frequently used site roads can reduce emissions by up to 85%. Alternatively geotextiles should be used to form flexible road surfaces.



- o Tarpaulin covering of all dusty vehicle loads transported to, from and between site locations.
- o Imposition of speed controls for vehicles on unpaved site roads. 8 km hr<sup>-1</sup> is the recommended limit.
- o Establishment and use of vehicle wheel and body washing stations at the exit point of the site, combined with cleaning of public roads where necessary.
- o If land based fill material is used, provision of a fixed spray bar system to wet fill material prior to load into barges before transporting to the reclamation.
- o Instigation of a control program to monitor the construction process in order to enforce controls and modify methods of work if dusty conditions arise.

#### *Noise*

- o Erection of noise barriers around stationary plant in accordance with BS5228 : 1984 or 'A Practical Guide for the Reduction of Noise from Construction Works' published by EPD.
- o All plant and equipment should be routinely maintained in good working condition.
- o Silencers, mufflers or acoustic linings should be used wherever possible.
- o Numbers of trucks at any one place at the same time should be minimised wherever practicable.
- o The 75 dB(A) construction noise guideline should not be included as a contract condition.

#### *Solid Waste*

- o On-site sorting of construction waste should be undertaken.
- o Priority consideration should be given to on-site disposal of demolition and inert construction waste.

#### *Environmental Monitoring and Audit*

- o The procedures and instructions within the Environmental Monitoring and Audit Manual shall be strictly adhered to.

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PROJECT ORGANISATION

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### **3 PROJECT ORGANISATION**

#### **3.1 Internal Organisation of the Project Team**

Figure 3.1 illustrates the suggested structure of the project management team and the way in which the Environmental Team (ET) fits into this structure. The chart is organised in such a way that the ET reports directly to UADO and EPD and is not directly responsible for cost and programme consideration. Therefore, environmental monitoring and auditing will not be constrained by conflict of responsibilities. This will obviously require a separate contract for the Environmental Team. 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 ET is to be fully effective.

The internal structure of the ET should be prepared and submitted for approval at least one month before the construction starts.

#### **3.2 Lines of External Communication regarding Environmental Issues**

The existing EPD complaint hotline should be utilized and any complaints received would then be passed on to the ET who would investigate and discuss with the Project Manager.

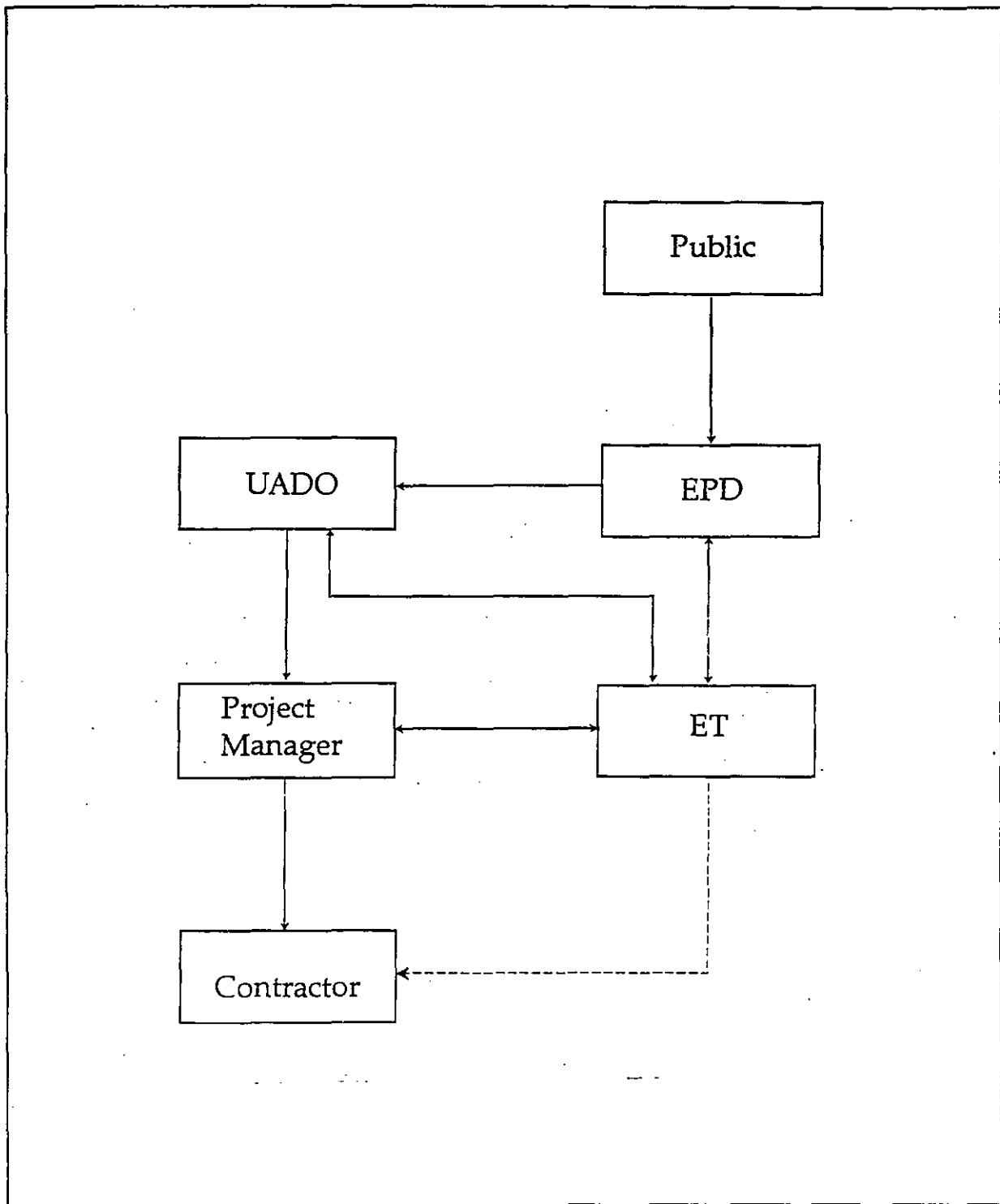


Figure 3.1 Recommended Organisation of the Project Team

PROJECT PROGRAMME

#### 4 PROJECT PROGRAMME

The proposed implementation programme is shown in Figure 4.1. It is assumed that the detailed design commences in early January 1994 and construction commences in mid 1994. The building contract for the HKCEC extension is programmed to start in January 1995. This programme would allow the opening of HKCEC Extension in mid 1997, as required by the Government. Key dates are shown below in Table 4.1.

**Table 4.1 Key Dates for the HKCEC extension project**

Activity	Key Date
• Appointment for Detailed Design Consultant for Reclamation and Infrastructure	3rd January 1994
• Call Tenders for Reclamation and Infrastructure Contract	4th April 1994
• Award Reclamation and Infrastructure Contract	4th July 1994
• Call Tenders for Building Contract	1st September 1994
• Award Building Contract	3rd January 1995
• Commence Pilling on Reclamation	3rd April 1995
• Complete Reclamation and Infrastructure Contract	31st December 1996
• Complete Building Contract and Open HKCEC Extension	30th June 1997

ACTIVITY	1993				1994				1995				1996				1997			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
1. Statutory and Administrative Procedures																				
1.1 Selection of Detailed Design Consultant																				
1.2 Gazette (Tenders and Standard Details)																				
1.3 Bids (Board Consultation)																				
1.4 Gazette (Bids Issuance)																				
1.5 Consultation with Pimpouse Owners																				
2. Detail of Design																				
2.1 Site Investigation																				
2.2 Design																				
2.3 Quantities and Cost Estimate																				
2.4 Tender Documents																				
3. Tendering and Prequalification																				
3.1 Prequalification																				
3.2 Tender Documents																				
3.3 Tender Period																				
3.4 Tender Assessment																				
4. Construction - Reclamation and Infrastructure																				
4.1 Mobilization																				
4.2 Retention Wall, Walkways																				
4.3 Reclamation and Seawalls																				
4.4 West Bridge																				
4.5 East Bridge																				
4.6 Pumping Station Sifts																				
4.7 Ferry Pier																				
4.8 Storm Drainage and Sewerage																				
4.9 Roads and Service																				
4.10 Landscaping																				
5. Construction - Building Contract																				
5.1 Mobilization																				
5.2 Utility Diversions and Foundations in Convention Avenue																				
5.3 Piling																				
5.4 Basement																				
5.5 Superstructure																				

Figure 4.1 Implementation Programme

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ENVIRONMENTAL MONITORING AND  
AUDIT REQUIREMENTS

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## 5 ENVIRONMENTAL MONITORING AND AUDIT REQUIREMENTS

### 5.1 Trigger, Action and Target Levels

The basic method of recording any changes in the 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:

<i>Trigger</i>	Trigger levels provide an indication of deteriorating ambient environmental quality.
<i>Action</i>	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.
<i>Target</i>	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 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 summarises the event and action plan.

**Table 5.1 Action Plans for Exceedance of TAT Levels**

Exceed. Level	Step 1	Step 2	Step 3
Trigger	<ul style="list-style-type: none"> <li>• Notify client/ Project Manager</li> <li>• Identify source</li> <li>• Review working methods</li> <li>• Continue scheduled monitoring</li> </ul>	<ul style="list-style-type: none"> <li>• Implement simple additional mitigation measures identified</li> </ul>	<ul style="list-style-type: none"> <li>• Notify client/ Project Manager following termination of exceedance</li> </ul>
Action	<ul style="list-style-type: none"> <li>• Notify client/ Project Manager</li> <li>• Commence additional monitoring</li> </ul>	<ul style="list-style-type: none"> <li>• Contact Project Manager to discuss and implement remedial action</li> </ul>	<ul style="list-style-type: none"> <li>• Notify client/ Project Manager following termination of exceedance</li> </ul>
Target	<ul style="list-style-type: none"> <li>• Notify EPD/client/ Project Manager</li> <li>• Continue additional monitoring</li> </ul>	<ul style="list-style-type: none"> <li>• Carry out analysis of procedures to identify and implement all additional mitigation measures that have been identified.</li> </ul>	<ul style="list-style-type: none"> <li>• Notify EPD/client/ Project Manager following termination of exceedance</li> </ul>

## 5.2 Equipment

The following monitoring equipment is suggested.

### 5.2.1 Air Quality

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

- GMWL-2000 High Volume Air Sampling System
- WD401 Wind Speed and Direction Sensor connected to a MET EL8 Data Logger will be used to collect meteorological data in accordance with the monitoring programme.

The TSP monitor should 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 monitoring when sources of dust are in doubt.

### 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 will be of a comparable professional quality. Standard acoustical principles and practices will be followed in the measurement and analysis of the noise under investigation.

Noise should be monitored using Bruel and Kjaer modular precision sound level meter type 2231, with statistical analysis module BE 7101 or other suitable instruments which comply with the IEC Publications 651:1979 (Type 1) and 804:1985 (Type 1) specifications.

### 5.2.3 Water

For water quality monitoring, the equipment given in Table 5.2 or similar specifications should be used.

**Table 5.2 Water Quality Monitoring Equipment**

Equipment Function	Manufacturer	Model Name/Number
Turbidity Measurement	Hach	2100P
Dissolved Oxygen and Temperature Measurement	YSI	Model 58 DO meter with 30m cable and YSI 5739 probe with YSI 5795A submersible stirrer for <i>in situ</i> DO measurements; YSI Model 33 conductivity meter for salinity for calibrating DO meter; YSI temperature sensor for temperature measurement.
Navigation and Positioning	Magellen	NAV 5000D or compass, where satellites are unavailable
Sampling at Depth for SS Determinations	Kahlsico	Kahlsico Water Sampler with vented drain and messenger
Depth Finding	Seafarer	Model 701 Echo Sounder

### 5.3 Methodology

#### 5.3.1 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  $L_{eq}(5 \text{ min})$  readings. The  $L_{eq}(30 \text{ minute})$  reading should be calculated from the  $L_{eq}(5 \text{ minute})$  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, BOD and  $\text{NH}_3(\text{N})$  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, BOD,  $\text{NH}_3(\text{N})$  determinations should be carried out according to APHA Standard Methods for the Examination of Water and Wastewater, 17 Edition, 1989 analysis no. 2540D, 5210B, 4500- $\text{NH}_3$  and 9213D 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)

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

## 5.4 Calibration

### 5.4.1 Introduction

Equipment should be maintained in calibration at all times and recalibration 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 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 everytime against gravimetric standards every 2 months. A calibration check against a known standard should be carried out on each occasion the meter is used.

### 5.4.3 Noise Monitoring

The sound level meters should be calibrated using a Bruel and Kjaer Sound Level Calibrator Type 4230, or other similar equipment, 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 d(A), then repeated until the calibrations before and after agree to within 1 d(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 titrations 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.

## 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. Station 1 - 6 are located around the reclamation site within the sediment plume modelled (shown by dotted line), station 7 is set up as a control. The station marked by letter E is the existing monitoring station sampled by EPD.

The parameters to be monitored will be :

Set A : DO, DO% sat, Turbidity, Temperature and Suspended solids.

Set B : BOD, NH<sub>3</sub>(N) and *E.coli*.

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

SS, BOD, NH<sub>3</sub>(N) and *E.coli* determinations should be carried out according to APHA Standard Methods for the Examination of Water and Wastewater, 17 Edition, 1989 analysis no. 2540D, 5210B, 4500-NH<sub>3</sub> and 9213D respectively.

It should be noted that stations 1 and 5 are located within the area of sediment plume predicted from the previous modelling studies, but are further away from the site compared with stations 2,3,4 and 6. Therefore, while exceedance of TAT levels for stations 1-6 should all be treated with appropriate action, any exceedance of TAT levels at stations 1-6 should be treated more seriously and investigated to see if this is indicating that a larger area has been affected by the project.

### 5.5.2 Air and Noise

Suggested locations of air and noise monitoring stations are shown in Figure 5.2. They are chosen with consideration of the likelihood of disturbance imposed.

Parameters monitored will be TSP (24 hrs) for air and L<sub>eq</sub> (5min) for noise.

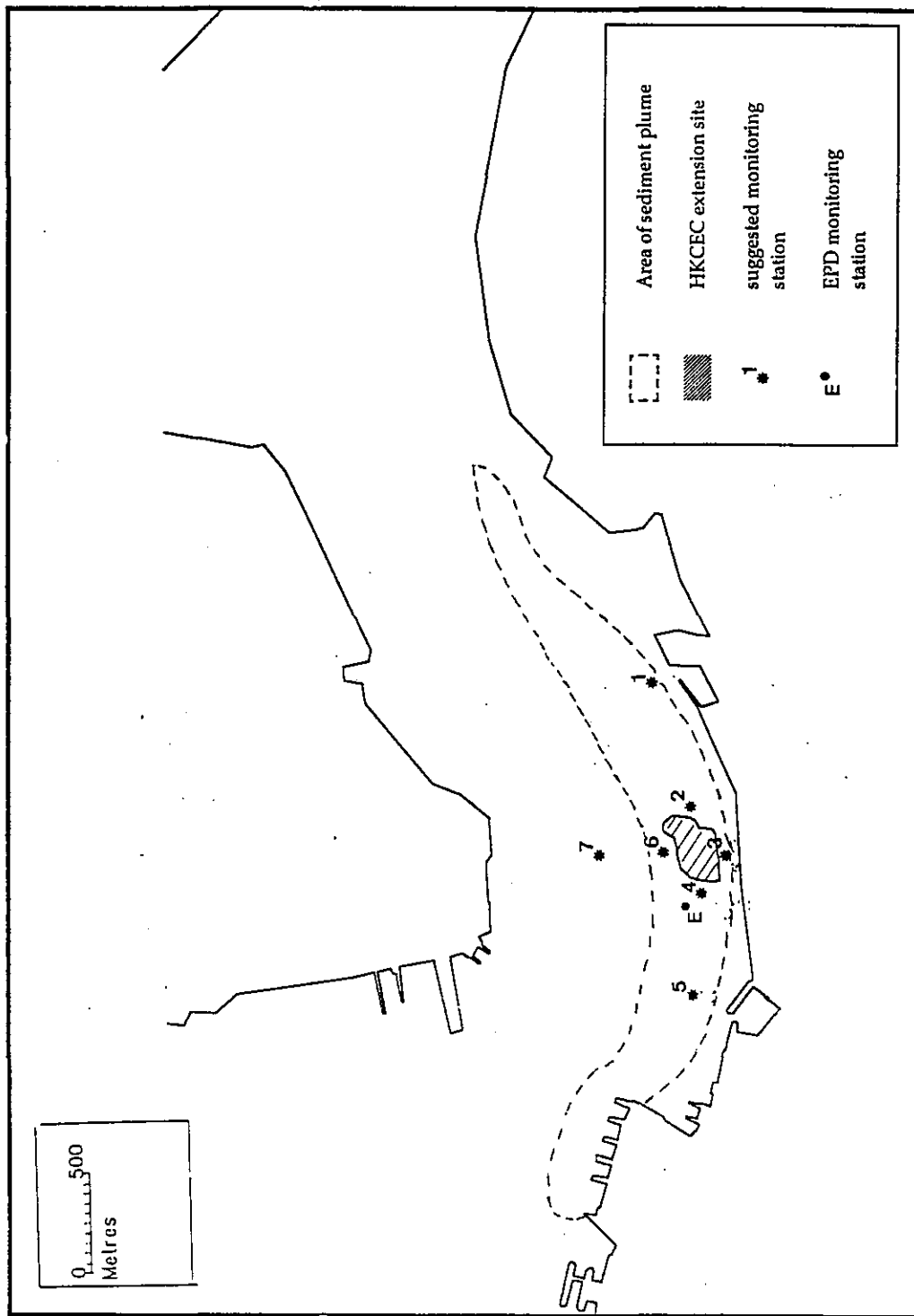


Figure 5.1 Water Quality Monitoring Locations

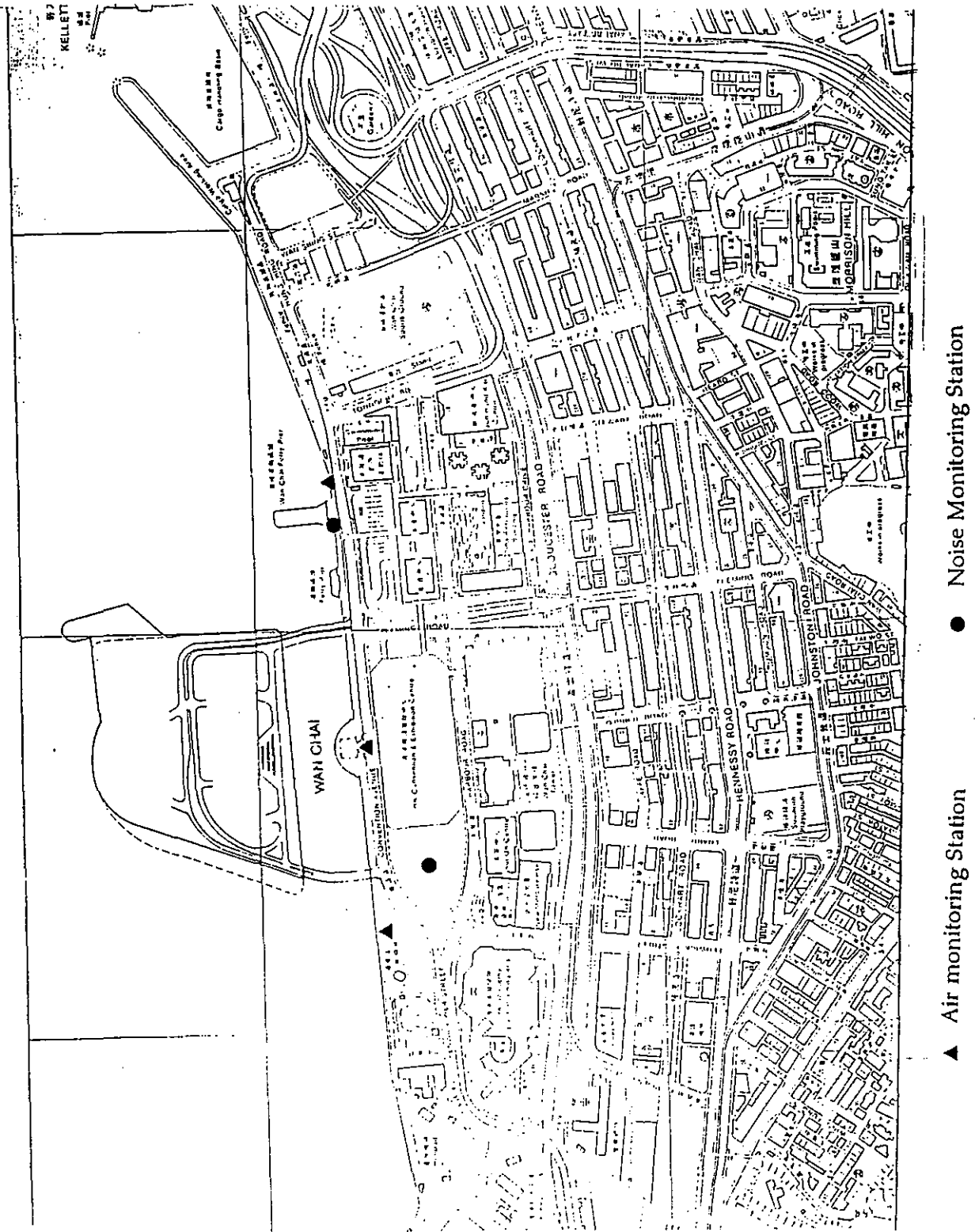


Figure 5.2 Air and Noise Monitoring Locations



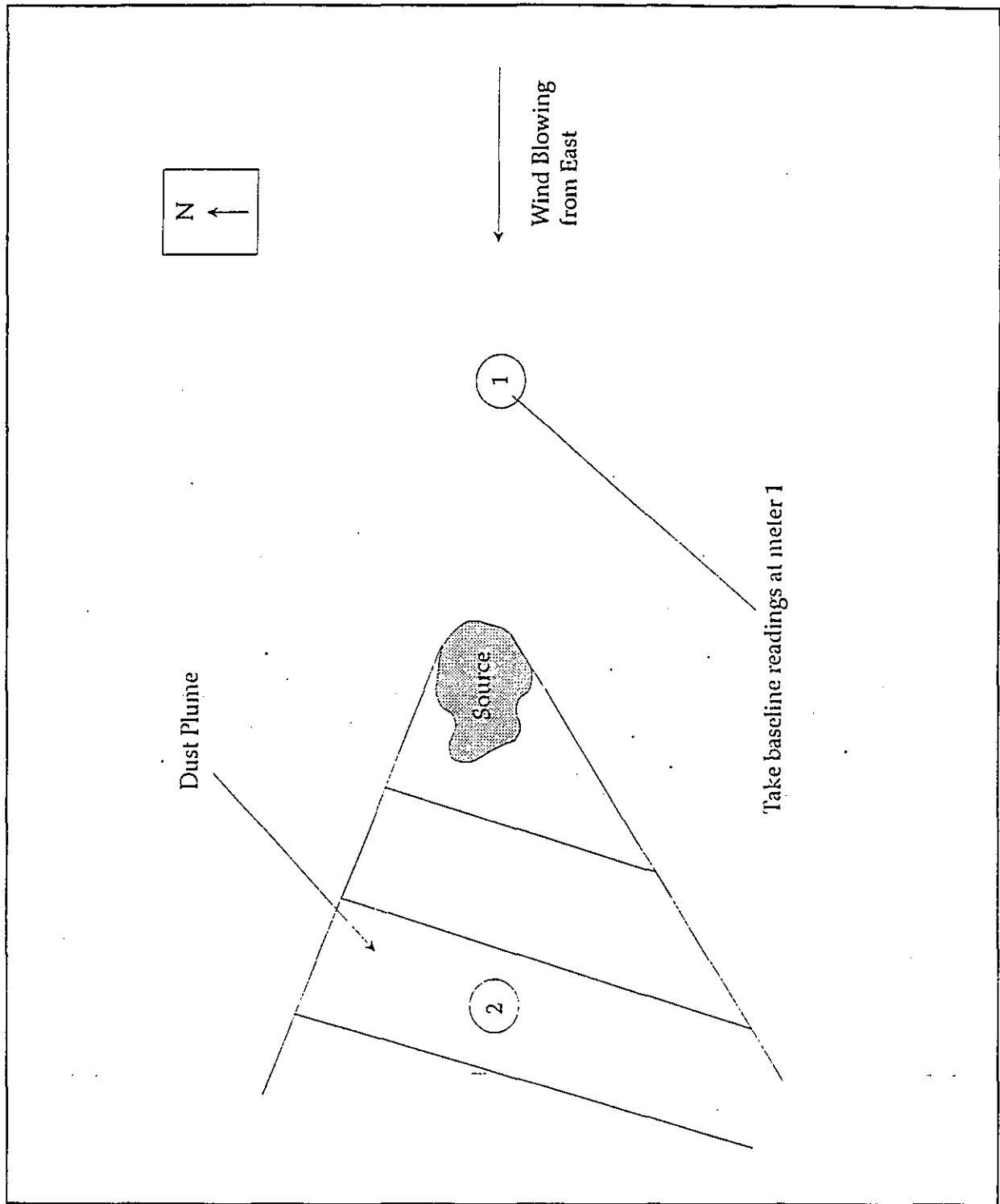


Figure 5.3 Rolling Baseline for Air Monitoring

## 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 following frequencies and durations are suggested:

<u>Parameters</u>	<u>Frequency/week</u>	<u>Duration</u>
Water set A	4	4 weeks
Water set B	4	4 weeks
Air	6	2 weeks
Noise	6	2 weeks

A rolling baseline approach for air quality monitoring is suggested during construction. The readings from the samples located at the opposite direction to the wind direction with reference to the source should be taken as the baseline readings for that instance. A simplified case is shown in Figure 5.3. This approach requires that wind directions to be recorded together with the time and readings from the meter.

The modelling studies carried out in the Stage 2 Report indicate that there is negligible increase in the BOD and NH<sub>3</sub>(N) concentrations. The predicted increase of *E.coli* concentration is also small and the data is highly variable. Therefore, if outfall M is rerouted, then there is probably no need for monitoring of the Water set B parameters. However, since the rerouting of outfall M is not confirmed at this stage, the monitoring of set B parameters is still included. If rerouting of outfall M is confirmed, this aspect of the monitoring programme may be deleted.

## 5.7 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:

<u>Parameters</u>	<u>Frequencies</u>
Water set A	3 days/week ( mid-ebb and mid-flood)
Water set B	3 days/week (mid-ebb and mid-flood)
Air	once/6 days
Noise	once/6 days

Ad-hoc monitoring using the portable dust meter could be performed if sources are in doubt.

Table 5.3 gives a summary of the monitoring programme.

**Table 5.3 Summary of Monitoring Programme**

Item	Air	Noise	Water
Parameter(s)	TSP (24 Hour) and <i>ad hoc</i> 1 hour sampling	6 consecutive readings of $L_{eq}$ (5 mins)	2 consecutive readings of Turb, Temp. DO and DO (%sat). Lab. analysis of SS, BOD, $NH_3(N)$ . EColi
No of locations	3	2	6 stations with 1 control station
Baseline Frequency and Duration	2 weeks prior to construction  6 times per week	2 weeks prior to construction  6 times per week	4 weeks prior to construction  4 times per week
Compliance	every 6 days	every 6 days	3 days/week for set A & set B, mid-ebb and mid-flood for each day
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 <i>ad hoc</i> 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'

### 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, EPD will 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-formas should be used for recording field data. 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.

Some sample data forms are shown in appendix A.

## 5.10 Reporting

Monthly EM & A reports should be submitted for water and quarterly reports for air and noise. These should include:

- Monitoring results for the month
- Any additional monitoring undertaken
- Any complaints and actions taken
- Audit of monitoring and

- schedule of monitoring for the next month

The reports should be in printed and magnetic formats compatible with EPD computer facilities.

### 5.11 Setting of levels

It is suggested that TAT levels should be based on seasonal effects and percentiles calculated from the baseline monitoring data and data from EPD monitoring station VM 5. For situations where current qualities are poor and ideal requirements cannot be met, it is suggested that Target levels should normally be based on 1% ile for dissolved oxygen and 99% ile for suspended solids and TSP. Otherwise, the Target level should be based on the local environmental constraints and statutory requirements.

For noise impact, the application of this approach would be somewhat difficult to the rapidly varying levels and also due to the subjective nature of noise nuisance. Therefore, TAT levels for noise are normally based on the number of complaints received once the noise level of the receiver exceeds a specific threshold as listed below:

Trigger	-	one noise complaint received
Action	-	three independent noise complaints received
Target	-	five independent noise complaints received

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ENVIRONMENTAL COMPLAINTS  
PROCEDURES

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**6 ENVIRONMENTAL COMPLAINTS PROCEDURES**

The following complaints procedures are recommended:

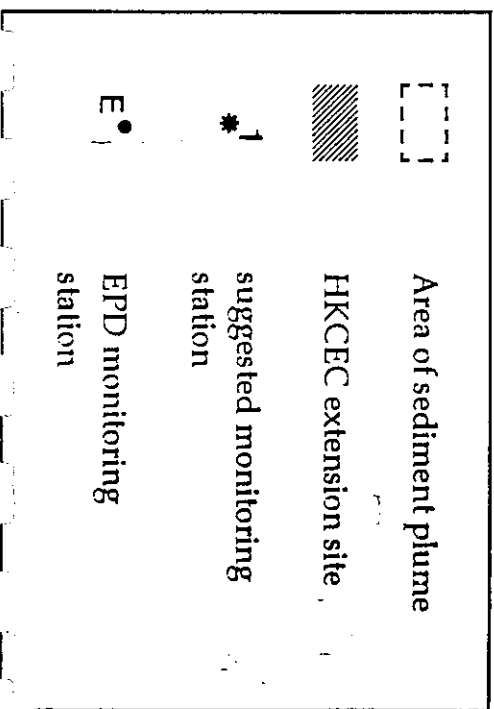
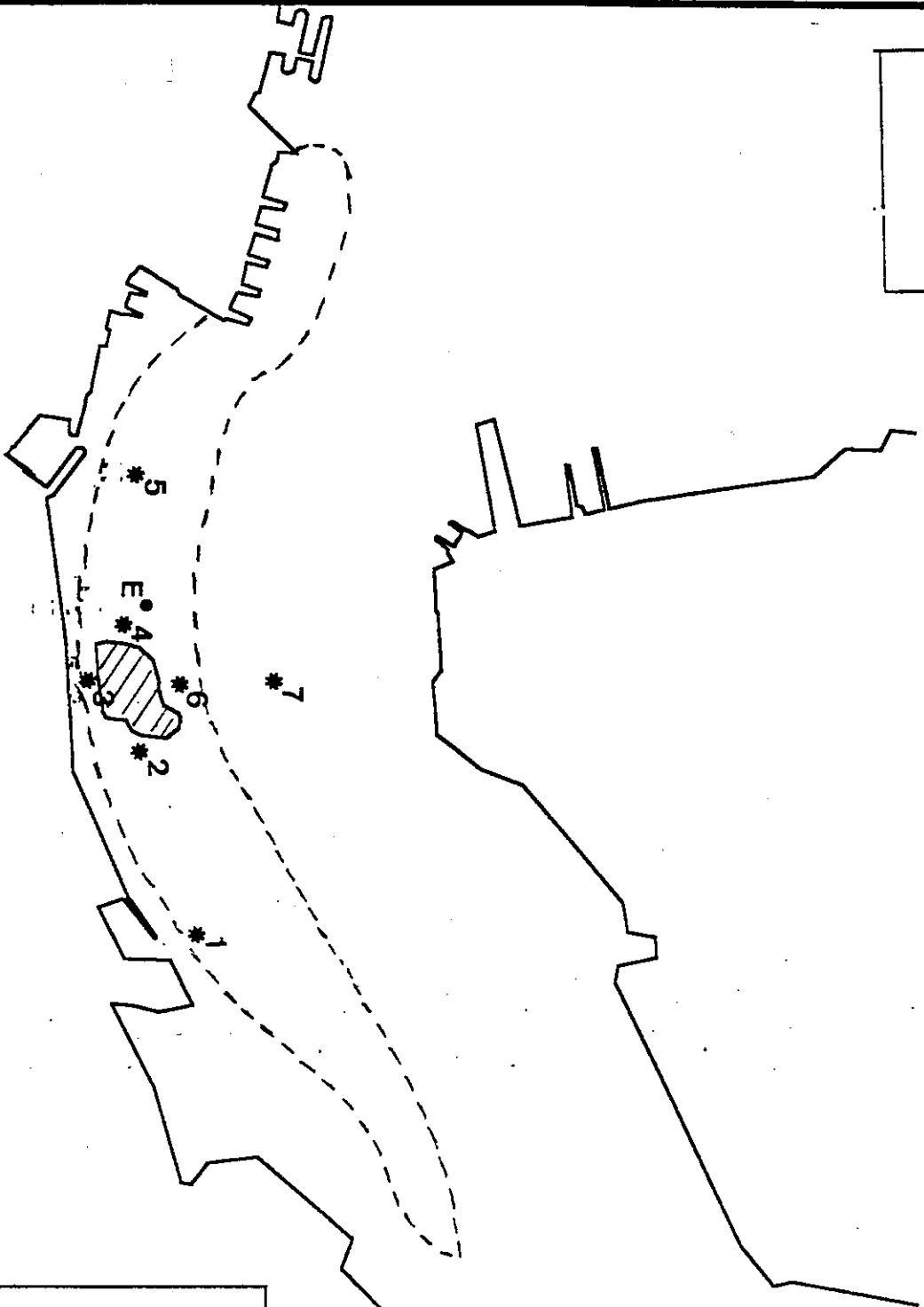
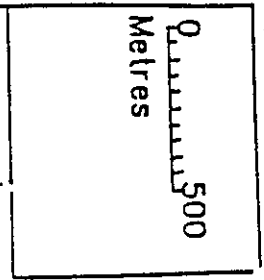
- Complaints from the Public should be made to EPD through the EPD hotline number.
- EPD should then inform the ET or the relevant representative of the complaint.
- Investigation of complaint to determine the validity of the complaint, and to assess whether the source of the problem is a one-off complaint or due to recurring works activities.
- ET to inform the complainant, the client 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.

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APPENDIX A

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**CES Consultants in Environmental Sciences (Asia) Ltd**

**WATER QUALITY MONITORING - FIELD DATA RECORD**

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
			S	M		1	2	1	2	1	2	1	2	
			1.0											
1	Start		S	1.0										
	Finish		M											
			B											
2	Start		S	1.0										
	Finish		M											
			B											
3	Start		S	1.0										
	Finish		M											
			B											
4	Start		S	1.0										
	Finish		M											
			B											
5	Start		S	1.0										
	Finish		M											
			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 \_\_\_\_\_



# CES Consultants in Environmental Sciences(Asia) Ltd

## DUST MONITORING

Date Started		Time Started	
Station ID	A	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 <sup>-1</sup> )	Wind Direction (°)	Hour	Wind Speed (ms <sup>-1</sup> )	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		

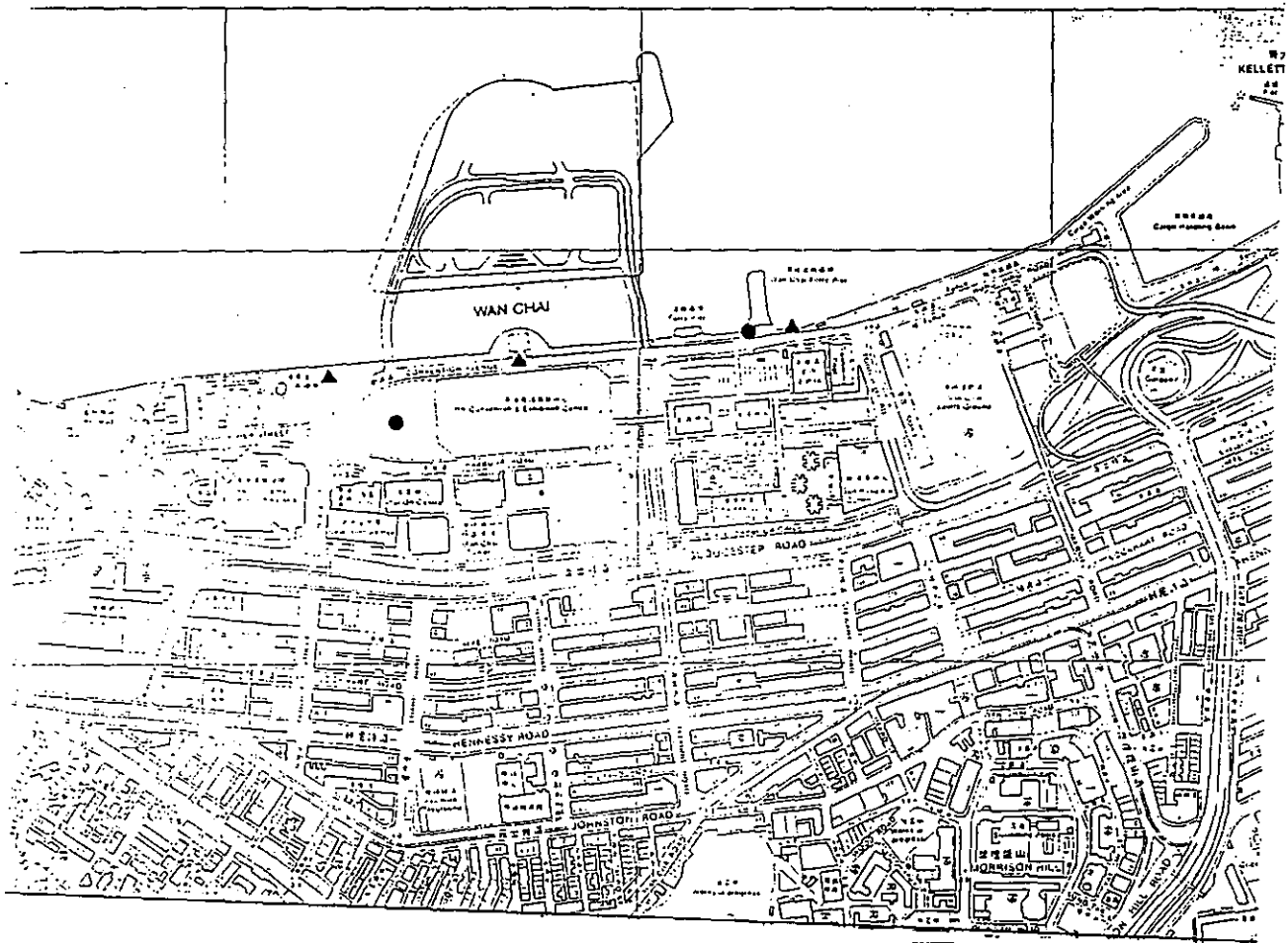
\* Delete if inappropriate

Prepared By : \_\_\_\_\_  
Date : \_\_\_\_\_

Checked By : \_\_\_\_\_  
Date : \_\_\_\_\_

**Air Sampling - Mark Significant Visible Dust Sources on Map Below - Use Notes to Explain**

**Notes**



▲ Air monitoring Station

● Noise Monitoring Station

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SCIENCES (ASIA) LTD**

**CES Consultants in Environmental Sciences (Asia) Ltd**

Noise Monitoring

Type of Sound Level Meter		B & K Type 2231		Serial No.	
Location		A( see diagram)			
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	B&K Type 4230	93.85 dB	1	
	After	B&K Type 4230	93.85 dB	1	

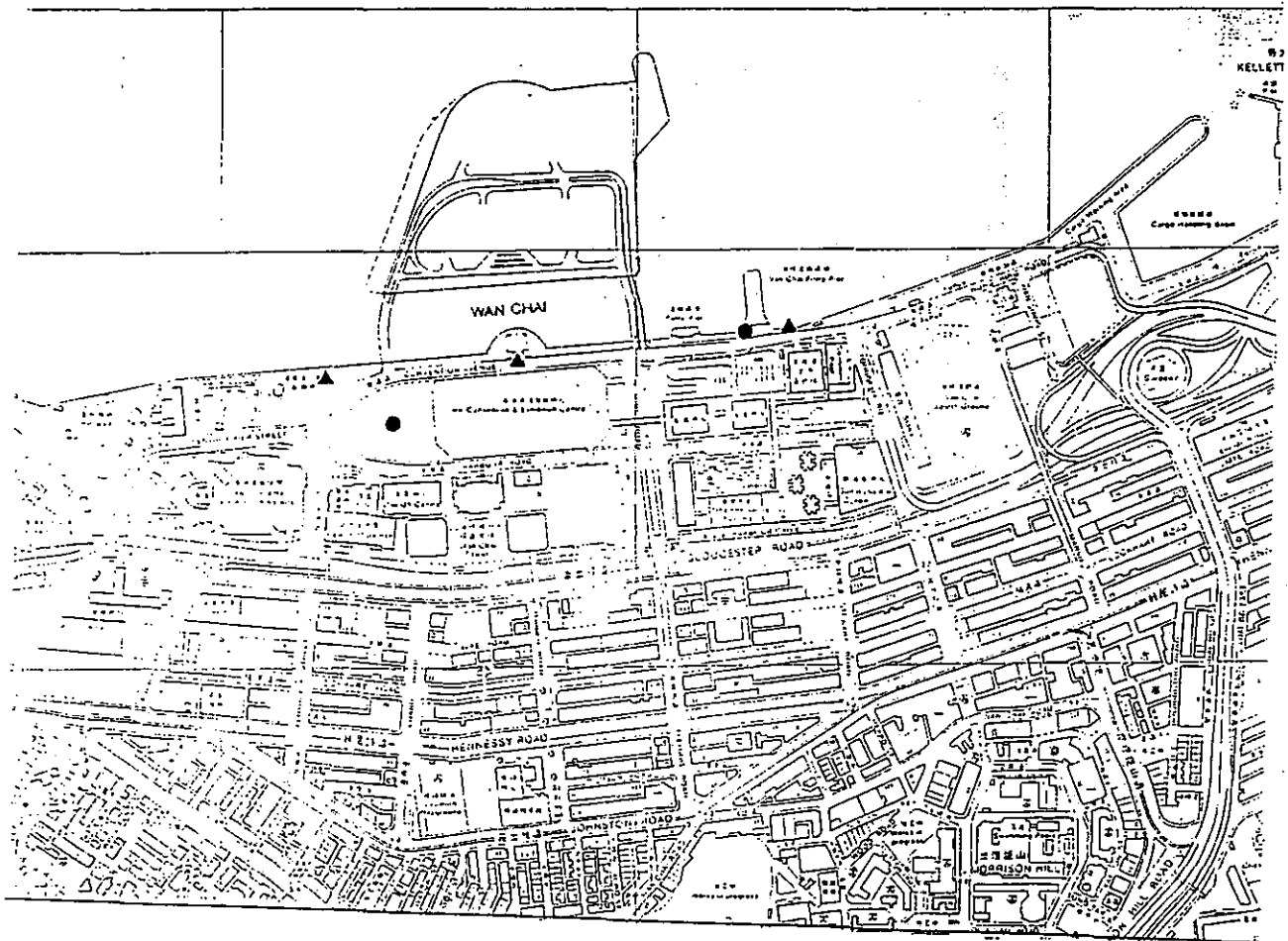
Please list any significant noise sources nearby on the back of this form stating activity and approximately location.

Tested by : \_\_\_\_\_ Checked by : \_\_\_\_\_

Date : \_\_\_\_\_ Date : \_\_\_\_\_

**Noise Sampling - Mark Significant Noise Sources on Map Below - Use Notes to Explain**

**Notes**



▲ Air monitoring Station

● Noise Monitoring Station

