FINAL REPORT

China Light and Power Company Limited

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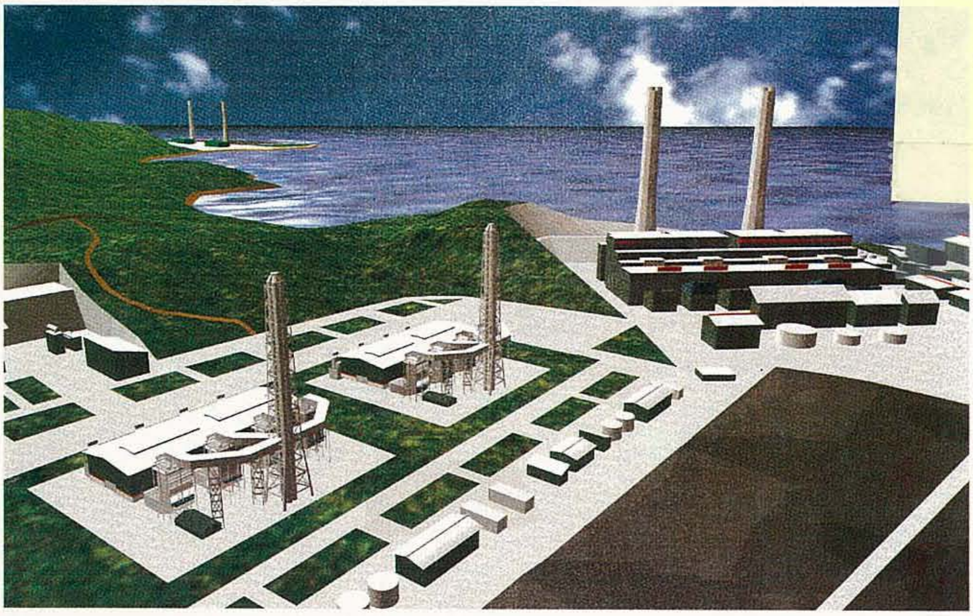

EIA of the Proposed 6000MW Thermal Power Station at Black Point: *Initial Assessment Report*

Volume 1 : The Surrounding Environment

November 1992

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Initial Assessment Report

Volume 1 : The Surrounding Environment

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EXECUTIVE SUMMARY

The China Light and Power Company Ltd (CLP) proposes to develop a large thermal power station (LTPS) in Hong Kong to meet forecast electricity demand during the late 1990s and into the next century.

In November 1989 CLP commissioned ERL (Asia) Ltd to lead a team of consultants to undertake a Site Search Study and Environmental Impact Assessment for the LTPS. The purpose, scope and objectives of the study were agreed between CLP and the Hong Kong Government Planning, Environment and Lands Branch (PELB) which set up an interdepartmental Study Management Group to assist in and monitor the progress of the study and to make recommendations to the Secretary for Planning, Environment and Lands at appropriate stages of the study.

The three phase Site Search study, comprising the identification of potential areas, the identification of potential sites and a comparative assessment of sites, resulted in the selection of Black Point.

The findings of the Site Search Report were accepted by the Study Management Group in August 1990 and following scrutiny by the Development Progress Committee (DPC) were submitted for approval to the Land Department Planning Committee (LDPC). The findings were endorsed by the LDPC on 7th December 1990.

Following the endorsement of the recommendation of the Black Point site, the Environmental Impact Assessment for the LTPS at the Black Point location was initiated, comprising two elements; the Initial Environmental Assessment, and the Key Issue Assessments.

The Initial Environmental Assessment provides an assessment and evaluation of the net environmental impacts and cumulative effects of the development, defines measurable parameters likely to be affected by the LTPS, and identifies environmental monitoring requirements.

The Key Issue Assessments provide detailed examinations of those environmental issues which could not be resolved at the initial assessment stage because of their complexity and need for detailed study as a result of their particular importance to the environmental acceptibility of the LTPS.

The need for two such Key Issue Assessments was identified at the commencement of the EIA, both of which were required to start at the same time as the Initial Assessment to ensure completion in line with the project programming. These were:

- the Stack Emissions (ie Air Quality) Key Issue Assessment; and
- the Water Quality Key Issue Assessment

The scope of work for these studies were agreed with the HK Environmental Protection Department, and the studies proceeded in parallel with the Initial Environmental Assessment. The findings of these studies are to be reported separately, in the Key Issue Assessment Reports.

During the discussion of the Draft of the Initial Assessment Report, the need for a third Key Issue Assessment was identified, dealing with the generation of solid byproducts. As with the two other Key Issue Assessments, the scope of the study was agreed with the EPD, and the findings are to be reported separately, in the Solid Byproducts Key Issue Report.

A summary listing of the issues considered in the Key Issue Assessments is provided at the end of this summary.

The findings of the Initial Assessment Report for the construction and operational phases of the LTPS are :

CONSTRUCTION PHASE

Air Quality Impacts

Good site dust practices in addition to careful siting of dust generating activities can effectively reduce the generation of dust by up to 90% and will ensure that adverse impacts on the environment and workforce are minimised. Construction impacts upon air quality both on and off site are therefore not considered to be significant.

Noise

Daytime noise levels during construction works are predicted to be well within the background plus 10 dB(A) criterion for receptors in the Black Point area.

Exceedances ranging from 2 - 9 dB(A) of the night-time noise criterion of 45 dB(A) are predicted at four of the five sensitive receivers, caused by nighttime dredging and marine support activities. It is recommended that where practicable, dredging activities be rescheduled to daytime hours, and the quietest type of dredger and silenced equipment used wherever possible.

Water Quality

Impacts arising from general construction activities will be minor and controlled by good construction site practice. Sediment plume modelling conducted at the Site Search stage indicates that the elevation in suspended solids at the nearest sensitive recievers during the dredging of marine muds will be insignificant when compared to the natural range of conditions in Deep Bay. Monitoring will be required during dredging works to ensure compliance with the Deep Bay Guidelines. Results obtained during initial dredging for the seawall should be used to assess the possible need for controls during the dredging for the access channel and turning basin.

Waste Disposal

Significant impacts from the disposal of construction wastes are not anticipated. Overburden and site debris can be disposed of at the adjacent WENT landfill, whilst chemical wastes will be taken to the Chemical Waste Treatment Facility on Tsing Yi. Marine sediments dredged from the site will require disposal at Gazetted Dump Sites. The need for additional disposal capacity has been recognised by FMC and sites such as disused borrow pits appear attractive. Suitability for dump site disposal will be confirmed by further sampling and analysis once the exact dredging area is known.

Traffic

It is anticipated that no significant traffic impacts need occur from LTPS construction. Road traffic impacts can be minimised by using marine transport for plant, materials and the workforce, by scheduling road deliveries outside peak hours and by careful design of site exits. Marine traffic, even at peak, involving 20 vessel movements per day, will only add approximately 5% to existing levels in the area and is thus not predicted to be significant.

Ecology

The site is of relatively low terrestrial ecological conservation value, and any fauna present are expected to escape during initial site clearance. Specimens or seeds of the two protected plant species found within the site can be relocated, either to AFD gardens or within the landscaping for the LTPS. The impact of construction activities on terrestrial ecology is thus not predicted to be significant.

Sampling of the marine ecology to date has not revealed any rare species. The sampling programme will be continuing in order to obtain data for all seasons and results will be considered in the Water Quality key issue report. The Chinese White (Pearl River) Dolphin is known to use the Urmston Road area, and the construction works may disturb the dolphins habitat; whilst the LTPS construction works will only be a part of the overall development planned for the shores of the Brothers Channel and Urmston Road, this is considered a potentially significant marine ecological impact associated with the construction of the LTPS.

Civil Aviation

Consultation with CAD and the New Airport Master Plan Study Consultants indicates that the construction activities will not violate the obstacle limitation surfaces associated with the future Chek Lap Kok airport or the existing Kai Tak flight paths. No impacts are therefore predicted.

Socio-Economics

The construction of the LTPS will provide a significant source of employment, which in turn will lead to the development of other goods and service related industries which will have a positive effect on the area. The site is located sufficiently far from population centres such that reduction in property value as result of disturbance from the LTPS construction work is unlikely to be of concern.

Cultural Heritage and Fung Shui

The Black Point area has been identified by the Antiques and Monuments Office (AMO) as an important archaeological site. A full mitigation plan for the investigation of these resources will be devised to the satisfaction of AMO.

Recreational and Visual Amenity

Yung Long beach will be removed by LTPS construction, although it is planned, in any event to be lost to PADS development.

Siting the LTPS to the north of Black Point substantially limits visual impacts during the construction period, although receptors to the south will be visually aware of the construction of the coal-fired unit stacks.

Decommissioning

Decommissioning of the LTPS is likely to begin around 2030 for Phase 1 of the station, and 2040 for Phase 2. Whilst CLP will be required to comply with the environmental legislation in force at that time, the broad issues which will need to be addressed have been identified, and generic mitigation measures to minimise impacts recommended; specific mitigation measures should be agreed with EPD (or its future equivalent) prior to the works commencing.

OPERATIONAL PHASE

Air Quality

Assuming that the EPD's BPM for emissions control are implemented, it is considered that the potential for human health impacts is only possibly significant with respect to the short term, i.e. 1-hour average concentrations. The extent and type of mitigation measures required cannot be determined at this stage, however, because of the uncertainty attached to the predictions made so far. This will be resolved during the Stack Emissions Key Issue Assessment.

The power station emissions are unlikely to cause significant dry acid deposition impacts however, the contribution of wet deposition requires further investigation in the Stack Emissions Key Issue Assessment.

Noise

Detailed assessment of noise impacts from the operation of the LTPS indicates that no significant impact will result either during the daytime or at night, from the operation of LTPS plant.

Water Quality

The operation of the LTPS is expected to be acceptable with regard to marine water quality. The following two key issues have be identified as requiring further study:

- Effect of sea flow patterns and the extent of the cooling water discharge thermal plume
- Dispersion of toxic metal discharges

The results of the mathematical modelling of these will be carried out as part of the Water Quality Key Issue Assessment.

Waste Disposal

Appropriate disposal locations for MARPOL and general operational wastes are available and will not give rise to significant impacts. Beneficial uses of PFA, FBA and gypsum have been identified and options which avoid the generation of solid byproducts (gypsum dissolution in seawater and seawater scrubbing suggested). However, these issues are to be studied further, and the findings presented in the Solid Byproducts Key Issue Report.

Traffic

No significant impacts are predicted to arise from operational road and marine traffic related to the LTPS.

Ecology

No significant impacts on terrestrial vegetation as a result of particulate, metal or dry acid species deposition are predicted. Potential impacts relating to wet acid deposition require further study and will be reported in the Stack Emissions Key Issue Report.

The marine ecological assessment is continuing, to allow the full annual seasonal range to be reported. The Chinese White (Pearl River) Dolphin makes use of the Urmston Road channel, and the development and operation of the LTPS, in conjunction with other deep waterfront industrial activities has the potential to affect the dolphins' environment. Further assessment on marine ecological issues will be presented in the Water Quality Key Issue Report.

Civil Aviation

The stacks for coal fired units will project above the anticipated obstacle limiting surface of the new airport at Chek Lap Kok. This is not considered significant due to the shielding effect of the Castle Peak range to the east, and will be discussed with CAD and the consultants for the new airport. The LTPS is not considered to pose any significant risks to aircraft from thermal or cloud generation effects.

Socio Economics

Operation of the LTPS will provide positive socio-economic impacts by enabling a future power shortfall in Hong Kong to be avoided, and providing direct and spin-off employment. The possibility of adverse impacts on commercial mariculture in Deep Bay is being addressed in the Water Quality Key Issue Assessment.

Cultural Heritage and Fung Shui

No significant cultural impacts are anticipated. Fung Shui impacts and mitigation requirements to be incorporated into the detailed design and layout of the LTPS are under investigation by CLP and local experts.

Visual

In the context of the semi-industrialised nature of the area, the visual impact of the LTPS is considered to be moderate. Should PADS developments proceed, the LTPS will be compatible.

Risk

The nearest population centres are under no significant hazard from the consequences of gas or oil incidents at the LTPS. Risks to potential PADS users immediately south of Black Point may be avoided by locating the gas pipeline route and oil berthing facilities such that the hazard distances involved lie wholly within the LTPS site.

A list of Key Issues to be addressed in specific Key Issue Reports is presented below.

Report	Issue
Stack Emissions - KIA	– Mitigation measures for emission control with respect to short term exposure (1-Hour AQO) and NO_2 – Recommend stack heights for coal, combined cycle and OCGT units – Assessment of contributions from LTPS to wet acid deposition
Water Quality - KIA	– Assessment of seaflow pattern and extent of thermal plume from cooling water discharge – Assessment of the dispersion of toxic metals from cooling water discharge – Assessment of impacts to marine ecology
Solid By-Product - KIA	– Confirm quantity of solid byproduct arisings from LTPS and Territory -wide over the next 20 years – Propose technically practical, economically feasible and environmentally acceptable management strategies for the byproducts (FBA,PFA,FGD gypsum and wastewater treatment sludges) over the same period

CONTENTS

1. INTRODUCTION

1.1 Background to the EIA

1.1.1 The Proposed Development

The China Light and Power Company Ltd (CLP) proposes to develop a large thermal power station (LTPS) in Hong Kong to meet forecast electricity demand during the late 1990s and into the next century. It is anticipated that the LTPS would ultimately provide 6000MW of power. Studies to date have assumed that approximately 5000MW would be generated from coal-fired units and upto 1000MW from gas turbine units fired on oil. Natural gas firing of part of the plant has also been considered and a site chosen so as not to preclude this option. The question of fuel type is one that is under active consideration by CLP as are options regarding the type of plant to be installed.

The implications for the extent and nature of environmental impacts resulting from fuel and plant choices require that two alternative fuel options be considered by the present study. These options are presented in Section V1/1.3.

1.1.2 Project History

In November 1989 CLP commissioned ERL (Asia) Ltd to lead a team of consultants to undertake a Site Search Study for the LTPS, based upon investigation of the following main issues:

- engineering feasibility;
- security of marine fuel supply;
- security of the transmission system;
- operational requirements;
- environmental protection;
- compatability with government planning;
- costs.

The purpose, scope and objectives of the study were agreed between CLP and the Hong Kong Government Planning, Environment and Lands Branch (PELB) which set up an interdepartmental Study Management Group (SMG) in order to:

- provide appropriate information for the consultants and advise on Government's opinions and concerns;

- monitor the progress of the study and review its findings;

- make recommendations to the Secretary for Planning, Environment and Lands at appropriate stages of the study.

The study consisted of three phases, as outlined below:

o **Phase 1: Identification of Potential Areas**; wherein possible areas for location of the LTPS were identified on the basis of adequate marine access for fuel delivery and avoidance of conflict with strategic development plans e.g. PADS. A shortlist of 9 general areas was agreed with the SMG and were taken forward to Phase 2.

- **Phase 2: Identification of Potential Sites**; during which civil engineering, transmission issues and strategic planning conflicts received more detailed attention. A shortlist of sites at the following areas:

  - Black Point;
  - Southwest Lantau;
  - Soko Islands;
  - Artificial Island area (south of Lantau);
  - Po Toi Island;

  was identified for comparative assessment in Phase 3.

- **Phase 3: Comparative Assessment of Sites**; this was undertaken emphasising environmental issues and resulted in an overall ranking of the sites and recommendations regarding site selection.

Details of the site selection process, including the sites considered, the methodology devised and the selection criteria adopted were presented in the Site Search Report[1] and the Site Search Executive Summary[2].

The study resulted in the selection of Black Point for the following reasons:

- The **Black Point** sites were assessed as acceptable on all issues, although it was noted that significant engineering and navigation issues are required to be resolved to achieve this situation.

  The Black Point site was judged to have considerable advantages over the others in the following areas:

  - the technological and environmental impact aspects of transmission lines;

  - PFA (and possibly FGD by-product) storage potential at existing Tsang Tsui Lagoons;

  - planning and amenity aspects;

  - the technological aspects of air pollution control.

- The choice of the **Artificial Island** site would have incurred an unacceptably high-risk transmission system, a significant strain on the Territory's fill resources, a delay of one year to the project programme and likely unacceptable impacts on the Territory's solid waste management strategy.

- Sites at **Po Toi** would have required the acceptance of an uproven transmission link configuration resulting in an unacceptability high-risk transmission system with a probable delay of one year to the project programme.

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1 ERL (1990) 6000MW Thermal Power Station Site Search Report. ERL (Asia) Ltd September 1990 for CLP.

2 ERL (1990) 6000MW Thermal Power Station Site Search Executive Summary ERL (Asia) Ltd September 1990 for CLP.

- The site at **Siu A Chau** would probably have involved unacceptable impacts on the Territory's solid waste management strategy and possibly unacceptable air quality impacts affecting upto 50% of the Lantau Country Parks.

- The sites at **Southwest Lantau**, although the best on security of supply grounds, were unacceptable because short-term and severe air quality impacts could not be avoided over much of western Lantau on occasions. In addition, the siting of the power station itself would have caused substantial degradation of the landscape and would have represented an unprecedented level of conflict with the Country Parks Ordinance.

The final recommendation of the Black Point site for the LTPS was, therefore, conditional upon:

- the possible need for additional emissions control at the nearby Castle Peak Power Station (CPPS) to be investigated in detail during the EIA study;

- design of the cooling water system to prevent adverse effects on Deep Bay, to the north of the site;

- agreement with the Civil Aviation Department on the compatability of the LTPS chimney stacks with the requirements of the new airport at Chek Lap Kok;

- agreement on transmission lines separate from those serving CPPS and preferably across the Castle Peak Firing Range;

- agreement on modifications to any passage practices in the Ma Wan Channel.

The findings of the Site Search Report were accepted by the SMG in August 1990 and following scrutiny bv the Development Progress Committee (DPC) were submitted for approval to the Land Development Planning Committee (LDPC). The findings were endorsed by LDPC on 7th December 1990. The location of Black Point within the Territory of Hong Kong is illustrated in Figure V1/1.1(a).

1.2 Objectives of the EIA and Initial Assessment Report

The objectives of the EIA, following identification of the (Black Point) site, were defined in the study brief and are as follows.

- to describe the characteristics of the LTPS and related facilities;

- to identify and describe the elements of the community and environment likely to affect or be affected by the LTPS including potential impacts on marine activities, obstacles in the environment from an aeronautical point of view, visibility reduction effects, updrafts caused by generation of hot air and effects on performance of radio navigational aids;

- to minimise pollution, environmental disturbance and nuisance arising from the total development and its construction, operation and decommissioning;

- to identify, predict and evaluate the net environmental impacts and the cumulative effects, including transboundary pollution, if any, expected to arise due to the construction, operation and decommissioning of the proposed development and any associated facilities;

- to identify and specify methods, measures and standards to be included in the detailed design, which are necessary to mitigate these impacts and reduce them to acceptable levels;

- to design and specify the environmental monitoring requirements for background, impact and compliance monitoring to ensure that the conditions mentioned above are met;

- to design and specify environmental audit requirements for compliance and post-project audit, which will review the data from the monitoring programme to ensure that statutory requirements, policies and standards are met and that the necessary remedial works are identified to remedy any unacceptable consequential or unforeseen environmental impacts of the works.

The structure of the study requires that this Initial Assessment Report (IAR) should:

- provide an initial assessment and evaluation of the net environmental impacts and cumulative effects of the development located at the site identified in the **Site Search Report**, including any transboundary pollution arising from the total development, sufficient to identify those issues of key concern during the construction, operating and decommissioning phases of the LTPS, which are likely to influence decisions on the LTPS;

- define measurable parameters likely to be affected by the LTPS and identify any environmental monitoring studies which are required both to provide a baseline profile of existing environmental conditions and to monitor impact and compliance during implementation, commissioning, operation and future decommissioning of the LTPS;

- provide an initial definition of environmental audit requirements for compliance and post-project audit, which shall include a review of the monitoring data both to identify compliance with regulatory requirements, policies and standards and to define any remedial works required to redress unanticipated or unacceptable consequential environmental impacts; and

- propose a detailed programme of investigation and reporting able to meet all other objectives of the assessment.

In addition, two **Key Issues** were identified at the commencement of the EIA, which required an immediate start in order to ensure completion in line with project programming. These were:

- Stack Emissions;
- Water - both cooling water and the effects of reclamations.

It is anticipated that a need for further KIRs may arise from the study and consideration of the findings of this report. The EPD have indicated that a Key Issue Report is needed on Solid By-Product Management.

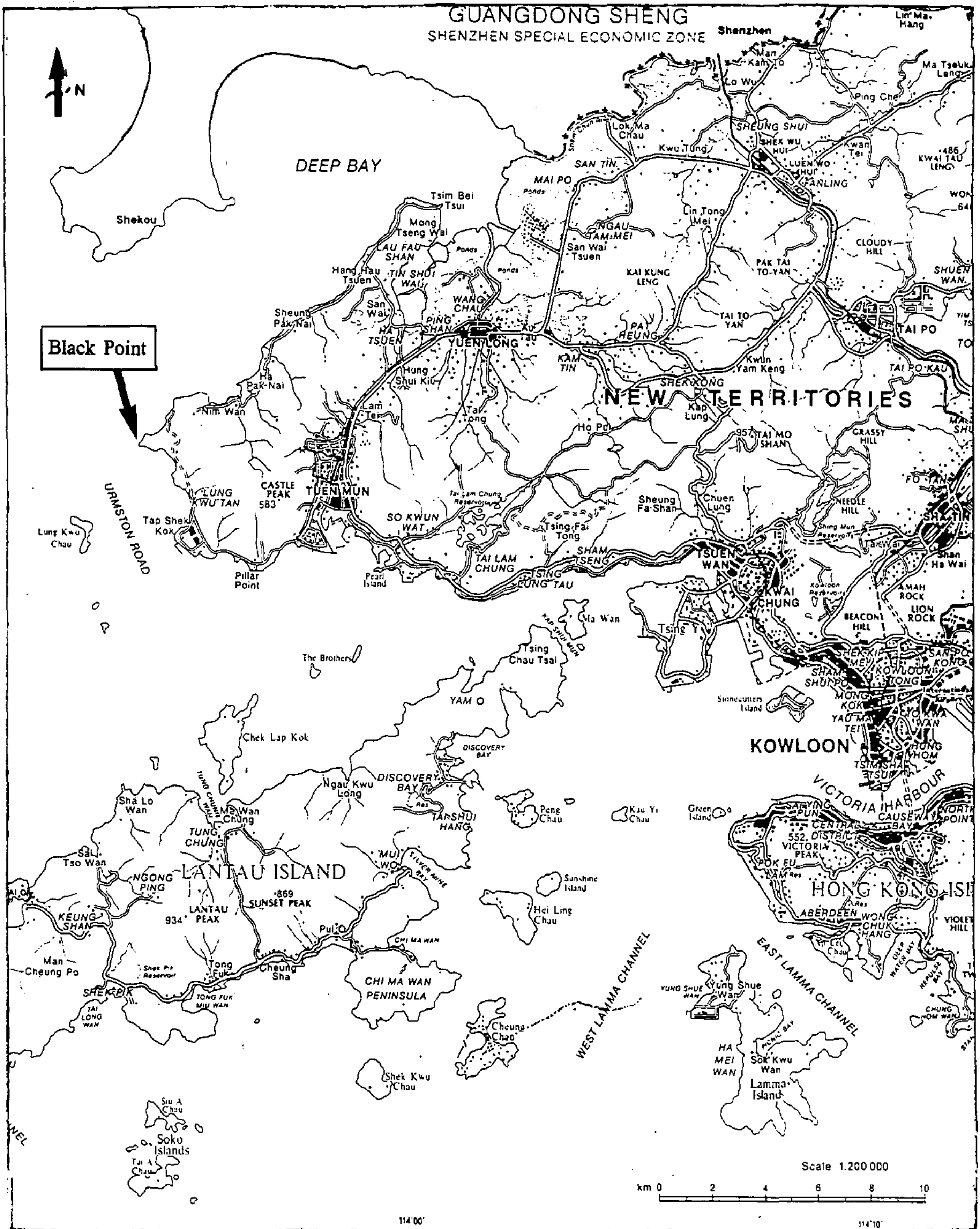

Figure V1/1.1 (a)

The Location of Black Point within the Territory of Hong Kong

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The programme of EIA study report submissions identified to date is indicated in Figure V1/1.2(a).

Figure V1/1.2(a)
Programme of EIA Study and Report Submissions

Report	1990 October	N	D	J	F	M	A	M	J	1991 J	A	S	O
IAR	●------------------------------►*												
Stack Emissions KIR	●--►*												
Water Quality KIR	●--►*												

● = start-up
* = completion

1.3 Scope of the Study

The scope of the study was outlined in the brief. The IAR presents the results of the assessment of the project and identifies a number of Key Issues which will address specific areas of impact in sufficient detail to determine their sigificance. As a consequence of the possibility that some units of the LTPS may be gas-fired it was necessary to consider the likely impacts to be associated with a firing scenario other than the coal base-case. CLP, therefore, directed ERL to consider two alternative firing scenarios, the outlines of which are presented in Table V1/1.3(a). It should be noted, however, that it is not the purpose of the EIA to compare these options on environmental grounds; gas-firing can only be undertaken if economically viable and if a secure supply can be ensured.

The IAR has considered oil firing only as an operational contingency. The effects of oil firing on a more frequent basis will be considered as part of the Stack Emissions Key Issue Assessment.

Table V1/1.3(a)
Alternative Firing Scenarios for the LTPS

Scenario	1996	97	98	99	00	01	02	03	04	05	06	07	08
		PHASE 1							PHASE 2				
I Coal	680	680			680	680		680	680			680	680
II Gas and Coal													
Gas	600	600			600	600							
Coal								680	680			680	680

All figures are Megawatts.
April commissioning assumed in each case.

The IAR addresses the following:

- **Construction**: Quantification of impacts where appropriate, assessment of the mitigation effects of proposed control measures, evaluation of effects on the existing environment, assessment in view of current statutory requirements and an evaluation of control procedures for construction of the LTPS. Discussion of impacts includes the following:

  - analysis of the method of construction and identification of potential major sources of dust and noise;

  - assessment of the impact of dust and noise producing processes, plant, vehicles and machinery on adjacent air and noise sensitive receivers;

  - consideration of the impacts of construction activities on the aquatic environment including effects of reclamation, jetty, berth, pipeline, intake, outfall and seawall construction and effects from silty runoff on water quality and circulation;

  - evaluation of the land and marine access requ. .ments, including the environmental impacts related to the movement of borrow material, dredging and maintaining marine access;

  - consideration of the impacts from construction of fuel storage facilities including impacts on the landscape character, visual impact and erosion and runoff during construction;

  - identification of the socio-economic impacts upon existing villages, cultural impacts upon places of worship and any identifyable fung shui implications; and

  - consideration of the impacts of construction activities, such as the use of tower cranes, on the aeronautical environment.

- **Operation** : For the operation of the LTPS the following were assessed for each of the two firing scenarios :

  - the cumulative impact of noise producing plant, vehicles and machinery associated with the operation of the site on adjacent noise sensitive receivers;

  - the direct and indirect enviromental impacts and cumulative effects on a local and a regional scale, due to aerial emissions from the proposed power station and associated facilities including the effects of sulphur oxides, nitrogen oxides, acid deposition, hydrocarbons, total suspended particulates, respirable suspended particulates, odour, toxic metals and chemicals, visibility and photochemical reactions, taking into account discharge and ambient standards as advised by the Director of Environmental Protection. Studies are continuing as part of the Stack Emissions Key Issue;

  - aqueous emissions (in terms of process effluents, cooling water, surface drainage, furnace bottom ash (FBA) pulverised fuel ash (PFA) and flue gas desulphurisation (FGD) wastes, leachate and on-site sewage & sullage) are identified and quantified with consideration for adequate interception, handling, treatment and disposal in order to comply with discharge and disposal guidelines approved by the Director of Environmental Protection. The necessary controls to minimise marine pollution are scoped. Studies are continuing as part of the Water Quality Key Issue;

- the effects of marine transport requirements on marine traffic, both those generated in or trading with Hong Kong and those to/from Chinese ports in the Pearl estuary, and water quality;

- transboundary pollution impacts;

- the effects of land transportation requirements on traffic congestion and road safety together with potential noise and dust impacts along proposed transportation routes;

- the disposal of any solid wastes in an integrated plant lifetime strategy, and the various possible methods of disposal and/or utilisation. Studies are continuing as part of the Solid By-products Key Issue study;

- the environmental impacts associated with the installation and operation of fuel supply and storage systems;

- visual impact of the installation;

- environmental monitoring requirements including baseline, impact and compliance monitoring;

- environmental audit requirements including compliance and post-project audit which will review the environmental monitoring data to identify compliance with regulatory requirements, policies and standards and any remedial works required to redress unacceptable consequential or unanticipated environmental impacts;

- the impact of construction activities, associated with the installation of later units, occuring concurrently with the operation of the plant.

1.4 Structure of the IAR

1.4.1 This report is organised in three volumes, as follows:

- Volume 1: The Surrounding Environment;
- Volume 2: The Construction Phase EIA;
- Volume 3: The Operational Phase EIA.

The scope of these volumes is outlined in the following sections.

1.4.2 Volume 1: The Surrounding Environment

This volume concentrates on the characteristics of the surrounding environment, describing both its present state and the manner in which it is anticipated to develop during the lifetime of the LTPS. The purpose is to define the receiving environment into which the LTPS will be placed. The lifetime of its operation and the planned development of the area are such that major changes are likely to occur. The impact of the LTPS can only be realistically assessed against an appreciation of the likely state of the surrounding environment during the project's lifetime. This volume is organised as follows:

o **Section 1**: An introduction outlining the background to the study, its scope and objectives and an indication of its outputs.

- **Section 2**: Planning and Landuse; in which relevant aspects of the existing environment are described both in their present state and in the way they are anticipated to change during the lifetime of the project.

- **Section 3**: Summary and Interpretation of Environmental Baseline Data; in which the baseline data collection programme is described and ambient air, water, sediment, noise and ecological conditions are summarised on the basis of initial site specific monitoring results and other existing relevant information. This section is supported by a presentation of data contained in the following annexes.

  - Annex V1/A – Meteorological Data
  - Annex V1/B – Air Quality Data
  - Annex V1/C – Marine Water Quality and Sediment Data
  - Annex V1/D – Groundwater Quality Data
  - Annex V1/E – Noise Environment Data
  - Annex V1/F – Terrestrial Ecology Data
  - Annex V1/G – Marine and Littoral Ecology Data

1.4.3 Volume 2: Construction Phase EIA

This volume describes the planned construction of the LTPS and predicts the likely associated impacts. Its organisation is as follows.

- **Section 1**: Introduction (as for Vol.1)

- **Section 2**: Contains a description of the proposed development including its main features, and phasing and programming details. In addition, a summary of the precise site layout development process is presented.

- **Section 3**: describes the construction activities that will be required during the course of the development, both for initial site formation and installation of the first units and for subsequent construction periods when additional units are added to the LTPS.

- **Section 4**: Describes the likely effects on Air Quality by identifying potential impact sources and sensitive receptors that may be affected; allowing prediction of likely levels of air pollution, which are assessed against existing criteria and anticipated changes in background levels.

- **Section 5**: Noise impacts are predicted, based on assumptions of the plant to be used and their associated sound power levels, together with the location of noise sensitive receivers. Likely changes in ambient noise levels are also considered and the resulting predictions are assessed against knowledge of the existing noise levels obtained from the monitoring programme and relevant criteria contained in the Noise Control Ordinance.

- **Section 6**: The impacts of construction activities on water quality will result primarily from dredging of marine sediments and the formation of reclaimed areas and the construction of the cooling water outfall and natural gas pipeline. The likely impacts associated with these activities are the subject of a detailed modelling exercise currently underway. It is expected that the result of this exercise will be presented in the Key Issue Report on Water Quality. The IAR is confined to a review of previous work undertaken in the area, together with the results of water quality and marine ecology sampling carried out for the study.

- **Section 7**: Waste disposal requirements during the construction phase are addressed in this section. Potential waste sources are identified from knowledge of construction activities and the necessary disposal arrangements are indicated.

- **Section 8**: Road and marine traffic generated by construction activity is estimated. Discussion of traffic impacts is confined in this section to severance and disturbance/nuisance effects. Air quality and noise impacts associated with site traffic are covered under Sections 4 and 5 respectively.

- **Section 9**: Both Marine and Terrestrial ecology impacts arising from construction are considered in this section. Terrestrial ecological impacts include both immediate site effects, and impacts on areas surrounding the site that may be affected by noise and dust. Marine ecology effects that may occur as a consequence of water quality impacts, will be examined via the modelling exercises in the Key Issue Report on water.

- **Section 10**: Possible impacts with regard to civil aviation are outlined in this section. Specifically, the height of construction equipment such as cranes is considered.

- **Section 11**: The socio-economic effects of plant construction are considered in this section. In particular, levels of local employment generation are considered.

- **Section 12**: The implications for cultural heritage in the area and potential Fung Shui effects are addressed in this section, on the basis of available recorded information.

- **Section 13**: Details impacts on recreation and visual amenity resulting from construction, based on preliminary plant layout.

- **Section 14**: Presents Conclusions and Recommendations.

- **Annex V2/A**: Contains a series of figures which illustrate the site development process which resulted in the present layouts.

- **Annex V2/B**: Contains Requirements for Environmental Monitoring to gauge impacts and test compliance during the Construction Phase.

- **Annex V2/C**: Considers impacts that will occur in the event that a coal conveyor is constructed between the existing CPPS and the LTPS at Black Point.

- **Annex V2/D**: Presents the current Construction Profile.

1.4.4 Volume 3: Operational Phase EIA

This volume describes the operational and decommissioning phases of the LTPS, and associated impacts. Impacts resulting from concurrent construction activities necessary for the installation of subsequent units are also detailed in this volume, which is organised as follows:

- **Section 1**: Introduction (as for Vol.1)

- **Section 2**: (as for Vol.2)

- **Section 3**: Presents an initial assessment of air quality impacts including an inventory of atmospheric emissions, identification of potentially sensitive receptors and appropriate criteria against which to identify impact significance. Alternative scenarios resulting from the two possible firing strategies are outlined. The effect of likely changes in background air quality (particularly SO_2 and NO_x) is a critical aspect of this. The air quality study will continue toward submission of a Stack Emissions Key Issue Report in October 1991.

- **Section 4**: Consideration of operational noise impacts involves an inventory of noise sources for each of the two fuel scenarios. Sensitive receivers are located and the effect upon them is modelled. These impacts are assessed against a predicted increase in background noise levels to allow impact identification and the development of mitigation proposals.

- **Section 5**: Presents the progress in the Water Quality Key Issue Studies. This proceeds from an inventory of effluent sources and likely discharges for both fuel scenarios, together with identification of sensitive receptors, to an indication of the likely effects of hydraulic changes and cooling water impacts. Consideration is given to likely changes in background concentrations when assessing the potential significance of impacts and the need for mitigation.

- **Section 6**: Solid by-product disposal requirements are predicted from an inventory of solid by-product sources and a preliminary solid by-product disposal strategy is developed. Both limestone/gypsum and seawater FGD systems are considered.

- **Section 7**: Operational road and marine traffic are predicted, the latter taking account of the two fuel scenarios. Severance and disturbance that may be associated with these movements are described. Noise and air quality impacts resulting from traffic are assessed in Sections 3 and 4 respectively.

- **Section 8**: Data outputs from the air quality study (Section V3/3) and the water quality study (Section V3/5) are used as a start point for the assessment of ecological impacts, with further input from preliminary marine and terrestrial ecological surveys. Potentially beneficial effects from proposed landscape planting and habitat provision are also considered.

- **Section 9**: Civil aviation implications, related to building heights and thermal plumes from stacks are explored.

- **Section 10**: Potential Socio-economic impacts are considered, in particular the generation of employment opportunities by LTPS development.

- **Section 11**: The cultural heritage and Fung Shui implications of the operation are assessed.

- **Section 12**: The visual impact is described, on the basis of the site location and the preliminary design layout of the plant. Zones of visual influence diagrams and montage illustrations are presented. Macro-scale mitigation potential is indicated.

- **Section 13**: This is a Risk Assessment of Scenario II concerning the supply and use of natural gas (NG) at the LTPS.

- **Section 14**: Key findings are presented, both definitive for the completed studies and preliminary for those areas of study that are the subject of Key Issue Reports.
- **Annex V3/A**: Illustrative figures of the site development process.
- **Annex V3/B**: Presents operational noise data.
- **Annex V3/C**: Investigates the likely impacts associated with the provision of a coal conveyor between the existing CPPS and LTPS.
- **Annex V3/D**: Illustrates pathways of trace elements through coal-fired units and FGD systems.
- **Annex V3/E**: Presents requirements for Environmental Monitoring to gauge impacts and test compliance during the operational phase.
- **Annex V3/F**: Indicates Environmental Audit requirements.

2. PLANNING AND LANDUSE

2.1 Strategic Development

2.1.1 Introduction

Electricity demand forecasts conducted by CLP indicate the future requirement for 6000 MW of generating capacity to be commissioned progressively between 1996 and 2008. This is partly to replace existing capacity that will be reaching the end of its operating life and partly to meet the increased demand forecast to result from Hong Kong's continued development and expansion.

2.1.2. Port and Airport Development Strategy (PADS)

The current territory population of about 5.7 million is expected to increase to the order of 6.4 million by 2001 and 6.6 million by 2011. Over this period, the numerous projects which are collectively grouped under PADS will be developed. The aim of these projects is to provide the necessary infrastructure to enhance and sustain the stability and prosperity of Hong Kong, well into the twenty–first century.

The PADS developments represent a huge undertaking for the territory and include:

- a new airport at Chek Lap Kok;
- associated road and possibly rail links to the metropolitan area, via developments on the North Lantau coast, a major fixed crossing to the mainland and the West Kowloon Reclamation;
- the Western Harbour Crossing;
- several container terminal developments; inc. Peninsula Port
- further highway linkage to Guangdong Province
- a major breakwater and new typhoon shelters in the western harbour; and
- sites for deep waterfront industries (Tuen Mun Port).

In 1997, Hong Kong will become a Special Administrative Region of the Peoples' Republic of China. The infrastructure projects planned under PADS are intended to help ensure that the future economic prosperity of the territory is guaranteed, both in terms of its status as a main gateway for southern China and as a regional base for high technology manufacturing.

2.2 Local/Sub Regional Planning–the Yuen Long/Tuen Mun District Context

2.2.1 Two main population centres are located in the general area of the LTPS site at Black Point. Significant immigration to Hong Kong from mainland China during the early 60's acted as a spur for the development of the territory's second "New Town" at Tuen Mun 7km east south east of Black Point. By the middle of that decade, the new town had been given the go–ahead, and the importance of this type of planned development to the territory's future had been recognized. The "new towns" programme faltered, however, as a result of a slowing down in the rate of population increase, and was only given fresh impetus in 1973 with the launching, by the government, of a massive housing plan to build 1.8 million individual accommodation units over a ten–year period. With foundations in place at three "new town" sites, one of which was Tuen Mun, these became the obvious places for the programme to be concentrated. With the growth in population in both the New Territories and Kowloon came growth in electricity demand and the progressive development, during the mid 80's of Castle Peak Power Station (CPPS) to 4100MW.

Further increase in housing demand prompted the decision to develop three existing market towns, one of which was Yuen Long, 13km east-north east of the Black Point site. In 1979 Yuen Long received new town status. In 1982 a decision was taken to develop a new town for 135,000 people at Tin Shui Wai, 2 km to the west of Yuen Long and 11km from the LTPS site.

2.2.2 The development history and proposed continuation of the three new towns is indicated in Table V1/2.2a.

Table V1/2.2(a)
Development of Population Centres near Black Point

Date of Designation	Tuen Mun 1965	Yuen Long 1978	Tin Shui Wai 1982
Population			
Original (approx.)	20,000	37,000	---
1981	86,400	50,600	---
1985	265,000	84,800	---
1990	389,000	133,800	5,000
1995	506,800	161,000	99,600
Ultimate	540,800	190,300	137,600

Source[1]

In summary the main centres of population in the general area of the LTPS at Black Point are:

- Approximately half a million people at **Tuen Mun**, 7 km to the east of the site.
- Over a quarter of a million people at **Yuen Long** and **Tin Shui Wai**, some 13 km distant from the site.

2.3 Conservation Policies and Environmental Strategies

2.3.1 Introduction

The Hong Kong Government's response to increasing territory-wide concern regarding the threat to the environment posed by pollution was set out in the White Paper *Pollution in Hong Kong: A Time to Act* June 1989. The document outlined a ten year plan comprising five main elements.

- planning against pollution to avoid the creation of new problems by development or redevelopment.

[1] Chiu, T.N. and So, C.L (1986) A Geography of Hong Kong (2nd Ed.) Oxford University Press Inc. New York.

- o legislation to control pollution.

- o services for collection, treatment and disposal of sewage, chemical and municipal wastes.

- o monitoring and investigation to provide a sound basis for the development of control policies and programmes and to check on their effectiveness.

- o education and public awareness to increase community involvement.

Environmental impact assessment (EIA) of major projects such as the LTPS forms a very significant part of the effort to plan against pollution. Recommendations concerning the manner in which EIAs should be carried out are contained in an EPD publication: Advice Note 2/90 "Application of the Environmental Impact Assessment Process to Major Private Sector Projects". This Note draws attention to a further two documents which have particular relevance to the LTPS at Black Point. These are:

- o Chapter 9, "Environment" of the Hong Kong Planning Standards and Guidelines[1] (HKPSG). This contains advice on the way in which the planning of developments can minimise environmental problems.

- o The Deep Bay Guidelines for Dredging Reclamation and Drainage Works[2], in and around Deep Bay. These were developed in order to standardise and speed up the EIA process for developments in this area.

Legislation, in the form of various Ordinances to protect the environment are considered in sections that follow.

2.3.2 Air Pollution Control

Controls on air pollution form part of a coordinated programme of air quality management designed to achieve and maintain levels of air quality which will protect the health and well-being of the community and environmental amenity. In the White Paper of 1989 a number of new initiatives were outlined :

- o the application of Air Quality Objectives (AQOs) to all parts of the territory by extending the patchwork of Air Control Zones.

- o prohibition of the use of high sulphur fuel oils throughout the territory.

- o a tightening of controls on dark smoke emitted from industrial chimneys.

- o a strengthening of the control and enforcement provisions of the Air Pollution Control Ordinance;

- o the development and implementation of a comprehensive new motor vehicle emission control strategy; and

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1 Planning Department: Hong Kong Planning Standards and Guidelines 1990.

2 The Deep Bay Guidelines for Dredging, Reclamation and Drainage Works for EPD by ERL (Asia) Ltd 1990.

- declaration of the Ozone Layer Protection Ordinance.

The main legislation controlling emissions from industrial sources is the Air Pollution Control Ordinance Cap. 311 (1983). This Ordinance enforces regulations which require industry to abate the emissions of air pollutants that may give rise to nuisance and to seek prior approval from the DEP where fuel burning equipment is being installed or modified. Major emitters, such as power stations are classified as "Specified Processes" and are controlled by individual license. The LTPS at Black Point will require such a license which will be granted providing that the plant complies with all relevant legislation. In addition, it is necessary that the plant be designed to comply with DEP's stated policy of "Best Practicable Means" (BPM) for reducing air pollution. DEP's position on BPM for the LTPS is that of 1% sulphur content coal, with 90% removal of sulphur dioxide (SO_2) from the flue gases, together with a 330 ppm limit on NO_x emission and a 50 mg/m^3 limit for particulates.

A removal efficiency of 90% for SO_2 implies the need to fit one of the higher efficiency flue-gas desulphurisation (FGD) systems, for example the limestone/gypsum process. The consequence of using this method of control, however, would be the production of large quantities of gypsum by-product, for which a market or a suitable disposal method must be found. In the event that the by-product disposal problem appears intractable, DEP has stated that the acceptability of using an alternative FGD system, one with a lower removal efficiency but producing no significant by-product quantities, would be considered. It would have to be demonstrated, however, that the AQO could be met with the lower removal efficiency.

The AQO and controls are presented in V2/4.4 and V3/3.4.

Other major areas of control relate to emissions from motor vehicles which contribute significantly to the level of NO_x and particulates, and measures to reduce effects on the ozone layer.

2.3.3 Water Pollution Control

A number of objectives exist for the management of the territory's water quality :

- to achieve and maintain the quality of inshore waters so that they can be beneficially used for their legitimate purposes;

- to provide adequate public sewerage to accept existing and proposed wastewater discharges.

- to provide adequate treatment and disposal for all wastewaters to ensure water quality objectives will be achieved and maintained.

- to enact and enforce legislation to safeguard the health of the community from adverse effects associated with the discharge of toxic chemicals, bacteria and pathogens.

The main item of water quality legislation is the Water Pollution Control Ordinance Cap. 358 (1980) which enables the establishment of Water Control Zones, within which specified categories of effluent may be controlled. Under this ordinance, the territory's waters have been delineated into ten Water Control Zones. To date, six Water Control Zones have been declared:

- Tolo Harbour and Channel;
- Southern Waters;
- Port Shelter;

- Junk Bay;
- Mirs Bay;
- Deep Bay.

The remaining zones are due to be declared. Of these, there is one zone relevant to the Black Point site; North Western Waters which is due to be declared in 1991. It will, therefore, be in force at the time construction at the site commences.

The purpose of these zones is to achieve and maintain a level of water quality which allows a number of beneficial uses (BUs) to be enjoyed. BUs were identified during the Sewage Strategy Study[1] and each have associated water quality objectives (WQO). Examples of these include :

- o *BU3 – As a habitat for Marine Life:* WQO aim to maintain marine resources regardless of their value as an exploitable resource.

- o *BU7 – Navigation and Shipping :* WQO to ensure the free movement of all vessels.

For each BU in each Water Control Zone, a number of WQO are developed to ensure water quality.

The WQO for the Deep Bay WPC2 were gazetted[2] in November 1990 and are presented in V2/6.4 and V3/5.4. The WQO for North Western Waters were not gazetted at the time of writing but are expected to be in 1991.

In order to assist in the maintenance of the WQO, current exemptions under the Water Pollution Control Ordinance will be replaced by a right to a license to discharge effluent under controlled conditions. The conditions are now listed in a Technical Memorandum[3] recently published by the Government. This document contains, for each Water Control Zone, and for each discharge within a given size range, a list of physico-chemical and biological standards which should be achieved. The volumetric discharge of cooling water from the LTPS will be far in excess of the flow rate ranges specified in the Technical Memorandum. In such cases, specific license conditions will be agreed between the project proponent and the EPD.

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1 Watson Hawksley, ERL (Asia) et al (1989) Sewage Strategy Study Appendices Part 1

2 Water Pollution Control Ordinance. Statement of Water Quality Objectives (Deep Bay Water Control Zone) HK Government November 1990.

3 EPD (1990) Technical Memorandum "Standards for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters (WPCO. Cap.358. 5.21) HK Government. November 1990

2.3.4 Waste Control

The statutory waste management framework is provided by the Waste Disposal Ordinance (WDO) Cap. 354 (1980), which contains licensing provisions to control environmental conditions at waste treatment and disposal facilities. A recent document[4] indicates the strategies that will be adopted towards dealing with various types of waste. Of these, the following are particularly relevant to the LTPS :

- *Pulverised Fuel Ash and Furnace Bottom Ash* should be sold for re-use or lagooned; the possibility of their use for reclamation or land restoration is acknowledged, pending further investigation.

- *Chemical Wastes* should be codisposed at landfill where possible. If this is not possible, disposal should be at a purpose-built chemical waste treatment centre (CWTC). The choice will be controlled by Regulations under the WDO. The Centre is being built and is to be commissioned in 1992.

It is further intended that a licensing system will be established in WDO Regulations for the collection and transportation of chemical and difficult wastes. In practice it is envisaged tha· the CWTC contractor (now appointed) will be the principle licensee to begin with.

For those waste arisings from marine vessels, Annex IV and V of the MARPOL convention require that waste reception facilities are made available.

2.3.5 Noise Control

Environmental noise in Hong Kong is controlled by the Noise Control Ordinance (NCO) Cap. 400 (1989). The purpose of measures to control environmental noise is to limit the exposure of the population to noise so that annoyance is minimised and basic activities such as sleep, conversation, work and recreation can continue unhindered. Noise control measures are affected by regulating the design, operation and location of noise sources and by reducing the exposure or sensitivity of receiving areas. These goals are achieved by a combination of the following :

- advice on noise implications of planning and development proposals.
- development of strategies, policies and technical standards for the control of noise; and
- control, via the implementation and enforcement of legislation.

In 1989, the main provisions of the Noise Control Ordinance concerning construction, neighbourhood and industrial noise came into operation. Of most relevance to the LTPS at Black Point are measures to control construction noise. This is divided into two types, depending on source :

- *Construction Noise: Powered Mechanical Equipment:* A permit is required to operate such plant between the hours of 7pm and 7am or on public holidays, and will only be granted if it is established that this will not significantly affect noise sensitive receivers (NSR). Noise from this source is controlled by provisions of the Technical

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4 EPD (1989) Waste Disposal Plan for Hong Kong. Planning, Environment and Lands Branch HK Government December 1989.

Memorandum on noise from construction work other than Percussive Piling[2]. This document defines the method to be employed in determining noise levels from this activity. It also defines acceptable noise levels (ANL) for neighbourhoods of a given character.

- *Construction Noise: Percussive Piling Work:* This activity is prohibited during the period 7pm to 7am and on Public holidays. At other times the permissible duration is controlled via a permit system. The Technical Memorandum on noise from Percussive Piling[1] defines the method for determining the permitted hours of operation for this activity.

Other criteria are relevant when considering the potential impacts of operational noise. HKPSG Chapter 9 refers to the Technical Memorandum for the Assessment of Noise from Places Other Than Domestic Premises, Public Places or Construction Sites, published under the NCO. Statutory Acceptable Noise Levels (ANL) are specified. In addition, however, it is stated that the level of noise at the facade of the nearest NSR should be either at least 5 dB(A) below the appropriate ANL shown in Table 3 of the TM, or in the case of background being 5 dB(A) lower than the ANL, the noise level should not be higher than the background.

Further guidance is given in HKPSG Chapter 9 regarding developments in rural areas. It is noted that as a general rule, any noise emitters introducing a fairly consistent excess of 10 dB(A) above the prevailing background should be avoided. Therefore, a daytime noise criteria of 70 dB(A) can be adopted (see Section 5.4.1). If unavoidable, then the noise emitter should incorporate any available design mitigation measures. It is interesting to note that whilst the initial phase of the LTPS will be introduced into a predominantly rural environment, the later phase may be developed against a background of on-going PADS-related activity where provisions designed to preserve "the existing tranquil environment" will not apply.

2.3.6 Amenity and Conservation

The protection of landscape, visual amenity and recreational resources in rural areas is assured under the Country Parks Ordinance Cap. 208 (1986). Development within parks is controlled by the Country Parks Authority and no new development can proceed without approval. Under the Ordinance, "Special Areas" of Crown Land may be gazetted to safeguard botanical, zoological, landscape or historical significance. The Black Point site lies well outside the Country Parks area and is thus not covered by such controls. This was a significant factor in the selection of the Black Point site.

At present there are no statutory controls on planning in other rural areas. It is understood, however, that a recent amendment to the Town Planning Ordinance provides for controls on planning for the whole of the territory. At the time of writing no detailed plans are available, but it is believed that the landuses intended for Black Point will be consistent with the existing planning guidelines and concept plans. The Site Search Steering Group accepted that use of Black Point for the LTPS was consistent with the Deep Waterfront Industry planning designation for the area under PADS. The latest plan indicates that the Black Point area is not a special area for conservation and recreational development.

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2 EPD - Technical Memorandum on Noise Generated from Construction Work other than Percussive Piling. HK Government 1989.

1 EPD - Technical Memorandum on Noise Generated from Percussive Piling. HK Government 1989

Chapter 9 of the Hong Kong Planning Standards and Guidelines contains principles which should be observed by developments. These are of a general nature and suggest that consideration should be given to visual impact and appropriate landscape treatment.

Other guidelines are presented covering, inter alia:

- the conservation, where possible, of "suitable" farmland, based on the advice of AFD.
- the need to consider freshwater fish culture and marine fishery resources.
- the need to preserve, where possible, potential recreational areas.
- the form which developments should take, including:
  - topography and site layout;
  - retention of existing vegetation; and
  - building design and landscape treatment.

The site location and layout development process has taken these very much into account.

2.3.7 Deep Bay

About 10 km to the north-east of the Black Point site is the entrance of the Shenzen River into Deep Bay, an internationally recognized conservation site for water fowl and other birds. Active management of land and habitats is practiced at Mai Po Marshes by the World Wide Fund for Nature and at the Fu Tien Nature Reserve in the Shenzen Special Economic Zone (SSEZ). The area meets the criteria laid down by both the Ramsar Convention on Wetland of International Importance and the Bonn Convention on the Conservation of Migratory Fauna for habitats worthy of conservation, both of which Hong Kong is a party to. However the area is not designated under either Convention. Although some parts of the Hong Kong side have been designated as sites of Special Scientific Interest (SSSI) this is no guarantee against development. The eastern shore of Deep Bay, from Ha Pak Nai northeastwards is designated a Mariculture Subzone under the Deep Bay Water Quality Objectives, with specified minimum levels of dissolved oxygen and maximum levels of E. Coli. The nearest part of the subzone to the edge of the proposed LTPS is a distance of just under 3km.

- *Birds*

  The importance of the area for birds lies in a combination of the numbers that visit the site, the diversity of species (over 250 have been observed), the recording of seven rare or endangered species and its position on the East Asian-Australian migration route.

- *Habitats*

  A number of estuarine habitats are important in their own right as well as providing habitats for visiting birds and other wildlife. These include intertidal mud flats, which extend southwest from inner Deep Bay to Tai Shui Hang, some 3.5km northeast of Black Point, and mangroves.

o *Fisheries and Shellfisheries*

There is a fisheries and shell fisheries operation which includes the following:

- Oyster cultivation, involving production of some 200–240 tonnes per year (HK production). The nearest beds are over 3km from the tip of Black Point.

- Freshwater fishponds around the Deep Bay coastline which account for approximately 10% of Hong Kong consumption.

- Shrimp Ponds; Deep Bay is the only remaining area where Gei Wais (tidally filled shrimp ponds) are still farmed in Hong Kong, although their importance rests more as a habitat than in volume of commercial production.

o *Conservation Status*; the significant sites of conservation interest are:

- Inner Deep Bay SSSI

- Fu Tien Nature Reserve

- Mai Po Marshes SSSI

- Tsim Bei Tsui SSSI, designated for its mature mangrove community and the occurrence of a locally rare mangrove species.

- Mai Po Egretry SSSI, a fung shui woodland where several hundred egrets and herons nest.

- Pak Nai SSSI, a sandpit used as a high tide roost site by gulls and terns.

A recent study[1] identified three major threats to the unique collection of habitats in Deep Bay. These are:

o the loss of habitat areas to development and disturbance to fringe areas from construction and operation activities.

o the deterioration of water quality in the Bay; and

o contamination of sediments as a result of pollutant loads via rivers and direct discharges into the Bay.

The last item currently results mostly from organic waste from sewage and livestock, but toxic metals and other effluents from industry are of increasing concern. The findings of the study indicated that unless rapid steps are taken to reduce water pollution and limit habitat loss the environmental significance of the Bay area will be greatly jeopardised and its international status as a conservation site for birds may be lost.

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1 ERL (Asia) Limited 1988 Deep Bay Integrated Environmental Management. Final Report.

Against this background the importance of water quality modelling and appropriate outfall design to ensure that Deep Bay marine ecology is not significantly affected by the LTPS development is clear, and will be addressed in full in the Key Issue Report on Water Quality. An initial assessment is provided in this IAR.

2.4 Civil Aviation

The approaches to Hong Kong's present international airport at Kai Tak, and its proposed replacement at Chep Lap Kok are maintained by a series of "obstacle limitation surfaces", which decrease in altitude with decreasing distance from the airport; structures may not project above these surfaces without the agreement of the Civil Aviation Department (CAD). Due to the highly variable topography of Hong Kong, these surfaces in places approach the height of the terrain on which they are superimposed, and so structures which project above an obstacle limitation surface, but which could be considered as being an extension to, or shielded by, an existing topographic feature may under certain circumstances, be permitted by the CAD.

Since the LTPS site lies within the boundary of the 155m altitude obstacle limitation surface for the proposed Chep Lap Kok airport, and approximately 2 km to the west of a range of 300–400 m hills, the compatability of the LTPS stack heights and the obstacle limitation surface is being assessed in consultation with the New Airport Masterplan Study consultants and the CAD. The possibility of the exhaust gases from the LTPS affecting aircraft operations is similarly under investigation as part of the Air Quality Key Issue Assessment.

2.5 Gazetted Marine Borrow and Dump Areas

In the area of Black Point, the seabed of Urmston Road and Deep Bay is subject to a number of gazettals, for the purposes of marine borrow areas. The relevance of the gazettals to the LTPS development lies in the fact that a number of the features of the LTPS may interact with the gazetted areas. The cooling water intake or outfall, the jetty (if required) or the marine access channel may be located in part in gazetted areas.

The boundaries of the gazetted areas are indicated on Figure V1/2.5(a). In order for material to be removed from the seabed, an area must first be gazetted. This publicises the intention to remove material and provides for a formal means of objection to any intention. Once gazetted for either marine borrow or dumping there is a presumption against any other use or development of that part of the seabed.

2.6 Topography and Landscape

2.6.1 The extent of the receiving environment that requires consideration is determined by the potential for significant impacts to occur. With regard to topography and landscape, the potential for air quality impact requires that areas relatively remote from the site also be considered. The description of the topography and landscape that follows, therefore, has been divided into far field descriptions of the north west New Territories as a whole, the Firing Range area to the east of the site, and the coastal fringe.

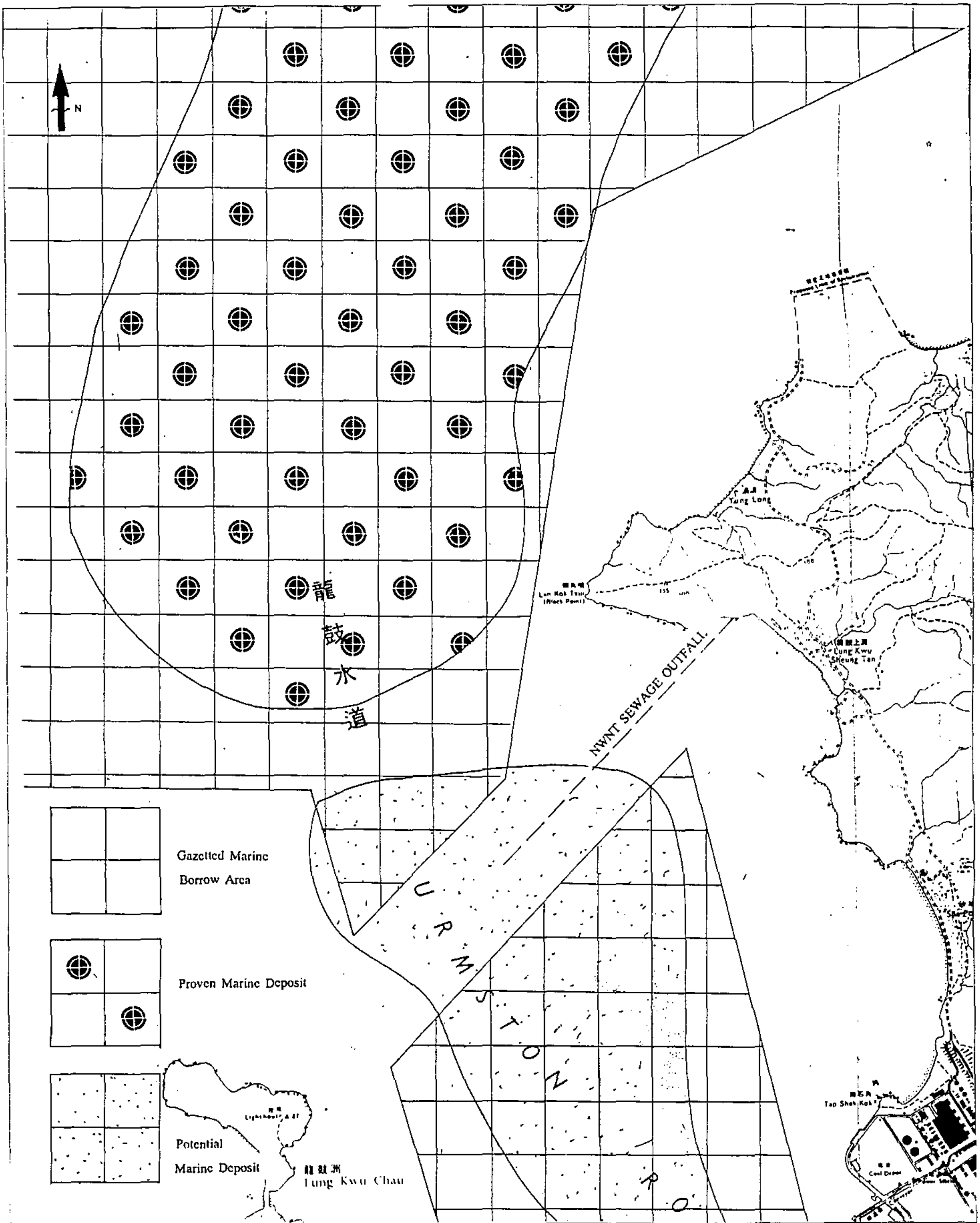


Figure V1/2.5 (a)

Gazetted Marine Borrow Areas adjacent to the LTPS site

ERL (Asia) Ltd.

11th Floor, Hecny Tower
9 Chatham Road,
Tsimshatsui,
Kowloon, HONG KONG

ERL

2.6.2 North West New Territories

The North West New Territories can be divided into the northern and southern areas:

- *Northern Area:* This is an area of flat land, dominated by the main towns of Yuen Long, Kam Tin, Shek Kong and Lau Fau Shan. The rock types are mainly granite and other volcanic rocks, with colluvium and extensive alluvial deposits also present at the footslopes of Tai Mo Shan, Shek Kong, Castle Peak valley, the Yuen Long area and the Mai Po and San Tin coastal plain areas. The landform gives rise to poor drainage and many areas regularly experience flooding. Extensive works are in train by Drainage Dept. to alleviate this flooding.
- *Southern Area:* This comprises the coastal area and the dissected plateau area around Tuen Mun. The Tai Lam Country Park, the western peaks of which commonly top 400m and in some cases 500m, dominates the southern area. Within the Park the Tai Lam Chung Reservoir lies 12km to the east of Black Point. Tuen Mun is a major urban centre, to the west of which lies the Castle Peak firing range, where the immediate topographical vicinity of the site can be considered to start.

2.6.3 Castle Peak range

Eastwards from the tip of Black Point, the land rises to a peak of 135m. The ridge then descends to a low point of 40m and the line of the coastal road. Further inland the land rises to peaks of over 200m and in some cases, as at Grid ref. 49QHQ013802 about 2.5km ESE of the site, to 310m. An area of some 12km^2 immediately eastwards of Black Point consists of this hilly ground, with steep valleys cut into the plateau. Except at the coastal fringes of this area the drainage is predominantly northwards. Virtually the whole of the area is designated as Castle Peak Firing Range, and as such no active management of the area is practiced (see Section V1/2.17). The area is traversed by many footpaths, most of which follow the line of streams.

2.6.4 Black Point Coastline

The coastal fringe is described here in a clockwise direction from the western edge of Tuen Mun, via the existing Castle Peak Power Station (CPPS) and Black Point itself up to the coastal settlements of Ha Pak Nai and Ngau Hom Sha (see also Figure V1/2.6(a)).

- *Butterfly Estate to Tap Shek Kok:* Westwards from the reclaimed land on which Butterfly Estate and Melody Garden stand, the Lung Mun Road follows the line of the coast round to the CPPS. At Shek Kok Tsui, the slopes of the hills are wooded, but after about 0.5 km the slopes of the hills to the north of the road are degraded by a patchwork of quarries and temporary uses upto a height of about 200m. A double line of electricity pylons that carry the CPPS output runs along the coastal slope at a height of about 100m.

  Just south east of the CPPS is a cement works. Behind both plants a massive rock cut slope rises to over 100m, faced locally in concrete.

  On the seaward side of the road is a line of reclamations supporting various industrial premises (mainly empty container storage at present) up to the Pillar Point sewage screening plant and pumping station. Between Pillar Point and the cement works is a bay with a sandy beach (This is Area 38).

- *Castle Peak Power Station to Black Point:* Northwards from CPPS the road continues inland from a beach and past the settlements of Lung Tsai, Tuk Mei Chung, Sha Po Kong, Nam Long and Pak Long which lie within or close to a cultivated area about 600m by 250m, inland of which are some small patches of woodland. This area lies some 2.5km south-west of the tip of Black Point. Northwards, the road leaves the line of the coast to pass inland of a rocky spur which is wooded on the seaward side. The road then rejoins the coast to pass through another cultivated area and the settlement of Lung Kwu Sheung Tan. The coastal slopes along this section are, for the most part, undisturbed and descend, over a distance of approximately 1km from a height of about 200m, to sea level. Every two or three hundred metres a stream runs down to the coast.

- *Black Point:* The point itself extends nearly 1km out from the general line of the coast. Its highest point is 135m, some 300m eastwards from the tip and boulders line the shore on both the north and southside.

- *Black Point to Tsang Kok:* North-east of Black Point lies the settlement of Yung Long, set in an area of cultivation inland from a sandy beach about 500m in length. The coastline then becomes rocky once more, before the Tsang Tsui Ash Lagoons are encountered. These extend seawards about 400m from the natural line of the coast and for a distance of about 800 metres. At the western limit of the lagoons the track finishes. At Tsang Tsui the western-most extent of the Nim Wan road is met. This follows the line of the coast to Tsang Kok.

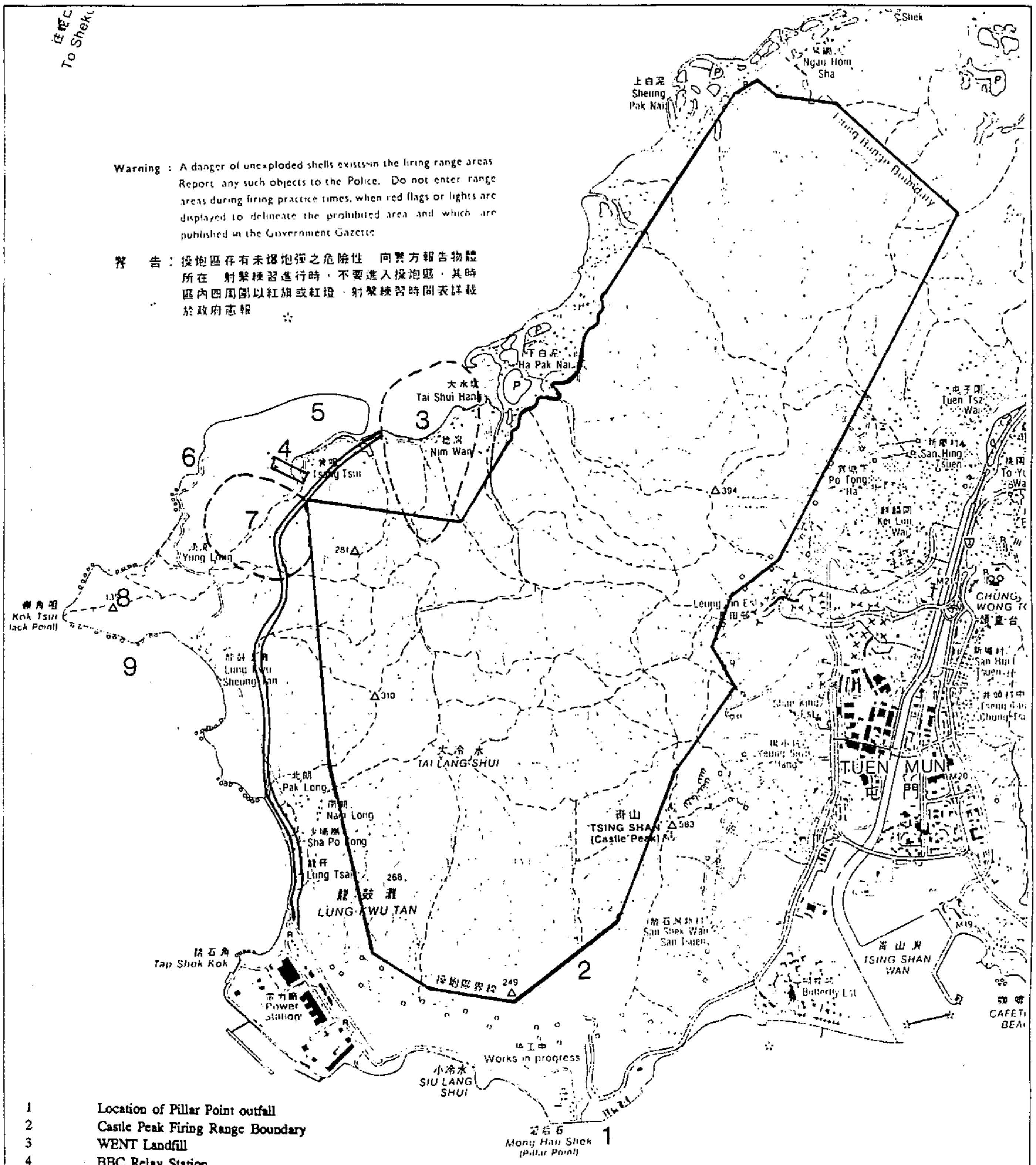
- *Tsang Kok to Ngau Hom Sha:* North-eastwards from Tsang Kok, the coastline changes noticeably from what has previously been described. A coastal fringe of up to 800m width extends the length of this section. It is characterised by a mixture of woodland, cultivated areas and ponds and, at the shore, the mudflats which extend up Deep Bay. Settlement is sparse but virtually continuous along this section of coast, the named settlements being Nim Wan, Ha Pak Nai, Sheung Pak Nai and Ngau Hom Sha.

2.6.5 Development of the Coastal Fringe

Under PADS, as it is proposed, the appearance of the coast from Tuen Mun round to Pak Nai will change completely. As indicated in Figure V1/2.6(b) reclamations will be formed to provide; areas for a river trade terminal, a private cargo working area, a port development and other deep waterfront industry. The first stage of this development will be from Pillar Point to the cement works, this is the Area 38 Reclamation (approx 100 ha). This will be followed by the Tap Shek Kok to Black Point Reclamation (approx 350 ha). This would possibly be followed by a reclamation from Black Point to the Ash Lagoons for industry. In consequence the whole nature of the coastline will change from essentially rural, to heavy industrial. The proposed LTPS will thus fit logically into this planning context.

2.7 Human Settlement/Communities

2.7.1 As indicated in V1/2.6, the human habitation in the area, once west of Tuen Mun, is confined to small coastal settlements. On the westward facing part of the coast these are found on flat alluvial deposits between headland areas. The northwestern-facing coast supports a virtually uninterrupted band of settlement from Tsang Tsui onwards. The official populations of these areas are indicated in Table V1/2.7(a). It has been noted during the course of the study, however, that the actual number of permanent residents in some villages may be smaller.



1 Location of Pillar Point outfall
2 Castle Peak Firing Range Boundary
3 WENT Landfill
4 BBC Relay Station
5 Tsang Tsui Ash Lagoons
6 Location of Borrow Area Jetty
7 Borrow Area
8 Location of Vessel Tracking Station
9 Location of NWNT Outfall
══ Southern Access Road

Figure V1/2.6(a) Black Point Area Infrastructure Plan

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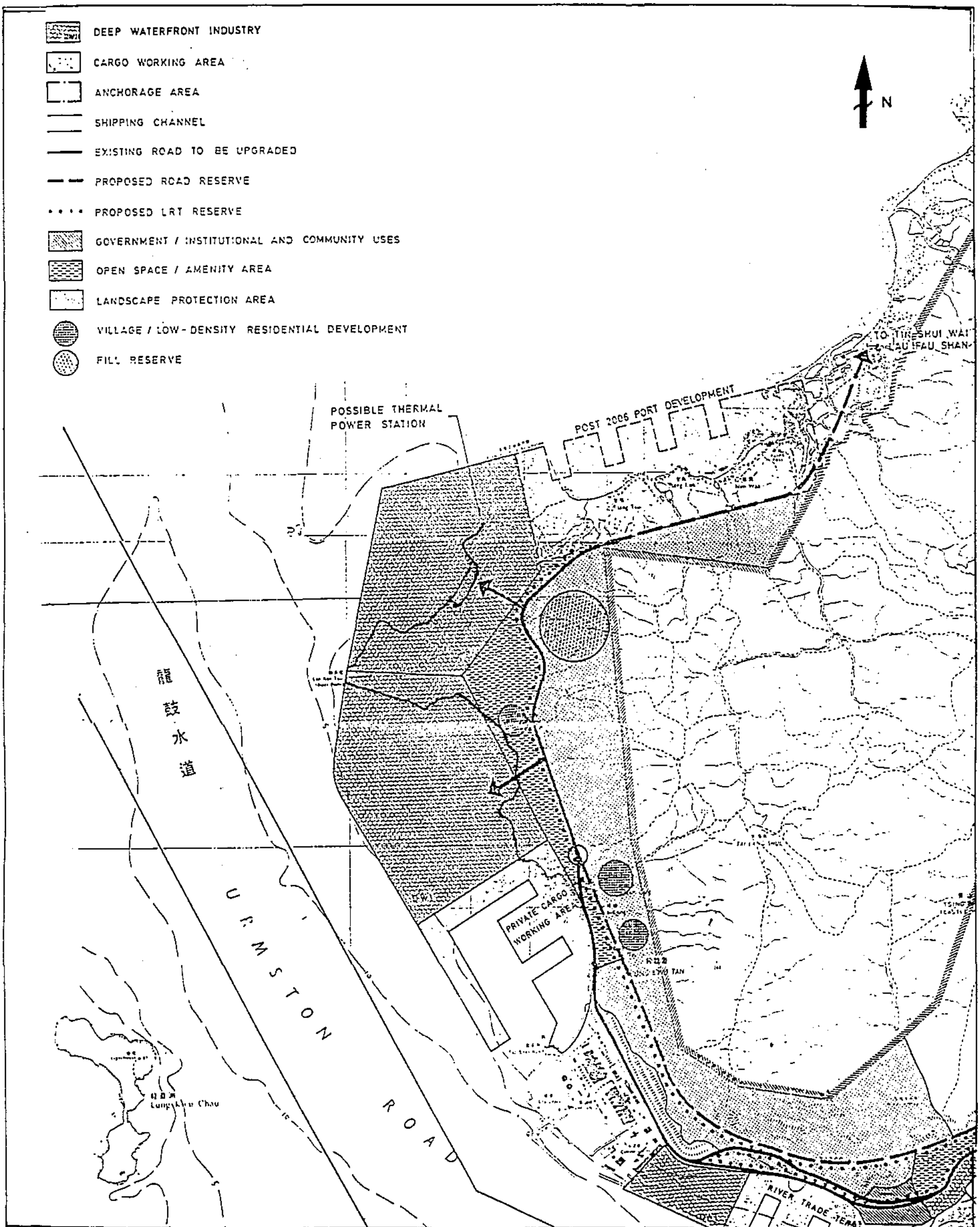

Figure V1/2.6(b)

Proposed PADS developments in the area west of Tuen Mun

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Table V1/2.7(a)
Coastal Population in the Black Point area

Settlement	Population (as at 1990)
Lung Tsai	55
Sha Po Kong	350
Nam Long	136
Pak Long	247
Lung Kwu Sheung Tan	65
Yung Long	3
Tsang Tsui, Tsang Kok	9
Nim Wan, Tai Shui Hang	200
Ha Pak Nai	710
Sheung Pak Nai	470
Ngau Hom Sha	100
Total	**2345**
Inland of the coastal fringe the area is uninhabited.	
Source: Tuen Mun and Yuen Long District Planning Office Feb 1991.	

The LTPS development will require displacement of the three residents of Yung Long.

2.7.2 Population Development

The Concept Plan for the area restricts development to industrial and port uses. Residential development has its western limit at Butterfly Estate and Melody Garden in Area 28, Tuen Mun. Some residential development (19,300 persons) is planned, however, in Area 45C, to the west of Pak Kok Temporary Housing Area (THA). Close to the LTPS site only natural growth of the villages at Lung Kwu Tan and Lung Kwu Sheung Tan would be permitted. This is not expected to increase present numbers significantly. The Yung Long settlement (population 3) would require relocation for the LTPS to proceed. The settlement of Lung Kwu Tan and Lung Kwu Sheung Tan would not require relocation for the LTPS but might well do for the PADS Reclamation from Tap Shek Kok to Black Point. From the Area 38 Development Plan it can be seen that to develop a reclaimed area for port and industrial uses the immediate hinterland requires land for back-up areas, roads and utilities and possibly an extension of the LRT. The continued presence of these villages could well prove a considerable constraint to the production of a viable Development Plan. Also the environmental impact of the construction and operation of the PADS Reclamation on those villages would be severe.

2.8 Land Traffic and Transport System

2.8.1 At present, the Lung Mun Road is a Trunk Road as far as Castle Peak Power Station. Beyond there the road becomes a single carriageway until the settlement of Pak Long. Thereafter it is unmetalled and only passable to appropriately equipped vehicles. The road continues in this form to the western limit of the Tsang Tsui Ash Lagoons. From Tsang Tsui village northeastwards, a single track metalled road continues towards Lau Fau Shan, with occasional branches. Traffic along this section is light, being only what is required to serve these agricultural communities. There is also military traffic to the Firing Range. Along the south coast, site traffic to CPPS and the cement works is light but there is very heavy lorry traffic to the empty container storage sites presently located at the western end of Area 38. These will go when Area 38 development begins.

The southern access road to the WENT landfill is currently under construction and will constitute a significant improvement to road links to Black Point.

2.8.2 If the proposed PADS developments proceed the whole road network around the coast will require significantly upgrading. As shown in Figure V1/2.6(a) the existing road will require improvement. Under the PADS study a proposed dual 3-lane carriageway is identified. Light rail transport links may also be extended westward from Tuen Mun. Heavy vehicles will form a significant proportion of total traffic, gaining access to the Western New Territories Landfill site and deep water front industries. Plans for road developments in this area exist only at the conceptual level. The Planning Department will be letting a consultancy study soon to determine projected traffic flows and road requirements for the area.

2.9 Marine traffic

Marine Traffic in the Black Point area is constrained by the Ma Wan channel capacity. This has been estimated as part of the Ma Wan Channel Improvement Study[1]. Table V1/2.9(a) indicates estimated capacity traffic and the traffic forecast for the year 2006, for ocean going vessels.

Table V1/2.9(a)
Estimated Capacity of the Ma Wan Channel

Ship Class (dwt)	Estimated Capacity	Traffic forecast (2006)
A (80,001 to 120,000)	1,170	198
B (30,001 to 80,000)	1,365	1,143
C (15,001 to 30,000)	15,600	5,034
D (300 to 15,000)	3,510	10,826
	21,645	17,192

It can be seen that forecast traffic levels are within the estimated capacity of the channel, and in particular there is considerable spare capacity within the tidal slot assigned to the largest classes of vessels into which most coal carrying vessels fall.

1 Mott MacDonald (HK) Ltd, ERL (Asia) Limited et al (1991) Ma Wan Channel Improvement Study for CESD.

2.10 Industrial Facilities

Although part of the coastal fringe from west Tuen Mun round to Tai Shui Hang remains rural; the industrial premises up to Pillar Point, the Area 38 development, the Cement Works, CPPS, Tsang Tsui Ash Lagoons, BBC Relay Station, the WENT landfill site and the Southern Access Road have done much to change that.

Future industrial developments have been mentioned in proceeding sections. Under PADS there will be port and berthing facilities along the entire stretch of coastline, together with back-up facilities in the hinterland. The character of the area will be comprehensively changed to industrial and port related.

2.11 Agriculture

Very little of the area, including the Firing Range, is cultivated. The areas of cultivation are exclusively coastal and associated with village settlements. In particular, the area of coast from Tai Shui Hang north-eastwards is dominated by fishpond aquaculture. This is designated as an Agricultural Priority Area and as such it is likely that some effort will be made to promote production in this area. This is particularly the case given the background of declining fishpond areas as a result of urbanisation in the north-west New Territories, in particular at Tin Shui Wai. The production of fresh water fish will potentially be the hardest hit by urban development in the north west New Territories area.

Agriculture is the main source of employment for the small number of people living in the area. Although planned developments will greatly increase the size of the work force, the jobs created will be of a different nature. Consequently, it is likely that people currently dependant on agriculture for a living will move from the area if their land is developed, and will be replaced by newcomers to the area who will work in the new industries. The LTPS will have no significant influence or impact on this process however.

2.12 Fisheries

Information provided by Agriculture and Fisheries Department (Table V1/2.12(a)) indicate the level of fisheries production in the area.

Table V1/2.12(a)
Fisheries Production in the Deep Bay Area

	Tuen Mun	Lau Fan Shan	San Pui Chung	Total
by weight (tonne)	43.4	38.0	44.0	112.7
by value (million HK$)	1.67	1.57	1.03	4.27

Total fishery production in Hong Kong in 1990 was 178,640 tonnes, so that Deep Bay production amounts to 0.06 per cent of the total.

During the course of site visits, trawling activities were recorded in the area. The results of the first season of marine ecological monitoring indicate that a number of species of commercial value such as shrimps and crabs may be caught in the area.

The mariculture subzone of Deep Bay Water Control Zone was designated in order to protect the oyster beds. The closest oyster beds to the proposed LTPS site occur at a distance of just under 3km. In the opposite direction, eastwards along Urmston Road, the Ma Wan Fish Culture Zones are approximately 20km from Black Point.

2.13 Recreation

Some informal recreation occurs in the Black Point area, specifically at Yung Long beach where a small canoe and sailboarding facility is located. Associated with these activities, the area near the beach is used for barbecuing during the summer months. The residents of the one remaining property in the village run an informal "bar". Whilst not a gazetted bathing beach the area is delineated as the "Yung Long Bathing Beach Subzone" in the Statement of Water Quality Objectives for the Deep Bay Water Control Zone. The numbers of people using the beach are unavailable, but, the condition of the access road suggests that the beach is unlikely to be used by large number of people. This local recreational resource will be lost by development of the LTPS.

Under the Tuen Mun New Town Western Extension Area Planning Guide (as at 1985) Yung Long beach and the immediate inland area was identified for a proposed outdoor recreation centre. Black Point itself was intended for footpaths, camp sites and picnic areas. Similarly, Lung Kwu Sheung Tan was intended for beach recreation and recreation orientated development. These plans had no statutory effect, but were rather intended as a guide for land transactions. Since PADS, the whole nature of planning for the area has changed, although outline zoning indicates that the area surrounding Lung Kwu Sheung Tan should be retained as an open space/amenity area. Eastwards, the slopes of the Castle Peak range are indicated as a landscape protection area.

2.14 Cultural Heritage and Fung Shui

2.14.1 Archaeological Resources

The Antiquities and Monuments Office (AMO) has identified two sites in the Black Point area which warrant the designation of Sites of Special Archaeological Interest (SSAI). The known and anticipated resources of these sites are outlined in Figure 2.14(a) and are considered below:

o **Yung Long**: This site lies to the north of Black Point, occupying the beach, the area immediately inland and the tidal zone. The area of particular interest is a raised platform of decomposed granite some 200m by 30m which lies to the north-east of the area. The site is believed to be late Neolithic/Early Bronze Age and to have been a pottery kiln site. The site is described as having excellent accessibility and among the artefacts found have been soft geometric shards, kiln furniture and polished stone tools. A subsurface investigation was carried out in late 1984, using two exploratory trenches, and confirmed the presence of an in-situ single component archaeological deposit either resting close to or cut into the surface of the rock marine terrace. A prehistoric pottery kiln was partially excavated. The site was further investigated by Mr Brian Peacock during 1985-1986, in a study funded by China Light and Power Co. Ltd., which produced further finds. It is considered by the AMO to have "outstanding" significance because:

  - it has in-situ archaeological deposits;

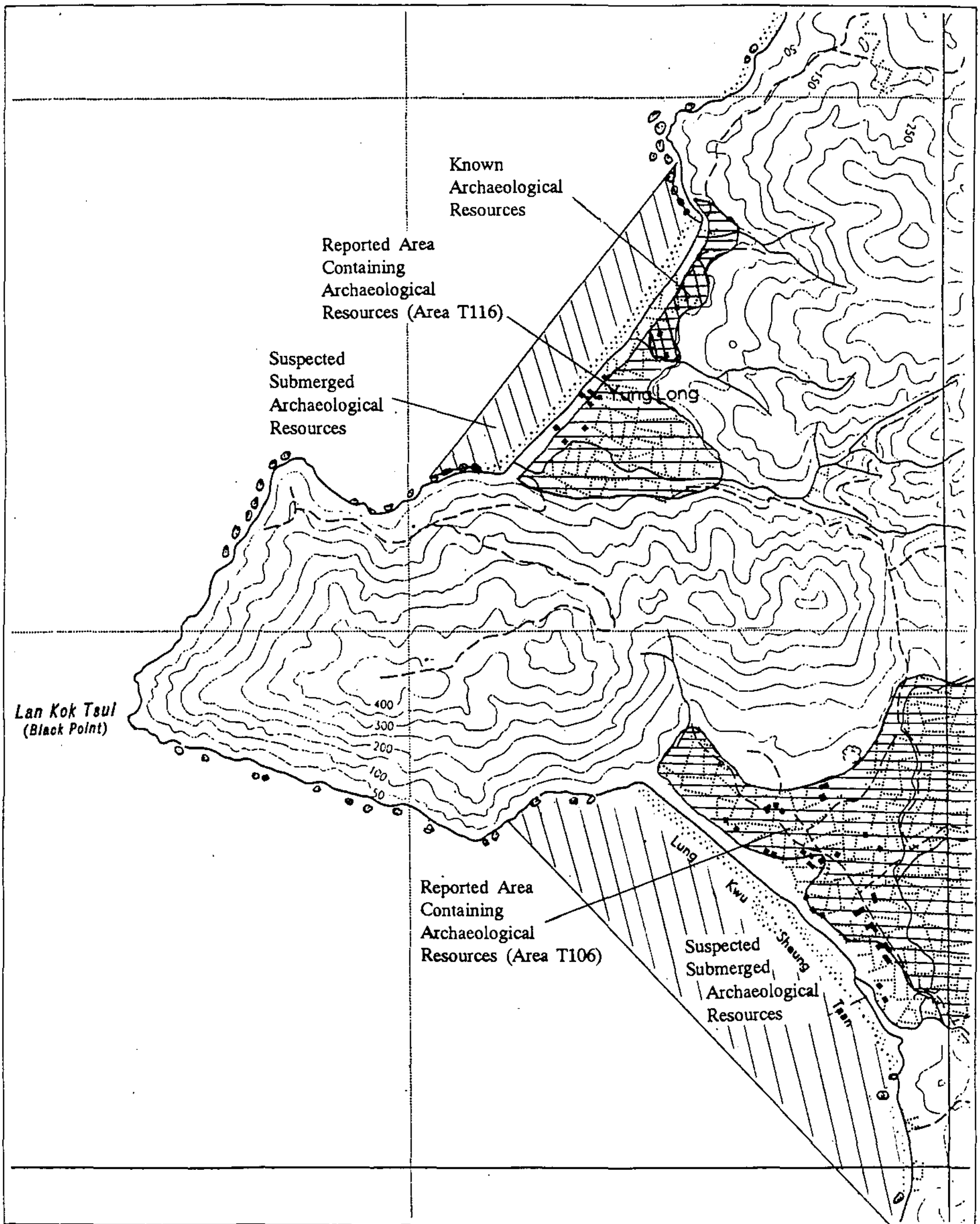

Figure V1/2.14 (a)

Black Point: Archaeological Resources

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- it has the potential to indicate the level of pottery technology in the Neolithic/Bronze Age period.

- it has only been shallowly disturbed by hand tool cultivation.

o **Lung Kwu Sheung Tan**: This site to the south of Black Point includes the whole of the bay. The area of particular interest occupies gentle colluvial slopes at the foot of heavily eroded hills and has an area of approximately 100m x 40m. It is thought to have been a prehistoric occupation site. Artefacts discovered include Coarseware, hard geometric pieces, quartz discs and glazed stoneware. The value of this site has been affected by the passage of the ash pipeline from CPPS to the Tsang Tsui Ash Lagoons, and by construction of the new WENT access road. Part of the site was also affected by the construction of a sewage tunnel which resulted in a rescue excavation funded by the Project Vote in 1989-1990.

These two sites are considered to be amongst the five most important archaeological sites in Hong Kong. Although there are no statutory provisions on protection of SSAI in Hong Kong, Government has administrative procedures which require the developer to excavate the archaelogical sites prior to construction.

2.14.2 Other Cultural Features

The area around Black Point also exhibits some historic interest. Whilst nothing at Yung Long pre-dates 1900, some existing structures in the area contain large granite blocks which may have been taken from earlier structures. A temple exists at Lung Kwu Sheung Tan.

2.14.3 Fung Shui

Lung Kwu Sheung Tan contains a "designated Fung Shui Area" and an ancestral clan hall (tzee tong) in the vicinity of the Southern Access Road intersection with the contractors' access road to the LTPS construction site. From site investigations carried out during this study it is considered that the Yung Long area may have a high Fung Shui value which is independent of that of Lung Kwu Sheung Tan which has suffered from interference brought about by ash-pipeline, sewage pipeline and road construction. Yung Long contains features of potentially high Fung Shui value, such as a small wooded stream passing between two hills of unequal size. Overall Fung Shui relationships in the area, considering the Castle Peak ridge and Black Point, are currently under investigation by CLP in conjunction with a local expert.

2.15 <u>Drainage and Sewerage</u>

2.15.1 Introduction

The sparse settlement of the area surrounding Black Point has meant that, until recently at least, man-made drainage systems were very limited in extent. Recent developments have caused some changes and one major project in particular has significantly altered the conditions in the area.

2.15.2 Drainage

The predominant direction of drainage in the area is from east to west, under the influence of the Castle Peak ridge. Streams of between 1 and 1.5km in length run down to the alluvial plains that lie inland of the beaches at Lung Kwu Tan, Lung Kwu Sheung Tan and Yung Long. 1km to the east of the proposed site, the drainage adopts a more northerly direction with streams converging just south of the BBC relay station before running eastward along the inshore boundary of the Tsang Tsui Ash Lagoons and entering the sea at Tsang Kok.

In the area where arable cultivation has been practiced, drainage modifications have occurred to provide irrigation. Recent road works to provide access to WENT have involved the use of cut-slopes and those have provoked the need for artificial slope drainage channels. These are most in evidence in the area some 2km east of the tip of Black Point. Both Yung Long and Lung Kwu Sheung Tan receive fairly significant flows at certain times of year. The proposed LTPS location will require culverting or re-routing of existing streamlines at Yung Long.

2.15.3 Sewerage

Sewerage in the area immediately adjoining the site is very limited. A major project is, however, under construction which will greatly increase the sewage discharge to the waters of Urmston Road. The North-west New Territories (NWNT) Sewerage Scheme, which is currently under construction will receive sewage from its catchment area and pump it to San Wai. At this point, the sewage will undergo preliminary treatment to remove gross solids. From the treatment works the sewage will pass to an outfall just south of Black Point (see Figure V1/2.6(a)).

Initial dry weather flow is anticipated to be of the order of $1.9m^3/s$. This mounts to a daily flow of approximately 164,000 m^3, somewhat larger than the current screened sewage discharge at Pillar Point. The scheme is designated for an ultimate flow capacity of 400,000 m^3/day DWF (4.6 m^3/s). Capacity will not be achieved for some while and will depend upon the fulfilment of predicted population growth, industrial development and the diversion of sewage from Yuen Long treatment works. When capacity is achieved it is anticipated that the contributions will be as follows:

	DWF m^3/d	DWF m^3/s	Peak Flow m^3/s (2.5 x DWF)
San Wai Treatment Works	225,000	2.6	6.5
Yuen Long Treatment Works	70,000	0.8	2.0
Industrial Sector	105,000	1.2	3.0
Total	400,000	4.6	11.5 (under surcharge)

Source[1]

Preliminary treatment will remove grit, large solids, floating and some suspended matter. It will not, however, significantly reduce BOD or remove grease, nutrients, or toxic elements.

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1 North West New Territories Sewerage Scheme Environmental Assessment (1990) Mott MacDonald.

Currently, sewage treatment works providing secondary treatment at Shek Wu Hui and Yuen Long discharge into the northern end of Deep Bay. In addition there is a discharge into Urmston Road at Pillar Point from a sewage screening plant. The sewage treatment works discharges are remote from the Black Point site (over approx 15 km sea distance away) so that, whilst they will have an influence on waters in inner Deep Bay, they are not directly relevant to waters of outer Deep Bay surrounding Black Point. This is supported by data on E. Coli levels reported by the EPD[1].

The discharge from Pillar Point however is closer, the distance being within the tidal range along Urmston Road (see Figure V1/2.6(a)). Sampling of this discharge is carried out on a monthly basis by Drainage Services Department (DSD). Data for 1990 have been used to derive the mean values presented in Table V1/2.15(a).

Table V1/2.15(a)
Sewage discharge at Pillar Point: 1990 Mean Values

Flow 10^3 (m^3/day)	pH	BOD^{-5} mg/L	COD mg/L	TSS mg/L	TP mg/L	CL mg/L	NH_3-N mg/L	Org-N mg/L
114	7.5	241	643	312	5.4	3859	36	16

Source: Drainage Services Department-monitoring data: based on monthly samples

Clearly, the Pillar Point discharge is a significant polluting load to the Urmston Road. The data indicate a likely BOD load of 27 tonnes per day, in addition to a COD load of 73 tonnes per day.

As a large component of the NWNT outfall flow will have undergone treatment at the San Wai or the Yuen Long works it is anticipated that the BOD and COD concentrations will not be as high as those recorded at Pillar Point. The flow, when it reaches capacity, however, will be over three times as great. Data on Yuen Long treatment works final effluent BOD and COD levels were obtained. Based on this, anticipated BOD and COD daily loads from the NWNT outfall are as follows:

- o BOD: 2.5 tonnes/day
- o COD: 22 tonnes/day

In addition to this there is likely to be a substantial metal loading. No data were available on metal concentrations from Pillar Point. Data do exist, however, for metal concentrations in sewage works inflows and outflows across the territory. Table V1/2.15(b) presents these data as they relate to Shek Wu Hui and Yuen Long treatment works. Data for the metal concentrations in inflow and outflow at each works were available on a monthly basis. Figures presented is the first four columns of Table V1/2.15(b) are annual means for 1990 based on between 9 and 12 recorded values. Mean values of metal concentration in inflows at the two works were derived, as were mean values for the outflows by combining Shek Wu Hui and Yuen Long data. These values, when applied to Pillar Point (assuming crude sewage concentrations) and NWNT outfall (assuming treated effluent concentrations) allow indicative daily metal loads to Urmston Road to be derived.

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1 EPD (1990) Marine Water Quality in Hong Kong, - Results from the EPD Marine Water Quality Monitoring Programme for 1989.

Table V1/2.15(b)
Sewage Treatment Works Metal Concentrations (mg/L)

Metal	Shek Wu Hui		Yuen Long		Inflow Average (Crude)	Outflow Average (Treated)
	Inflow	Outflow	Inflow	Outflow		
Copper	0.04	0.02	0.15	0.04	0.095	0.03
Zinc	0.40	0.09	1.2	0.45	0.8	0.27
Nickel	0.03	0.015	0.14	0.06	0.085	0.05
Chromium	0.06	0.02	0.22	0.04	0.14	0.03
Lead	0.02	0.04	0.03	0.02	0.025	0.03
Cadmium	0.004	0.002	0.006	0.001	0.005	0.002
Silver	0.004	0.003	0.008	0.003	0.006	0.005

Source: Drainage Services Department–monitoring data

The derived metal loads, as a function of flow and concentrations, are indicated in Table V1/2.15(c).

Table V1/2.15(c)
Estimated Metal Load from Existing and Future Sewage Outfalls to Urmston Road (kg/day)

	Pillar Point	NWNT	Total
Flow m^3/day	114,000	400,00	
Copper	11	12	23
Zinc	91	108	199
Nickel	10	20	30
Chromium	16	12	28
Lead	3	12	15
Cadmium	0.6	0.8	1.4
Silver	0.7	2.0	2.7
Total	**132**	**167**	**299**

Note : Pillar Point loads based on crude sewage metal concentrations, NWNT loads based on final effluent metal concentrations.

Whilst it is accepted that these estimates are based on a small data set, it is considered that they do indicate a considerable potential for water pollution. Sediments sampled in the vicinity of Pillar Point show higher levels of metals than those currently obtained from the Black Point area. It might be assumed that once the NWNT discharge begins, sediment quality will begin to deteriorate in that area.

2.16 Water Supply

The water demand from the proposed LTPS has been estimated to be as follows:

Year	1996	1997	2000	2001	2003	2004	2006/7	2008
Water Demand m^3/day	10,750	16,500	21,500	28,500	35,000	42,000	48,500	55,000

This includes the water requirement for construction. The water requirements for Scenario II would be substantially lower, rising to about 7,000 m^3 per day in 2001 and peaking at about 35,000 m^3 per day in 2008.

To supply this demand up to the year 2000 a reservoir at Black Point (an area for which has been reserved by Water Supplies Dept.) will be put into operation with the subsequent construction of a distribution main to the LTPS and an inlet main to the reservoir from the planned Area 38 pumping station. Beyond this date extra treatment facilities are expected to be necessary.

2.17 Castle Peak Firing Range

This land use dominates the area west of Tuen Mun in terms of area. It covers approximately 2,400 ha and occupies about 60 to 70% of the land west of the western edge of Tuen Mun. The range is indicated on Figure V1/2.6(a).

It is the only military training site of its type in the territory and no alternative locations exist for it. Alternative use for the land would be very difficult and dangerous due to the presence of unknown numbers of unexploded devises in unspecifiable locations.

It is generally accepted that the Range is likely to remain in military hands long into the future.

As a site neighbour it is considered to be non-sensitive, in that it has; no permanent population either of residents or employees, no significant recreational aspects and designated cultural or scientific area and no free access. In this regard it provides a good 'buffer' between the Tuen Mun Valley and the PADS-related coastal developments, including the LTPS. This is in addition to the obvious topographical screening it affords.

It does not generate any significant road or marine traffic in the area. It does not constitute a security hazard to the LTPS.

2.18 Nim Wan Landfill Site (WENT) and Associated Jetty and Road

This is one of the new 'big three' controlled landfill sites in the New Territories, WENT, NENT and SENT. They are an essential part of the Government's Waste Disposal Plan and will receive domestic refuse from the Transfer Stations now being established in the urban areas. The WENT site occupies approximately 110 ha. The feasibility and implementation of these sites is being carried out by the EPD and the highest priority has been given to environmental performance and control. At WENT the collection of leachate and prevention of wind-blown matter from leaving the site has been given particular attention. The site location is indicated on Figure V1/2.6(a).

The waste arriving at WENT will be domestic refuse and will be in sealed containers. It will come both by road along the Southern Access Road and by sea from the Island East Transfer Station on Hong Kong Island. In 1987 it was estimated[1] that the amount of waste delivered to the site would be as follows:

1990: 2400 t/day
2001: 5500 t/day

Assuming all waste is delivered in container vehicles for which the payload is 16 tonnes and assuming the southern access road is the only one available then the number of heavy vehicle journeys generated by WENT on the Southern Access Road would be as follows:

1990: 300
2001: 690

It is estimated that 1 vessel will arrive at the jetty each day.

The feasibility study for the Island East Tranfer Station (IETS) from which seaborne waste will originate, identified five possible locations for the marine off-loading facilities, and amongst them two options with marine reception at Phase II/III seawall of WENT and at the existing jetties at Yung Long were reviewed. The recommended arrangement, in the IETS Final Report, was to locate the marine reception facility at the Yung Long Jetty. LTPS site development, however, (see V2/2.4 and Annex V2/A) progressed such that the proposed site encompassed the jetty. Consequently, an alternative arrangement, locating the IETS marine reception facility on a section of vertical seawall at Phase I of WENT landfill is currently being considered by EPD. This solution would require provision of a dredged channel along the wall of the Tsang Tsui ash lagoons.

The southern access road to the WENT site is currently under construction. Its presence will greatly alter the character of the area of Lung Kwu Sheung Tan.

The WENT site will start to receive waste in mid-1992.

2.19 BBC Relay Station

This installation is immediately adjacent to both the Tsang Tsui Ash Lagoons and the WENT Landfill Site. It occupies approximately 4 ha, as indicated on Figure V1/2.6(a).

No effects are envisaged of the LTPS on the Relay Station. It is understood that the Relay Station may possibly be removed from this site by 1997 partly due to potential for interference with the navigational systems of the new airport at Chep Lap Kok.

The road traffic serving it is virtually nil.

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1 Ove Arup & Partners (1991) Pers. Comm.

2.20 Castle Peak Power Station (CPPS)

CPPS is 4.5km south of the LTPS site and the largest industrial facility in the area. It occupies approximately 60 ha. Traffic generated at CPPS has been recorded and on a typical day approximately 300 vehicles enter and leaves the site (Stations A and B combined). Of these, the vehicle composition is as follows.

- Coaches/Buses 100
- Private Cars/Vans 110
- Lorries/Trucks 90

The CPPS also generates a significant quantity of marine traffic. A recent study[1] predicted that by the year 2001 the following deliveries will be made.

75 A Class vessels of 100,000 DWT or more
50 B Class vessels of 50,000 DWT
50 Oil Barges of 1,500 DWT

The combined effects of stack emissions, noise emissions and cooling water discharges from the CPPS and LTPS are referred to in Volume 3 Sections 3, 4 and 5 respectively.

There are some logistical advantages in the CPPS being only 3km away from the LTPS. The most significant from the environmental point of view is that the strategic store of fuel oil for operational contingency held at CPPS can also serve the LTPS. Similarly the strategic coal stock can be smaller than it otherwise would have been at LTPS.

2.21 Tsang Tsui Ash Lagoons

These are situated adjacent to the preferred layout boundary at the north eastern end of the site. The proximity of these lagoons means that no additional lagoons are needed for the first 2 units of the LTPS and if significant further utilisation of PFA proves possible i.e. in reclamation or in cement replacement, then additional lagoons may not be needed for many years. This is a very considerable environmental advantage for the Black Point site.

2.22 Vessel Tracking Station (VTS)

The Vessel Tracking Station at Black Point is the property of Marine Department, and forms part of the vessel traffic management system. It consists of a radar antenna which permits monitoring of vessel movements in the area between Black Point, Macao and the Pearl Estuary. Development of the LTPS will require removal and replacement of the VTS.

2.23 Black Point Borrow Area

Just inland from Yung Long is a borrow area from which fill material is exported via the Yung Long jetty. This facility has also contributed to the de-ruralisation of the area.

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1 Scott Wilson Kirkpatrick, ERL et al (1990) Expanded Development Study of Tuen Mun Area 38.

3. SUMMARY AND INTERPRETATION OF ENVIRONMENTAL BASELINE DATA

3.1 The Baseline Data Gathering Programme

3.1.1 Introduction

In order to enable the extent and significance of the environmental impact associated with the LTPS to be determined, it was necessary to establish the existing baseline conditions for the environmental media that may be affected. This information provided a yardstick against which environmental impacts predicted to result from the construction and operation of the LTPS could be assessed. These data also served to define the states of the environment in relation to statutory limits or guideline values, for example Air and Water Quality Objectives.

In addition, the lengthy project programme for both construction and operational phases requires that an attempt be made to consider the likely state of the environment in the future. Consequently it is important to identify any long-term trends in the environmental media being considered. In order to do this, several years of data were required to determine if, for example, water quality in the area is improving, remaining constant or declining. Any observed trends can then be extrapolated to cover the project lifetime.

Besides general background data, site specific data were also required. These were necessary to define as precisely as possible the existing conditions at Black Point and also to provide input to the predictive modelling components of the study. This Initial Assessment Report presents available background data and the results of CLP's monitoring programme as were available at the time of writing. Data collection is continuing and the results will be incorporated into the Key Issue assessments on Air and Water Quality which are currently underway.

3.1.2 Methodology

Two main sources of data were used in this study :

- o **General Background Data** were obtained from routine sampling programmes run by EPD (marine water, marine sediments, meteorology and air quality). In addition, data from previous studies were also used. These included :

  - Deep Bay Integrated Environmental Management Study[1],
  - Deep Bay Guidelines for Dredging, Reclamation and Drainage Works[2],
  - The North West New Territories Sewerage Study[3],
  - Various reports associated with CLP's Castle Peak Power Station.

- o **Site Specific Data** were obtained from an extensive data gathering programme carried out by CLP. This included :

  - Expansion and upgrading of their existing air quality and meteorology monitoring network;

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1 ERL (Asia) Ltd (1988) Deep Bay Integrated Environmental Management Study for EPD.

2 ERL (Asia) Ltd. (1990) Deep Bay Guidelines for Dredging, Reclamation and Drainage Works for EPD.

3 Mott MacDonald (1990) North West New Territories Sewerage Study for EPD.

- Development of near- and far-field marine water quality and sediment monitoring;

- Provision of groundwater quality data from existing boreholes;

- Collection of 24-hour background noise data from five sites in the vicinity of Black Point;

- Commissioning of ecological surveys for both the terrestrial and marine environments.

The subsections that follow outline the data sources and sampling methodologies used in this study. Sections V1/3.2 to 3.8 then summarise the environmental data obtained. Associated with each of these sections is an Annex containing more extensive descriptions of data collection and processing methods, together with results. It should be noted that the sampling programmes for Air and Meteorological data, together with marine water quality and ecology are ongoing. These data show seasonal variation and a full year's sampling is required to adequately reflect conditions. These data will be incorporated in the Air and Water Quality Key Issue studies for the LTPS.

3.1.3 Meteorology

In order to assess the likely impacts of dust emissions during construction and operation, and in particular to predict the likely behaviour of operational stack gas emissions, a clear understanding of prevailing meteorological conditions was required, both for the Black Point area and for the Territory as a whole.

Background Meteorology data were obtained from the Royal Observatory for :

- wind speed and direction;
- rainfall (quantity and composition);
- insolation;
- temperature, relative humidity and barometric pressure;

from a number of sites within the Territory :

			Grid Ref.
-	Lau Fau Shan;	:	49Q HQ 075 880[1]
-	Tuen Mun;	:	49Q HQ 065 800
-	Chek Lap Kok;	:	49Q HQ 030 712
-	Tai Mo Shan;	:	49Q KV 035 812
-	King's Park;	:	50Q KV 085 704

(1) All references UTM grid

The type of data obtained included detailed seasonal readings for wind, temperature and pressure including 10-minute average (6/hr) throughout one month for each of the seasons in Hong Kong, and seasonal radiosonde data up to a height of 2000m. Data were obtained in hard copy and diskette format, to aid compilation of supporting information (as presented in V1/A).

In addition to this background information, meteorological data specific to the Black Point site will be provided from a network of CLP monitoring stations, some of which were commissioned specifically for the project. The locations of these stations are indicated in Table V1/3.2(a). The type of data recorded from these stations will include both wind directions and velocity, and in some cases, Relative Humidity, Barometric Pressure and rainfall.

3.1.4 Air Quality

Air quality data were obtained from the routine monitoring programme for the urban area, that has been carried out by EPD for the last 5 years. The stations relevant to the study are located at :

- Kwun Tong;
- Sham Shui Po;
- Causeway Bay;
- Tsim Sha Tsui;
- Central/West; and
- Junk Bay.

Data were obtained for :

- Sulphur Dioxide;
- Nitrogen Oxides;;
- Ozone;
- Suspended Particulates (total suspended and respirable).

The results of other short-term monitoring carried out by EPD were also included to provide air quality data for this assessment. Details of the monitoring results are discussed in Section V1/3.3.

In addition to this, data were also obtained from CLP's air quality monitoring network. The following stations have been in use for eight years, being associated with monitoring for CPPS licence requirements, although some were upgraded for the purpose of this study.

The four operating air quality monitoring stations are located at :

- Au Tau;
- Hung Shui Kiu;
- Tuen Mun;
- San Hui.

These four stations record the levels of sulphur dioxide and the meteorological conditions (wind speed and direction). CLP plan to upgrade the Au Tau and San Hui stations to measure nitrogen dioxides and particulate levels. Moreover, one further monitoring station will be located at Butterfly Estate in Tuen Mun as a supplementary short term monitoring exercise, to monitor the levels of SO_2 and NO_2 as well as the prevailing wind conditions.

A further three stations were commissioned by CLP at Lau Fau Shan, Black Point and Tung Chung for 6 to 12 months from January 1991 to supplement the existing monitoring network. Full details of the air sampling network and programme are contained in Annex 1B.

3.1.5 Marine Water Quality and Sediment Data

CLP's monitoring stations are indicated in Figure V1/C1(a). The sampling programme was developed in order to provide background data against which to assess :

- near-field impacts during construction;
- near-field impacts during operation;
- far-field impacts during operational cooling-water discharge.

Monitoring is carried out on a monthly basis and will continue until late 1991 in order to obtain data to cover a twelve month period and so reflect seasonal variation. A total of 41 determinands are sampled as indicated in Tables V1/C1(a) to (c). At each site a variety of surface, mid-depth and bottom samples are taken. In addition samples of marine sediments and in some cases oysters are taken. For each sample a number of the 41 analyses are performed. The determinants were chosen in consultation with ERL in order to maximise the utility of the information gained from the monitoring programme without resorting to exhaustive sampling at all depths at each site and analysis of all determinands for each sample. To do so would have placed excessive demands on sampling and analytical resources without necessarily increasing the usefulness of information on waters in the area. Details of the analytical methodologies used by CLP are presented in Annex V1/C.

Background marine water quality and sediment data were obtained from the EPD routine monitoring programme which has been providing regular results since 1987. The Black Point site is located on the boundary between the Deep Bay and the North Western Waters Control Zones. The marine water quality stations are shown in Figures V1/C2(a) and V1/C2(b) of Annex C2. The sediment sampling stations are shown in Figures V1/C3(a) and V1/C3(b) of Annex C3.

3.1.6 Groundwater Quality

In order to determine the existing hydrogeological conditions at the Black Point site, a review of published geological information was carried out and was supplemented by borehole data obtained near the site. The data sources were :

- Report on the Geological Survey of Hong Kong, 1971.
- H.K. Geological Survey, 1:20,000 Solid and Superficial Geology Sheet No.5, Tsing Shan (Castle Peak); and
- borehole logs from boreholes at the following locations:

In 1987, two boreholes were drilled into the land-based aquifer inland of the Tsang Tsui Ash Lagoons. These boreholes are sampled on a monthly basis. Summary data are presented in Tables V1/D1(a) to (c).

3.1.7 Noise Environment

No previously recorded results were available for background noise in the area. In any case, the nature of noise is such that site specific sampling is necessary at noise sensitive receivers (NSR) specific to the LTPS development. It is generally accepted that background noise levels do not vary significantly on a seasonal basis. However, substantial variation may occur on a diurnal basis. Consequently, 24-hour continuous noise monitoring was carried out at five sites in the vicinity of Black Point in order to adequately reflect conditions at NSR's during daytime, evening and nighttime. The locations of the noise monitoring sites are shown in Figure V1/1 of Annex 1E.

Measurements were carried out over a 36-hour period, from 7:00pm to 7:00am two days later, at the following sites.

– Site A : Pak Long	:	Grid Ref: 49Q HQ005793[1]
– Site B : Lung Kwu Sheung Tan	:	Grid Ref: 49Q GQ998806
– Site C : Yung Long	:	Grid Ref: 49Q GQ995815
– Site D : Tsang Tsui	:	Grid Ref: 49Q GQ997825
– Site E : Nim Wan	:	Grid Ref: 49Q HQ016825

Detailed site descriptions are presented in Annex V1/E. Measurements were taken during the period late October-early November 1990, during fine, mild conditions, and were unaffected by rain, fog or excessive wind speeds.

In addition to standard dB(A) noise parameters, third octave, real-time frequency analyses were also carried out during daytime and night-time periods to identify the background noise components at different sampling sites.

3.1.8 Terrestrial Ecology

In order to determine the significance of terrestrial ecological impacts resulting from the development of the LTPS it was necessary to conduct an ecological survey of the area. Construction of the LPTS will involve loss of some areas of habitat and disruption to neighbouring areas along site boundaries and access roads. Operation of the LTPS has the potential to produce far-field ecological effects as a result of stack gas emissions. The purpose of the ecological survey was to record the presence of any unique species or communities in the areas to be affected. On the basis of the survey results the ecological value of the site will be determined.

The terrestrial ecology survey is being conducted in two stages. The winter sampling was completed early in January 1991 and was carried out by a local expert. The summer survey is scheduled for July 1991. The purpose of sampling in two seasons is to ensure that all species present are observed and recorded. A summary of the data and a community zonation map are presented in Section V1/3.7 and a full assessment is presented in Annex V1/F.

3.1.9 Marine Ecology

The LTPS development will also have the potential to affect the marine ecology of the area in a number of ways, both during construction – by removal and covering of habitats, and during operation, when site effluents, maintenance dredging and cooling water discharges will affect the marine habitat. The marine habitat is more complex in terms of the sampling necessary to adequately determine the species and communities present. The following surveys were carried out :

- littoral communities; rocky shores and sandy beaches in both Yung Long and Lung Kwu Sheung Tan;
- benthic communities; north, west and south of Black Point;
- pelagic and demersal fish: north, west and south of Black Point; sampled by gill nets and trawling.

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1 All references UTM grid

Each survey requires specific techniques and is subject to different seasonal requirements. Four marine ecological surveys are being conducted to collect representative data for the winter, spring, summer and early autumn (1991 conditions within southwestern Deep Bay and northwestern Urmston Road.). The programme will include four seasonal surveys for demersal and pelagic fish and two seasonal surveys each for benthic invertebrates and shore biota. Trawling for demersal fish will also provide some data for larger benthic invertebrates. Full details of the surveys are presented in Annex V1/G. A summary and interpretation of the data obtained so far is presented in Section V1/3.8.

Data on the marine ecology of the area were also obtained from Lam, V. WW. "The Tap Shek Kok Power Plant, Hong Kong - A Marine Environmental Impact Assessment" (1987) Univ. of Hong Kong. PhD. dissertat

3.2 Meteorology

3.2.1 Introduction

Meteorological conditions in Hong Kong and the New Territories have been summarised in numerous reports and books (Malone, 1977; Koo, et al, 1984; Chin, 1986)[1,2,3] and generally reflect its subtropical location in the eastern portion of the SW-NE Monsoon zone. Meteorological conditions during construction and operation of the LTPS relate primarily to the distribution of winds and rainfall and indirectly with those elements which may affect local atmospheric circulation and dispersion. Since the long construction schedule spans several years, construction effects will be experienced under all possible meteorological conditions. "Worst-case" impact assessments can reflect any combination of meteorological conditions which will produce the "worst-case" effects, although they may not persist for more than a few hours to a few days.

The physiography (open water, ridges, orientations, etc) of the western New Territories (and most of Hong Kong) creates unique local meteorological conditions which have required numerous meteorological stations to be located throughout the region. As part of the LTPS Project a meteorological station has recently been established at Lung Kwu Chau to document the local conditions. The following summary does not include data from any new stations but does summarise available data pertinent to the CLP Project.

3.2.2 Data Sources

Both the Royal Observatory and other agencies and companies have established meteorological stations in the western New Territories and on Lantau Island immediately to the south. The Royal Observatory had a station at Tsim Bei Tsui (1975-1982) and Lau Fau Shan which provide information regarding the Deep Bay and northerly approaches to the Black Point site. The Royal Observatory also maintained a recording station at Chek Lap Kok (September '84 to March '90) which provides some information regarding the southerly winds.

CLP has established stations as indicated in Table V1/3.2(a) to assess influences upon and from the Castle Peak Power Station and to the north and east of Black Point. CLP has established a new monitoring program (Table V1/3.2(a), 1991 and "New" columns) for collecting data for the LTPS design and planning (see also Key Issue Report for Air Quality).

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1 Malone, D.J. (1977). Hong Kong Forecasters' Manual. Royal Obser., Technical Note No.14.

2 Koo, E., B.Y. Lee, and C.M. Tam, 1984. A meteorological assessment of Atmospheric Transport Conditions in the Deep Bay Air Shed. Royal Obser., Occas. Pap. No.60.

3 Chin, P.C., 1986. Climate and Weather. (In Chiu, T.N. and C.L. So. A Geography of Hong Kong. Oxford Univ. Press)

Table V1/3.2(a)
Project and CLP monitoring Stations in Northwestern New Territories

Stations	Monitoring Parameters	Years of Records	
<u>Coastal</u>			
Lau Fau Shan (NE)	AQ + -	1982-85	1991
Tsang Tsui A,B,C,D (NE)	D + W		1991
Black Point (North Side)	AQ + M		New
Lung Kwu Chau (SW)	M		New
Castle Peak (SSE)	W		New
<u>Interior (East of Castle Peak [Ha Tsuen] Ridge)</u>			
Shek Kong (ENE)	S	1982-85	
Au Tau (ENE)	S + W	1981-85	1991
Yuen Long (ENE)	S	1984-85	
Hung Shiu Kiu (E)	S + W	1981-85	1991
Tuen Mun (SE)	AQ + W	1982-85	1991
San Hui (SE, Tuen Mun)	S + W	1982-85	1991
Butterfly Estate (SE)	SN + W		New
<u>Other Areas</u>			
Tung Chung (SSE,Lantau Is.)	AQ + M	Others	1991
Dills Corner	S	1982-85	
Kelvin Tower	S	1983-85	

Direction given in reference from Black Point, Site 1, North Side of BP Ridge

AQ : General air quality, D:Dust and Particulates, S:Sulphur dioxide (SO_2), and N:Nitrogen oxides (NO_X).

M : General meteorological parameters, W : Wind directions and velocity

3.2.3 General Features

The general meteorological features are summarised to provide a background for understanding the circulation and dispersion of air emissions on the western perimeter of the New Territories.

- **Temperatures and Other General Features**

The subtropical, monsoonal climate of Hong Kong is clearly reflected in the seasonal variations of temperatures and other elements shown on Table V1/3.2(b). The monthly means vary with the sunshine duration and intensity of solar radiation over the region and pass from lows of 15–16°C in January and February to highs of 27–29°C with sharp rises during March and April of 3–8°C per month followed with similar falls during October through to December. In keeping with Hong Kong's subtropical marine location, mean diurnal temperature variations are generally about 5°C throughout the year.

Relative humidity does not vary widely and means rise to a high of 84% in the summer to a low of 69% in the winter. Similarly, mean monthly atmospheric pressures vary over a range of 1014 hPa in the summer to 1035 hPa in the winter, with diurnal ranges of 3–4 hPa. When major storms pass through pressure may rapidly fall below 1000 hPa.

- **Rainfall**

General annual rainfall over Hong Kong and the New Territories exceeds 2000 mm and occurs primarily (80%) in May through to September (more than 300mm per month at Royal Observatory) Chen (1974) showed that the distribution of rainfall in the New Territories varies widely from less than 1600 mm along the coastal perimeter to 50% higher, more than 2400 mm, along the ridges and peaks in central and eastern New Territories. The physiographic influence upon maximal rainfall and shadow patterns is very apparent (Figure V1/A38. Rainfall at Black Point and Castle Peak sites would be expected to be about 1600 mm annually and is assumed to fall at approximately the same ratio as at Royal Observatory (80% during May through September, and 50% in June–August) and virtually no rain during November through January.

- **Winds**

For local meteorology pertinent to circulation of air pollutants, winds are generally separated into three components: ground level, mid level, and high level winds. Ground level winds up to 200m above ground surface are most affected by local terrain features and influence the dispersion of surface generated air pollutants (e.g., dust from construction). Mid level winds (200–1000m) are usually affected by more regional weather patterns (monsoons) and either lie above or contain the temperature inversion level. Because of the location of Hong Kong in relationship to the equatorial winds and the blocking effects of the Tibetan Plateau (up wind, or to the windward side), upper level winds (1000–3000m) also affect the general meteorology and the monsoonal changes in circulation.

Offshore winds (recorded at Waglan Island) show the unobstructed low level conditions with prevailing winds from ENE to E during all months , except July when the winds flow from the SW with the summer monsoon. Mean monthly wind speeds rise from lows during April to September of 19–21 km/hr up to highs of 26–27 km/hr during October–November and persistent winds of 23–25 km/hr during December–February.

Table V1/3.2(b)

Monthly Normals of the Meteorological Elements for the 30 Years 1951-1980
Extreme Values between 1884-1939 and 1947-1988
in Hong Kong

MONTH	PRESSURE		AIR TEMPERATURE		RELATIVE HUMIDITY	RAINFALL	BRIGHT SUNSHINE	WIND	
	Mean	Mean Diurnal Range	Mean	Mean Diurnal Range	Mean	Total	Duration	Prevailling * Direction	Mean Speed*
	hPa	hPa	°C	°C	%	mm	h	degrees	km/h
January	1,020.1	4.1	15.6	5.5	71	26.9	153.5	070	23.8
February	18.6	4.1	15.9	5.1	78	41.9	108.7	070	23.1
March	16.2	4.1	18.5	5.0	82	54.8	101.4	070	21.4
April	13.1	3.8	22.1	5.0	83	139.4	120.2	080	19.0
May	09.1	3.3	25.9	5.0	83	298.1	162.6	090	18.8
June	06.2	3.0	27.7	4.8	84	431.8	159.2	090	20.9
July	05.4	3.2	28.6	5.3	81	316.8	230.9	230	18.9
August	05.2	3.5	28.2	5.3	83	413.4	206.0	090	18.2
September	08.5	3.6	27.5	5.3	79	320.4	188.5	090	21.4
October	14.0	3.6	25.0	5.2	72	121.2	209.9	090	26.1
November	17.6	3.8	21.3	5.5	69	34.7	191.5	080	26.8
December	19.8	4.0	17.7	5.6	69	29.3	179.3	080	24.9
Year	1,012.8	3.7	22.8	5.2	78	2,224.7	2,011.6	080	21.9
Observed at	Royal Observatory							King's Park	Waglan Island

* 1953 - 1982

For air pollution meteorology, the occurrence and variation of the inversion and wind circulation in the mid altitude levels is very important, since the chimney and plume rise of the power station emissions will carry the pollutants into this zone.

Ground level winds i.e. between 10 and 200m, are most susceptible to local influences and show wide geographical (horizontal and vertical) and temporal variations. Specifically, Black Point winds and meteorological conditions may be more variable since the site lies at the transition zones between the open water to the west, north, and south and the Castle Peak ridge on the east. Variations can be expected to be extreme and not closely or directly related to the Royal Observatory stations in King's Park, the eastern New Territories, or any of the southern islands (e.g., Waglan and Cheung Chau).

Ground winds at Tsim Bei Tsui (TBT) and over Deep Bay (Koo, et al,1984) were recorded, compared to, and modelled in relationship to Tate's Cairn (+575m, 900mb) and Kai Tak Airport, to Shekou in the PRC, and to mid-high level winds data from radiosondes. Wind roses in Annex V1/A show a general low representation of southwest and north winds at Tsim Bei Tsui (TBT) compared to both Tate's Cairn and Shekou. Winter monthly winds (October-March) at TBT had a greater frequency of NE winds compared to north and east winds at both Tate's Cairn and Shekou, while the summer winds (May-August) showed small southwesterly and easterly components. Monthly diurnal winds at TBT had a similar dominance of NE, E, and S winds.

Winds at TBT had a mean annual average of 5.9 knots, compared to 7.6 knots at Kai Tak Airport, and commensurately, light (less than 7 knots) winds were more frequent and lasted longer at TBT than at Kai Tak. Light winds of more than 50 hours duration occurred most frequently during November to January.

With regard to Mid-Level Winds (>200 - <1000m) inversions usually develop during the winter monsoon when cold air masses from the northeast enter the area beneath warmer air masses above 1000m (900mb - millibar) and when the radiative nighttime cooling is greatest due to the occurrence of clear nights and low winds.

Upper level winds follow the same general seasonal changes as those at lower levels (Chin and Lai, 1974)[1]. Winter winds at the 850 mb level or about 1500m are strongly disturbed by the the Tibetan Plateau to the west and are more influenced by storms travelling southward from China's Interior. Higher westerly winds at the 700mb (3000m) are generally unaffected by the Plateau and major wind shifts from northeasterlies to westerlies occur above 2000m. During January to April, 850mb winds are variable but more commonly from the northeast during January and February (NE Monsoon) and may be quite different from the 700mb persistent westerly winds (10-20 knots). During May, the 850mb winds rotate 180° and join with the 700 mb winds which shift about 45° to form a consistent southwesterly air stream across Hong Kong without the Plateau disturbing effects.

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[1] Chin, PC and Lau M.H., (1974)

In May to July, the southwesterlies slowly rotate counterclockwise until August and September when both levels approach Hong Kong from the SE to ENE as part of a mid level low pressure system. The breakup of the Southwest Monsoon in October is reflected by a continuing rotation of the lower mid-level winds to the NE to NNE across Hong Kong and an increase in wind speeds (10-15 knots). The Northeast (NE) Monsoon is fully established during November and December with 850mb winds flowing into Hong Kong from the NE. The variable mid-level winds are protected or isolated by the Tibetan Plateau. The lower winds flow counter to the higher 700mb winds which have rotated around to the west. This discontinuity continues during the winter and early spring.

o **Typhoons**

Typhoons are an important feature of the northern part of the South China Sea and frequently cause major wind changes usually to the south and southeast and increased turbulence as they pass either to the south or to the east of Hong Kong. Although they may change regional wind, depress barometric pressure, and increase clouds and rain, winds over Hong Kong only reach typhoon levels (115+ km/hr) about once every ten years. Because of the heating of the equatorial regions to the southeast, typhoons usually approach Hong Kong and the South China Sea between June and October, although some significant typhoons have occurred in May.

3.2.4 Circulation and Dispersion

Circulation and dispersion of air emissions in the western New Territories was discussed by Koo, et al (1984) based on recordings and modelling for the Deep Bay area. The following summarises important points from this report.

o **Stability**

Stability for the Deep Bay area was established using the standard Classes A-G (equated to numeric system of 1-7 respectively). Atmospheric conditions were unstable at around midday, most unstable in August and most stable during nighttime calm winds in December. March conditions were stable ("less unstable") due to persistent strong winds.

Unstable conditions usually developed with light northwesterly winds and little or no southerly winds (generally onshore daytime winds). Stable conditions usually developed during southerly (nighttime) offshore winds and with cold northeasterly winds during the winter monsoon (producing an inversion with warmer air above 300m).

o Mixing Heights

Mixing heights were derived from data at Junk Bay, compared with data from Shezhen, and considered by Koo, et al (1984)[1] sufficient to be applied to Deep Bay. Data indicated nighttime minima and afternoon maxima with a mean maximum of 430 m in February rising to >1000m in July. King's Park inversions were also between 360 and 600m during the winter months. Inversions were observed 90% of the time at Shenzhen with ground based inversion most common in the summer and autumn; inversions at 1900 hours were more ground based during the autumn.

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1 op cit.

Inversions averaged over 400m during June to October and 200–300m in January through to April; maxima of more than 600m occurred in May through to December.

o **Modelling**

Koo, et al (1984)[1] conducted wind field modelling across the entire Deep Bay and western New Territory area, including Black Point and Castle Peak. Table V1/3.2(c) summarises modelling of the changes between general (>300m) and Black Point 5–knot wind directions:

Table V1/3.2(c)
5–knot Wind Direction Variations between Black Point and General Data

General	Black Point
NNE	NNE
NE	NNE
ENE	NNE–NE
E	ENE–ESE
ESE	SE–SSE
SSE	SSE–SSW
S	S–SW
SSW	SSW–SW
W	SW–WNW

The local ground level winds at Black Point show a 15–30° clockwise advance over the general winds. Greater deflections (90 degrees) were shown at and across the top of Castle Peak (Ha Tsuen) ridge and in the Tuen Mun valley during westerly winds.

3.2.5 Circulation and Air Emissions

Several studies have been published regarding general meteorological conditions which were expected or known to relate to air pollution and may have some impact upon the general conditions even in Deep Bay.

o **Stability**

Lee and Koo (1987)[1] developed Pasquill's stability classes for the Hong Kong area and related them to various meteorological conditions during the annual cycle:

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1 op cit.

1 Lee, B.Y. and E. Koo, 1987. Atmospheric Stability in the Eastern Victoria Harbour Hong Kong. Roayl. Obser. Technical Note (Local) No.39.

Period	Meteorology	Stability
October–December	low cloudiness	highest stable conditions
February–April	increased cloudiness +higher winds	more neutral/less stable
June–August	warm, insolation, winds	unstable

and with the winds at Kai Tak International Airport:

A–C	more WSW/SW and SSE–SSW winds A=June–August:3–4% in each month, B=June–October:9.5–12.1% C=more uniformly distributed through year May–August:15–17.5%
D–	higher velocities from ENE–SE; some NW–NNW 45.5% of the year All months:31–71% (most frequent class) 71% in March, 67 in Feb, 62 in April
E–G	lighter winds more uniformly distributed October–December:25–28% January and June–September:12.6–19.3%

Stable ground and mid level wind conditions prevail during the winter and during the generally lower wind conditions during the summer. Neutral stability was most common throughout the year. Unstable conditions do occur during the peak power (and hence emissions) generating summer period.

o **Diurnal Variations**

Peterson (1980)[1] described diurnal variations in Hong Kong and the New Territories and some features are important to understanding possible effects upon air emission dispersion, potential for fog generation, and "cleansing" effects of rainfall. Highest temperatures usually occur at 2pm during summer and winter, while lowest temperatures occur at about 5am, although the diurnal variation is only about 5.3°C. Peak ground level winds occur at 2pm (7.5 knots) in July while winds reach secondary maxima of 3.6km at 11 pm and 2 am in May to July. During the winter, winds reach maxima at about 11 am which may reflect nighttime surface cooling reinforcing winter monsoon. Mist, fog (visibility of <5km), cloud cover (oktas), and rain reach maxima during the morning (8am, fog and mist or clouds in March 5.9% or 6.7 oktas; rain in June 33%). Rainfall distribution showed morning dominance and afternoon and evening lows:

1 Peterson, P., 1980. Note on the Diurnal Variation of Meteorological Elements. Royal Obser., Technical Note 64 (Climat. Note No.6).

Maxima			Minima
8 am	June	33%	8 am Nov. 5%
5-6	June-August		
5 am	Nov.	10.1%	7 pm Other months
3 pm	Nov.		
7 pm	April (Anomaly)		
4 am	Dec.-Jan.		

Peterson relates that morning rainfalls arose as "onshore-westerlies" during the early morning, carrying humid Pearl Estuary air eastward (along with the southerly and southwesterly summer monsoon winds). As the saturated air met the physiography and thermal conditions of the land, the air rose and rain occurred. When winds travelled from east-offshore, the dry air from the continent would not have sufficient moisture to cause noticeable rainfall on the eastward-facing slopes. These "rain" winds during the summer were also related to the general monsoon patterns:

Wind Direction/Speed (at 900mbar)	Time	Rainfall (mm)
SW >=20 knots	am	14.3-22.7
	pm	7.5-10.7
SE >=20 knots	am	7.4-17.4
	pm	5.7-10.3
NE July >=20	am	10.5
	pm	22.7

A weak secondary maximum occurred in the afternoons with SE/NE winds of 10-19 knots.

Rainfalls and their "cleansing" effects generally occur before the morning-afternoon peak power and emissions generating periods. Similarly, fogs, mists, and clouds are most common during the morning and then dissipate (burn-off) with increasing temperatures.

3.3 Air Quality

3.3.1 Introduction

As mentioned in section V1/3.2, Hong Kong experiences a subtropical coastal climate with a seasonally dependent SW-NE Monsoon. The sea-breeze system assists the dispersion of air pollutants generated in Hong Kong and brings fresh air in from the sea. As a result, air quality is generally good throughout the Territory, except in cases where sensitive receptors are located very close to pollution sources. Current planning practice attempts to avoid these situations. It was identified in the Site Search stage of the study that emissions from the proposed LTPS could affect areas in the New Territories, North Lantau and nearby regions of China.

It has been estimated that the winds will carry emissions to over 1 million inhabitants (including PADS developments and PRC population) for 40% of the time. For the remaining 60% of the time, emissions will disperse out to sea where there are no sensitive receptors.

Before assessing the cumulative impact from the proposed LTPS at Black Point, it is necessary to establish the existing air quality in Hong Kong.

In order to obtain comprehensive background air quality data in the vicinity of the proposed development and the potential sensitive receptors, an extensive air quality monitoring programme was commissioned in January 1991, to run for a period of six to twelve months. Details of the monitoring programme are discussed in Annex V1/B1.

3.3.2 Urban Air Quality Data for Hong Kong

For several years EPD has maintained an air quality monitoring network. The monitoring stations however, are located within the urban environment and so will be affected by local emission sources such as industrial activities and vehicle exhaust. Measurements of sulphur dioxide (SO_2), nitrogen dioxide (NO_2), ozone (O_3), total suspended particulates (TSP) and respirable suspended particulates (RSP) are available for the years between 1985 and 1989 for several sites; the annual average concentration at each site is summarised in Tables V1/B2(a)–(e) in Annex V1/B2.

The observed annual average SO_2 concentrations do not exceed the Hong Kong air quality objective(AQO) of 80 $\mu g/m^3$ at any of the sites except Kwai Chung which showed exceedance at 126 and 111 $\mu g/m^3$ in 1988 and 1989 respectively. This indicates that Kwai Chung is affected by the close proximity of industrial activities.

On the other hand, Kwun Tong shows high concentrations of NO_2 and the AQO was exceeded for three out of the five years (ie. annual average $NO_2 > 80$ $\mu g/m^3$). This is probably the result of dense industrial development within this area. Other sites are within the acceptable level.

Not all monitoring stations record ozone levels. Only the stations at Central/Western and Junk Bay have more than 5 years of records. The results indicate that the O_3 concentrations are significantly higher at Junk Bay. This may be the result of O_3 being used up in reaction with the nitrogen monoxide (NO) produced from combustion sources. Junk Bay is relatively free from major air pollution sources, the O_3 levels are therefore higher than Central/Western.

The particulate levels within the urban environment are high and the annual average TSP and RSP concentrations always exceed the AQO,. As stated in the White Paper *"Pollution in Hong Kong – A time to Act "*, about 3 million people are exposed to high levels of particulates which are the result of industrial activities, vehicle emissions and construction activities.

These sources have a significant bearing on urban air quality.These results stem from Hong Kong's coastal location, whereby for a high percentage of the time relatively clean maritime air affects the territory, contributing to low background levels of pollution. Short-term monitoring data reveal that Hong Kong AQO's and other guideline values are regularly exceeded locally, in the urban areas, due to peak traffic emissions and widespread industrial activity.

3.3.3 Rural Background Air Quality Data for Hong Kong

Detailed measurements of air pollutants were carried out by EPD for a three month period, between June and August, 1985, at a remote site next to the High Island Reservoir; these have been assumed to be representative of the background air quality in Hong Kong.

The results of this background air quality monitoring are summarised in Annex V1/B2 Table V1/B2(f). The wide range of pollutant concentrations observed at this background site reflect the different pollutant concentrations in maritime and continental air which affect the territory periodically throughout the year.

All of the observations made at this site are within the Hong Kong AQO and can be considered as representative of general background conditions in Hong Kong.

Another short term air quality monitoring exercise was carried out in April and November 1985 at Tin Ha Road near Hung Shui Kui and the results are summarised in Annex 1B, Table V1/B2(g). Although these results may be influenced by vehicular emissions from Castle Peak Road, the results should be representative of the background concentrations within the Deep Bay area. Average pollution levels were low when compared with monitoring results collected from within the urban environment.

Since 1981, CLP has been monitoring the ambient air quality in the north-western side of the New Territories in order to study the impact of stack emissions from the CPPS. Annual average SO_2 concentrations at the four continuous monitoring stations located at San Hui, Tuen Mun, Hung Shui Kui and Au Tau between 1983-1989 are given in Annex V1/B3, Table V1/B3(a).

For all sites, SO_2 concentrations were generally low and in no case approaching the AQO. Moreover, the results do not show any significant increase or decrease in SO_2 over the monitoring period, despite the increase in electricity production at the CPPS.

In 1990, CLP also commissioned short term ambient SO_2 monitoring for 2 weeks, to identify the background air quality in the vicinity of the Black Point Site. Results from this monitoring programme also show low hourly SO_2 concentrations (below 50 $\mu g/m^3$) and on occasion, higher concentrations, up to 100 $\mu g/m^3$ were recorded.

Since the monitoring period only lasted for 2 weeks, the results may not be very representative. In order to establish a more representative picture of background air quality for the area of concern, a comprehensive monitoring programme, such as is now commissioned, will provide more useful data to establish the background air quality in the western side of the territories. Monitoring will continue and will provide an input to the air quality key issue assessment which forms part of the EIA study.

In order to obtain comprehensive background air quality data in the vicinity of the proposed development and the potential sensitive receptors, an extensive air monitoring programme was commissioned in January 1991, to run for a period of twelve months. Details of the monitoring programme are discussed in Annex V1/B1.

To monitor the dust emissions from CLP's ash disposal lagoons at Tsang Tsui, deposited particulates and suspended respirable particulates have been monitored at stations close to the ash lagoons since 1987. Details of the monitoring stations are shown in Figure V1/B3(a) of Annex V1/B3.

Measurements of deposited dust have taken place at sites A, B and C using a bowl deposit gauge. Results of the monitoring are shown in Annex V1/B3, Table V1/B3(b). The annual daily average levels measured for deposit gauges range between 38 to 85 mg/m^3/day. This is well below the nuisance level of 200 mg/m^2/day adopted in the U.K.

On the other hand, the respirable suspended particulates (RSP) levels are measured by high volume air samplers with 10 micrometer sized selective inlets over a sampling period of 24 hours every 6 days, in accordance with the U.S. Environmental Protection Agency procedures. The measured levels are likely to be influenced by meteorological variables such as wind speed, wind direction and rainfall. The monitoring results are clearly affected by seasonal variation in meteorological conditions but the 24 hour RSP concentrations are within the AQO levels of 180 μg/m^3. Results of the monitoring at site B are presented in Table V1/B3(c) in Annex V1/B3.

Results are available from the short-term air quality monitoring programme started in January 1991 to collect background air quality data at the following sites:

- Tung Chung
- Lau Fan Shan
- Black Point

The monitoring programme will last for 6 to 12 months to obtain adequate data for the air quality key issue assessment. This will determine baseline air quality before the development of the LTPS, and Tuen Mun Port developments at north Lantau such as the new airport.

3.3.4 Interpretation of the Results

From the existing air quality monitoring data no significant trends in the annual means of the pollutants being monitored are apparent. Fluctuations may be the result of changing weather conditions. In general, the existing air quality in the north west New Territories is generally good and this can be confirmed by various monitoring results as shown in Annex V1/B. However, more definite background air quality will be determined by the 6 to 12 months monitoring programme and the results will be presented in the Air Quality Key Issue Study.

3.4 Marine Water Quality and Sediments

3.4.1 Marine Water Quality

The waters off Black Point are a mixture of flows from the Pearl River estuary and the waters of Deep Bay which mainly come from the Shenzhen River, coupled with ocean water. The two former flows are fresh water and the latter saline, which produces wide salinity variations with depth, location and time. In the summer months, when river flows are at their highest, the surface salinity drops to its lowest and the water column has a marked salinity profile. In winter this profile goes and a typical ocean salinity prevails throughout the depth.

The waters are well covered by the EPD marine water quality and sediment monitoring programme and as part of the current EIA study, CLP are gathering further data. A summary of both EPD data (for 1989) and CLP data (for Oct., Nov. and Dec. 1990) is given in Table 3.4(a). From an administrative standpoint the waters are divided into the Deep Bay Water Control Zone and the North Western Waters Control Zone (NWW).

Generally the water quality is fairly good. Suspended solids are very variable due to the Pearl River and Deep Bay catchment inputs. BOD is low in NWW, 1mg/L or less and a mean of 1mg/L in Outer Deep Bay ranging up to 5.4mg/L. Dissolved oxygen is generally high with Deep Bay comfortably above the WQO.

Effects of domestic sewage loads are evident however. E. coli is quite high in NWW (up to :400 counts/100ml) but lower in Outer Deep Bay (below 500 counts/100ml).

Ammoniacal nitrogen and other nutrients are quite high an Outer Deep Bay and significantly less in NWW.

Toxic metal contamination is low in both locations.

3.4.2 Marine Sediments

The available data on these is presented in V1/Table 3.4(b). These sediments are generally uncontaminated by toxic metals reflecting the location, away from immediate sources of industrial pollution. Some contamination, however, in the form of E. coli is present. It is considered that this comes both from the Pillar Point Sewage Screening Plant outfall and the raw and lightly treated sewage flows into Deep Bay. This will be added to in 1992 when the NWNT trunk sewer is commissioned.

The results of CLP water quality and sediment monitoring to date are contained in V1/C1(a) – (c).

Comparison of this data with the results of EPD monitoring indicate a number of differences. In particular, the levels of metals recorded in sediments by CLP are lower. It is suggested that a number of factors may contribute to this variation :

- precise sample point location;
- sampling technique; and
- analytical techniques.

It is understood that methods employed by the Government Chemist result in a recording of the total amount of metals present in the sample, whilst CLP's current method is more indicative of the quantity of metal readily "available" within a sample. The water and sediment quality sampling programme is on-going and will provide inputs to the water quality key issue report. Further refinements may be considered as appropriate.

Both EPD and CLP sampling and analysis programmes confirm that the levels of toxic metals in sediments are well below those presented in the Deep Bay Guidelines[1] (see V1/6.2.1) which have been used as criteria for determining the suitability of sediments for marine Dump Site disposal. It is understood, however, that a revised set of limit values are likely to be adopted in the near future. In this event, the suitability of LTPS sediments for marine disposal will be considered against these new criteria.

Full details of the sampling and analysis procedures and results are contained in Annex V1/C.

1 "The Deep Bay Guidelines for Dredging, Reclamation and Drainage Works" prepared for Hong Kong Government by ERL (Asia) Ltd. 1990.

Table VI/3.4 (a)
Marine Water Quality off the LTPS Site at Black Point

	Outer Deep Bay				North Western Waters			
Parameter/ Determinand in mg/l unless otherwise specified	EPD's 1990 Monitoring Results	EIA Monitoring Results			EPD's 1990 Monitoring Results	EIA Monitoring Results		
		Oct 1990	Nov 1990	Dec 1990		Oct 1990	Nov 1990	Dec 1990
pH (pH units)	m 8.3 r 7.9 - 8.6	7.8	8.1	8.2	m 8.3 r 8.2 - 8.4	7.8	8.1	8
temperature °C	m 23.4(S) 24.3 (B) r (15-30) (15-30)	23	21.3	19	m 23(S) 22.4 (B) r (17 - 28) (16 - 18)	23	22.5	20
Colour (Lovibond Units)*	5.22 (NTU)	3.4 (NTU)	0.6 (NTU)	0.7 (NTU)		3.7 NTU (S) 1.3 NTU (M/B)	2 (NTU)	0.5 - 8.3 (NTU)
Suspended Solids	m 20 r 2.5 - 91	7.7	2	2	m 12 r 4.5 - 17	2	2	1 - 2
BOD	m 1.2 r 0.2 - 5.4	1	<1	1	m 0.5 r 0.3 - 0.6	1	1	1
CCD	n.r.	n.d.	n.d.	n.d.	n.r.	n.d.	n.d.	n.d.
Oil & Grease	n.r.	0.2	0.07	1	n.r.	0.05	0.1	0.03
Iron	n.r.	0.43	0.091	0.068	n.r.	0.22	0.137	0.1
Boron	n.r.	n.d.	n.d.	n.d.	n.r.	n.d.	n.d.	n.d.
Barium	n.r.	n.d.	n.d.	n.d.	n.r.	n.d.	n.d.	n.d.
Mercury	n.r.	n.d.	n.d.	n.d.	n.r.	n.d.	n.d.	n.d.
Cadmium	n.r.	<0.00005	<0.00005	0.00013	n.r.	0.00054	<0.00005	<0.00005
Other toxic metals individually	n.r.	see below	see below	see below	n.r.	see below	see below	see below
Total toxic metals	n.r.	see below	see below	see below	n.r.	see below	see below	see below
Cyanide	n.r.	n.d.	n.d.	n.d.	n.r.	n.d.	n.d.	n.d.
Phenols	n.r.	n.d.	n.d.	n.d.	n.r.	n.d.	n.d.	n.d.
Sulphide	n.r.	<0.01	<0.01	n.d.		<0.01	<0.01	n.d.
Total residual clorine	n.r.	<0.1	<0.1	n.d.		<0.1	<0.1	<0.1
Total nitrogen	m 1.1 r 0.6 - 2.3	0.23	0.77	n.d.	m 0.7 r 0.4 - 1.1	0.2	0.15	n.d.
Total phosphorus	m 0.13 r 0.03 - 0.4	0.21	0.25	n.d.	m 0.05 r 0.03 - 0.06	0.13	0.1	n.d.
Surfactants (total)	n.r.	0.01	<0.05	n.d.	n.r.	<0.05	<0.05	n.d.
E.Coli (count/100ml)	m 25 r 0 - 470	300	200	200	m 467 r 160 - 1360	320 - 2700	220 - 1000	280 - 3400
Calcuim	n.r.	334	371	380	n.r.	310	n.d.	390
Sulphate	n.r.	2200	2300	2310	n.r.	2275	2500	2500
Dissolved Oxygen	m 7.2 r 6.3 - 8.7	7.7	7.8	8.3		7.2	8	8 - 8.7
Salinity (g/kg)	m 19 r 8 - 29	29	27	28		29.5	30	28 - 31
Ammonia (as N)	n.r.	0.02	0.46	n.d.	n.r.	0.02	0.06	n.d.
Chromium	n.r.	0.00009	0.0015	0.0014	n.r.	0.0008	0.0014	0.0016
Copper	n.r.	<0.005	<0.005	<0.005	n.r.	<0.005	<0.005	<0.005
Lead	n.r.	0.0007	0.00038	0.00066	n.r.	0.0009	0.00033	0.0006
Nickel	n.r.	<0.005	<0.005	<0.005	n.r.	<0.005	<0.005	<0.005
Zinc	n.r.	0.0083	0.0054	0.0049	n.r.	0.013	0.0058	0.01
Arsenic	n.r.	<0.001	<0.001	<0.001	n.r.	<0.001	<0.001	<0.001
Manganese	n.r.	0.029	0.038	0.020	n.r.	0.02	0.012	0.012
Selenium	n.r.	<0.001	<0.001	<0.001	n.r.	<0.001	<0.001	<0.001

Table V1/3.4(b) Selected Statistics for Sediment Characteristics

Sampling Programme	EPD (1987 - 1989)		CLP (Oct. and Nov. 1990)	
Sample Point Location	NS4 Urmston Road	DS3 Outer Deep Bay	F1 Proposed LTPS Site	B6 South of Black Point
Determinand				
NH_3-N (mg/Kg)	3.15	0.16		
TKN/SP (mg/Kg)	323.0	1083.0		
TP/SP (mg/Kg)	253.0	410.0		
COD (mg/Kg)	14000.0	21300.0		
TVS (% W/W)	19.0	6.8		
TS (% W/W)	171.0	54.0		
CN (mg/Kg)	0.2	0.01		
S/SP (mg/Kg)	2.5	1.28		
S.G.	2.5	2.6		
pH	8.1	7.9		
TOC (% W/W)	1.0	1.1		
Arsenic (mg/Kg)	7.1	7.0	0.4	0.5
Boron (mg/Kg)	8.9	14.5		
Cadmium (mg/Kg)	0.5	1.1	0.08	0.09
Chromium (mg/Kg)	20.0	23.0	8.2	9.0
Copper (mg/Kg)	26.0	24.0	34.0	44.0
Mercury (mg/Kg)	0.08	0.12	<0.2	<0.2
Manganese (mg/Kg)	658.0	693.0	279.0	330.0
Nickel (mg/Kg)	12.0	15.0	8.5	10.0
Lead (mg/Kg)	42.0	42.0	28.0	24.0
Zinc (mg/Kg)	65.0	71.0	30.0	36.0
DWR (W/W)	0.56	0.53		
PCBs (ug/Kg)	11.0	26.0		
PAH (ug/Kg)	84.0	195.0		
Eh - ve	356.0	259.0		
Selenium mg/Kg	-	-	<0.05	<0.05
Aluminium %	-	-	0.165	0.2
<63 um (%)	61.9	89.6		
No. of Observations	4	3	2	2

3.5 Groundwater Resources

3.5.1 Introduction

This section establishes the physical framework for the proposed power station by describing the geological setting and the prominent hydrogeological features of the proposed site.

Sources of Information

The sources of information used in this discussion of geological and hydrogeological conditions at the proposed site include the following:

- Report on the Geological Survey of Hong Kong, published in 1971;

- Hong Kong Geological Survey, 1:20,000 Solid and Superficial Geology Sheet No. 5, Tsing Shan (Castle Peak); and

- borehole logs from selected borings advanced in the geotechnical investigation of the LTPS site carried out by Gammon Hong Kong Ltd and Oriental Boring and Engineering Ltd.;

- CLP groundwater monitoring survey at Tsang Tsui.

3.5.2 Geological Setting

The proposed LTPS site is located in the Black Point area, which consists of a 134 metre high ridge composed of granitic bedrock. This bedrock is formally known as the Cheung Chau Granite, which is the most common granitic unit in Hong Kong. The granite is described as a medium grained and sparingly porphyritic granite. Veins of quartz and other intrusive rocks occur in association with the Cheung Chau Granite.

Superficial deposits overlie the Cheung Chau Granite in the bays located to the north and to the south of the Black Point promontory. These superficial deposits consist of alluvium, debris flow deposits and marine sediments. Alluvium is typically found in the valley floors and generally consists of coarse grained, poorly sorted clayey sand. Debris flow deposits are present at the base of the valleys and consist of poorly sorted sand, gravel, cobbles and boulders immersed in a clay/silt matrix. Marine deposits are represented by raised beaches, present beaches, shingle banks and sand bars typical of coastal areas. These deposits consist of dark grey organic–rich silt and fine sand, with abundant shell material and some well sorted, clean beach sand.

Borehole logs drilled in the area show a thick weathered profile represented by two to five metres of a fine to coarse grained sand which is a result of the chemical decomposition of the granite. This material is referred to as 'saprolite', and typically develops over granitic bedrock in humid subtropical climates. Beneath the saprolite, evidence of chemical weathering of the granite diminishes within one to two metres. Fresh granite, with closely–spaced joints, occurs beneath this weathered horizon at a depth of approximately three to eight metres below ground level.

3.5.3 Hydrogeological Conditions

Information collected during the geotechnical investigations at the proposed site indicate that groundwater is encountered at depths ranging from approximately three to five metres below ground level. At higher topographic elevations, groundwater was found at depth, within the fresh granite bedrock. In areas of lower topographic elevation, groundwater is encountered at shallow depths, within the saprolite. The data indicate that groundwater flow direction beneath the Black Point promontory follows the topographic gradient of the area, ultimately discharging to the sea. Recharge of groundwater in the area is expected to be accomplished entirely by rainfall.

Neither the granite nor the saprolite is considered a significant aquifer in the Black Point area. The granite is expected to have very limited reserves, as groundwater is restricted to fractures within the bedrock. The groundwater in the saprolite covers a relatively limited area, mostly in topographic low areas, and the reserves of the groundwater in the saprolite area expected to be small.

China Light and Power have carried out groundwater monitoring studies at Tsang Tsui, immediately adjacent to the LTPS site. Two boreholes have been sunk into the Tsang Tsui aquifer and samples analysed for sodium and chloride (as representative of salinity) and a series of trace metals. One borehole is situated adjacent to the coastal lagoons with the other 800m inland. Comparison of sodium and chloride in the samples taken from the coastal borehole showed a consistently higher level than those from the borehole further inland. This indicates that the major source of sodium and chloride is due to the ingress of seawater into the groundwater aquifer. Previous studies[1] revealed a close correlation between seasonal fluctuations in the salinity changes in the Pearl River estuary and levels recorded in the groundwater samples from September 1986 to July 1987. This correlation was not found to occur in samples taken during a later study (Wong & Kwok, 1989)[2], and was concluded to be due to the completion of the impermeable seawall of the ash lagoons on the coast in the area, which may be hindering the natural exchanges of seawater.

Concentrations at both boreholes were at least a factor of four below the WHO recommended control limits for these elements, e.g. 200 mg/l for sodium and 250 mg/l for chloride. Summary Data for borehole water quality analysis is presented in Annex V1/D.

The borehole samples were analysed for a range of trace metals; arsenic, cadmium, chromium, lead, molybdenum, selenium and boron, as well as for sulphate. To give an indication of the significance of the concentrations determined in the samples they are compared to the World Health Organisation (WHO) Guidelines for Drinking Water Quality.

The concentrations of arsenic, chromium, molybdenum, boron and selenium were below their respective detection limits for analysis. The concentrations are, therefore, assumed to be below the WHO guideline where these have been set (no limit is set for either molybdenum or boron). For both lead and cadmium measurable concentrations occurred, although for both metals all samples proved to contain concentrations below WHO guidelines. One recent sample (May 1990) indicated levels of Cadmium in excess of the WHO limit. Subsequent sampling indicated that concentrations had returned to an order of magnitude lower than the WHO limit. CLP are monitoring the situation.

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1 Travers Morgan (1987) Environmental Monitoring of the Tsang Tsui Ash Lagoons: Groundwater Monitoring, September 1986 to July 1987.

2 Wong & Kwok (1989) Environmental Monitoring of the Tsang Tsui Ash Lagoons: Groundwater Monitoring, September 1986 to August 1989.

Although the monitoring results have been compared to WHO Guidelines for Drinking Water Quality, as a means of judging the significance of the metal levels recorded, it should be noted that the Water Supplies Department, Geotechnical Control Office and the Building and Lands Department have no record of groundwater abstractions in the vicinity of the proposed site, and residential water supplies are reportedly taken from surface water sources. Therefore, groundwater is not expected to be a significant issue in the context of the proposed development.

In the event that any dwellings in Lung Kwu Sheung Tan have groundwater wells, it is not considered that the LTPS development would present a problem as the wells would be located up gradient and any possible contamination would drain away from the village areas.

3.6 Noise Environment

3.6.1 Introduction

The proposed LTPS will be located to the north of Black Point, the seawall merging with CLP's Tsang Tsui Ash Lagoons. The site will occupy the whole of the beach and bay at Yung Long. As the site is in a rural area and away from other major development, the existing noise levels are typical of a quiet rural setting. The noise environment is significantly different, however, to the south of the proposed site. The villages at Lung Kwu Tan are exposed to noise from vehicle traffic and community activities as well as some noise emitted from CPPS to the south. Moreover, road improvements through the area are in progress and have significantly altered the noise environment during the daytime.

3.6.2 Noise Monitoring Programme

To assess the existing noise environment around the proposed LTPS site, a comprehensive baseline survey has been carried out at five different locations to determine 24-hour noise profiles. Measurements were carried out under free-field conditions with microphones set at a height of 1.2 metres above ground. All the equipment used throughout the surveys complied with IEC 651:1979 (Type 1) and 804:1985 (Type 1) specification. Each item of noise monitoring equipment was calibrated immediately before and after the noise measurement to ensure validity. All the measurements were taken under fine, or mild weather conditions and none were affected by rain, fog or excessive wind speeds. The survey was carried out in late-October to early November 1990.

Five background monitoring sites were selected in the vicinity of the proposed site as follows:

Lung Kwu Tan (Site A)

The site is located at a distance of approximately one km to the north of the existing CPPS and 2.5 km to the south east of the proposed LTPS, close to the entrance of a small village called Pak Long. The exact measurement site itself was located at a basketball playground around 10m from a one-way carriageway close to the shore. Passing construction trucks and miscellaneous village activities raise the background noise levels during the daytime whilst contributions to night-time noise levels arise mainly from insects and the noise of the sea as well as intermittent noise from barking dogs and people in conversation. The measurement point has a direct line-of-sight to the CPPS whilst the proposed LTPS site is shielded by hilly terrain to the north west of the measurement point. The background noise level (Leq) varied from about 39dB(A) during the night to 68dB(A) during the day. (See Figure V1/E2(a) in Annex V1/E2)

Lung Kwu Sheung Tan (Site B)

The measurement site is located at Lung Kwu Sheung Tan, around 1.5 km to the east of the proposed LTPS. The site is rural in character with no residential dwellings in the immediate neighbourhood although there are some wooden huts scattered among the farm land. It has direct line-of-sight to the promontory at Black Point. Background noise levels consisted primarily of noise from road construction activities to the north, as is clearly shown by Figure V1/E2(b). Daytime Leq increased to about 63dB(A) during construction periods but the general background level can be as low as 37dB(A) at night.

Yung Long (Site C)

The measurement site is located at the small village of Yung Long which is just over 1 km to the north east of Black Point and, similar to Lung Kwu Sheung Tan, has a direct line of sight to the LTPS. Indeed, under Phase 2 of both development Scenarios, the site will lie with the boundary of the LTPS. It is located close to and in front of CLP's air quality monitoring station and around 20 metres from a block of residential properties. Night-time noise occurs primarily from natural sources such as the wind and the noise of waves hitting the shore whilst daytime noise is influenced by construction site activities, planes and motor vehicles. However, Yung Long is less affected by construction activities than some of the other sites and the recorded noise levels varied between 38 and 56dB(A) (Figure V1/E2(c)).

Tsang Tsui (Site D)

This site is located in the vicinity of Tsang Tsui village which is approximately 2 km to the north east of Black Point and lies close the Tsang Tsui Ash Lagoons. There are scattered residential dwellings in this area but none in the immediate vicinity of the monitoring location. Daytime noise levels were perceived primarily to originate from distant construction activities as well as intermittent noise from cars and boats while night-time noise comes primarily from natural sources such as insects. The background noise level ranged from 39 dB(A) at night to 61dB(A) during the daytime. (Figures V1/E2(d))

Nim Wan (Site E)

This measurement site is the furthest from Black Point at around 4 km from the proposed LTPS. It is located near a small village known as Nim Wan which is intended for demolition soon after the commencement of the WENT Landfill site construction project to the rear of Tsang Tsui. Daytime noise is primarily from natural sources. The background noise level varied between 40 to 63dB(A) (Figures V1/E2(e)).

3.6.3 Monitoring Results

All measurements were performed with equipment set up at ground level. Figure V1/3.6(a) indicates the approximate locations of the selected sites around the Black Point area. The results of the monitoring are presented in Annex V1/E2 and Table V1/3.6(a) summarises the existing ambient noise levels in the vicinity of the development. Moreover, one-third octave noise spectrum data for each monitoring location is shown in Annex V1/E2, Figures V1/E2(f) - (j). Figure V1/E2(f) suggests that the noise spectrum may be significantly affected by the low frequency component from the CPPS. It is, therefore, suggested that the low frequency characteristics of noise from power generation plant constitute a significant component of the noise assessment for the LTPS. It should be noted, however, that the spectra are based on real time analysis for an instantaneous sound pressure level and therefore reflect a very short (and changeable) time domain.

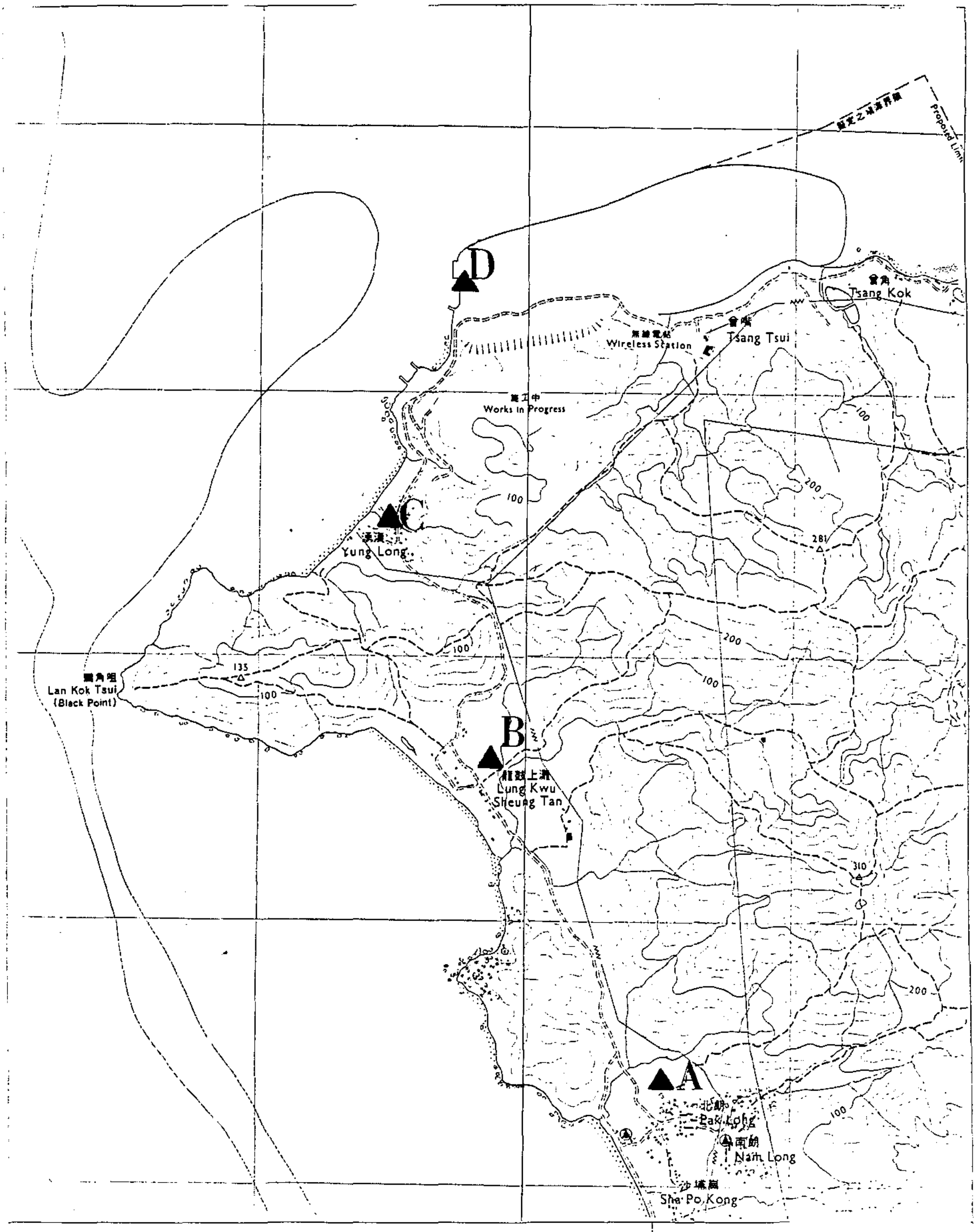

Figure V1/3.6 (a) Noise Survey Locations

ERL (Asia) Ltd.

11th Floor, Hecny Tower
9 Chatham Road,
Tsimshatsui,
Kowloon, HONG KONG

ERL

Location	Day time Leq/dB(A)	Evening & Night time Leq/dB(A) 19:00-07:00
Lung Kwu Tan	60.8 (52.7 - 68.0)	46.0 (38.8 - 60.5)
Lung Kwu Sheung Tan	56.2 (43.1 - 62.9)	45.3 (37.2 - 51.1)
Tsang Tsui	46.8 (41.4 - 60.8)	44.6 (39.1 - 53.6)
Yung Long	46.5 (40.0 - 55.5)	43.5 (37.7 - 49.6)
Nim Wan	55.9 (45.6 - 63.2)	45.3 (40.3 - 51.1)

3.6.4 Interpretation of the Results

In general, the area around the proposed site is relatively quite except when the noise levels are being affected by nearby construction activities. The daytime average noise levels range from 47 to 61dB(A) while the night-time noise levels vary from 44 to 46dB(A). These measured levels can assist in the definition of noise criteria for assessment purposes. Details of the noise assessment will be discussed in the relevant sections of this Report. However, it should be appreciated that the noise background is likely to increase due to other developments in the vicinity, such as the construction and operation of the WENT Landfill and access road and Tuen Mun Port. The existing noise levels therefore only reflect the present situation and recognition should be made of likely future changes to the noise climate.

3.7 Terrestrial Ecology

3.7.1 Introduction

The LTPS will be developed on an area encompassing the northern half of the Black Point headland and the Yung Long beach and bay area. Black Point is the western-most part of the the New Territories, extending approximately 1 km westwards of the general line of the coast. The promontory is 135m high at its highest point and is asymmetrical; the southern face being steeper than the north. It is almost completely undeveloped, with a natural vegetation cover. Much of the LTPS site will occupy land reclaimed from the sea, however, the beach at Yung Long and the area immediately inland together with the north slope of Black Point will be taken.

No known ecological studies have been carried out previously for either Black Point or Yung Long. To aquire sufficient data to assess the impacts of the LTPS on the ecological resources of the area, a survey is being conducted to establish the baseline conditions for the terrestrial ecology in the area. The survey is being conducted in two seasons, winter and summer and the results of the winter survey are summarised in this section and presented in Annex 1F.

3.7.2 Vegetation of Hong Kong

The Hong Kong climate is transitional between humid subtropical and warm temperate maritime, so that many tropical as well as temperate zone plant families are represented. Therefore, despite the small land area involved, the plant life in Hong Kong shows great diversity and richness. However, the distribution of the vegetation communities in Hong Kong is greatly disrupted and suppressed by human activities. The Hong Kong population has concentrated in areas of most favourable terrain and water supply which were formerly the areas carrying the most luxuriant vegetation. On the other hand, those areas which do not attract population due to the hilly terrain and poor water supply are areas of naturally impoverished vegetation. The decline of natural vegetation was accelerated due to widespread hillside fires and clearing. This has resulted in a general degradation of the physical environment, such that forest is rarely found to regenerate under natural conditions. Thus, those areas which currently carry "natural" vegetation are those with an unfavourable physical environment, while little of the former more luxuriant plant cover survives.

Apart from specialized coastal communities, such as marshland, and urban habitats, the terrestrial vegetation in Hong Kong can be broadly classified into: forest/woodland, scrubland and grassland. The true vegetation communities are difficult to map due to the relatively small size and fragmentary nature of areas. The actual boundaries of distribution are indistinct and in many cases the ecosystems represent transitional stages in a succession from grassland through grassland with shrubs, scrubland with trees, to a climax forest community. However, due to the widespread use of fire, Hong Kong lacks any large areas of completely natural forest. It has been estimated that on average, 5% of the total area of Hong Kong is burnt every year, but the distribution of fires is patchy, some areas are burnt annually and maintain a vegetation of grass and scrub, while others escape fire for many years and keep the relics of native forest plants. Most of the remnants of primary forest are found in the north and east of the New Territories, none is found on north Lantau or west of the Castle Peak Range.

From the conservation viewpoint, forest, be it the relic of primary forest or secondary one, should be accorded a high priority. This is because, firstly, forest is the climax stage of ecological succession which takes a long time to attain and is easily disrupted by human activities, especially in Hong Kong. Secondly, the forest habitat represents the highest level of biological diversity and species richness which is not found in the more primitive stages. Other terrestrial habitats can be ranked in terms of the height, density and area of tree and shrub cover. For the baseline study here, these criteria will be adopted to establish the ecological value and thereby the significance of conservation in the Black Point area.

3.7.3 NW New Territories

The north-west New Territories may have had a longer history of major human impact than the rest of Hong Kong. There is evidence for deforestation starting two thousand years ago at Futian, just north of the Chinese border and there was a military post near Castle Peak from the 18th century onwards. Despite the low population density, much of the area is an extreme example of the ecological devastation which results from deforestation and repeated burning on granitic slopes. As a result, there are no remnants of primary forest and only very small patches of secondary forest in the remote low flat land areas. The steep terrain of the Castle Peak Range west has mainly grass cover probably due to exposure to strong wind, thin top soil and frequent erosion.

There are a number of sensitive ecological areas in the NW New Territories including the SSSIs at Mai Po, 15km NW of the site, Lung Kwu Chau 4km to the SW, Tree Island and Sha Chau, which were all designated in the late seventies. Mai Po Marshes (381 ha) contain the largest area of dwarf mangroves in Hong Kong and it is also the only area where large numbers of duck, shore and marsh birds can regularly be seen. It thus has a very considerable scientific and educational value. Lung Kwu Chau, Tree Island and Sha Chau are important as a resting ground for the migratory birds en route to Mai Po Marshes. The characteristics and significance of the other SSSIs in NW New Territories is presented in Table V1/3.7(a).

The Site Search for the LTPS identified Lung Kwu Tan, and probably the Sheung Tan, as the only previously recorded breeding sites in Hong Kong of the giant King Crab (Tachypleus gigas).

3.7.4 The Black Point Area

The detailed description of the winter ecological survey, together with lists of the vegetation and animals found, is presented in Annex 1F. This section, however, will focus on the vegetation community present in the Black Point area in order to assess its primary importance for conservation. The vegetation cover at the area is illustrated in Figure V1/3.7(a). The criteria against which the ecological value of the area are established will be, as mentioned in Section V1/3.7.2, that forest will accord highest conservation priority whereas the other terrestrial ecosystem will be ranked depending on the state of the tree and shrub cover.

o Black Point

Most of the area surrounding Black Point exhibits signs of disturbance and appears to contain no special communities or species. The vegetation on the Black Point headland, however, is better developed. This is thought likely to be because of its isolated position, with the presence of sea on three sides, which has contributed to a reduced frequency of burning. Nearly all accessible rural areas in Hong Kong experience a high frequency of burning which maintains a grassland habitat on the hillsides with only very remote areas able to maintain natural forest.

Table V1/3.7(a)
The Characteristics and Significance of the SSSIs in NW New Territories

Sites of Special Scientific Interest	Date of Designation	Area (ha)	Significance
Mai Po Marshes	15.9.76	381	The marshes are the only area in Hong Kong where large number of duck, shore and marsh birds can regularly be seen and as such have a very considerable scientific and educational potential. The marshes contain the largest and most important area of dwarf mangroves in Hong Kong.
Mai Po Village	16.2.79	53	Egretry and a piece of Fung Shui Woodland.
Tsing Shan Tsuen	23.6.76	-	Two semi-mature trees of Cinnamomum cassia grew here. (Only one tree remains at present).
Castle Peak	5.2.80	76.4	The grassy summit is the home of the Bell-flower, Platycodon grandiflora. Interesting forested ravines occur on the east and west faces with rare shrubs like Uvaria hamiltonii.
Tai Mo Shan (part)	5.2.80	-	The breeding place for montane birds and the habitat of four species of snakes, all of which are extremely rare and three of which have been found in Hong Kong only on or near the summit.
Pak Nai	5.2.80	15.5	Of ornithological interest.
Lung Kwu Chau, Tree Island & Sha Chau	20.9.79	78.7	Of ornithological interest.
Inner Deep Bay	18.3.86	2300	Inner Deep Bay contains the largest and most important dwarf mangrove communities in Hong Kong. The huge mudflats with dwarf mangroves is a highly productive eco-system which provides feeding and resting ground for over 250 species of birds, some are considered internationally as rare or endangered. The mudflats and shallow water habitats also support a wide variety of organisms which are of economic value and scientific importance.
Tsim Bei Tsui	10.1.85	2.1	A mature mangrove community with rare species Bruguiera conjugata and the only habitat for the snail Ellobium polita.

Source: Northwestern New Territories Sub-regional Planning Statement Topic Paper 8, 1987, Town Planning Office.

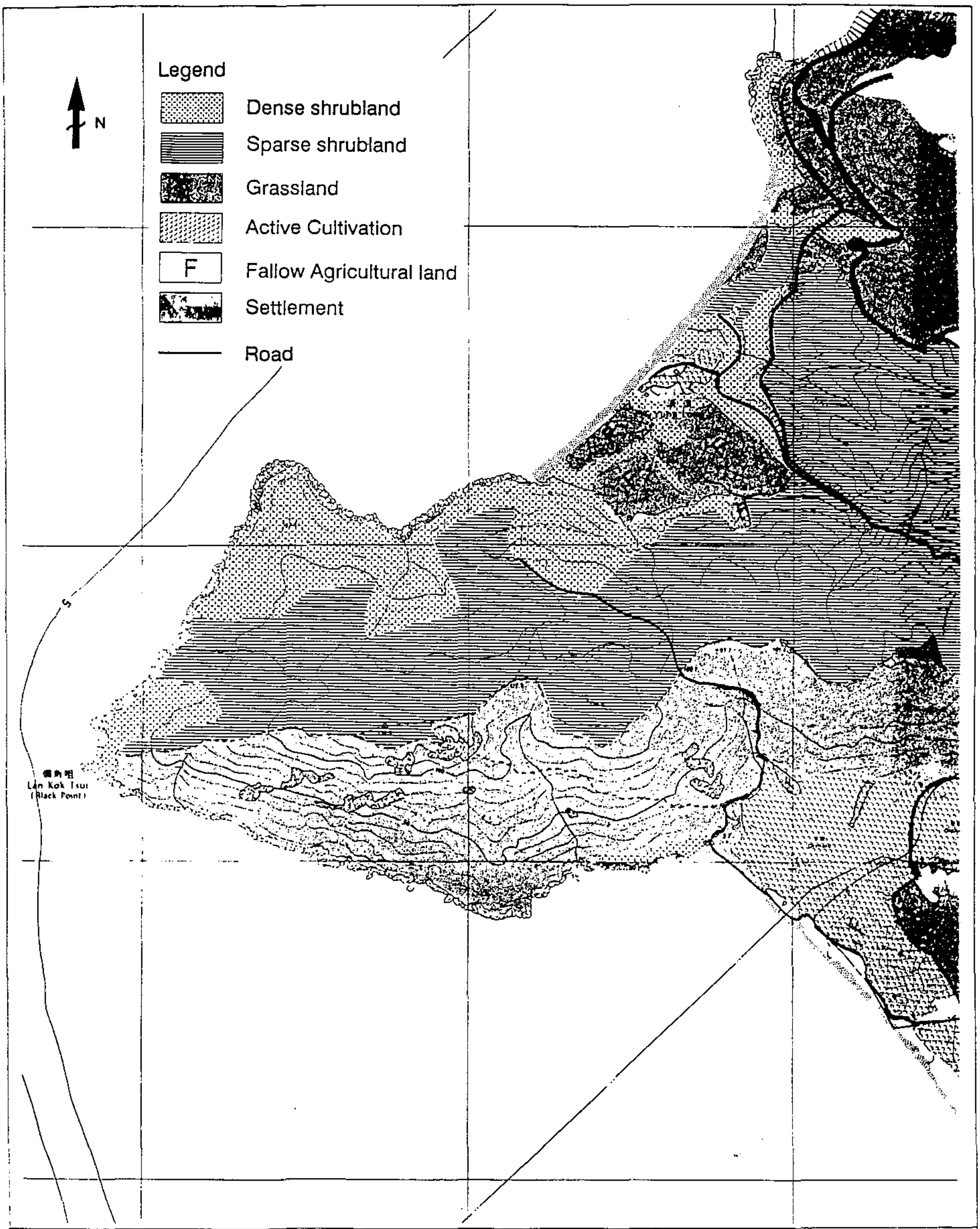

Figure V1/3.7(a)

Vegetation Pattern at Black Point

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Tsimshatsui,
Kowloon, HONG KONG

The vegetation of Black Point consists of a mosaic of grasssland, fernland and shrubland communities, with all possible intermediates. The grassland is dominated by Ischaemum spp., Arundinella sp, Eulalia sp. and Cymbopogon sp., whereas the shrubland mainly consists of Rhodomytus sp., Eurya sp and Rhaphiolepis sp. and the fernland consists of pure stands of Dicranopteris linearis. In general, probably due to the relatively sheltered position and thicker top soil on the north, the headland has denser and taller shrub cover on the north face than the south, the latter being largely grassland with scattered barren boulders. This type of vegetation is an unpromising habitat for mammals, other than the common hillside rat.

- **Yung Long**

At the back of Yung Long Beach is a levelled area which was once actively cultivated. Most of the cultivated fields have been abandoned to tall grasses and the only fields remaining in use are those associated with the single occupied dwelling. Under cultivation are fruit crops, vegetables and an orchard. A small lotus pond is also cultivated probably for its edible roots, seeds and leaves.

There is no native woodland or shrubland and the few trees are all planted and mostly exotic. Land that is not currently cultivated is covered in a varying mixture of native (e.g. Ischaemum spp and Cymbopogan sp.) and exotic weedy species (Agave sp. and Crassocephalum), whereas at the rear of the beach is an admixture of native coastal species (Hibiscus sp. and Scaevola sp.).

- **Lung Kwu Sheung Tan**

The large coastal flat land areas at Lung Kwu Sheung Tan were once very actively cultivated but now most of the fields are lost due to emigration, the construction activities of NWNT sewerage scheme and WENT landfill road, and the open vehicles dump yard. Nevertheless, traces of cultivated fields can still be seen at the beach back for fruit and vegetable crops, whereas actively maintained orchards are found further inland.

3.7.5 Conclusion

Although there are a few exotic trees at Black Point they do not constitute a significant wooded area. Better scrubland can be found at the rear of Yung Long beach and on the north face of Black Point but is also not very luxuriant. The relatively poor vegetation at Black Point is a contributor to the generally poor ecological value of the site. Thus, the conservation value of the area is very limited. This accords with the stated government policy of protecting the eastern, rather than western, coast of the New Territories as recreation and conservation priority areas.

However in the absence of areas of natural forest, the focus of the ecological impacts assessment shifts away from considering the possibility of the destruction of important on-site habitats to a consideration of individual plant and animal species of particular interest.

For the construction impact assessment, another set of assessment criteria is adopted which concern mainly the removal of individual plant and animal species which are protected or of scientific interest.

The scope of the ecological impacts study associated with the operating plant will be wider and will focus on the effects of stack emissions on ecologically sensitive areas, including the SSSIs, and on the general ecological environment of the whole territory.

3.8 Marine Ecology

3.8.1 Introduction

Marine Ecology of the proposed LTPS site at Black Point consists of semi-tropical marine and estuarine biota and is similar to that of many other locations in the western New Territories and the Islands. Black Point occupies the western-most location within the New Territories and lies at the transition point between the predominantly marine waters of Hong Kong and the freshwater discharge from the Pearl River. The Urmston Road provides the only fully marine connection between Deep Bay and The Brothers-Ma Wan Channel and as such is the main entry point for summer Pearl River flood waters into the remainder of Hong Kong marine water. The marine life of the Urmston Road and Deep Bay is less diverse compared to more typical marine habitats in central (south of Hong Kong Island) and eastern (Mirs and Daya Bays) areas, although shell and fin-fisheries remain quite productive.

Several marine ecological surveys have been conducted along Urmston Road and the south shore of Deep Bay. These studies provided background against which the marine ecological survey for the LTPS was developed. Surveys undertaken for the LTPS development will provide data regarding biotic composition and abundance and general numerical relationships between the species found at different locations. Ecological relationships will be determined by consideration of marine biotic relationships and the results of physico/chemical monitoring also being carried out for this study (V1/3.4).

Initial results from the marine ecological survey are summarised below and initial records of species compositions and occurrence are presented in Annex 1G. Field studies have included marine biotic surveys for one winter season (beach and rocky intertidal, benthic and fish surveys). The initial winter surveys will be repeated through the remaining seasons of 1991. China Light and Power is conducting marine water quality and cirulation surveys in the same areas as the marine ecological surveys and will be continuing such for 1991. These results will be integrated with those of the marine biotic surveys in the Water Quality Key Issue Report.

3.8.2 Other Studies

A number of environmental assessments have been conducted for various development projects in the western New Territories and these studies provide ecological information of relevance to this study:

- **Castle Peak Power Station** : Following commissioning of Unit A of the Castle Peak Power Station, marine biotic surveys were conducted and reported by V. Lam (Ph.D., Dissertation, 1987)[1]. Composition and community relationships indicated some impact from thermal discharges and large impacts from fisheries impingement and entrainment in the cooling water intake.

- **WENT Landfill and South Access Road** : The WENT Landfill lies 3 km northeast of the project area and should not directly affect the project area or vicinity. The landfill extends into the intertidal and shallow benthic zones; marine deliveries of refuse also have the potential to affect the local marine ecology.

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[1] V. W-W Lam (1987) Tap Shek Kok Power Plant, Hong Kong. - A Marine Environmental Impact Assessment 2 Vols Thesis for PhD. Uni of Hong Kong.

The NW New Territories Sewerage Scheme includes an outfall across the intertidal zone at Lung Kwu Sheung Tan, which discharges to Urmston Road. No marine survey is known to have been conducted in connection with this project.

- **PADS, 1989** : The PADS studies plan waterfront industrial development for the shoreline of Urmston Road and the south Deep Bay shore, from Area 38 at Tuen Mun to the Tsang Tsui Ash Lagoons. Although the Deep Bay portion is assigned to a 2006 timeframe, the planned industrial development would directly destroy all shallow marine biota and ecology within 400 m of the shore. Planned reclamation of this zone and others around Lantau Island will require large amounts of fill. Mining of marine sands in Urmston Road and the outer edges of Deep Bay will deepen the seafloor to more than 20 m depth, destroy most seafloor life and disturb and disrupt open water biota for several years. These planned losses and disturbances of seafloor and intertidal zones, together with associated disturbance increases from maritime traffic will radically alter the entire shoreline, much of the seafloor, and the open water environment adjacent to the LTPS site at Black Point. No marine survey has been conducted to quantify or assess the losses and impacts on marine biota, especially the Chinese White Dolphin.

- **Tin Shui Wai** : Marine dredging for the Tin Shui Wai development in southeastern Deep Bay has involved large seafloor areas at the mouth of Deep Bay. Marine biotic surveys were conducted for these dredging areas and physicochemical surveys of marine waters and sediments. The species composition and general distribution are as shown in Tables V1/G1(a) to (f) of Annex V1/G.

Other proposed developments in the area have the potential to affect marine ecology, for example the use of worked out borrow pits in Urmston Road for the disposal of contaminated marine sediments.

3.8.3 Shoreline Surveys

The intertidal zones of three characteristic shorelines are being surveyed as part of the marine ecological surveys; including the low angled muddy shore of Lung Kwu Sheung Tan, the rocky/bouldery shoreline of the main Black Point promontory, and the steep coarse sandy beach with muddy lower intertidal zone at Yung Long.

- **Lung Kwu Sheung Tan** beach area shows a wide tidal zonation because of the low angle of beach and shallow intertidal area. Many rocks and ridges provide good substrates for many organisms, while Black Point ridge protects the area from the direct force of the northerly winds, swells, and waves. A productive and diverse intertidal community occupies this beach. The biota include the following species:

  - Saccostrea cucullata
  - Bursa granularis
  - Nerita albicilla & N. chamaeleon
  - Morula musica
  - Parasesarma pictum
  - Monodonta neritoides
  - Haliplanella luciae

- o The steeper, coarse sandy beach of **Yung Long** contained very few species and exhibited low productivity. Coarse sand beaches are generally very unstable and attached and other organisms requiring stable sediment cannot survive; furthermore, the long fetch and shallow waters of Deep Bay allow wave-induced turbidity especially in the shallow benthic and intertidal zones to interfere with, or clog, many filter-feeders and to bury sediment-feeders. Only Ceratonereis sp. were significant.

- o The **Rocky shoreline** does not possess any significant "tide pools", of the kind which provide diverse and highly significant habitats in southern and eastern Hong Kong. A few flattened shelves have been cut along the upper levels of the north intertidal shore of the Point but these surfaces and attached organisms are inundated primarily during high tides and during high winds and swells with turbid waters from Deep Bay. Rocky crevices and exposed surfaces contain many snails and clams with some crabs and other motile animals in the lower layers of the tidal zone. The following species are represented:

  - Saccostrea cucullata
  - Thais clavigera
  - Haliplanella luciae
  - Patelloida pygmea
  - Tetraclita squamosa
  - Entermorpha compressa
  - Nodilttorina exigua, N. millegrana & N.pyramidalis

3.8.4 Benthic Survey

Benthic surveys were conducted with grabs and bottom trawling nets and collected at least three diverse marine communities. Cohesive bottom sediments allowed good penetration and retrieval of grabs, while trawls were hampered by rocks and debris.

The benthic biota consisted primarily of soft, muddy bottom species, but the diversity appeared to be less than that reported in more open water marine conditions south of Lantau, Lamma, and Hong Kong islands and east of Hong Kong and the New Territories. The biota was dominated by urchin, turritella snails, worms, and crabs and appear similar to those reported from near the Castle Peak Power Station and from more easterly portions of Deep Bay.

The following species have been identified from the seafloor around Black Point:

–	Polychaetes: (Worms)	Mediomastus californiensis Nephtys lyrochaeta Ophelina acuminata Hexapus anfractus
–	Echinoderms: (urchins, starfish, & sand dollars)	Protankyra bidentata Paracaudina spp. Temnopleurus reevsii Ophiura kinbergii
–	Snails:	Turritella terebra
–	Holothuroids:	Protankyra bidentata
–	Crabs:	Eucrate spp.

3.8.5 Fish Survey

Fish sampling was conducted using suspended gill nets and bottom trawling nets. Fish surveys were conducted on the north, west, and south sides of Black Point in water depths of 5 to 25 m. Bottom trawls were severely hampered by large rocks and debris. Fish surveys will be repeated three more times (one per season). Various species of Jellyfish, Crabs, Shrimps and fish were found.

3.8.6 Marine Mammals

During marine surveys of Urmston Road and Deep Bay, the Chinese White (Pearl River) Dolphin (Annex V1/G2) was observed around Black Point on two occasions. The Dolphin herd numbered 6 to 10 (with at least one individual of 2 m length) and was generally moving towards Deep Bay or the Pearl River Delta (north towards Shekou). A dolphin-sighting record programme organised by the World-wide Fund for Nature indicates over 20 sightings of the Dolphin since the programme began in November 1990. These sightings are generally in the Ma Wan-Brothers Channel, Urmston Road and Deep Bay, north of Black Point.

Little is known of the Dolphin's habitat requirements, although it was first noted in the Pearl River Delta and near Canton; some reports indicate that the Dolphin has been sighted in Canton during the last 20 years. The sightings, and the sighting map (V1/G2(a)), show a high degree of concentration in the Ma Wan to Black Point area. Two sightings west of Urmston Road may only be indicative of higher use, due to the low frequency of observers visiting the boundary area either to the west of Urmston Road and west of Lantau Island or in the northern portion of Deep Bay. Virtually all observations are during the day and under favourable weather conditions and their habits and requirements during the storms, high river flows, and at night are unknown. One report was for south of Lantau near Ngan Kwong Wan (Discovery Bay) and one for Victoria Harbour (dead individual which may have floated out on the tides. Based on the existing information, the Dolphin appears to be a coastal/estuarine Dolphin rather than a "true" river dolphin, restricted to freshwater habitats, and can use much of the coastal area of Hong Kong. Restrictions of sightings to the western New Territories may indicate either a foodchain preference or perhaps needs for periodic freshwater (e.g., removal of marine/frewater parasites) or for more turbid waters (avoidance of predators).

The Chinese (Pearl River) Dolphin is a rare species of cetacean and should be considered as a threatened or endangered species. Habitat conservation has been recognised as important as individual preservation and should be applied to the local Dolphin, before it assumes the same status as the Yangtze River Dolphin (PRC Class I, similar to that for the Panda).

3.8.7 General Ecological Conditions

Transitions and migratory routes between major ecological communities or areas are generally more important than the more central portions of broad uniform ecological areas. Small changes in these areas may allow one community to fully replace another, or removal of one portion of a migratory (daily or seasonal) route may completely cut off both ends of the general distribution of community (e.g., dredging of a peninsula to form two islands, a dam or lock across a river, etc). Black Point represents such a transition and connector for the northern estuarine and southern marine communities. Loss of a similar sized area in the West Lamma Channel would have less biotic impact than that at Black Point and at the mouths of Silver Mine Bay, Tolo Channel, or Long Harbour.

Because of the transitional character of the Black Point area, many species may be near the edge of their ecological limits, especially those physiochemical aspects of temperature, salinity, and suspended solids and biotic aspects of parasitism and competition. Physiochemical parameters are known to be the most affected by marine construction of thermal power stations, and the Castle Peak Power Station is known to selectively impinge and entrain many species. The LTPS could be expected to more strongly influence the marine ecology than that of the CPPS because of the former's position in respect to the marine/estuarine transition. Similarly the more confined migratory route around Black Point will be more affected by the same size power station and reclamation than at Pillar Point/Castle Peak which are adjacent to the wider portions of the Brothers and south Urmston Road channel.

ANNEXES

ANNEXES

ANNEX V1/A

METEOROLOGICAL DATA

TECHNICAL DATA ANNEXES

ANNEX A - METEOROLOGICAL DATA

Meteorological data provided in this Annex has been acquired and compiled from many different sources, but the primary source of all important meteorological data in Hong Kong is the Royal Observatory (Natham Road, Kowloon). Some following data are derived from various other reports, others are generalised information from the Royal Observatory, and detailed records for four local stations and radiosondes have been acquired from the computerised data base files of the Royal Observatory.

The Royal Observatory is not responsible for the selection, review, and analyses of the data and has not participated in any interpretations from these data with regard to the dispersion of air pollutants.

A.1 Data Collection and Processing Techniques

Meteorological data are available primarily from the Royal Observatory, Hong Kong (Natham Road) and generally include all basic meteorological elements and many specialised data sets for particular projects. Earlier, the Royal Observatory conducted numerous studies related to dispersion of air pollutants and to air pollutant relationships with general meteorological conditions (e.g., visibility and exhaust particulates). Some records and studies from this earlier air pollution study period have been reviewed and incorporated into this data annex. The Royal Observatory currently does not conduct any air pollution or exhaust dispersion analyses (such being conducted by EPD and other agencies) but still continues wind monitoring in support of studies of general and local wind circulation in Hong Kong.

A.1.1 General Recording Stations

The Royal Observatory operates more than ten recording station in the New Territories and five other stations on Hong Kong and other islands (Figure V1/A1; including Chek Lap Kok, off Lantau Island). Several stations are continuously recording but only three have complete and long-term (more than five years) monitoring periods. Other meteorological data are somewhat limited either in the duration of recording (less than five years) or the range of elements monitored at local stations. Some monitoring stations have been discontinued or were established only for limited, project-related monitoring of specific elements (wind, rainfall, or general meteorologic elements only).

Royal Observatory data are generally recorded at near-ground level (10+ m) stations on exposed sites. Unfortunately, some stations may come under the subsequent interference of surrounding urban development, and the King's Park Station was discontinued as Hong Kong's primary station and replaced by the remote Waglan Island Station. The primary stations, either King's Park and especially Waglan Island) lie more than 25 km ESE and SE of Black Point and across several 200+ m high ridges and islands. Ground-level data from these primary stations can not be assumed to be representative of conditions occurring along the western side of Castle Peak Ridge.

Four local stations were selected for further review as to best represent meteorological conditions around the LTPS site following discussions with Royal Observatory staff: Tai Mo Shan, Chek Lap Kok, Tuen Mun, and Lau Fau Shan (Figure V1/A1). The latter three stations are those with the most complete wind records in the western New Territories and encircle the Castle Peak Power Station and the Black Point site for the LTPS on the south, east, and northeast. No station of the Royal Observatory lies to the other westerly or northerly directions (closest stations being Macau or Chi Wan, respectively). These three stations lie below 100 m elevation and recordings may be influenced by each station's relationship to open water and ridges and should not be expected to correlate well with those of Waglan Island or central Hong Kong (e.g., King's Park). Each station does have some differences of exposure compared to the conditions expected at Castle Peak Power Station or the LTPS site, but they do represent the best available data sources for this general area of the western New Territiories.

The fourth station selected is the Tai Mo Shan Station which lies above 500m at 24 km directly east of Black Point. Although the station is distant from the LTPS site, its data could reflect conditions within the summertime westerly wind fields from the LTPS and could be expected to indicate downwind conditions at approximately the altitude of the exhaust plume from the power station (500+ m).

Detailed meteorological data from these four local recording stations were acquired from Royal Observatory computer data bases and consist of 10-minute averaged recordings (six per hour) for a total of six representative one-month intervals during 1989 and 1990 (Samples of the data are shown in Section A.5). The specific temporal selection was influenced by requiring a period during which all four stations were simultaneously operating, early 1989 to mid 1990. Monthly means for 1989 (12 each) were also acquired as summaries of complete records for the four stations; 1990 summaries were not available for inclusion in this annex.

A.1.2 Shen Zhen

No direct numerical information was accessed from the PRC which has some monitoring stations in Shen Zhen and Chi Wan (Special Economic Zone, Guangdong Province) on the northeastern and northern sides of Deep Bay and more than 25 and 9 km, respectively, from the LTPS site. Some general meteorological data were available and are included for general consideration.

A.1.3 Radiosonde Data

The earlier physical wind tunnel modelling for design of the Castle Peak Station "B" Stack did not use any upper wind data and indicated this to be a deficiency (CERL, 1981). Upper wind data (66–26,000m) have been collected from the Royal Observatory since 1981; meteorological conditions are recorded and derived during ascents of radiosonde and radiowind devices, twice a day for each (08:00, 20:00; 02:00, 14:00, respectively). Recorded data include: height (m), atmospheric pressures (hPa, or mb), temperature (celsius, shown times 10), relative humidity (%), dew point temperatures (celsius, shown times 10), and wind direction (degrees from north) and speed (m/s, shown times 10) from near surface (1000 hPa, 50+m) to high altitude (20 hPa, 26,500 m). The 1988 data have been summarised in the Royal Observatory Summary of Radiosonde-Radiowind Ascents made in 1988 (1989) which included the meteorological means at 13 basic pressure heights (1000, 850, 700 hPa, etc., and up to 20 hPa, see Section A.2 for winds) and the inferred freezing and tropopause levels and lapse rates.

Selected radiosonde data are further summarised in Sections A.2 and A.5 and demonstrate variations with altitude and the needs, as indicated in the CERL study (1981), for additional information through the mixing zones (up to 2000 m) above Black Point and Hong Kong. Higher altitude winds and lapse rates change markedly, especially during the morning in August, from those at surface (e.g., wind direction changes of 50+ degrees, speed changes of time 4, and 50% changes in lapse rates).

Data were selected from the lower 2000+ m of recordings following review of the data, heights of stack plumes and surrounding terrain features, and maximum mixing heights (and wind tunnel scaled heights). More than ten years of data for twice daily recordings at 40–70m intervals are recorded (total of more than 250,000 sets of data) and available in magnetic files. From this large data base, over 12,000 sets of meteorological data (6 months x 30 days x 2/day x 35 recording levels of each ascent) were selected for representative months during the same period for surface recording data

(January, April, and August in 1989 and 1990, see Sections A.2 and A.5 for samples of data format). These and other available data will be used in the development of further modelling for the Key Issues Study for Air Quality.

Data from August 1989 and 1990 are summarised in Sections A.2 and A.5 for the present review and further indications of the variations expected between the near-ground surface and upper mixing layer winds and temperature changes.

A.2 Wind Speed and Direction

A.2.1 General Wind Data

The following numerical summary (Table V1/A1-A2) and wind roses (Figure V1/A2-/A17) provide general review of the variations across Hong Kong (from Waglan Island on southeast to Lau Fau Shan/Tsim Bei Tsui on northwest, total distance of about 50 km) and into Shen Zhen (Special Economic Zone, Guangdong Province; 45 km north of Waglan). Many general Royal Observatory data are included in or referred to as "Hong Kong" climatological elements, although the older King's Park (near Royal Observatory offices) Station lies 20 km northwest of the newer station on Waglan Island.

Unfortunately, annual wind summaries and roses provide little reliable information of "worst-" or "best-" case wind conditions for daily and hourly dispersals in Hong Kong, since the Territory lies in the highly variable transitional zone between continental and marine, temperate and tropical, monsoonal and maritime, and even China Sea and Pacific maritime climatic units and lies downwind of the turbulent zone induced by the Himalayan ranges. As indicated in Figures V1/A19-A22 and V1/A2-A18, the seasonal variations of wind directions and speeds and the geographical differences between local areas of Hong Kong and adjacent PRC (Chi Wan and Shen Zhen) further demonstrate the highly variable conditions in this general locale.

A.2.2 Wind Fields

The Royal Observatory has conducted and is conducting integrated studies of the wind circulation over the entire Hong Kong area and have computer models for complex wind field studies. Examples of earlier modelling results for Deep Bay (including Urmston Road, Castle Peak Power Station, and the site of the LTPS) are shown in Figures V1/A23-A24. More recent studies may become available during the development of the Key Issues Studies and may be reported in later submittals.

A.2.3 Local Recording Station

Based on earlier review of these general wind data, detailed wind data (10-minute averages, for speed and direction) were acquired from the Royal Observatory for four recording station: Tai Mo Shan, Chek Lap Kok, Lau Fau Shan, and Tuen Mun (Example of Data is shown in Table V1/A3; Royal Observatory 1989 data summaries reflect incomplete directional records in Section A.5, Tables V1/A20-A23). The former three stations (Figure V1/A1) are up to 20 km apart, but the latter three stations lie along a relatively unobstructed 20-km NNE-SSW zone across the west end of the New Territories. Tai Mo Shan data from this elevated "ground-level" monitoring station may be comparable with those from the radiosonde recordings and may allow comparsions between surface and upper mixing layer winds.

Figures V1/A25-A29 show the frequency distributions and short-term temporal variations for August (1989) winds at the three western-most recording stations, while Figures V1/A30-/A31 show more detailed variations during one day in August at Chek Lap Kok and Lau Fau Shan.

A.2.4 Radiosondes

Radiosonde data for 1988 were compiled and reported by the Royal Observatory (1989) and some important data from the lower altitude data and summarised in Table V1/A4. Additional detailed data from the 1989 and 1990 radiosonde recordings were also acquired from the Royal Observatory and an example of the data is presented in Table V1/A5. These data can be compiled in various manners, and as an example, data were compiled for the comparable August 1989 periods (Figures V1/A32–A37) as those at the local recording stations (Figure V1/A25–A31) for comparisons and for demonstration of changes between ground-level and higher altitude winds.

A.3 Rainfall

A.3.1 General Rainfall and Distribution

As indicated in Section A.2, the sub-tropical, marginal monsoonal location of Hong Kong exposes the area to moderate to high rainfalls and occasionally to extremely high rainfall during typhoons. Annual, monthly, daily, and hourly rainfall data from various recording and gauging stations are presented in Tables V1/A6–A7 and /A9–A10 and Figure V1/A40 (later in Section A.5, general meteorological Tables V1/A18–A23, also include rainfall values). Based on these data and those from various rain gauges scattered throughout Hong Kong, the Royal Observatory developed the distribution of rainfall in Hong Kong (Figure V1/A38). This figure shows the wide variation throughout the New Territories and the relatively moderate (low for the Territory) rainfall of less than 1600 mm for the site of the LTPS, which is supported by rainfalls recorded at western New Territories stations (Figure V1/A39 and Table V1/A5). Summarised 1989 rainfall data were acquired for Chek Lap Kok and Lau Fau Shan (not available for Tuen Mun and Tai Mo Shan; Tables V1/A18–A19).

The impacts of rainfall and evaporation and evapotranspiration are shown in Tables V1/A8–A10 and Figures V1/A40–41.

Available rainfall summaries and rainfall relationships with summertime typhoons are included also for the Shen Zhen (PRC) station (Figures V1/A42–A45) and further demonstrate the seasonal and geographical variation in this area.

A.3.2 Rainfall Composition

Currently no significant recordings are made regarding the composition of rainfall in Hong Kong. However, earlier studies by the Royal Observatory did review rainfall compositions as indicators of the "washing" effect of rainfall on particulate and other pollutants. Summertime reduction of airborne "natural" dust (Table V1/A11) was suspected to relate to the "washing" of particulate matter. General chemical data, acidity, and correlations from these studies are also included in Tables V1/A12–A16.

A.4 Insolation

Insolation data are not widely collected and have not been specifically acquired for this study. General summarised insolation and insolation-related meteorological data are included in Figures V1/A46–48) for Hong Kong and Shen Zhen (PRC) and also in Section A.5 (clouds, solar radiation, sunshine, and visibility; Tables V1/A18–A19,A24; Figures V1/A49–A51).

A.5 Temperature, Relative Humidity, and Barometric Pressure

A.5.1 General Meteorological Conditions

Both generalised information and detailed recordings from the four ground–level stations are available for Hong Kong and Shen Zhen (PRC), and general information are presented in Tables V1/A18–24. Samples of detailed recordings are presented in Table V1/A3.

A.5.2 Radiosonde

Interpreted radiosonde data from 1988 (Royal Observatory, 1989) provided estimates of lapse rates which were summarised in Table V1/A4 as they relate to the lower altitude layer where detailed data were acquired for various months in 1989 and 1990. This latter radiosonde data for pressure and temperatures are available in computer files (formats as shown in Table V1/A25). Morning temperature data from radiosonde ascents in August 1989 were summarised in Figure V1/A32–A37 demonstrate their potential use.

Table VI/A1

Hong Kong Wind Direction and Percentage Frequency (1884–1939, 1947–1960)

	Percentage Frequency of Wind Direction at the Royal Observatory (1884 - 1939 & 1947 - 1960)																	Mean Wind Speed	Mean Rainfall Amount	Mean Rainfall Duration	Mean absolute humidity (at Kai Tak)	Mean No. of hrs. with visibility less than 3.2km at R.O.
	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Calm	kt	mm	hr	$g m^{-3}$	hr
JAN	9	8	6	16	26	14	2	1	<0.5	<0.5	1	1	2	2	1	5	5	7.7	31.7	50	9	9.9
FEB	7	7	5	17	29	15	2	1	1	1	1	1	2	2	1	4	4	8.9	46.9	66	10	14.6
MAR	4	4	4	19	33	17	2	2	1	1	1	1	1	1	1	2	5	9.4	72.2	84	13	28.7
APR	2	3	3	18	32	16	2	3	4	3	1	2	2	2	1	1	5	8.7	135.8	82	16	23.8
MAY	1	2	2	14	26	14	3	4	6	6	5	4	3	2	1	1	6	8.3	292.7	91	20	7.1
JUN	<0.5	1	2	8	15	9	4	7	11	12	12	7	3	2	1	1	5	7.6	401.2	67	22	3.4
JUL	1	1	2	7	13	10	6	7	9	9	9	7	5	3	2	1	9	6.8	371.7	72	22	3.2
AUG	1	1	2	8	14	9	4	5	6	6	8	8	7	5	2	1	12	6.5	370.8	72	22	4.3
SEP	4	4	5	13	20	12	4	3	2	2	2	4	5	3	2	3	11	7.8	278.8	59	20	4.3
OCT	8	9	8	17	25	14	3	2	1	1	<0.5	1	1	1	1	4	5	8.5	99.2	32	15	0.9
NOV	11	11	9	16	22	12	2	1	<0.5	<0.5	1	1	1	1	1	5	5	7.8	43.1	31	12	1.3
DEC	11	10	7	15	22	12	2	1	<0.5	<0.5	1	1	2	1	1	6	6	7.2	24.9	37	10	3.0
YEAR	5	5	5	14	23	13	3	3	4	3	3	3	3	2	1	3	7	7.9	2168.8	763	16	104.5

<·············· 70% ·············>

Table V1/A2

Monthly Mean Wind Direction and Speed at Tsim Bei Tsui

Month	Prevailing Direction (degree from N)	Mean Speed (m/s)
January	060	2.9
February	070	3.1
March	090	3.7
April	110	3.6
May	110	2.9
June	130	3.0
July	150	3.2
August	130	2.7
September	060	3.0
October	060	2.9
November	050	2.9
December	050	2.7

Source : Royal Observatory

Table V1/A3

Example of Detailed Meteorological Data, including Wind Directions and Speeds

DETAILED METEOROLOGICAL DATA FROM CHEK LAP KOK RECORDING STATION

PERIOD: August, 1989

Yr/Mon	Day/ Hr	Wind Direction (Degree)	Wind Speed (m/s)	Temp. (x10) (Cels.)	Baromtr. Pressure (x10 hPa)
8908	100	280	21	265	10023
8908	100	280	18	265	10021
8908	100	290	18	264	10021
8908	100	290	24	263	10019
8908	100	310	29	264	10019
8908	101	310	27	265	10019
8908	101	310	32	265	10019
8908	101	330	32	264	10018
8908	101	320	29	264	10018
8908	101	330	33	264	10018
8908	101	330	25	263	10017
8908	102	350	15	262	10017
8908	102	350	13	262	10017
8908	102	10	24	261	10018
8908	102	20	23	261	10017
8908	102	360	18	260	10017
8908	102	340	19	259	10017
8908	103	340	20	258	10017
8908	103	340	22	257	10016
8908	103	330	19	258	10016
8908	103	330	26	259	10016
8908	103	320	35	259	10016
8908	103	360	27	257	10017
8908	104	10	24	256	10017
8908	104	10	28	255	10017
8908	104	360	23	254	10017
8908	104	360	23	254	10017
8908	104	350	26	253	10017
8908	104	350	30	253	10017
8908	105	350	33	252	10017
8908	105	350	29	252	10017
8908	105	360	27	251	10017
8908	105	360	28	251	10017
8908	105	10	24	251	10016
8908	105	360	31	250	10017
8908	106	340	30	251	10017
8908	106	330	22	251	10018
8908	106	300	28	252	10019
8908	106	310	38	254	10020
8908	106	330	43	254	10021
8908	106	40	32	253	10022
8908	107	10	28	252	10022
8908	107	340	27	253	10023
8908	107	350	22	255	10024
8908	107	10	17	256	10025
8908	107	30	14	255	10026
8908	107	20	17	254	10026

Table V1/A4

Summary of Important Data from Lower Altitudes of Radiosonde-Radiowind Ascents

		Annual Means			August Means		
Time	Pressure	Elevation	Winds Direction	Wind Speed	Wind Elevation	Wind Direction	Speed
Radiosonde Data-Low Altitude Winds							
08:00							
	700	3143	247	4	3135	210	4
	850	1512	166	2	1486	199	5
	1000	117	84	2	63	251	5
20:00							
	700	3140	252	6	3135	234	5
	850	1507	226	2	1484	227	4
	1000	108	94	2	59	221	1
Radiowind Data-Low Altitude Winds							
02:00							
	700		248	6		235	5
	850		191	2		207	4
	1000		92	2		219	1
	Surface		98	1		160	1
14:00							
	700		244	5		216	5
	850		207	2		215	4
	1000		103	2		258	1
	Surface		115	1		215	1

(Data arranged by pressure, reflects decreasing elevations)

Table V1/A5

Example of Detailed Radiosonde Meteorological Data, including Wind Directions and Speeds

RADIOSONDE DATA FROM ASCENTS AT THE ROYAL OBSERVATORY

(King's Park Releases, Each Day 08:00 and 20:00 hours)

August, 1989

YrMon DayHr No.Obs	Elev. metres	Atmos. Pres. (hPa)	Tempr. Celius (x 10)	Relat. Humid. (%)	Dew Pt. Temp. (x10 C)	Winds Direct. (degree)	Winds Veloc. (x10 m/s
8908	66	9947	248	81	213	280	20
108	130	9876	243	74	194	278	19
30	199	9799	239	69	179	313	21
	270	9720	235	67	170	333	29
	336	9646	232	67	168	342	35
	402	9575	228	68	166	347	42
	468	9502	223	69	164	351	48
	538	9425	218	71	163	360	51
	610	9347	213	72	161	360	54
	680	9273	208	74	160	360	57
	754	9194	203	74	155	360	57
	830	9113	205	73	155	362	53
	906	9033	205	73	155	359	59
	987	8950	203	74	155	358	57
	1069	8865	200	75	155	358	56
	1151	8782	198	74	150	360	54
	1234	8699	197	74	150	360	52
	1314	8618	192	75	147	360	49
	1394	8538	187	76	144	360	47
	1472	8462	181	79	144	360	45
	1547	8388	174	81	141	362	43
	1620	8316	169	82	138	362	41
	1693	8246	164	81	132	362	38
	1762	8179	165	78	127	362	37
	1831	8113	165	75	121	362	37
	1895	8053	164	74	118	360	36
	1960	7992	161	74	115	360	35
	2024	7931	159	75	115	360	35
	2093	7868	158	76	116	358	35
	2166	7801	153	78	115	358	34
8908	66	9928	281	79	241	260	10
120	127	9861	277	76	231	264	9
34	192	9789	273	74	223	315	24
	259	9715	268	73	216	322	40
	326	9641	264	74	214	323	54
	391	9572	260	75	212	325	65
	458	9499	255	76	210	326	74
	523	9430	251	78	210	329	80
	585	9363	247	77	204	328	84
	650	9295	245	76	200	328	88
	718	9223	239	77	196	330	90
	785	9153	234	78	194	331	88
	851	9084	230	78	190	333	88
	915	9018	225	78	185	334	89
	981	8950	221	78	181	337	81
	1049	8880	218	77	176	341	73
	1117	8811	215	75	169	347	66
	1185	8743	212	74	164	352	63
	1251	8677	208	74	160	366	52
	1317	8611	203	75	157	375	48
	1384	8544	199	76	156	378	54

Table V1/A6

King's Park Mean Hourly Rainfalls for Winter and Summer (and other data)

Hour H.K.ST.T.	No. of Hours with fog at Kai Tak in 8 years	Mean Wind Speed at R.O. in Winter (Dec., Jan., Feb.)	Mean Wind Speed at R.O. in Summer (June, July, Aug.)	Mean Hourly Rainfall at R.O. in Winter (Dec., Jan., Feb.)	Mean Hourly Rainfall at R.O. in Summer (June, July, Aug.)	Mean Relative Humidity (all months)
		kt	kt	mm	mm	%
01	4	8.9	6.0	0.05	0.41	84.7
02	5	9.0	6.2	0.05	0.45	84.9
03	5	8.9	6.3	0.06	0.52	85.1
04	10	8.9	6.2	0.06	0.57	85.3
05	9	8.8	6.1	0.05	0.67	85.3
06	12	8.7	6.0	0.04	0.68	85.1
07	20	8.7	6.1	0.05	0.69	84.6
08	16	8.8	6.5	0.05	0.78	82.7
09	14	9.2	7.4	0.05	0.80	79.4
10	6	9.9	8.2	0.05	0.70	76.9
11	5	10.0	8.7	0.04	0.63	74.8
12	3	10.2	8.9	0.04	0.62	73.6
13	2	10.2	8.9	0.05	0.60	72.8
14	0	10.2	9.1	0.04	0.51	72.5
15	0	10.1	9.0	0.04	0.45	73.3
16	1	9.9	8.7	0.04	0.41	74.4
17	1	9.5	8.4	0.04	0.35	76.3
18	3	9.0	7.8	0.04	0.32	78.7
19	6	8.5	6.9	0.04	0.31	80.6
20	7	8.5	6.3	0.04	0.34	82.0
21	6	8.7	6.0	0.04	0.38	82.8
22	3	8.8	5.9	0.05	0.34	83.4
23	2	8.9	5.9	0.05	0.34	84.1
24	3	9.0	5.9	0.05	0.37	84.3
Period of Record	1955 - 1962	1948 - 1959	1948 - 1959	1884 - 1939; 1947 - 1964	1884 - 1939; 1947 - 1964	1947 - 1958

Table V1/A7

Mean Monthly Rainfalls for Gauging Stations in Western New Territories

	Station 118	Station 119	Station 17	Mean
January	18.2	19.0	22.9	20.0
February	27.9	27.0	37.2	30.7
March	39.9	53.8	51.2	48.3
April	127.1	122.8	125.0	124.9
May	236.3	240.8	236.6	237.9
June	305.8	297.8	283.7	295.7
July	266.7	232.8	280.4	259.9
August	271.3	233.8	302.9	269.3
September	184.8	178.0	231.5	198.1
October	83.5	97.4	93.6	91.5
November	22.7	30.8	34.9	29.4
December	23.8	20.3	25.4	23.2
Total	1608.0	1554.3	1725.3	1628.9

Note:

Mean annual rainfall (mm) at other landfill sites in Hong Kong

Jordan Valley	2400
Ma Yau Tong	2400
Junk Bay	2300
Shuen Wan	2200
Gin Drinkers Bay	1950
Pillar Point Valley	1600

Table V1/A8

Mean Monthly Pan Evaporation at King's Park (1958–1975)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm
1958	94.8	86.6	99.2	123.9	177.0	179.7	212.4	193.4	195.2	204.7	169.9	132.8	1869.6
1959	128.2	50.0	122.4	145.1	160.7	149.6	154.9	182.2	177.2	204.4	167.0	122.7	1764.4
1960	117.0	137.2	104.5	109.1	132.1	153.3	203.1	148.8	171.4	170.9	138.3	119.2	1704.9
1961	125.4	72.8	125.9	126.9	159.3	180.5	164.7	135.9	125.1	185.4	129.9	113.8	1645.6
1962	116.3	105.3	101.7	105.1	148.6	138.9	176.5	190.6	169.9	170.4	133.4	149.7	1706.4
1963	156.2	111.3	115.8	136.3	208.9	153.5	167.3	170.7	166.5	187.0	133.1	130.4	1837.0
1964	72.7	84.4	124.5	153.0	181.0	151.8	186.9	152.5	131.2	153.1	179.0	147.7	1717.8
1965	153.1	93.7	139.6	114.6	146.5	133.3	164.5	180.9	168.0	126.7	123.6	103.6	1648.1
1966	99.3	98.4	99.7	109.2	203.8	167.0	182.6	182.4	241.8	209.9	178.8	117.5	1890.4
1967	139.0	92.7	114.7	121.9	179.1	186.5	208.7	163.5	169.3	183.1	147.4	151.2	1837.1
1968	118.3	65.7	105.2	139.3	145.6	135.7	186.9	167.2	165.8	170.6	151.0	117.8	1669.1
1969	78.5	83.3	100.9	119.6	177.4	151.9	181.4	190.1	186.2	173.1	158.3	139.4	1740.1
1970	106.0	100.0	61.3	133.9	128.3	144.9	190.9	146.6	142.8	146.0	136.8	100.8	1538.3
1971	123.6	93.7	124.4	146.1	134.6	161.1	187.0	170.4	173.8	187.3	168.8	103.2	1774.0
1972	101.5	72.0	144.7	119.4	136.3	155.1	167.5	159.3	156.6	136.5	128.2	109.3	1586.4
1973	85.6	83.2	118.7	97.0	152.5	130.6	116.2	130.1	134.7	176.9	139.8	165.1	1530.4
1974	101.4	88.8	97.9	121.1	160.6	145.1	206.3	182.2	146.6	162.5	114.3	104.6	1631.4
1975	72.0	93.9	75.0	127.9	130.0	140.2	173.6	148.6	154.6	147.6	117.0	116.9	1497.3
Mean	110.5	89.6	109.8	125.0	159.0	153.3	179.5	166.4	165.4	172.0	145.3	123.7	1699.5

Table V1/A10

Daily Rainfalls, Evaporation, and Temperatures for Months of 1989 at King's Park

JAN 1989

DAY	Air Temperature Maximum	Air Temperature Mean	Air Temperature Minimum	Wind Movement	Pan-water Temperature Maximum	Pan-water Temperature Mean	Pan-water Temperature Minimum	Evaporation	Rainfall Total	Rainfall Inst. Maximum
	°C	°C	°C	km	°C	°C	°C	mm	mm	mm/h
1	18.9	15.6	12.3	39	21.3	16.0	10.7	2.0	---	---
2	18.7	16.6	14.4	32	19.5	16.4	13.3	1.9	---	---
3	21.6	18.5	15.3	74	23.3	18.9	14.4	2.3	---	---
4	22.0	18.2	14.3	77	24.0	19.1	14.2	2.1	3.4	17†
5	17.0	15.7	14.3	86	17.8	16.1	14.4	0.4	2.1	1
6	17.3	16.7	16.0	98	17.7	16.5	15.3	0.3‡	0.1	‡‡‡
7	23.9	20.3	16.8	20	23.8	19.9	15.9	0.9	---	---
8	25.2	22.3†	19.3	21	28.4†	23.6†	18.8	1.8	TRACE	‡‡‡
9	23.3	19.9	16.4	83	27.2	21.9	16.6	1.7	0.3	‡‡‡
10	19.2	17.9	16.6	75	20.3	18.3	16.2	1.4	TRACE	‡‡‡
11	25.6†	21.1	16.6	25	28.4†	23.0	17.5	2.2	0.3	4
12	18.0	14.3	10.5	43	19.0	15.4	11.8	0.7	5.3†	11
13	11.0	8.7‡	6.4‡	78	13.0	10.3	7.5	0.4	3.8	12
14	10.7	9.0	7.3	63	11.9	9.8‡	7.6	1.1	0.1	‡‡‡
15	12.4	10.5	8.6	44	13.1	10.0	6.9‡	1.6	---	---
16	13.8	11.9	9.9	35	13.5	11.1	8.7	1.0	---	---
17	19.2	16.3	13.3	41	24.3	18.1	11.9	2.2	---	---
18	24.0	19.5	14.9	42	27.9	21.7	15.5	1.2	---	---
19	19.0	17.0	15.0	64	22.9	18.6	14.2	2.6	---	---
20	23.6	19.2	14.7	59	26.9	20.5	14.0	3.1†	TRACE	‡‡‡
21	17.9	16.3	14.7	34	20.2	17.6	15.0	1.5	TRACE	‡‡‡
22	18.6	13.7	8.7	76	21.5	14.3	7.0	3.1†	---	---
23	19.3	14.5	9.7	36	21.0	14.3	7.6	2.9	---	---
24	18.5	15.4	12.3	71	20.3	15.0	9.7	2.5	0.1	‡‡‡
25	16.4	14.9	13.3	10	16.4	14.9	13.4	0.5	1.2	‡‡‡
26	15.5	12.9	10.2	63	15.7	13.3	10.8	0.5	3.7	4
27	14.4	11.9	9.3	82	16.9	13.5	10.0	1.2	0.5	‡‡‡
28	12.0	10.7	9.4	109†	12.3	11.2	10.0	1.4	0.1	‡‡‡
29	17.7	14.5	11.2	75	19.9	14.8	9.7	2.0	---	---
30	16.4	14.9	13.3	47	16.7	14.5	12.2	1.4	---	---
31	21.3	17.7	14.1	27	22.4	17.8	13.1	1.7	---	---
Mean	18.5	15.7	12.9	56	20.2	16.3	12.4	1.6		
Total				1729				49.6	21.0	

‡‡‡ Rate of rainfall too small to be recorded by the instrument
‡ Minimum
† Maximum

Table V1/A11

Monthly Natural Airborne Dust Levels

(1967 - 1968)

Month	Level of Radio-activity in Picocuries per cubic metre of air
JAN	61.1
FEB	48.6
MAR	34.8
APR	28.7
MAY	17.7
JUN	12.8
JUL	21.4
AUG	17.1
SEP	28.4
OCT	40.6
NOV	48.0
DEC	50.1

Table V1/A12

Statistical Analysis of Rainwater Acidity (Weekly Samples in 1984/85)

Statistical Analysis of Rainwater Acidity (Weekly Samples)

Site	Kwun Tong	Central/Western
Maximum	3.62	3.42
Minimum	7.77	6.78
Median	4.56	4.76
90 percentile	3.70	3.60
75 percentile	4.00	4.25
25 percentile	5.25	5.75
Weighted mean	4.28	4.31

Note : (1) All figures shown are pH values.

(2) Since increased acidity results in a decrease in pH, maximum acidity corresponds to minimum pH.

(3) The sampling period covered is from 4.10.84 to 31.3.85, i.e. the complete winter period for 1984/85.

Table V1/A13

Total Dry and Wet Deposition (Winter, 1984/85)

Site		Kwun Tong		Central/Western	
Deposition		Wet	Dry	Wet	Dry
Weight of Wet Deposition (T/ha)		3761	-	3957	-
Weighted Mean pH		4.28	7.31	4.31	8.31
Number of Samples		12	25	12	25
Filtrate (kg/ha)	NH_4^+	2.24	0.52	2.59	0.23
	NO_3^-	0.88	0.32	1.05	0.29
	SO_4^{2-}	13.35	9.21	15.55	7.53
	Cl^-	8.33	7.15	9.40	6.98
	Na	3.96	3.29	3.73	3.28
	K	0.91	0.85	0.74	0.58
	Ca	1.92	9.98	2.39	7.65
	Mg	0.51	0.53	0.40	0.47
Residue (kg/ha)	Weight of Residue	25.56	324.33	14.10	147.01
	Si	4.55	73.05	1.88	32.13
	Ca	0.14	4.55	0.09	9.93
	Al	1.30	19.68	0.53	7.52
	Fe	0.57	8.23	0.29	3.88

Note : (1) The sampling period covered is from 4.10.84 to 31.3.85, i.e. the complete winter period for 1984/85. Twelve wet deposition samples and twenty five dry deposition samples were collected.

(2) The data capture for wet deposition is 100% and 96% for dry deposition.

(3) The total rainfall recorded during the sampling period by the Royal Observatory was 449.7 mm.

Table V1/A14

Correlations for Wet Deposition, Kwun Tong

		pH	SAMPLE	NH_4^+	NO_3^-	SO_4^{2-}	CL^-	NA^+	K^+	CA^+	MG^+	RESIDUE
pH	1	1.000										
SAMPLE	2	-0.167	1.000									
NH_4^+	3	-0.249	0.868	1.000								
NO_3^-	4	-0.293	0.852	0.979	1.000							
SO_4^{2-}	5	-0.167	0.857	0.983	0.959	1.000						
CI^-	6	-0.193	0.605	0.465	0.550	0.422	1.000					
NA^+	7	-0.126	0.683	0.502	0.557	0.450	0.978	1.000				
K^+	8	-0.112	0.919	0.861	0.868	0.875	0.507	0.565	1.000			
CA^+	9	0.463	0.605	0.416	0.455	0.420	0.718	0.776	0.557	1.000		
MG^+	10	-0.119	0.656	0.502	0.561	0.448	0.981	0.996	0.550	0.778	1.000	
RESIDUE	11	0.706	0.400	0.361	0.345	0.460	0.014	0.074	0.546	0.604	0.072	1.000
SI	12	0.769	0.310	0.276	0.258	0.380	-0.029	0.025	0.442	0.581	0.026	0.990
CA	13	0.927	0.021	-0.038	-0.065	0.068	-0.076	-0.028	0.126	0.549	-0.019	0.866
AL	14	0.833	0.238	0.193	0.178	0.294	-0.035	0.017	0.355	0.602	0.020	0.972
FE	15	0.746	0.358	0.286	0.285	0.363	0.046	0.114	0.499	0.651	0.115	0.975
SO_2	16	-0.250	0.204	0.104	0.107	0.122	-0.149	-0.174	0.003	-0.165	-0.213	-0.026
NO_2	17	-0.325	-0.047	-0.056	-0.029	-0.139	-0.109	-0.104	-0.122	-0.155	-0.124	-0.236
SR	18	0.013	-0.433	0.666	-0.596	-0.634	0.140	0.072	-0.415	-0.115	0.072	-0.359
RF	19	-0.284	0.809	0.770	0.858	0.795	0.666	0.624	0 851	0.514	0.615	0.361
ION	20	-0.572	-0.187	-0.001	0.134	0.014	0.241	0.048	-0.109	-0.282	0.072	-0.388
ACIDITY	21	-0.163	0.855	0.981	0.959	1.000	0.422	0.448	0.876	0.422	0.447	0.466

		SI	CA	AL	FE	SO_2	NO_2	SR	RF	ION	ACIDITY
SI	12	1.000									
CA	13	0.916	1.000								
AL	14	0.992	0.947	1.000							
FE	15	0.971	0.870	0.965	1.000						
SO_2	16	-0.015	-0.164	-0.032	-0.103	1.000					
NO_2	17	-0.254	-0.283	-0.249	-0.247	0.476	1.000				
SR	18	-0.313	-0.086	-0.270	-0.279	-0.301	-0.412	1.000			
RF	19	0.275	-0.028	-0.206	0.305	0.211	-0.085	-0.230	1.000		
ION	20	-0.384	-0.409	-0.404	-0.449	0.175	0.144	0.229	0.330	1.000	
ACIDITY	21	0.386	0.074	0.300	0.368	0.124	0.143	-0.629	0.799	0.020	1.000

Table V1/A15

Correlations for Wet Deposition, Central and Western Hong Kong

		pH	SAMPLE	NH_4^+	NO_3^-	SO_4^{2-}	CL^-	NA^+	K^+	CA^+	MG^+	RESIDUE
pH	1	1.000										
SAMPLE	2	-0.418	1.000									
NH_4^+	3	-0.506	0.825	1.000								
NO_3^-	4	-0.434	0.958	0.900	1.000							
SO_4^{2-}	5	-0.506	0.837	0.979	0.890	1.000						
Cl^-	6	-0.321	0.454	0.561	0.647	0.543	1.000					
NA^+	7	-0.419	0.700	0.874	0.861	0.850	0.857	1.000				
K^+	8	-0.417	0.933	0.872	0.929	0.850	0.461	0.718	1.000			
CA^+	9	-0.190	0.383	0.523	0.521	0.410	0.549	0.691	0.446	1.000		
MG^+	10	-0.350	0.469	0.804	0.646	0.740	0.626	0.886	0.537	0.800	1.000	
RESIDUE	11	-0.081	0.571	0.523	0.633	0.449	0.468	0.664	0.504	0.816	0.683	1.000
SI	12	0.065	0.459	0.466	0.528	0.379	0.380	0.586	0.494	0.836	0.672	0.866
CA	13	0.121	0.185	0.406	0.247	0.336	0.009	0.271	0.192	0.469	0.469	0.315
AL	14	0.149	0.381	0.364	0.422	0.282	0.320	0.501	0.411	0.831	0.592	0.891
FE	15	0.048	0.518	0.544	0.595	0.448	0.406	0.633	0.576	0.871	0.703	0.909
SO_2	16	0.142	0.114	-0.197	0.103	-0.175	0.275	0.114	-0.146	0.336	-0.004	0.476
NO_2	17	0.108	-0.124	-0.069	-0.144	-0.164	-0.367	-0.278	-0.022	-0.039	-0.142	-0.262
SR	18	0.146	-0.532	-0.746	-0.541	-0.705	-0.039	-0.437	-0.668	-0.305	-0.519	-0.325
RF	19	0.382	0.815	0.614	0.829	0.643	0.738	0.676	0.756	0.255	0.280	0.371
ION	20	-0.774	0.461	0.671	0.452	0.702	0.214	0.447	0.434	0.013	0.431	0.020
ACIDITY	21	-0.505	0.844	0.975	0.895	1.000	0.546	0.849	0.853	0.404	0.732	0.450

		SI	CA	AL	FE	SO_2	NO_2	SR	RF	ION	ACIDITY
SI	12	1.000									
CA	13	0.262	1.000								
AL	14	0.957	0.298	1.000							
FE	15	0.899	0.431	0.927	1.000						
SO_2	16	0.290	0.034	0.358	0.274	1.000					
NO_2	17	-0.194	0.444	-0.210	-0.115	-0.314	1.000				
SR	18	-0.309	-0.591	-0.326	-0.477	0.503	-0.212	1.000			
RF	19	0.247	-0.128	0.190	0.290	0.222	-0.285	-0.188	1.000		
ION	20	-0.105	0.095	-0.226	-0.096	-0.366	-0.151	-0.440	0.312	1.000	
ACIDITY	21	0.377	0.327	0.280	0.446	-0.163	-0.173	-0.696	0.653	0.697	1.000

Table V1/A16

Factor Analysis of Rainwater Composition, Kwun Tong and Central/Western

A) KWUN TONG

Rotated Factor Loadings (Pattern)

		Factor 1	Factor 2	Factor 3
H^+	1	0.008	0.027	1.000)
NH_4^+	2	0.970)	0.239	-0.015
NO_3^-	3	0.936)	0.305	0.119
SO_4^{2-}	4	0.968)	0.186	0.001
CL^-	5	0.251	0.943)	0.213
NA^+	6	0.282	0.958)	0.019
K^+	7	0.805)	0.353	-0.125
CA^+	8	0.248	0.751)	-0.305
MG^+	9	0.283	0.955)	0.044
	VP	3.684	3.594	1.170

B) CENTRAL/WESTERN

		Factor 1	Factor 2
H^+	1	0.728)	0.065
NH_4^+	2	0.880)	0.475
NO_3^-	3	0.720)	0.562
SO_4^{2-}	4	0.867)	0.454
CL^-	5	0.135	0.931)
NA^+	6	0.539	0.843)
K^+	7	0.811)	0.333
CA^+	8	0.233	0.671)
MG^+	9	0.528	0.714)
	VP	3.873	3.401

The VP for each factor is the sum of the squares of the elements of the column of the factor pattern matrix corresponding to that factor. When the rotation is orthogonal, VP is the variance explained by the factor.

Table V1/A18

General Meteorological Conditions at Royal Observatory

Monthly Normals of the Meteorological Elements for the 30 Years 1951 - 1980

Extreme Values between 1884 - 1939 and 1947 - 1989

in Hong Kong

MONTH	PRESSURE				AIR TEMPERATURE						DEW POINT	WET-BULB TEMPERATURE	RELATIVE HUMIDITY				AMOUNT OF CLOUD	RAINFALL								BRIGHT SUNSHINE		WIND		
	Absolute Maximum	Mean	Absolute Minimum	Mean Diurnal Range	Absolute Maximum	Mean Daily Maximum	Mean	Mean Daily Minimum	Absolute Minimum	Mean Diurnal Range			Mean	Mean at 0200 hours	Mean at 1400 hours	Absolute Minimum		Total	Duration	Number of Days with 0.1 mm or more	Number of Days with 25.0 mm or more	Number of Days with 50.0 mm or more	Maximum Hourly	Maximum Daily	Maximum Monthly	Duration	Percentage of Possible	Prevailing Direction *	Mean Speed *	Maximum Gust †
	hPa	hPa	hPa	hPa	°C	°C	°C	°C	°C	°C	°C	°C	%	%	%	%	%	mm	h				mm	mm	mm	h	%	degrees	km/h	km/h
January	1 035.4	1 020 1	1 003.1	4.1	26.9	18.7	15.6	13.2	0.0	5.5	9.8	12.8	71	76	62	10	59	26.9	45	6.00	0.13	0.03	21.8	99.8	214.3	151.5	45	070	23.8	103
February	37.7	18.6	998.3	4.1	27.8	18.8	15.9	13.7	2.4	5.1	11.7	13.7	78	82	70	13	71	41.9	66	8.33	0.30	0.07	24.6	86.1	241.0	108.7	34	070	23.1	110
March	32.4	16.2	1 001.9	4.1	30.1	21.3	18.5	16.3	4.8	5.0	15.0	16.5	82	87	74	16	76	54.8	85	9.30	0.50	0.07	50.1	125.4	428.0	101.4	27	070	21.4	103
April	28.4	13.1	999.9	3.8	33.4	25.0	22.1	20.0	9.9	5.0	18.9	20.1	83	88	75	22	76	139.4	78	10.63	1.90	0.77	92.4	156.2	436.5	120.2	32	080	19.0	96
May	20.2	09.1	981.1	3.3	35.5	28.9	25.9	23.9	15.4	5.0	22.7	23.7	83	88	76	23	73	298.1	91	15.30	3.27	1.87	104.8	520.6	1 241.1	162.6	40	090	18.8	140
June	14.4	06.2	973.8	3.0	35.6	30.4	27.7	25.6	19.2	4.8	24.5	25.4	84	88	77	29	75	431.8	90	20.60	5.17	2.27	108.2	382.6	962.9	159.2	39	090	20.9	194
July	14.8	05.4	975.0	3.2	35.7	31.6	28.6	26.3	21.7	5.3	25.0	26.0	81	86	74	43	66	316.8	65	18.43	4.03	1.87	100.7	534.1	763.8	230.9	56	230	18.9	158
August	16.3	05.2	961.6	3.5	36.1	31.2	28.2	25.9	21.6	5.3	24.8	25.8	83	87	76	41	66	413.4	77	18.20	5.33	2.40	82.1	334.2	672.2	206.0	52	090	18.2	209
September	18.2	08.5	953.2	3.6	35.2	30.5	27.5	25.2	18.4	5.3	23.2	24.6	79	84	71	26	62	320.4	71	14.87	4.00	1.87	84.0	325.5	844.2	188.5	51	090	21.4	230
October	24.5	14.0	977.3	3.6	34.3	27.9	25.0	22.7	13.5	5.2	19.3	21.4	72	77	64	21	52	121.2	43	8.37	1.07	0.67	71.6	252.2	718.4	209.9	58	090	26.1	184
November	33.2	17.6	974.9	3.8	31.8	24.4	21.3	18.9	6.5	5.5	14.9	17.7	69	75	59	17	52	34.7	33	5.10	0.40	0.17	44.2	149.2	224.2	191.5	58	080	26.8	175
December	33.5	19.8	1 004.6	4.0	28.7	20.8	17.7	15.2	4.3	5.6	11.4	14.4	69	75	60	14	52	25.3	34	4.50	0.17	0.10	51.7	177.3	206.9	179.3	54	080	24.9	104
Year	1 035.4	1 012.8	953.2	3.7	36.1	25.8	22.8	20.6	0.9	5.2	16.4	20.2	78	83	70	10	65	2 224.7	777	139.63	26.27	12.13	108.2	534.1	1 241.1	2 011.6	45	080	21.9	230
Date on which the Extreme Value was recorded	6 January 1903		1 September 1962		19 August 1900				18 January 1893							16 January 1959							12 June 1966	19 July 1926	May 1889					5 September 1964
Observed at	Royal Observatory																									King's ‡ Park		Waglan Island		

‡ Observations in years 1947 - 1960 were taken at the Royal Observatory

* 1953 - 1982

† 1953 - 1989

SAVE AND RECYCLE

Table VI/A19

General Meteorological Conditions at King's Park

Factor	Unit	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Pan Evaporation (E)	mm/month	110.5	89.6	109.8	125.0	159.0	153.3	179.5	166.4	165.4	172.0	145.3	123.7
Vapour Pressure Difference ($e_w - e_d$) (VPD)	mbar	5.7	4.9	5.6	6.8	8.8	9.1	10.6	10.2	10.0	9.5	7.8	6.4
Air Temperature (T_a)	°C	15.5	15.8	18.8	22.4	26.2	27.6	28.5	28.2	27.5	25.0	21.6	17.8
Water Temperature (T_w)	°C	15.1	16.0	19.1	23.1	27.1	28.6	29.7	29.3	28.0	24.7	21.0	17.1
Sunshine Duration (SD)	h/month	160.3	110.9	116.4	125.5	174.7	158.2	231.7	211.4	189.2	206.3	185.1	175.4
Solar Radiation (SR)	MJ/(m^2 day)	12.9	12.6	13.2	15.2	18.0	17.3	20.1	18.2	17.8	16.8	14.3	12.8
Wind Movement (U)	km/day	160	166	179	168	159	147	128	121	141	166	169	153
Relative Humidity (RH)	%	65	75	77	80	80	81	80	80	76	68	66	65
Barometric Pressure (P)	mbar	1020.2	1018.8	1016.3	1013.3	1009.1	1005.9	1005.0	1005.3	1008.3	1013.9	1017.5	1019.5

Table V1/A20

Monthly Means of Meteorological Elements at Tai Mo Shan, 1989

MONTH	ATMOSPHERIC PRESSURE Abs. Max.	Mean	Abs. Min.	M.D.R.	AIR TEMPERATURE Abs. Max.	Mean Max.	Mean	Mean Min.	Abs. Min.	M.D.R.	DEW Point	WET BULB	RELATIVE HUMIDITY Mean	Abs. Min.	RAINFALL Total	Freq.	Hourly Max.	Daily Max.	WIND Prev. Dir.	Mean Speed	Max. Gust
	hPa	hPa	hPa	hPa	°C	°C	°C	°C	°C	°C	°C	°C	%	%	mm	Days	mm	mm	deg.	m/s	m/s
JAN	******	******	******	****#	****	****	****	****	****	****#	****#	****#	**	**#	******	***	*****	*****#	***#	8.5#	29.7#
FEB	******	******	******	****#	****	****	****	****	****	****#	****#	****#	**	**#	******	***	*****	*****#	***#	7.4#	22.5#
MAR	******	******	******	****#	****	****	****	****	****	****#	****#	****#	**	**#	******	***	*****	*****#	***#	7.3#	23.1
APR	******	******	******	****#	****	****	****	****	****	****#	****#	****#	**	**#	******	***	*****	*****#	***#	7.7#	23.8#
MAY	******	******	******	****#	****	****	****	****	****	****#	****#	****#	**	**#	******	***	*****	*****#	***#	9.3#	46.1#
JUN	******	******	******	****#	****	****	****	****	****	****#	****#	****#	**	**#	******	***	*****	*****#	***#	9.2#	30.3#
JUL	******	******	******	****#	****	****	****	****	****	****#	****#	****#	**	**#	******	***	*****	*****#	***#	8.0#	50.6#
AUG	******	******	******	****#	****	****	****	****	****	****#	****#	****#	**	**#	******	***	*****	*****#	***#	5.6#	25.4#
SEP	******	******	******	****#	****	****	****	****	****	****#	****#	****#	**	**#	******	***	*****	*****#	***#	7.4#	23.0#
OCT	******	******	******	****#	****	****	****	****	****	****#	****#	****#	**	**#	******	***	*****	*****#	***#	8.2#	30.1#
NOV	******	******	******	****#	****	****	****	****	****	****#	****#	****#	**	**#	******	***	*****	*****#	***#	7.2#	21.0#
DEC	******	******	******	****#	****	****	****	****	****	****#	****#	****#	**	**#	******	***	*****	*****#	***#	5.4#	20.4#
YEAR	******	******	******	****#	****	****	****	****	****	****#	****#	****#	**	**#	******	***	*****	*****#	110#	7.6#	50.6#
Date of record	*** **		*** **		*** **				*** **					*** **			*** **	*** **			JUL 18

REMARKS :-

- Abs. - Absolute
- Max. - Maximum
- Min. - Minimum
- M.D.R. - Mean diurnal range
- Freq. - Number of days with measureable rainfall (i.e. >= 0.5mm)
- Prev. Dir. - Prevailing wind direction
- YEAR - Yearly results
- Date of record - Date of recording max. or min.
- # - All values to the left under the same element are derived from incomplete data
- ****** - Data not available

SAVE AND RECYCLE

Table VI/A21

Monthly Means of Meteorological Elements at Tuen Mun, 1989

MONTH	ATMOSPHERIC PRESSURE Abs. Max.	Mean	Abs. Min.	M.D.R.	AIR TEMPERATURE Abs. Max.	Mean Max.	Mean	Mean Min.	Abs. Min.	M.D.R.	DEW Point	WET BULB	RELATIVE HUMIDITY Mean	Abs. Min.	RAINFALL Total	Freq.	Hourly Max.	Daily Max.	WIND Prev. Dir.	Mean Speed	Max. Gust
	hPa	hPa	hPa	hPa	°C	°C	°C	°C	°C	°C	°C	°C	%	%	mm	Days	mm	mm	deg.	m/s	m/s
JAN	******	******	******	****#	24.8	17.1	14.4	12.1	5.0	5.0#	11.2#	12.8#	82	43#	******	***	*****	*****#	***#	2.7#	19.9#
FEB	******	******	******	****#	24.3	19.2	16.3	13.5	7.6	5.6#	11.9#	13.9#	76	30#	******	***	*****	*****#	***#	2.2#	18.5#
MAR	******	******	******	****#	26.0	21.1	18.3	15.7	10.1	5.3#	13.7#	15.7#	75	39#	******	***	*****	*****#	***#	2.3#	16.9#
APR	******	******	******	****#	29.5	24.3	22.3	20.8	17.9	3.4#	19.3#	20.4#	84	41#	******	***	*****	*****#	***#	2.2#	17.4#
MAY	******	******	******	****#	30.7	27.3	25.0	23.2	19.4	4.0#	21.6#	22.7#	82	50#	******	***	*****	*****#	***#	2.6#	25.4#
JUN	******	******	******	****#	32.7	29.7	27.6	26.0	23.4	3.7#	23.2#	24.6#	77	54#	******	***	*****	*****#	***#	2.7#	18.0#
JUL	******	******	******	****#	34.8	30.9	28.6	26.5	20.9	4.4#	23.5#	25.1#	75	43#	******	***	*****	*****#	***#	2.6#	28.5#
AUG	******	******	******	****#	33.9	31.4	28.5	26.3	24.1	5.0#	24.0#	25.4#	77	49#	******	***	*****	*****#	***#	1.5#	15.7#
SEP	******	******	******	****#	32.4	30.6	27.9	[illegible]	20.9	5.2#	22.6#	24.3#	74	34#	******	***	*****	*****#	***#	[illegible]	[illegible]
OCT	******	******	******	****#	30.6	27.5	24.8	22.6	17.5	4.9#	18.6#	20.9#	69	38#	******	***	*****	*****#	***#	2.4#	[illegible]
NOV	******	******	******	****#	28.4	24.1	20.8	15.0	[illegible]	6.0	13.3	16.7	63	22	******	***	*****	*****#	***#	3.0#	22.4
DEC	******	******	******	****#	24.2	20.1	16.9	13.9	10.1	6.2#	11.1#	13.8#	70	21#	******	***	*****	*****#	***#	1.5#	16.1#
YEAR	******	******	******	****#	34.8	31.4	28.6	12.1	5.0	4.8#	17.8#	19.6#	75	21#	******	***	*****	*****#	030#	[illegible]	28.5#
Date of record	*** **		*** **		[illegible]				[illegible] 14					DEC 02			*** **	*** **			[illegible]

REMARKS :-

Abs. - Absolute

Max. - Maximum

Min. - Minimum

M.D.R. - Mean diurnal range

Freq. - Number of days with measureable rainfall (i.e. >= 0.5mm).

Prev. Dir. - Prevailing wind direction

YEAR - Yearly results

Date of record - Date of recording max. or min.

- All values to the left under the same element are derived from incomplete data

****** - Data not available

SAVE AND RECYCLE

Table V1/A22

Monthly Means of Meteorological Elements at Chek Lap Kok, 1989

MONTH	ATMOSPHERIC PRESSURE Abs. Max.	Mean	Abs. Min.	M.D.R.	AIR TEMPERATURE Abs. Max.	Mean Max.	Mean	Mean Min.	Abs. Min.	M.D.R.	DEW Point	WET BULB	RELATIVE HUMIDITY Mean	Abs. Min.	RAINFALL Total	Freq.	Hourly Max.	Daily Max.	WIND Prev. Dir.	Mean Speed	Max. Gust
	hPa	hPa	hPa	hPa	°C	°C	°C	°C	°C	°C	°C	°C	%	%	mm	Days	mm	mm	deg.	m/s	m/s
JAN	1023.3	1019.8	1009.6	3.8#	25.3	17.1	14.5	12.5	4.8	4.5#	11.6#	13.1#	83	37#	23.5	7	2.0	9.5#	***#	5.2#	[illegible]
FEB	1025.9	1019.2	1010.2	4.4#	26.9	19.5	16.2	13.8	7.6	3.5#	11.6#	13.8#	76	9#	1.0	1	.5	1.0#	***#	5.9#	[illegible]
MAR	1028.7	1016.8	1009.3	4.3#	27.5	21.8	18.5	16.4	10.6	5.4#	12.0#	15.1#	68	19#	35.0	4	9.5	31.5#	***#	5.7#	21.4#
APR	1018.1	1011.3	1003.9	3.8#	29.8	24.6	22.1	20.6	17.9	4.0#	18.5#	19.8#	80	39#	152.5	11	15.5	50.0#	***#	5.9#	[illegible]
MAY	1016.2	1009.2	996.0	3.5#	31.1	27.4	24.9	23.0	19.3	4.3#	22.2#	23.1#	86	49#	[illegible]	19	37.5	135.0#	***#	6.8#	[illegible]
JUN	1012.8	1008.1	1003.2	2.9#	31.9	29.8	27.2	25.4	22.5	4.4#	24.3#	25.2#	85	65#	120.0	9	25.5	79.5#	***#	6.1#	25.4#
JUL	1012.9	1006.5	989.8	4.1#	35.2	31.4	26.3	26.0	21.0	5.3#	23.6#	24.9#	78	48#	28.5	4	4.5	21.5#	***#	5.1#	35.7#
AUG	1019.9	1005.5	1000.4	3.1#	34.0	31.6	28.3	26.0	22.7	3.5#	24.3#	25.3#	80	49#	178.0	12	42.5	79.5#	***#	3.0#	[illegible]
SEP	1016.0	1008.0	995.7	3.6#	32.9	30.3	27.4	25.2	21.1	3.0#	22.9#	24.4#	78	31#	112.0	14	12.0	29.0#	***#	[illegible]	[illegible]
OCT	1021.7	1014.3	1007.1	3.5#	31.1	27.5	24.3	22.5	16.0	4.9#	16.7#	20.3#	71	35#	11.5	[illegible]	1.0	3.5#	***#	3.8#	[illegible]
NOV	1022.5	1020.0	1013.1	4.2	28.7	24.3	20.9	18.4	10.3	[illegible]	13.9	17.0	66	23	6.0	2	1.0	4.0	***#	4.2#	17.2
DEC	[illegible]	1020.8	1014.3	4.2#	23.5	19.9	17.0	14.7	10.4	3.2#	11.5#	14.1#	72	23#	20.0	3	1.5	7.0#	***#	4.1#	[illegible]
YEAR	1032.5	1013.3	989.8	3.8#	35.2	31.6	22.4	12.5	4.8	3.8#	17.9#	19.7#	76	9#	1055.0	94	42.5	135.0#	100#	5.2#	[illegible]
Date of record	NOV 23		JUL 18		JUL 16				JAN 24					FEB 25			AUG 05	MAY 20			[illegible]

REMARKS :-

Abs. - Absolute

Max. - Maximum

Min. - Minimum

M.D.R. - Mean diurnal range

Freq. - Number of days with measureable rainfall (i.e. >= 0.5mm)

Prev. Dir. - Prevailing wind direction

YEAR - Yearly results

Date of record - Date of recording max. or min.

- All values to the left under the same element are derived from incomplete data

****** - Data not available

SAVE AND RECYCLE

Table V1/A23

Monthly Means of Meteorological Elements at Lau Fau Shan, 1989

MONTH	ATMOSPHERIC PRESSURE Abs. Max.	Mean	Abs. Min.	M.D.R.	AIR TEMPERATURE Abs. Max.	Mean Max.	Mean	Mean Min.	Abs. Min.	M.D.R.	DEW Point	WET BULB	RELATIVE HUMIDITY Mean	Abs. Min.	RAINFALL Total	Freq.	Hourly Max.	Daily Max.	WIND Prev. Dir.	Mean Speed	Max. Gust
	hPa	hPa	hPa	hPa	°C	°C	°C	°C	°C	°C	°C	°C	%	%	mm	Days	mm	mm	deg.	m/s	m/s
JAN	1028.5	1019.5	1010.1	4.1#	26.7	17.8	14.6	12.1	5.1	5.7#	10.3#	****#	76	35#	36.5	10	3.5	13.5#	***#	3.5#	14.6#
FEB	1025.8	1018.9	1009.6	4.6#	27.4	20.6	16.3	13.3	7.1	7.3#	10.1#	****#	65	15#	3.5	3	1.0	2.5#	***#	3.6#	16.5#
MAR	1028.8	1016.4	1009.1	4.6	29.0	22.7	18.5	15.4	10.1	7.2	11.9	****#	67	23	28.5	6	4.0	20.5	***#	3.5#	14.9
APR	1017.8	1010.7	1003.4	3.9#	31.8	26.2	22.7	20.6	17.6	5.6#	18.5#	****#	76	35#	212.5	15	27.5	57.5#	***#	3.5#	17.7#
MAY	1016.1	1009.0	997.1	3.5#	33.1	28.7	25.3	23.1	19.5	5.5#	21.5#	****#	80	55#	573.0	17	37.0	199.5#	***#	4.0#	22.2#
JUN	1012.6	1007.8	1002.7	3.1#	34.3	31.7	28.1	25.7	22.9	6.0#	23.4#	****#	76	51#	42.0	11	9.5	15.5#	***#	4.1#	15.1#
JUL	1012.7	1006.2	991.0	4.1#	36.0	32.5	28.9	26.2	21.1	6.3#	23.5#	****#	73	41#	114.0	9	6.5	59.5#	***#	4.0#	23.9#
AUG	1010.6	1005.0	997.8	3.3#	35.4	32.3	28.7	26.0	24.1	6.3#	24.0#	****#	77	43#	223.5	13	32.5	48.5#	***#	2.8#	18.4#
SEP	1015.7	1007.7	998.2	3.8#	34.1	31.3	27.9	25.2	20.3	6.0#	22.6#	25.1#	74	35#	27.5	7	9.5	13.0#	***#	3.1#	13.5#
OCT	1020.7	1015.1	1007.2	3.9#	32.2	28.1	24.6	22.3	17.9	5.8#	20.0#	21.6#	76	41#	5.5	2	3.5	4.0#	***#	3.6#	15.0#
NOV	1032.7	1019.9	1012.7	4.4#	30.0	25.2	21.4	18.4	10.6	6.8#	14.5#	17.5#	66	28#	11.0	1	5.5	11.0#	***#	3.6#	13.0#
DEC	1031.1	1021.0	1014.6	4.2#	26.0	20.8	17.2	13.8	10.5	7.0#	12.3#	14.5#	75	31#	30.5	7	2.5	9.0#	***#	3.0#	11.5#
YEAR	1032.7	1013.1	991.0	3.9#	36.0	32.5	22.8	12.1	5.1	6.2#	17.7#	19.6#	73	15#	1303.0	101	37.0	199.5#	070#	3.5#	23.9#
Date of record	NOV 30		JUL 19		JUL 12				JAN 14					FEB 25			MAY 21	MAY 21			JUL 19

REMARKS :-

Abs. - Absolute

Max. - Maximum

Min. - Minimum

M.D.R. - Mean diurnal range

Freq. - Number of days with measureable rainfall (i.e. >= 0.5mm)

Prev. Dir. - Prevailing wind direction

YEAR - Yearly results

Date of record - Date of recording max. or min.

- All values to the left under the same element are derived from incomplete data

****** - Data not available

LFS : Temperature may overread when winds are from the southeast since March 1988

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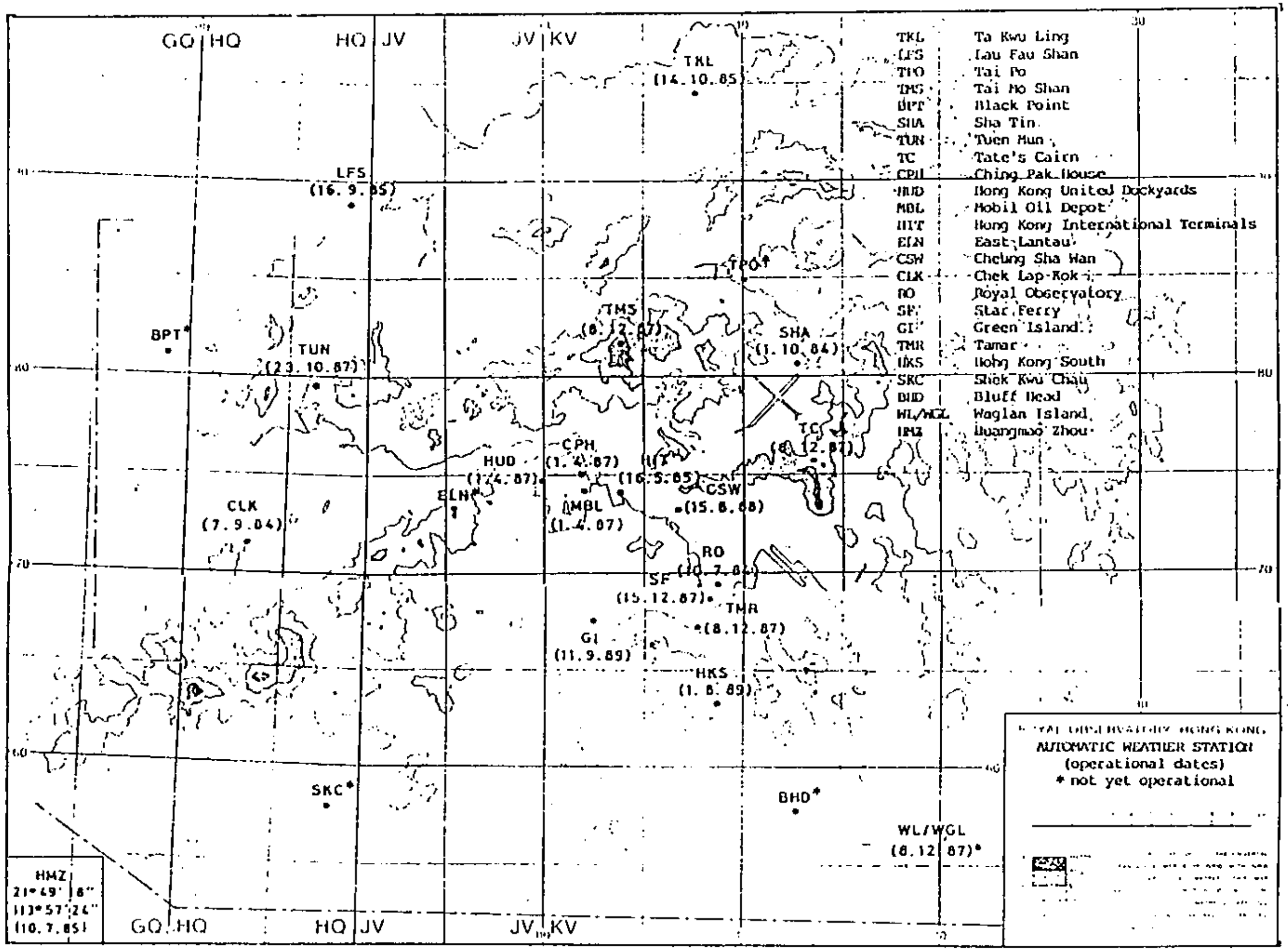
Table VI/A24

Visibility and Winds at the Royal Observatory and Kai Tak

Wind Direction (Deg.)	Number of hours			
	Visibility at Royal Observatory better than that at Kai Tak	Visibility at Royal Observatory equal to that at Kai Tak	Visibility at Kai Tak better than that at Royal Observatory	Total
350 - 120 (NE)	1079	19346	1529	21954
130 - 270 (SW)	359	2906	82	3347
280 - 340 (NW)	132	709	58	899
Calm and Variable	265	1201	174	1640
Total	1835	24162	1843	27840

Figure VI/A1

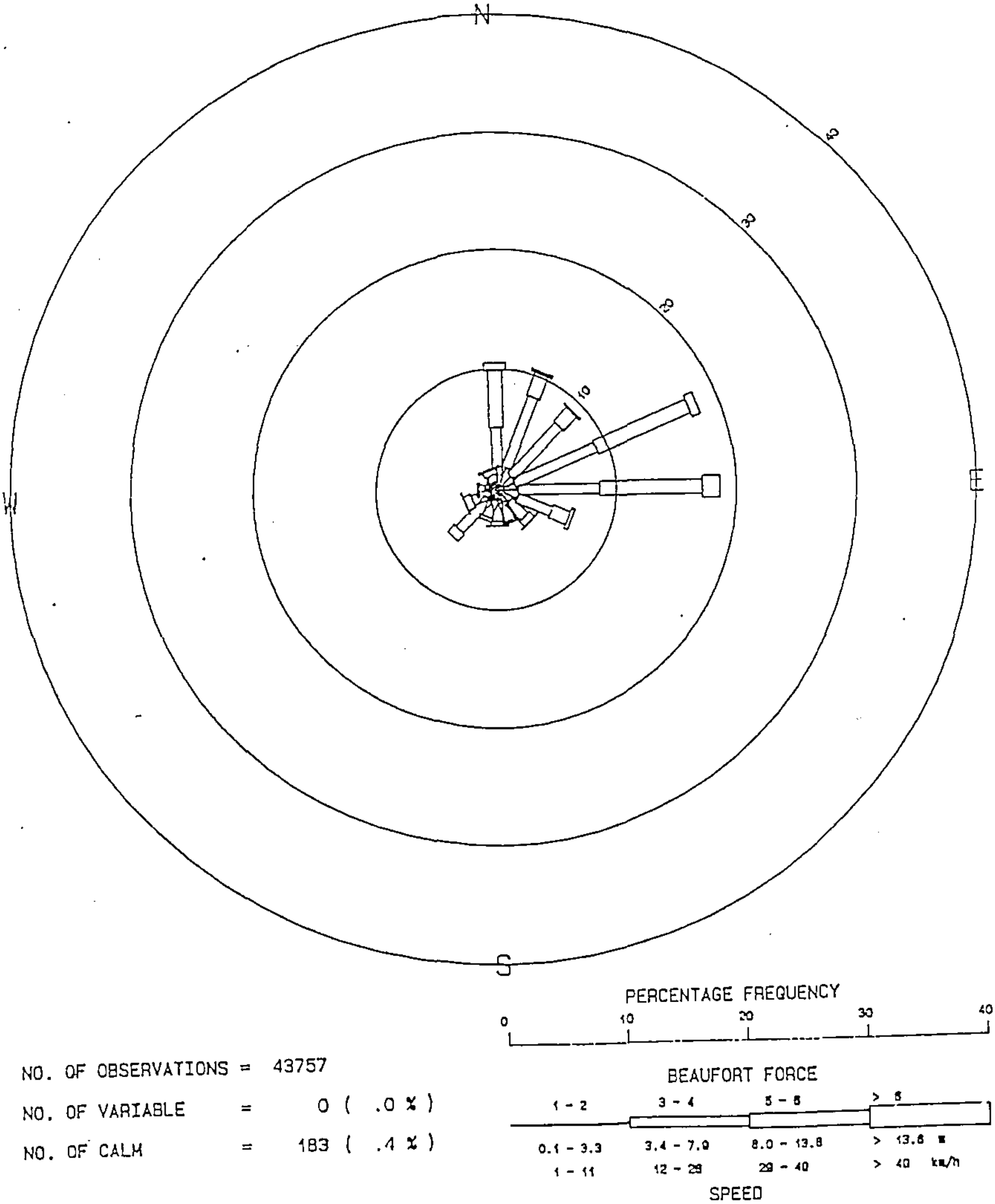
Map of Royal Observatory Automatic Weather Stations



SAVE AND RECYCLE

Figure V1/A2

Windrose for Waglan Island



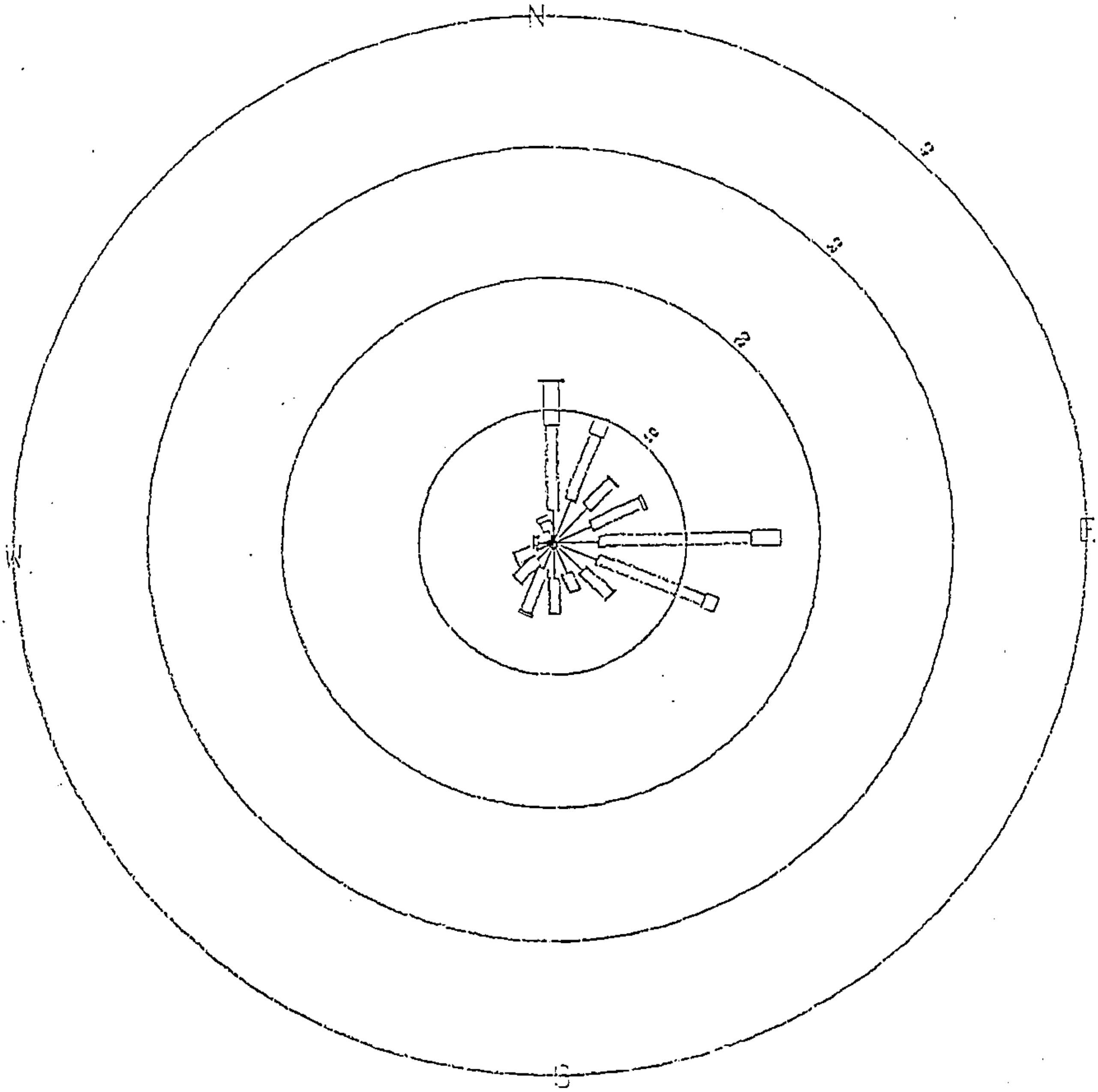
NO. OF OBSERVATIONS = 43757

NO. OF VARIABLE = 0 (.0 %)

NO. OF CALM = 183 (.4 %)

Figure V1/A3

Windrose for Cheung Chau



NO. OF OBSERVATIONS = 8760

NO. OF VARIABLE = 21 (.2 %)

NO. OF CALM = 36 (.4 %)

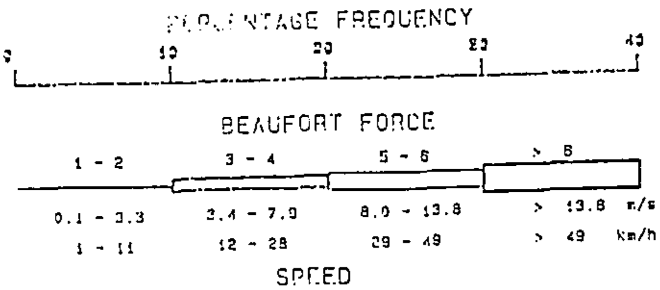


Figure V1/A4

Windrose for Junk Bay

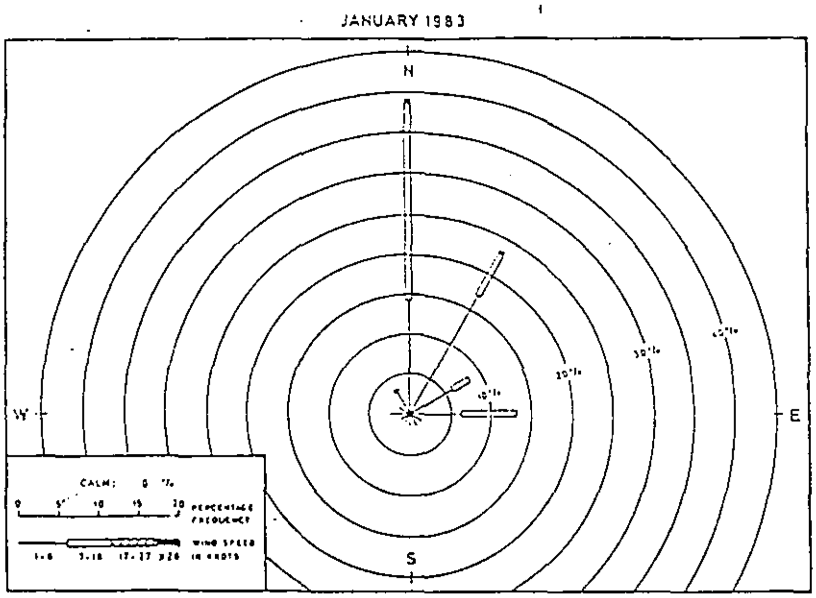


Figure V1/A5

Windrose for Tates Cairn

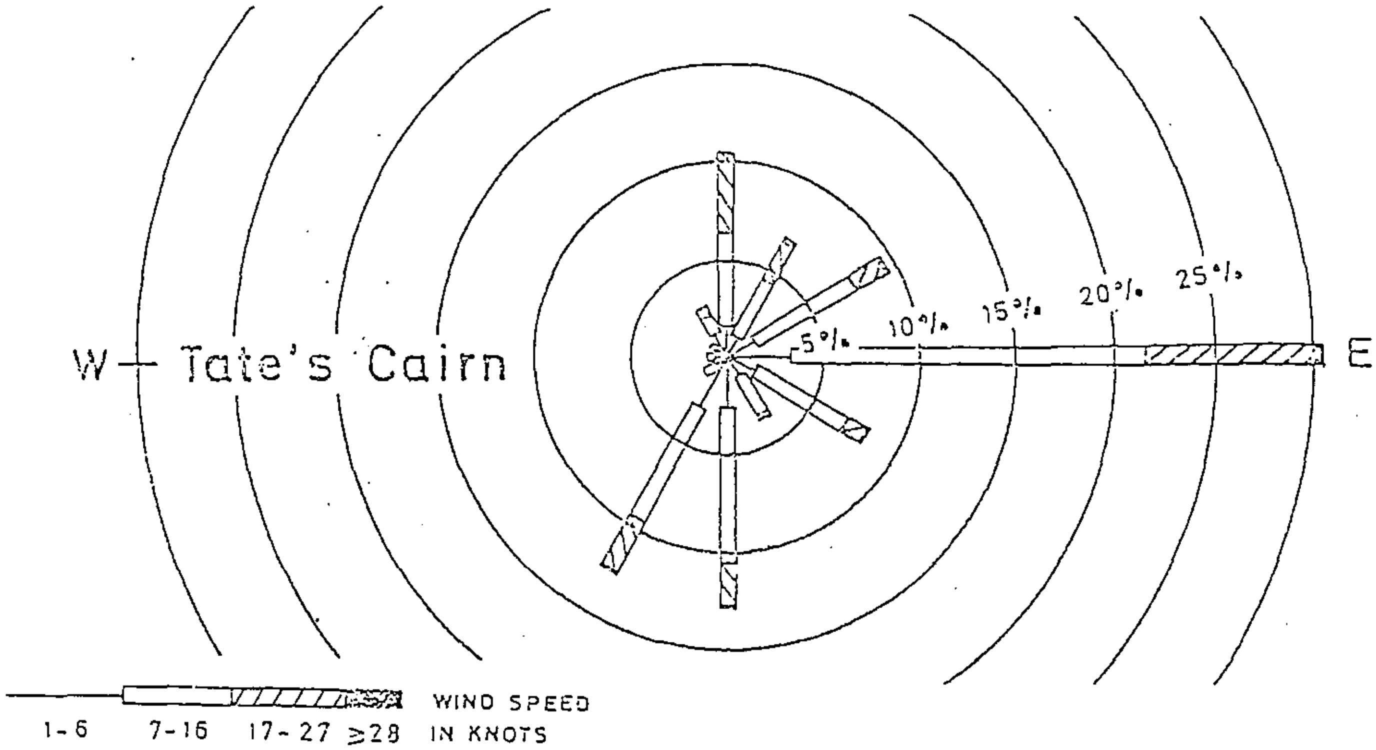


Figure V1/A6

Windrose for Hong Kong International Airport

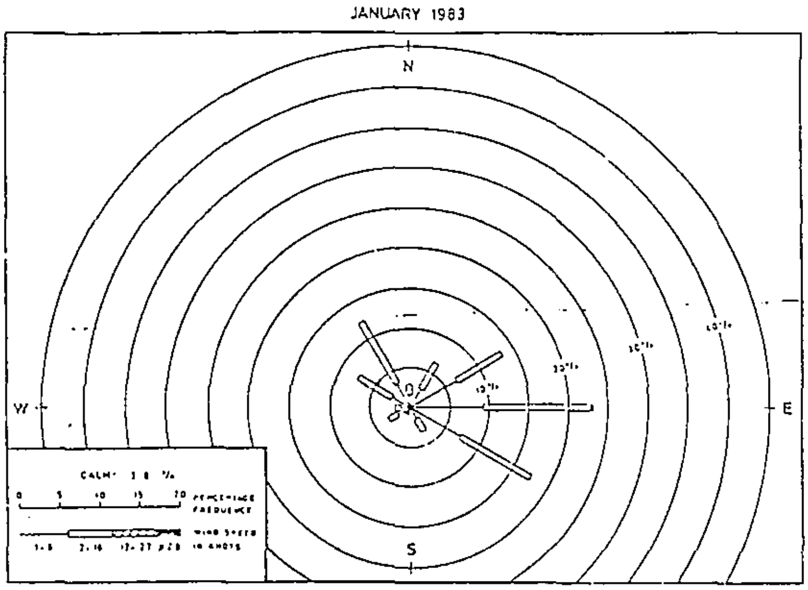
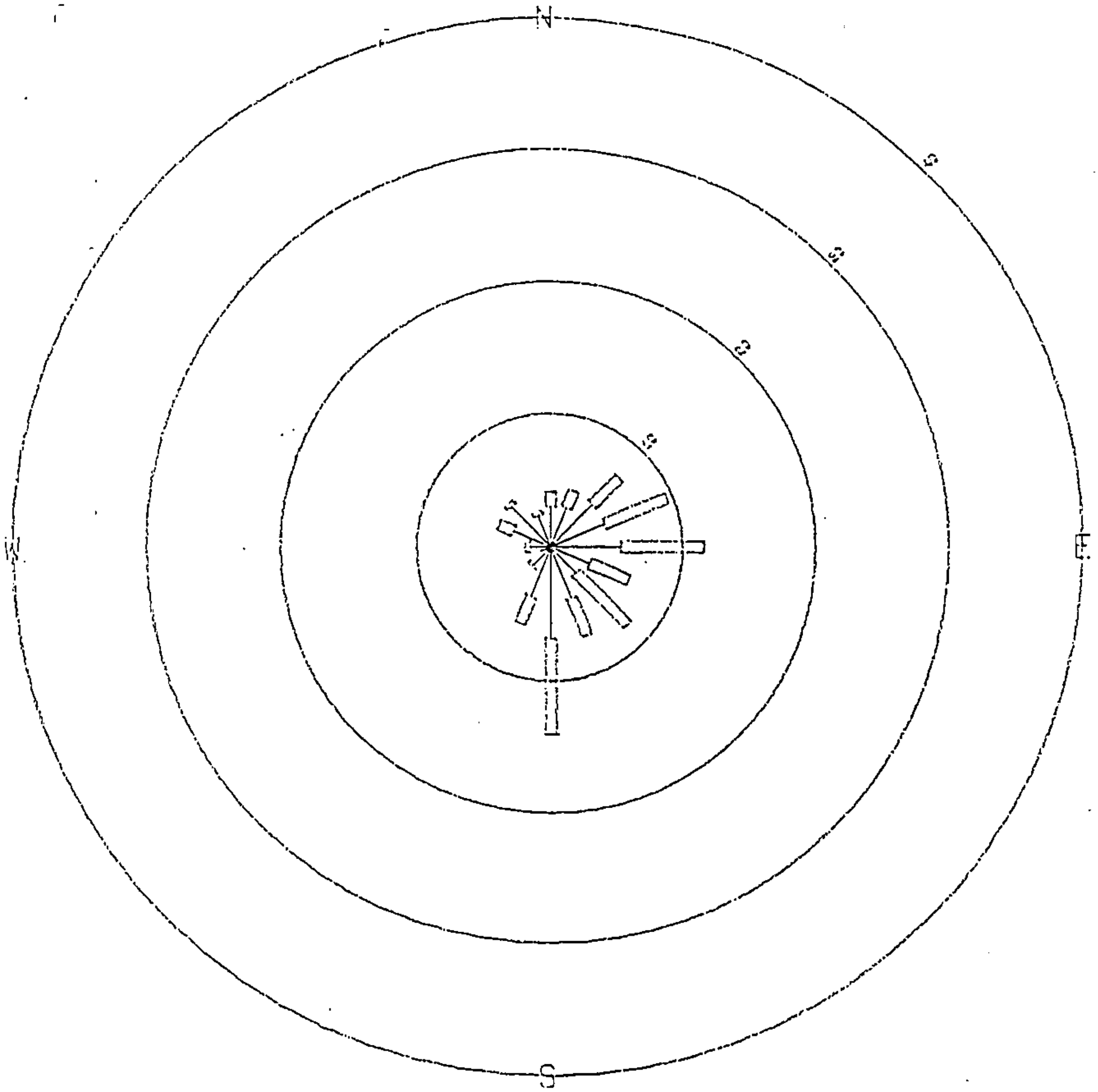


Figure V1/A7

Windrose for Mobil Oil Depot



NO. OF OBSERVATIONS = 8457

NO. OF VARIABLE = 370 (4.4 %)

NO. OF CALM = 0 (.0 %)

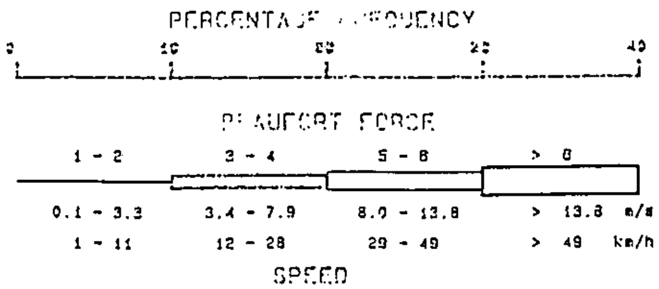
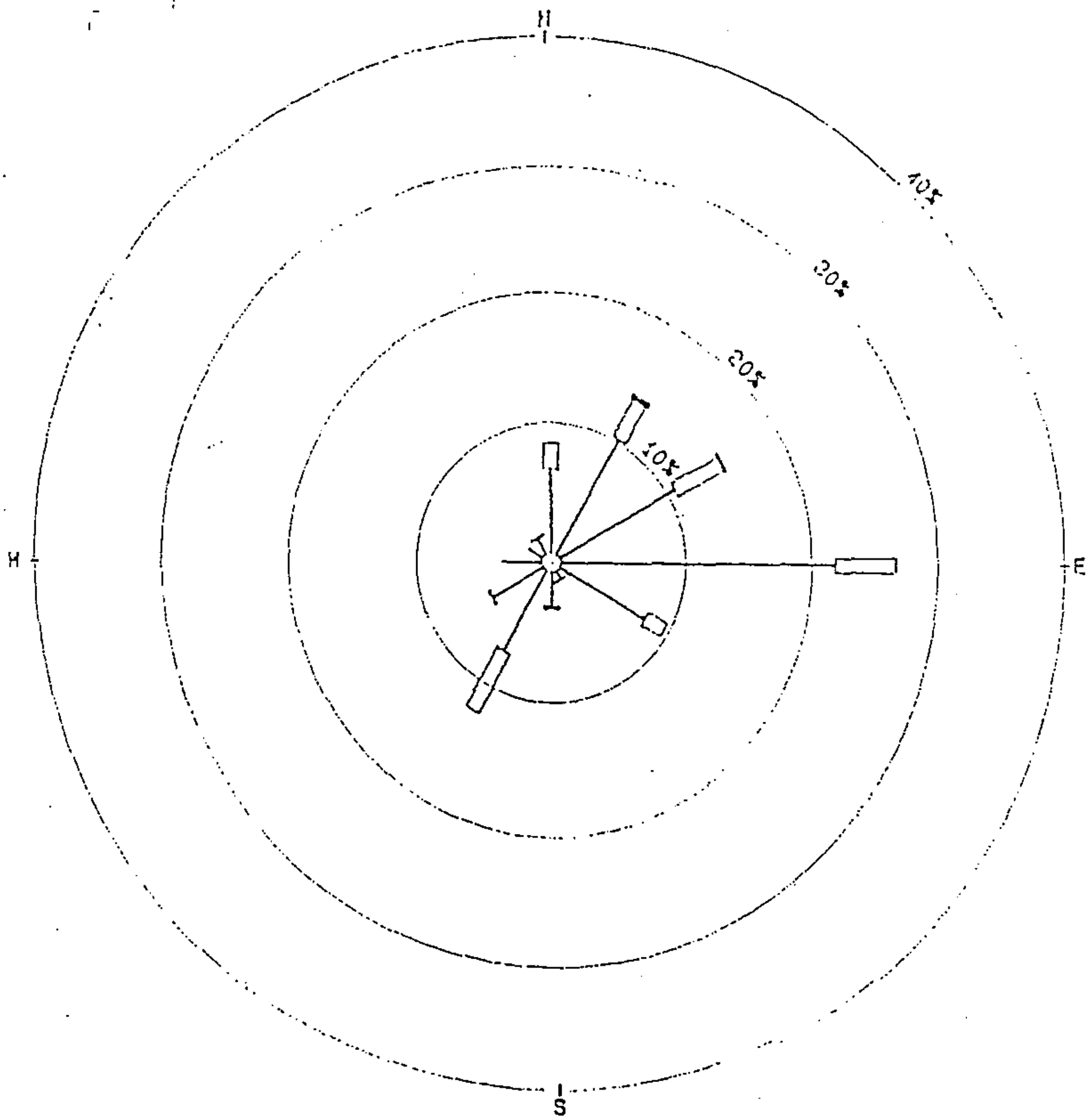
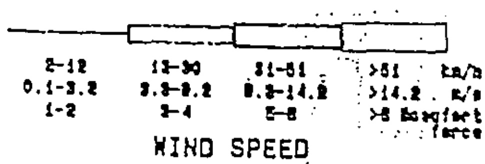


Figure V1/A8

Windrose for Cheung Sha Wan





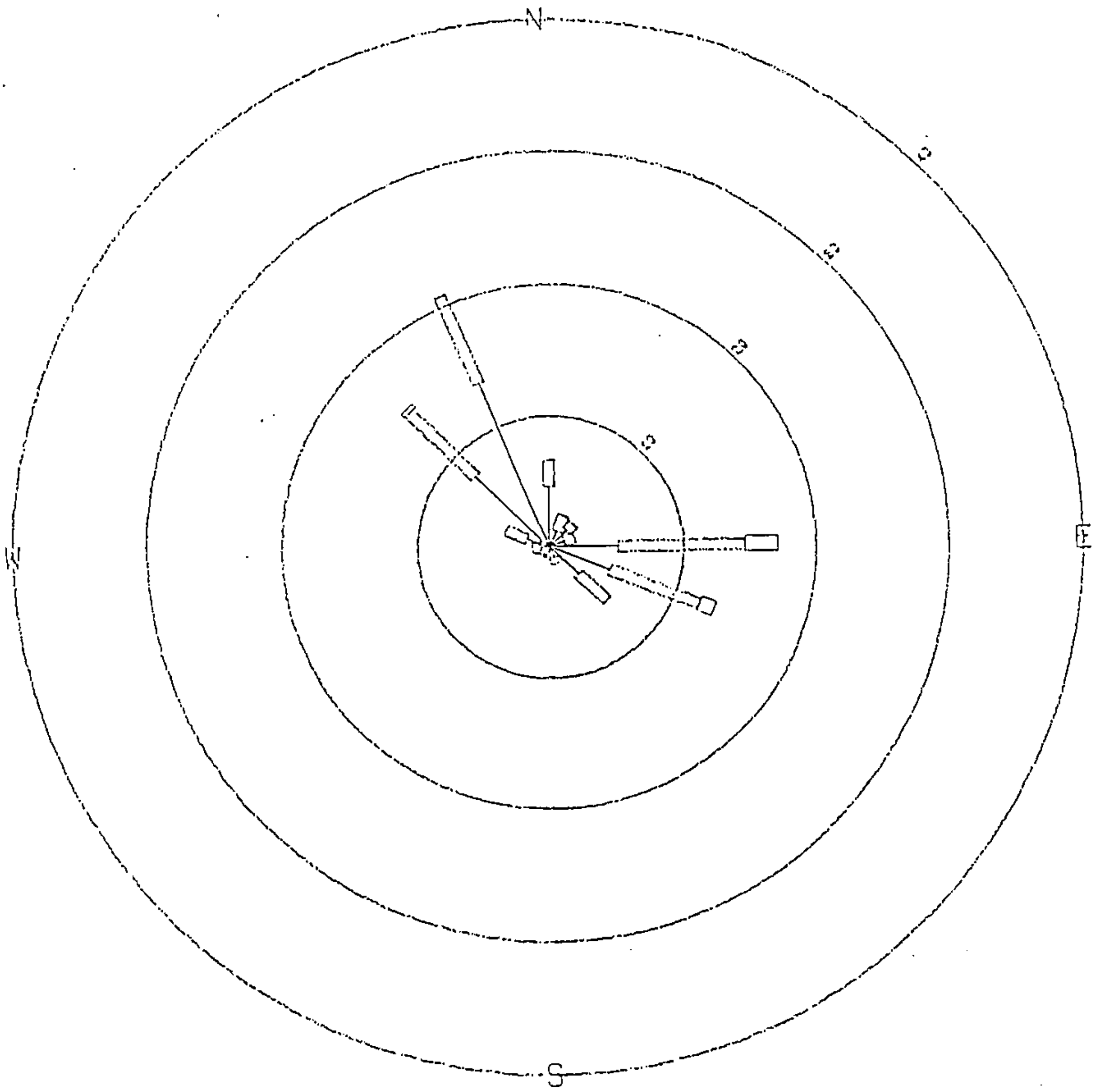
NO. OF OBSERVATIONS = 7890

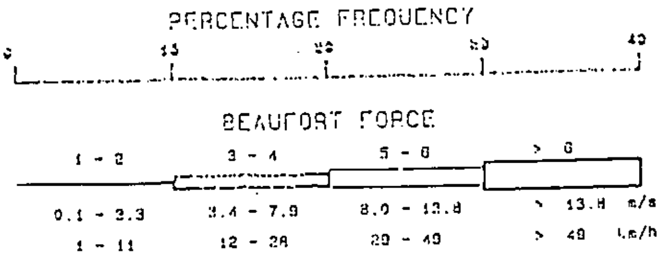
NO. OF VARIABLE WINDS = 0 (.0%)

NO. OF CALM WINDS = 3 (.0%)

Figure V1/A9

Windrose for Hong Kong United Dockyard





NO. OF OBSERVATIONS = 610

NO. OF VARIABLE = 34 (5.6 %)

NO. OF CALM = 0 (.0 %)

Figure V1/A10

Windrose for Tai Mo Shan

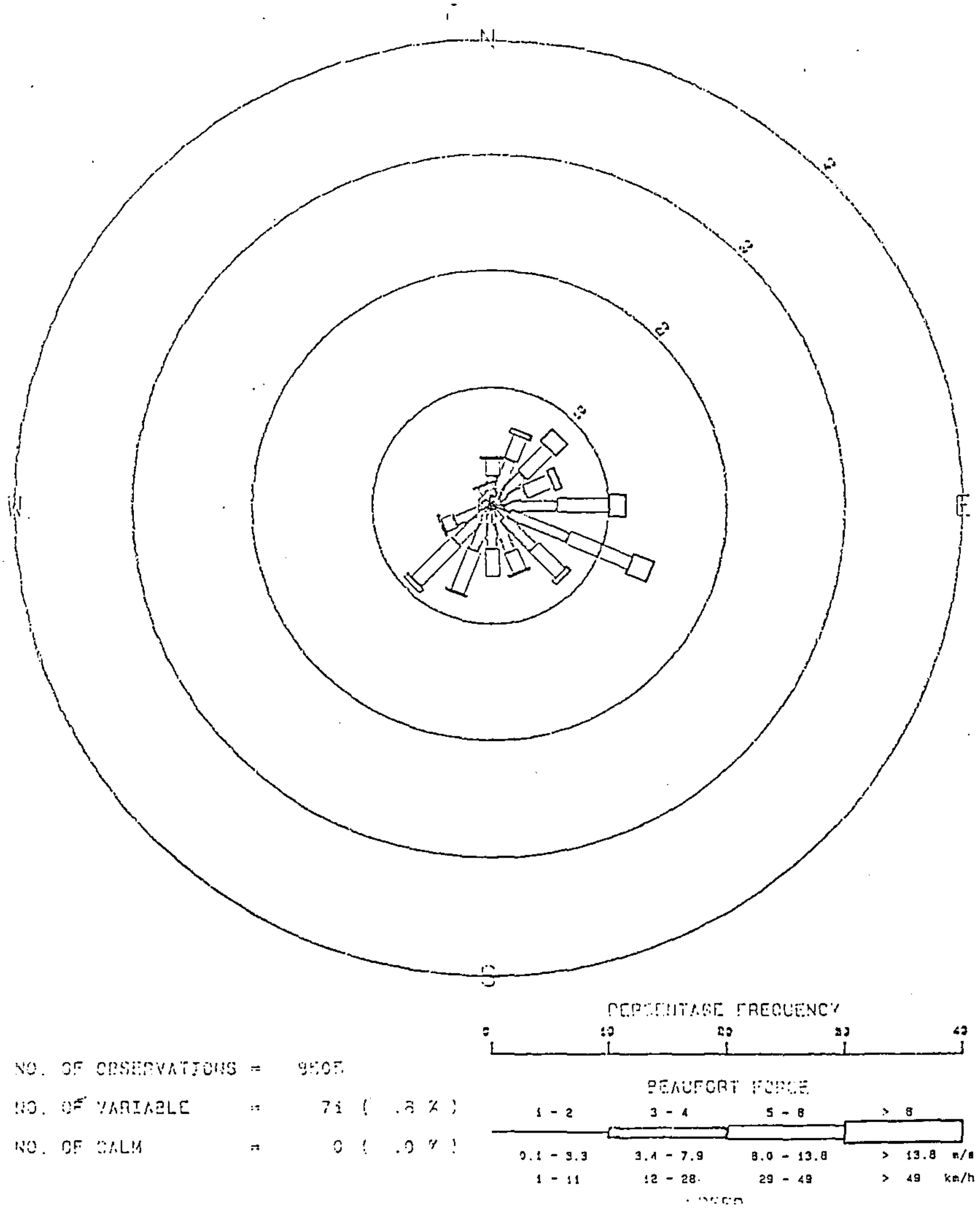
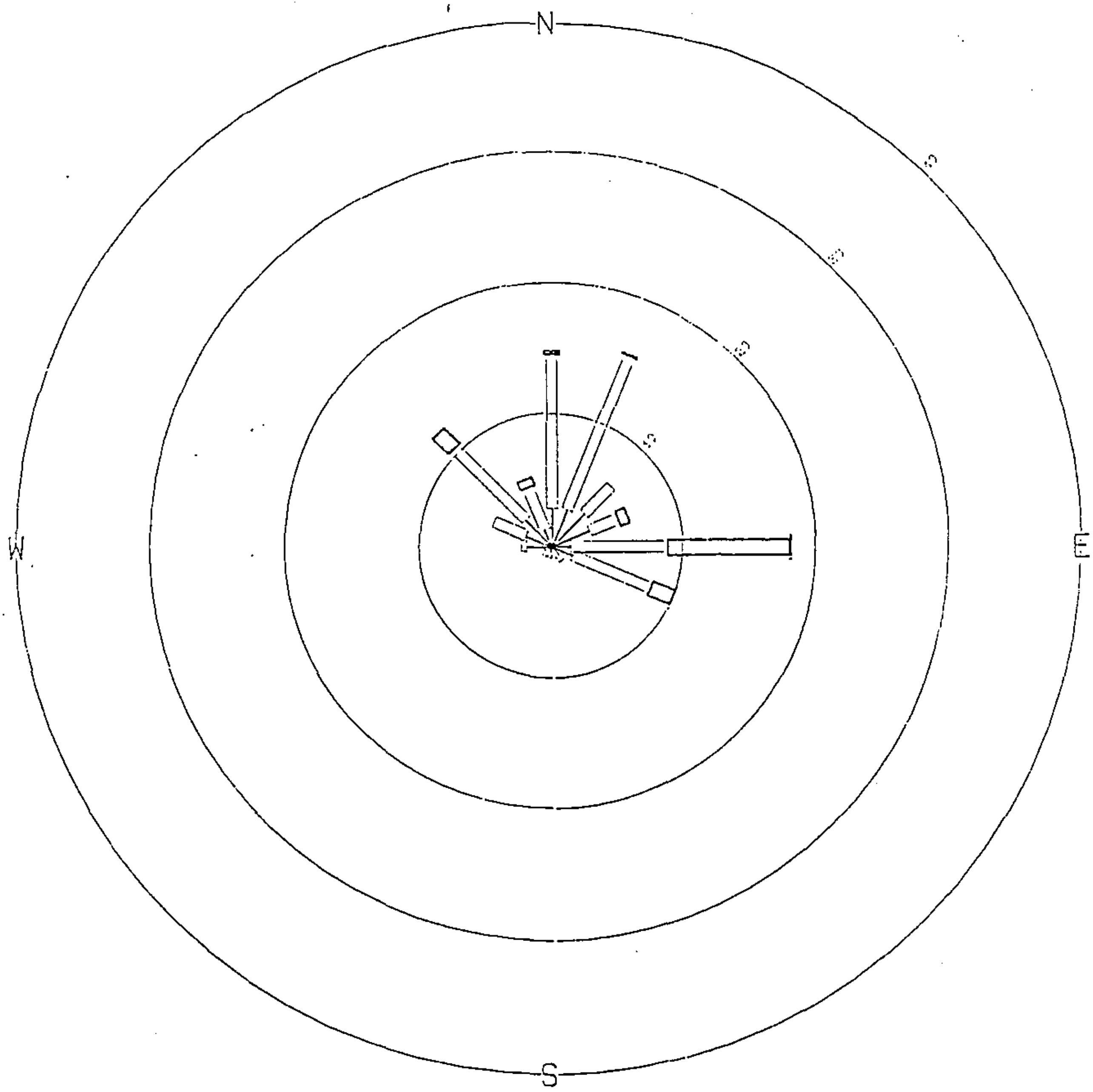
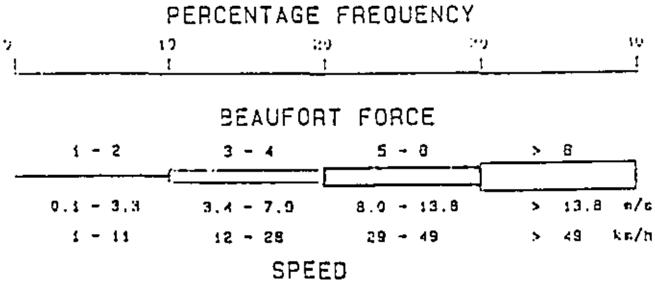


Figure V1/A11

Windrose for Chek Lap Kok





No. of observations = 719

No. of variable = 0 (.0 %)

No. of calm = 0 (.0 %)

Figure V1/A12

Windrose for Lau Fau Shan

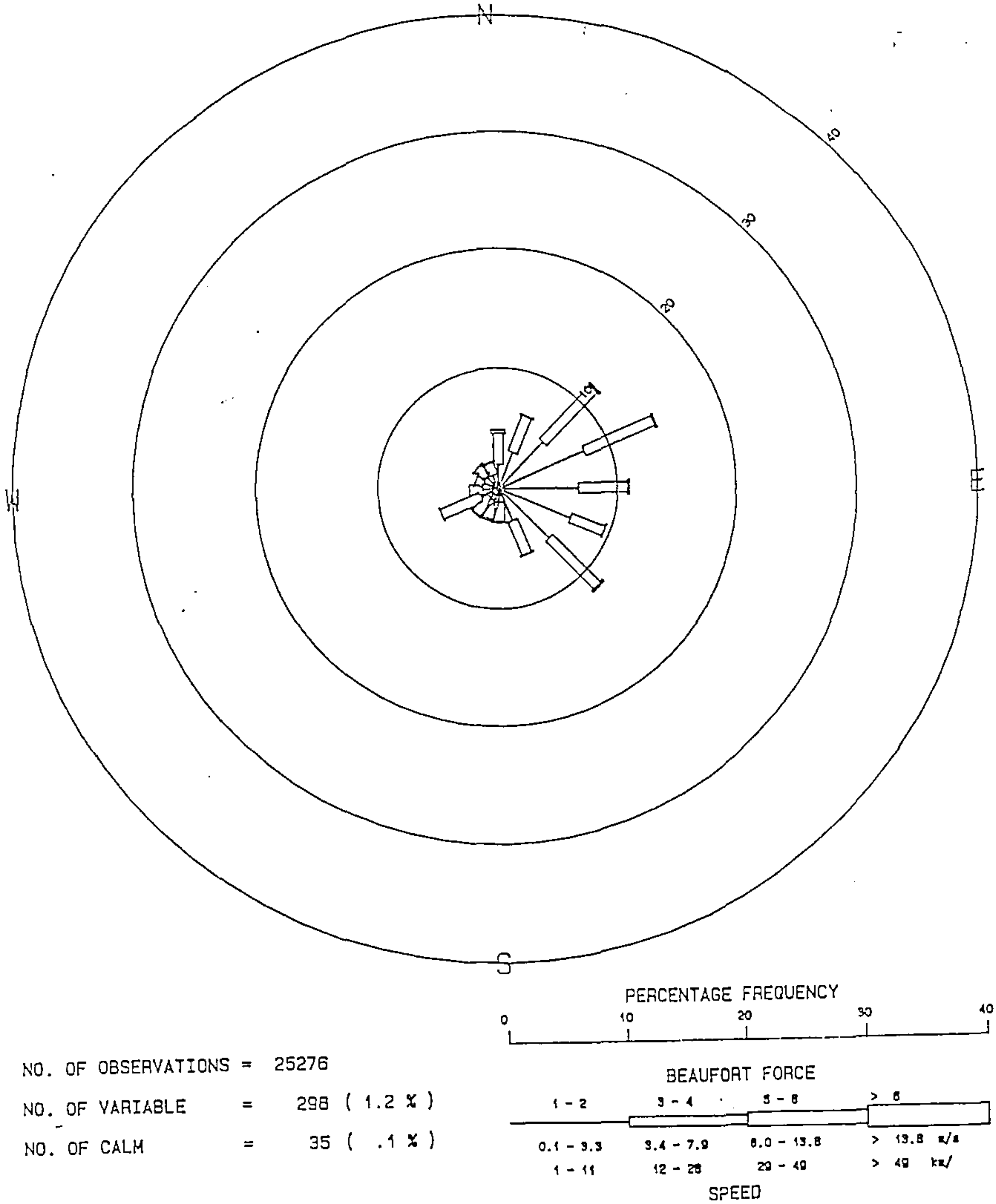


Figure V1/A13

Annual Windrose for Tsim Bei Tsui

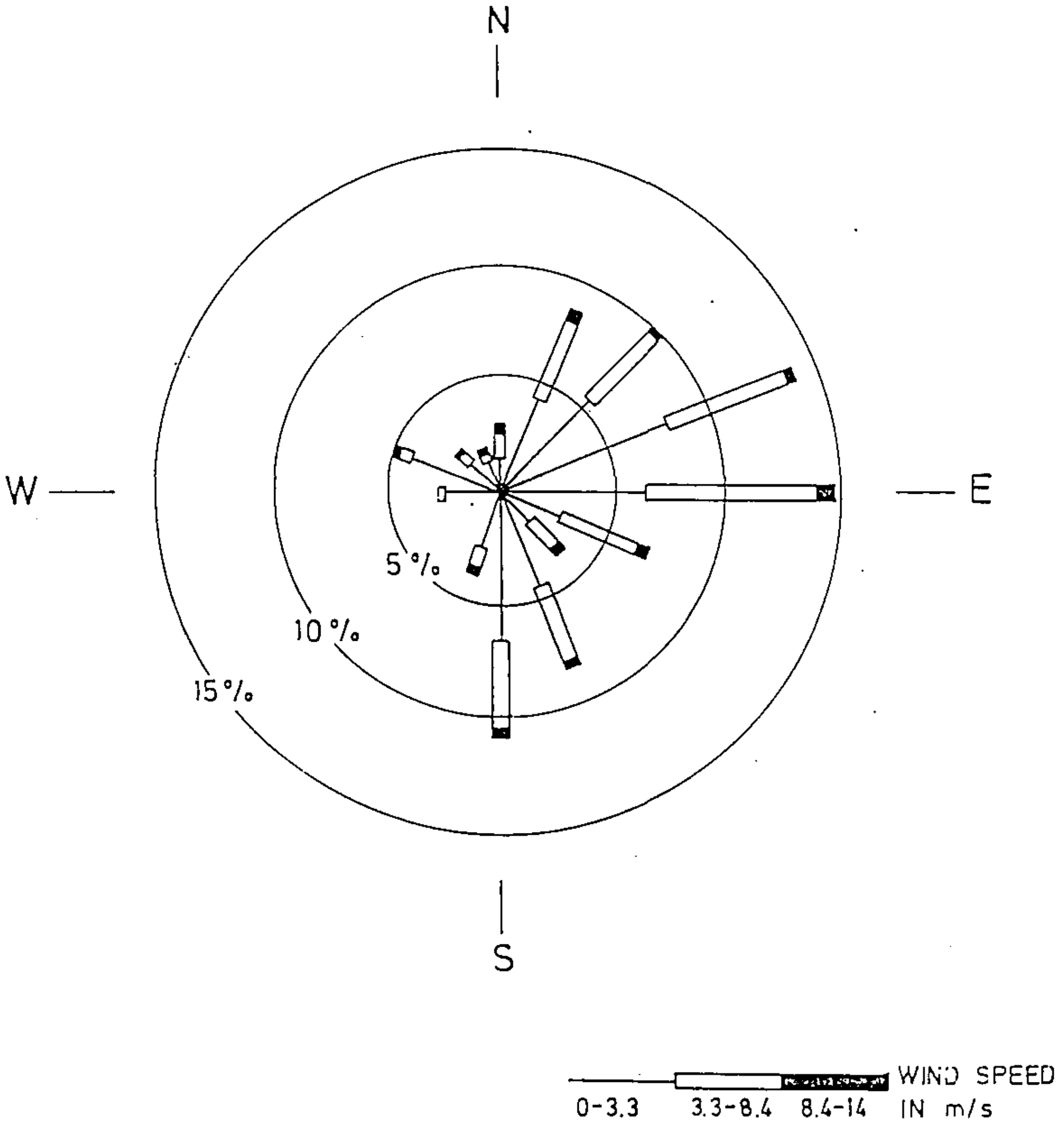
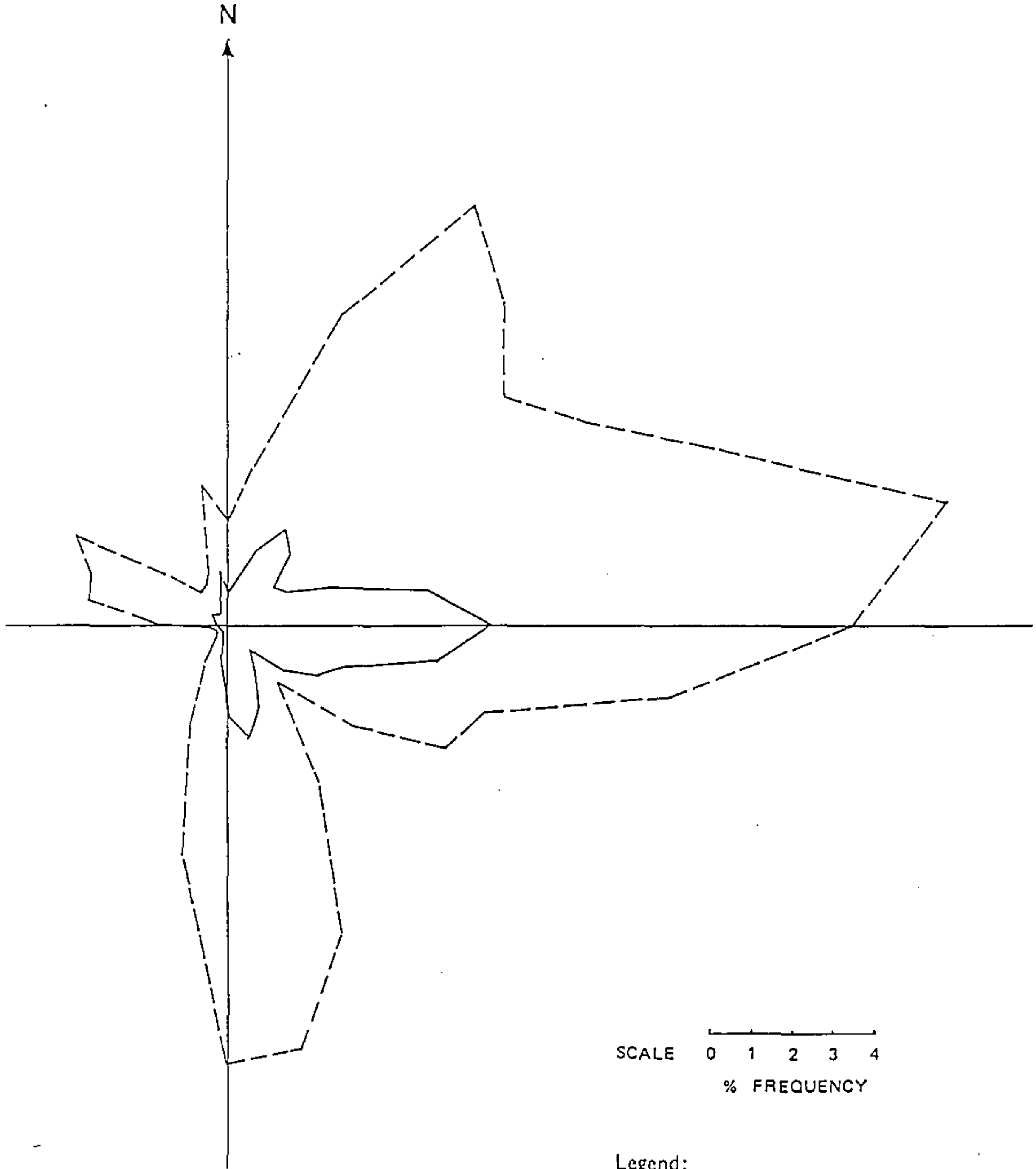


Figure V1/A14

Annual Windrose for Tsim Bei Tsui
(Winds of 3 and 10 knots)



OBSERVATION PERIOD: Jan. to Dec. (1975-1982)

NUMBER OF OBSERVATION: 52219

Legend:

- - - - - All wind above 3 knots

——— All wind above 10 knots

SAVE AND RECYCLE

Figure V1/A15

Monthly Wind Speeds at Tsim Bei Tsui

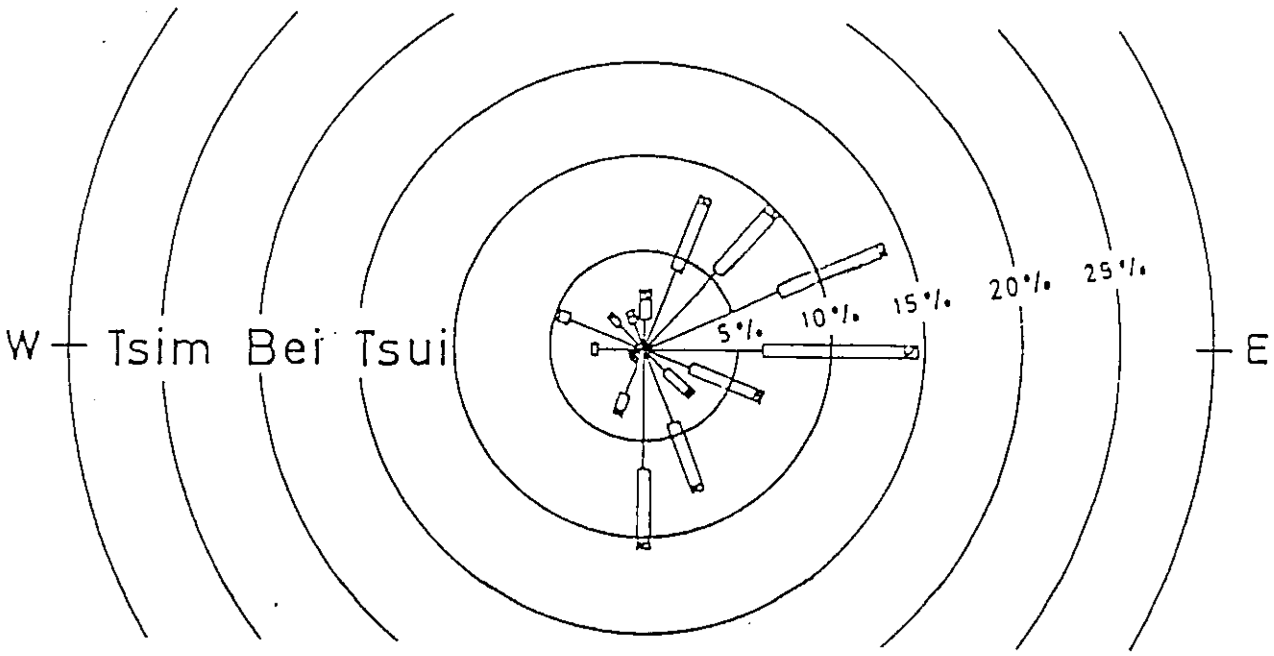


Figure V1/A16

Light Wind Spells Probability for Tsim Bei Tsui and Hong Kong International Airport

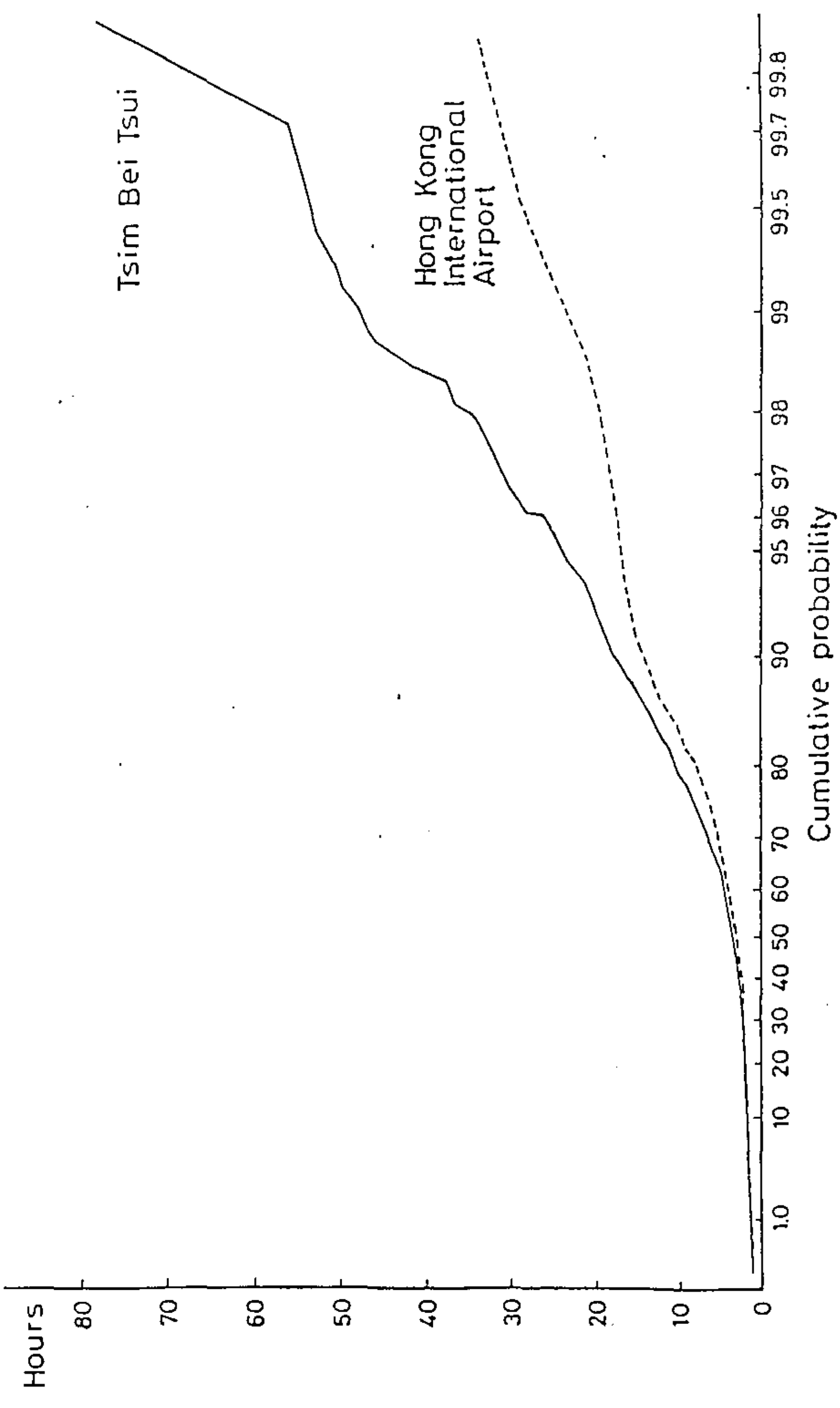


Figure V1/A17

Monthly Windroses for for Tsim Bei Tsui and Chi Wan (Shen Zhen Special Economic Zone, PRC)

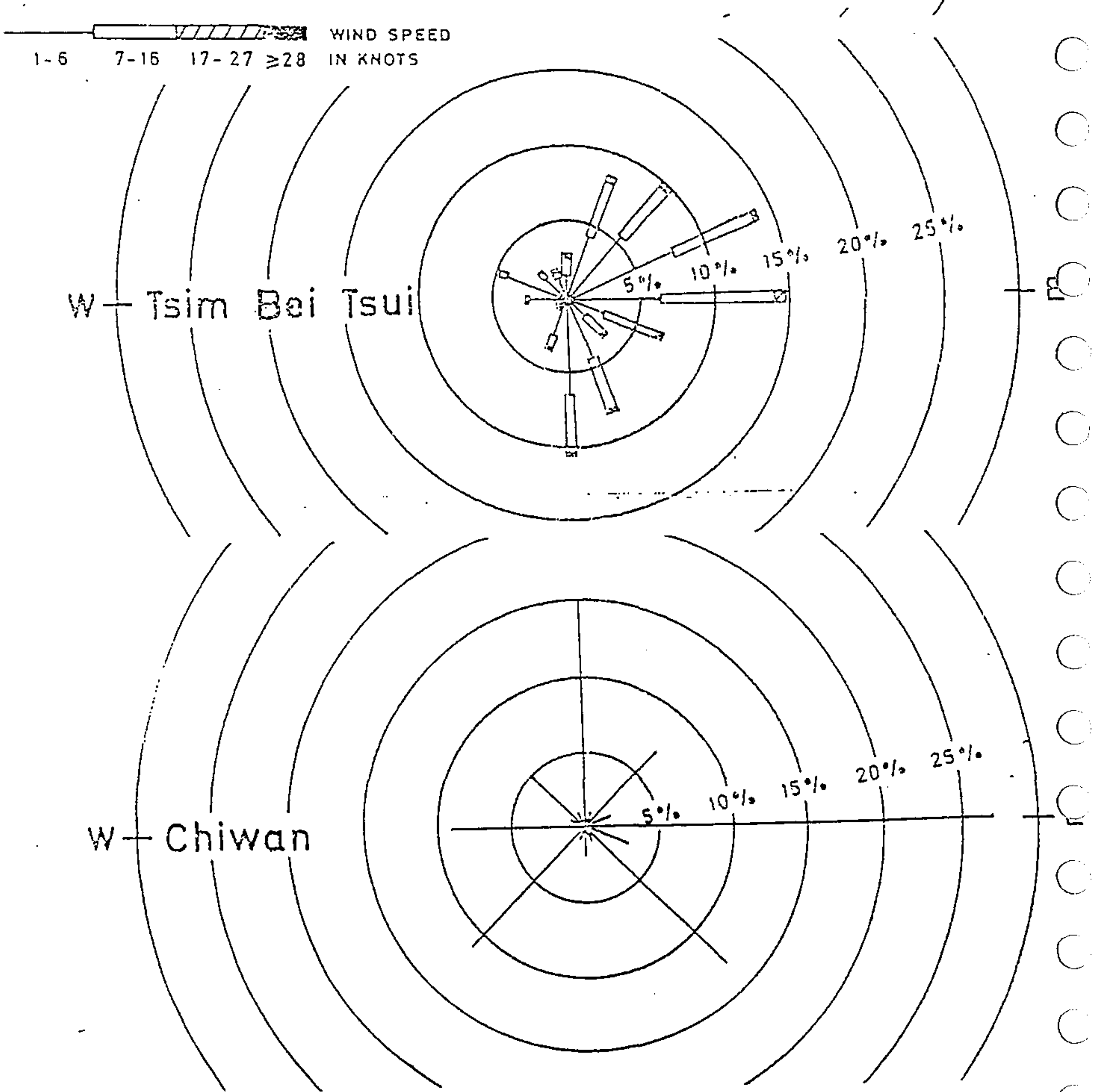


Figure V1/A18

Windrose for Chi Wan (west of Shekou, Shen Zhen SEZ, PRC)

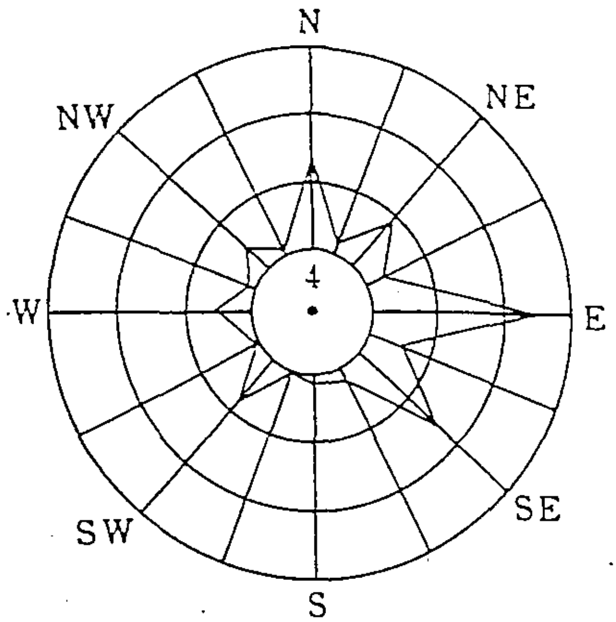


Figure V1/A19

Windrose for Shen Zhen (Annual and Seasonal) [City, SEZ, PRC]

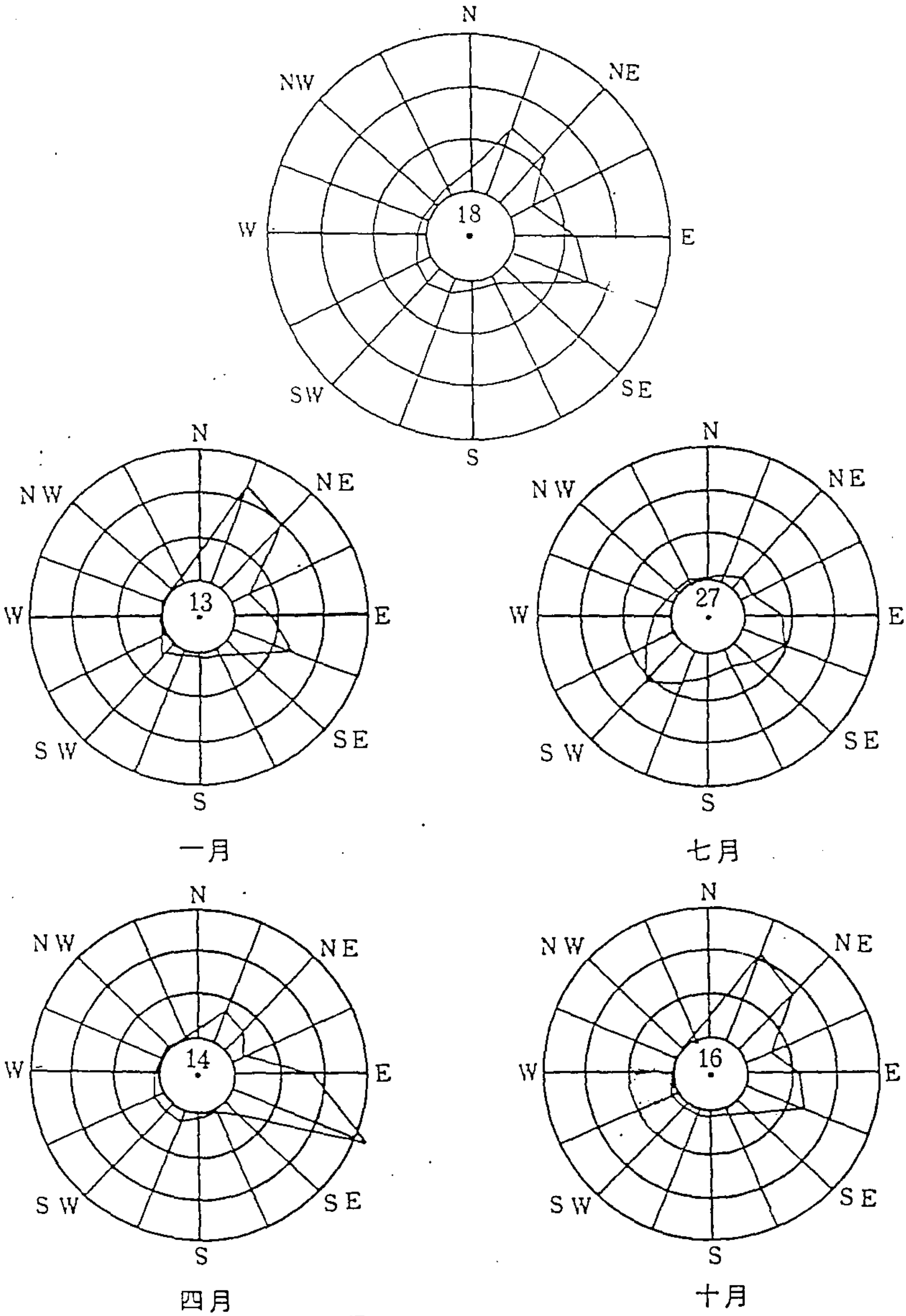


Figure V1/A20

Monthly and Annual Means for Diurnal Wind Variations at Tsim Bei Tsui (Deep Bay)

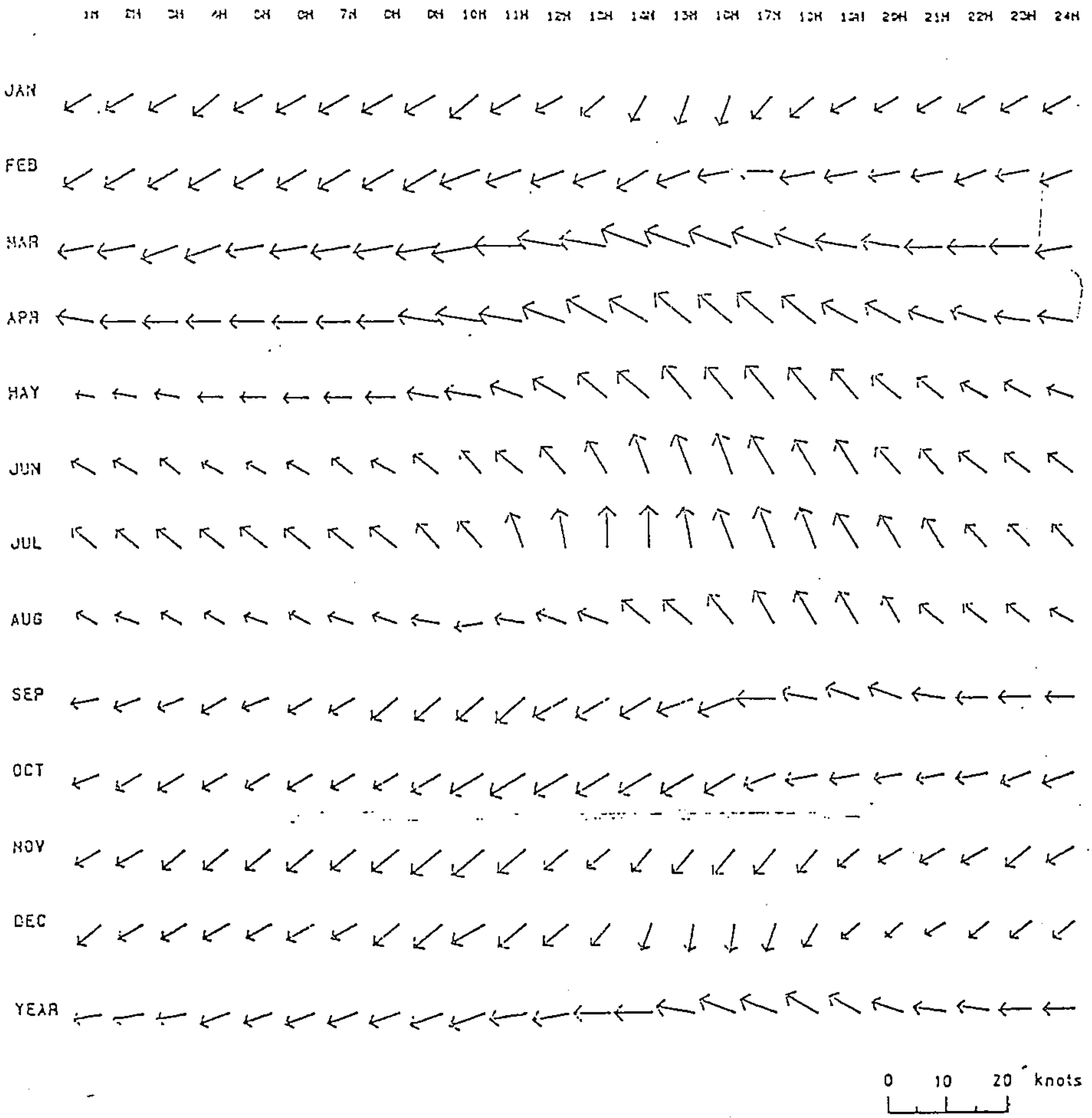


Figure V1/A21

Annual Wind Roses at Tsim Bei Tsui for Overall, Unstable, Neutral, and Stable Atmospheric Conditions

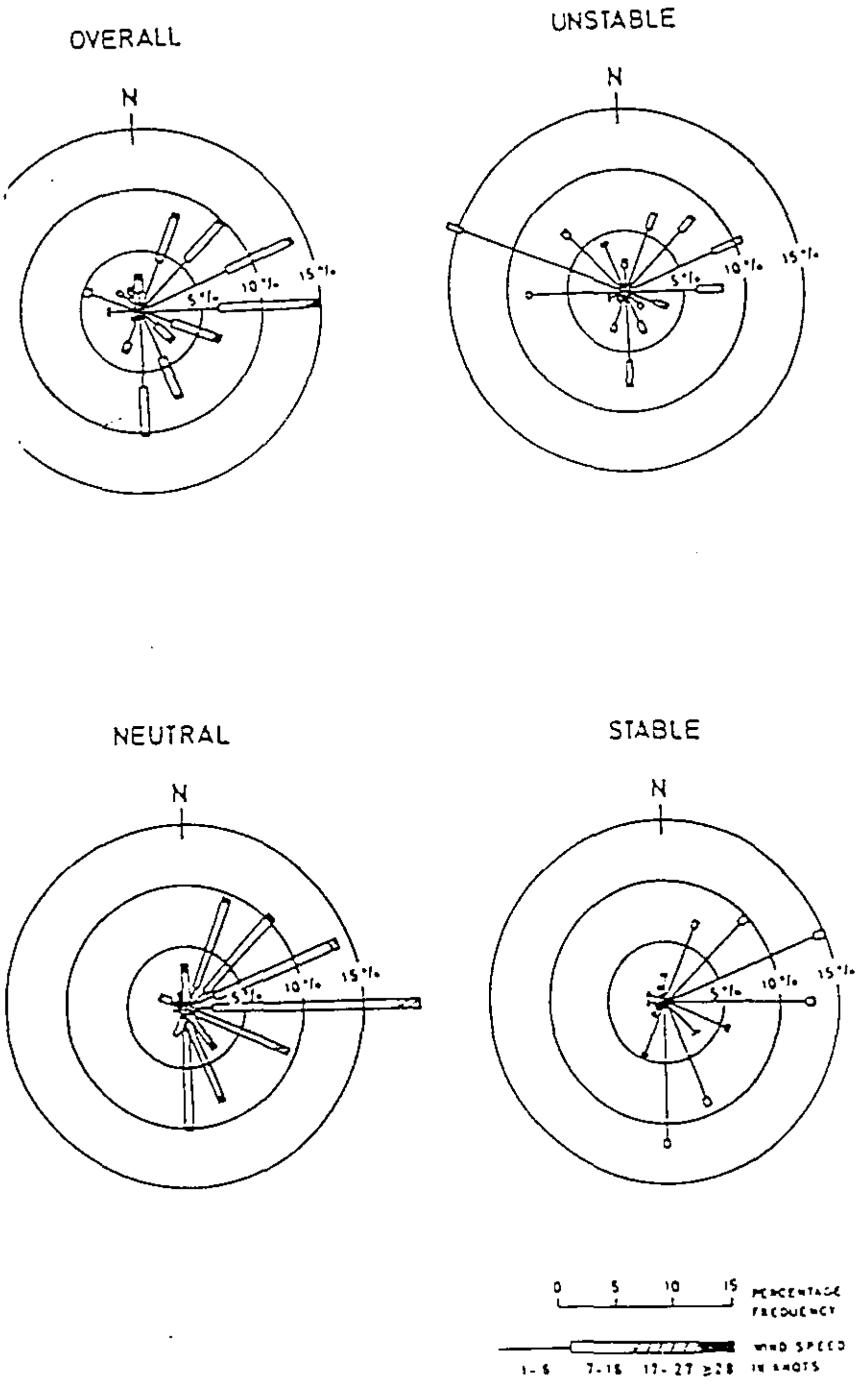


Figure V1/A22

August Wind Roses at Tsim Bei Tsui for Overall, Unstable, Neutral, and Stable Atmospheric Conditions

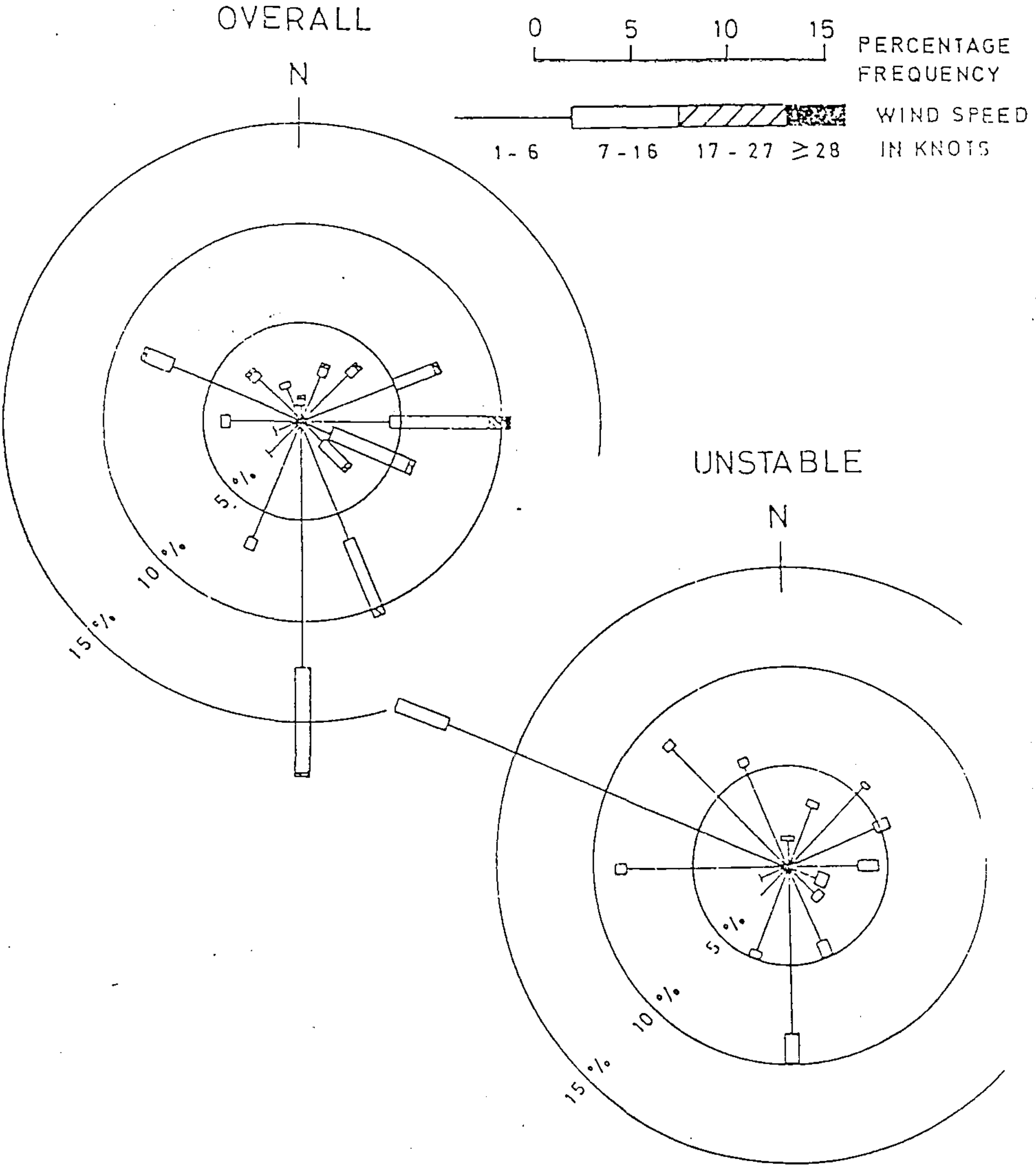


Figure V1/A22

August Wind Roses at Tsim Bei Tsui for Overall, Unstable, Neutral, and Stable Atmospheric Conditions

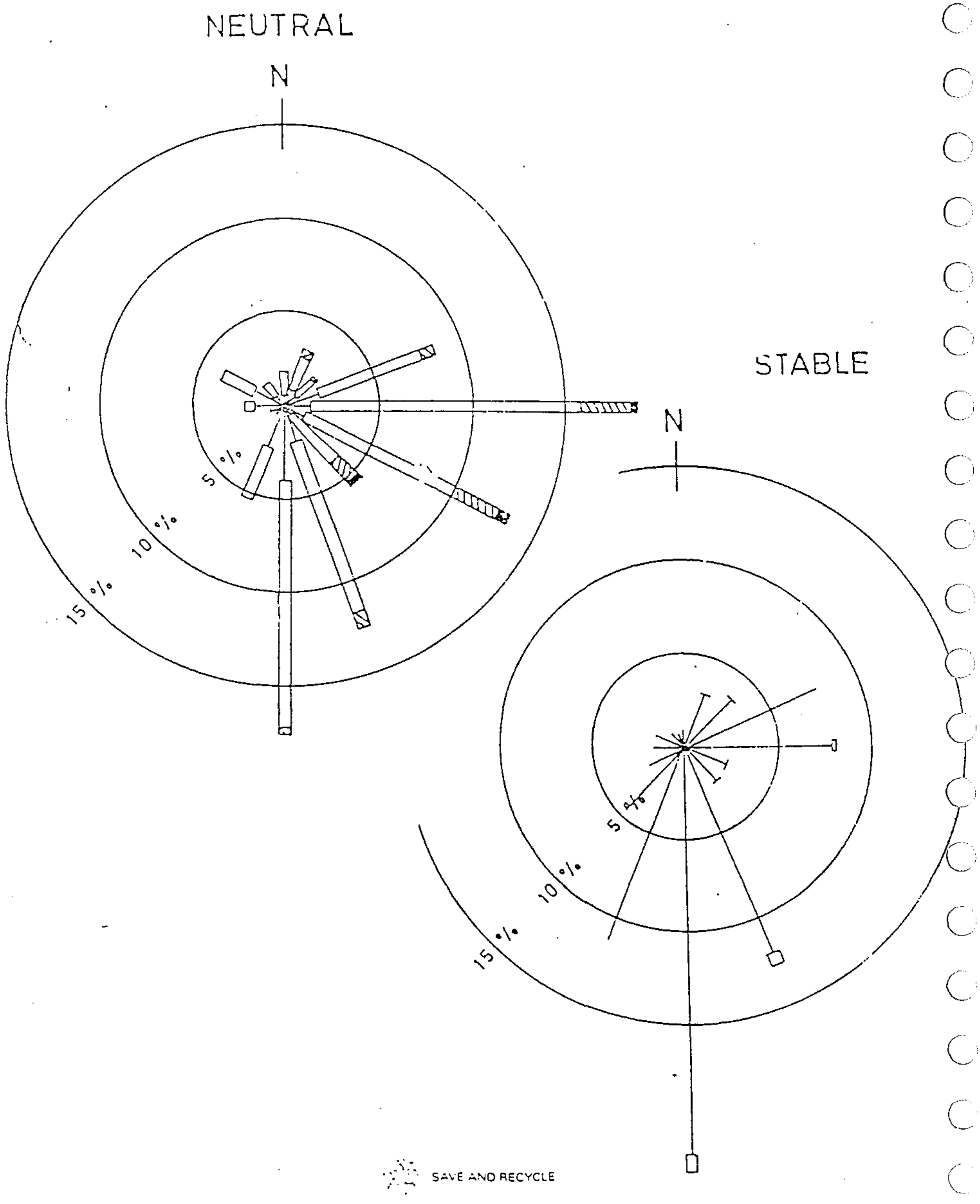


Figure V1/A23

Simulated Wind Fields for Deep Bay, 5-knot Westerly Winds

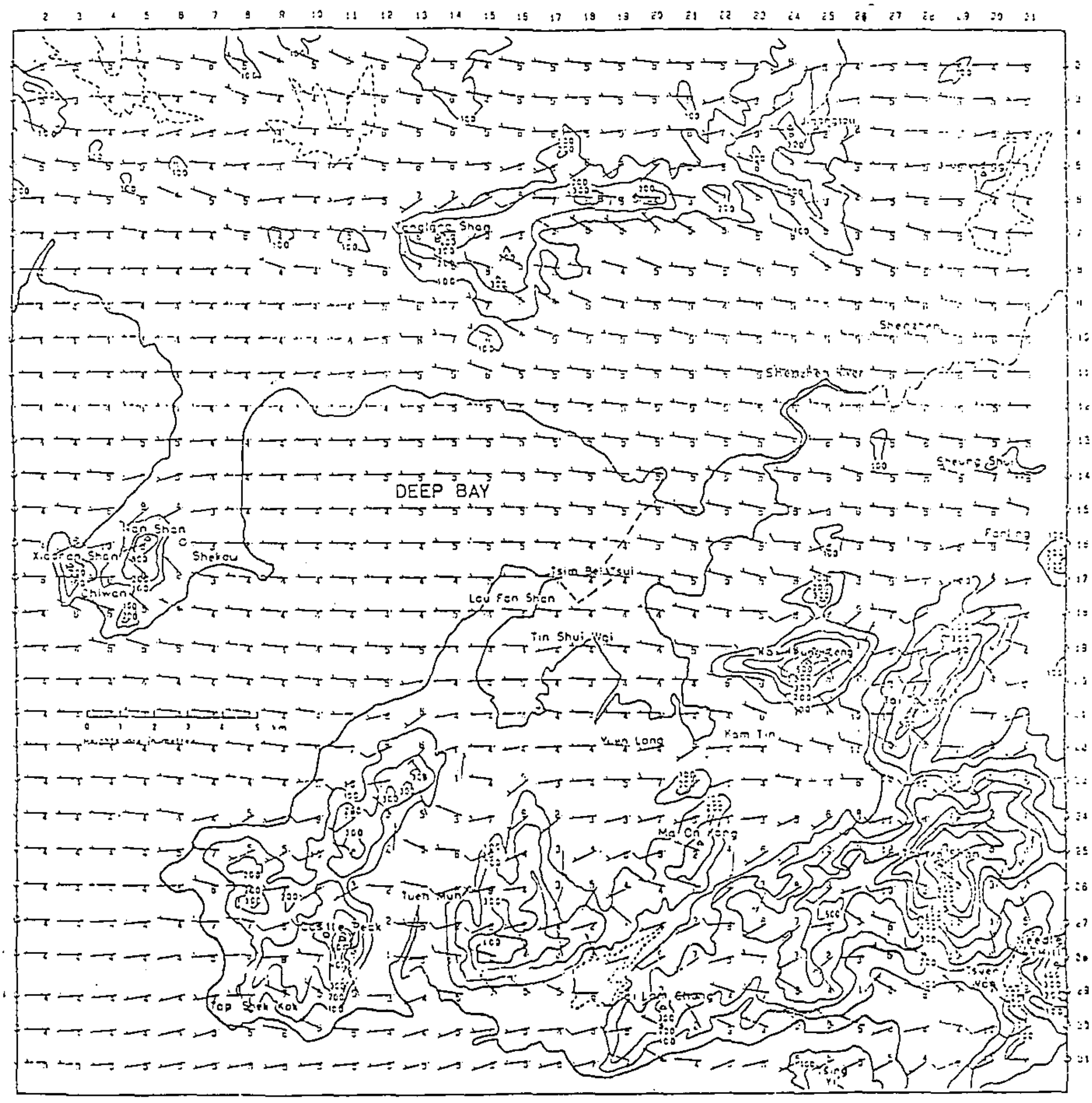


Figure V1/A24

Simulated Wind Fields for Deep Bay, 5-knot North-Northeasterly Winds

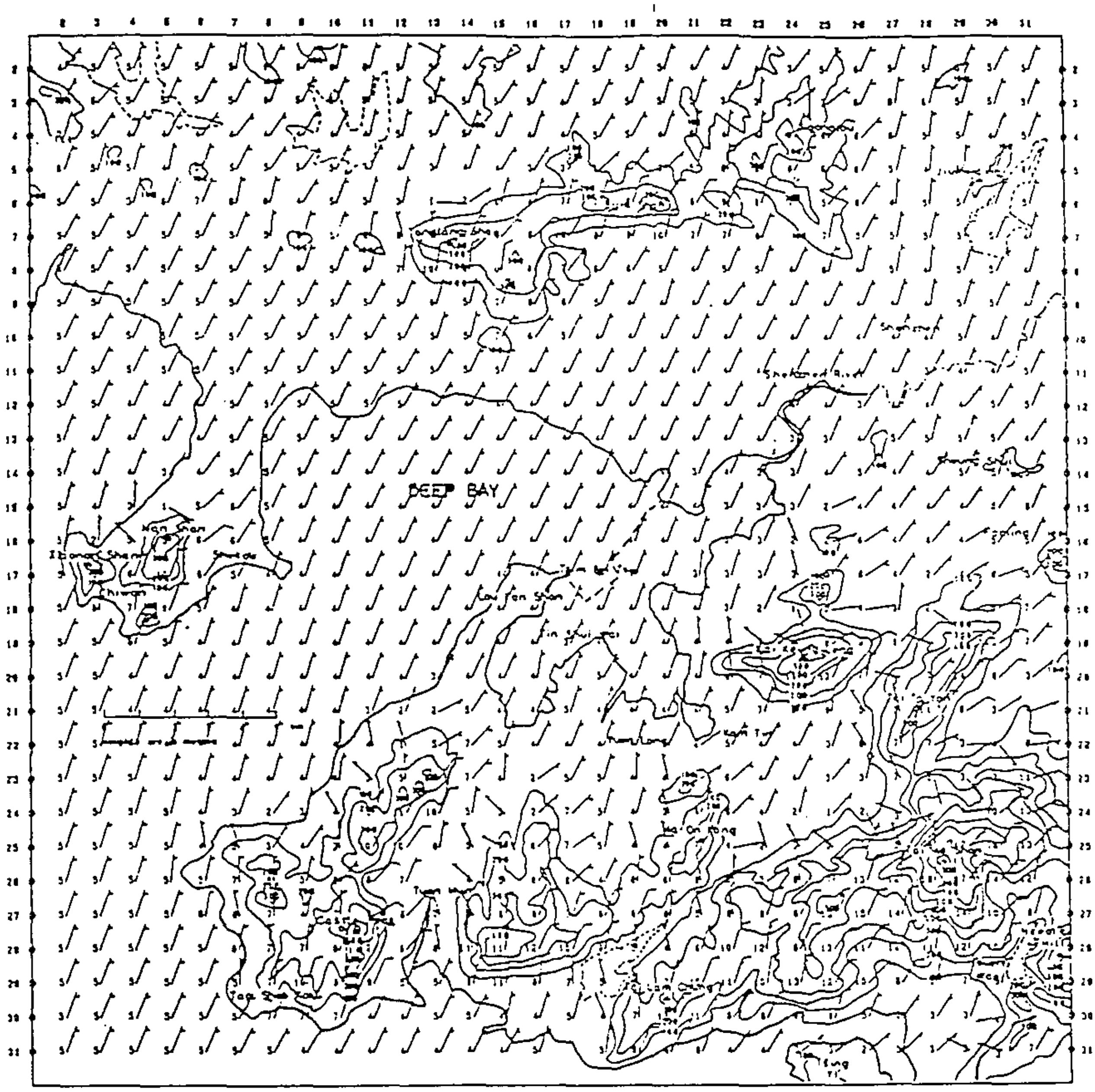
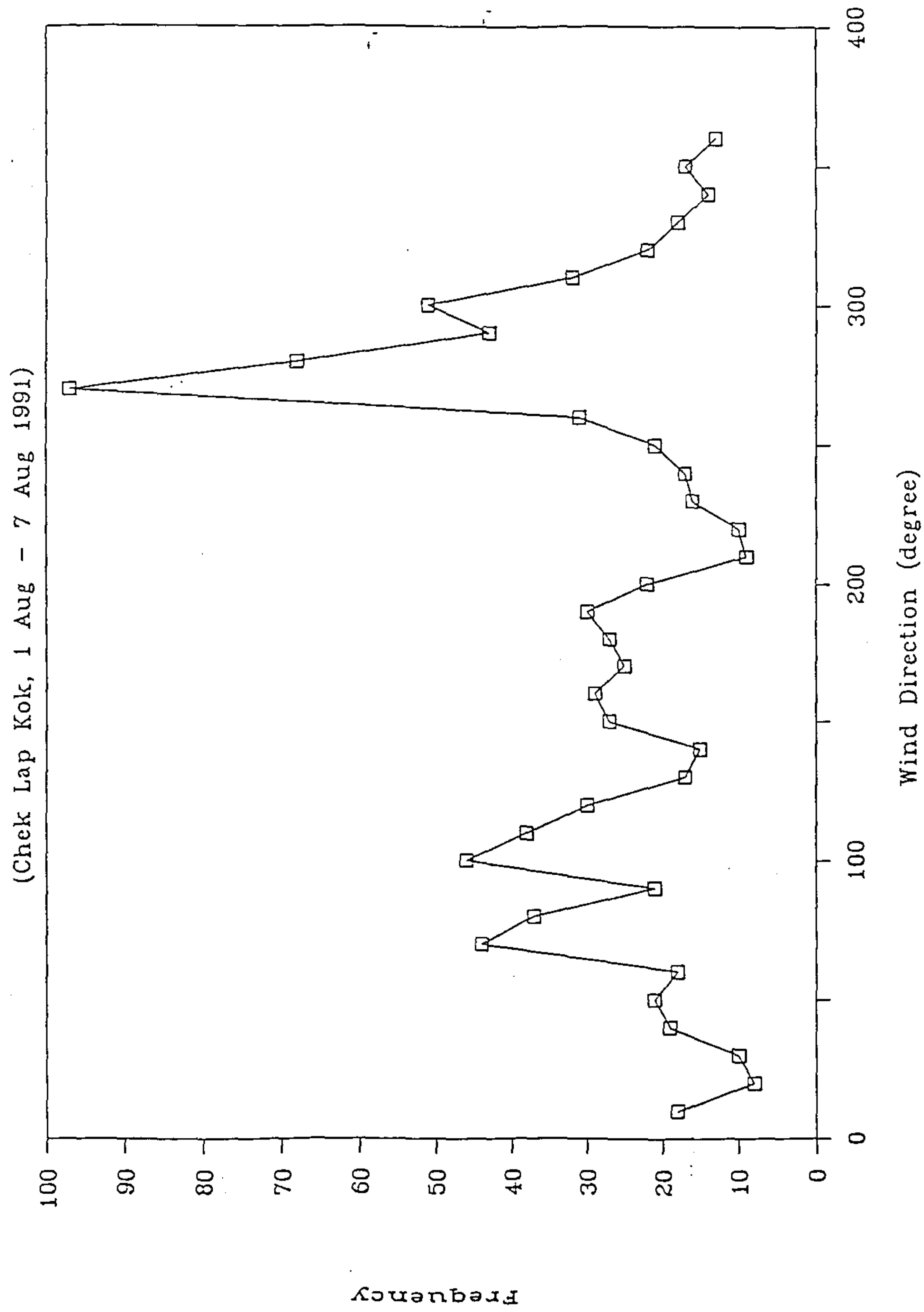
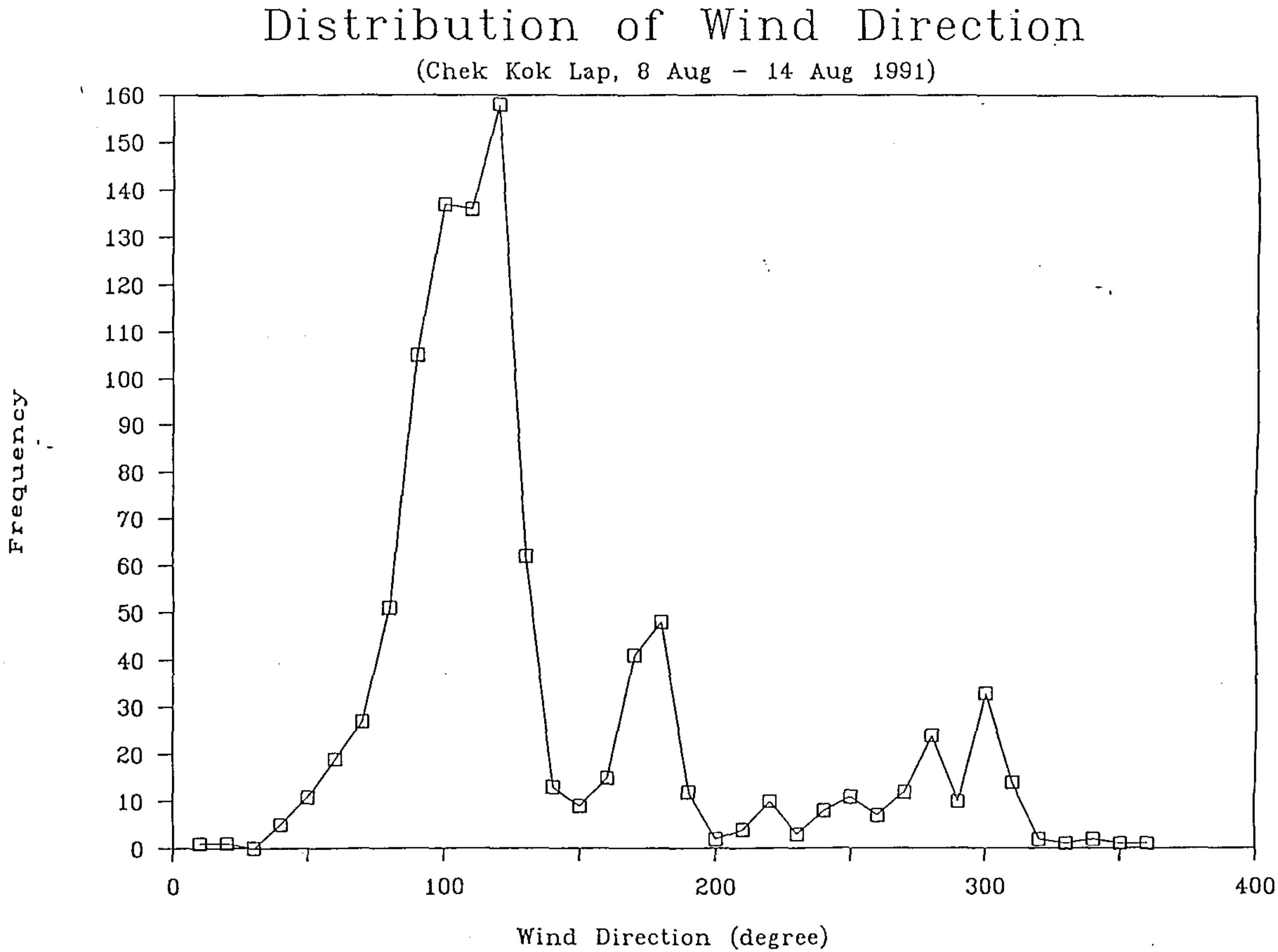


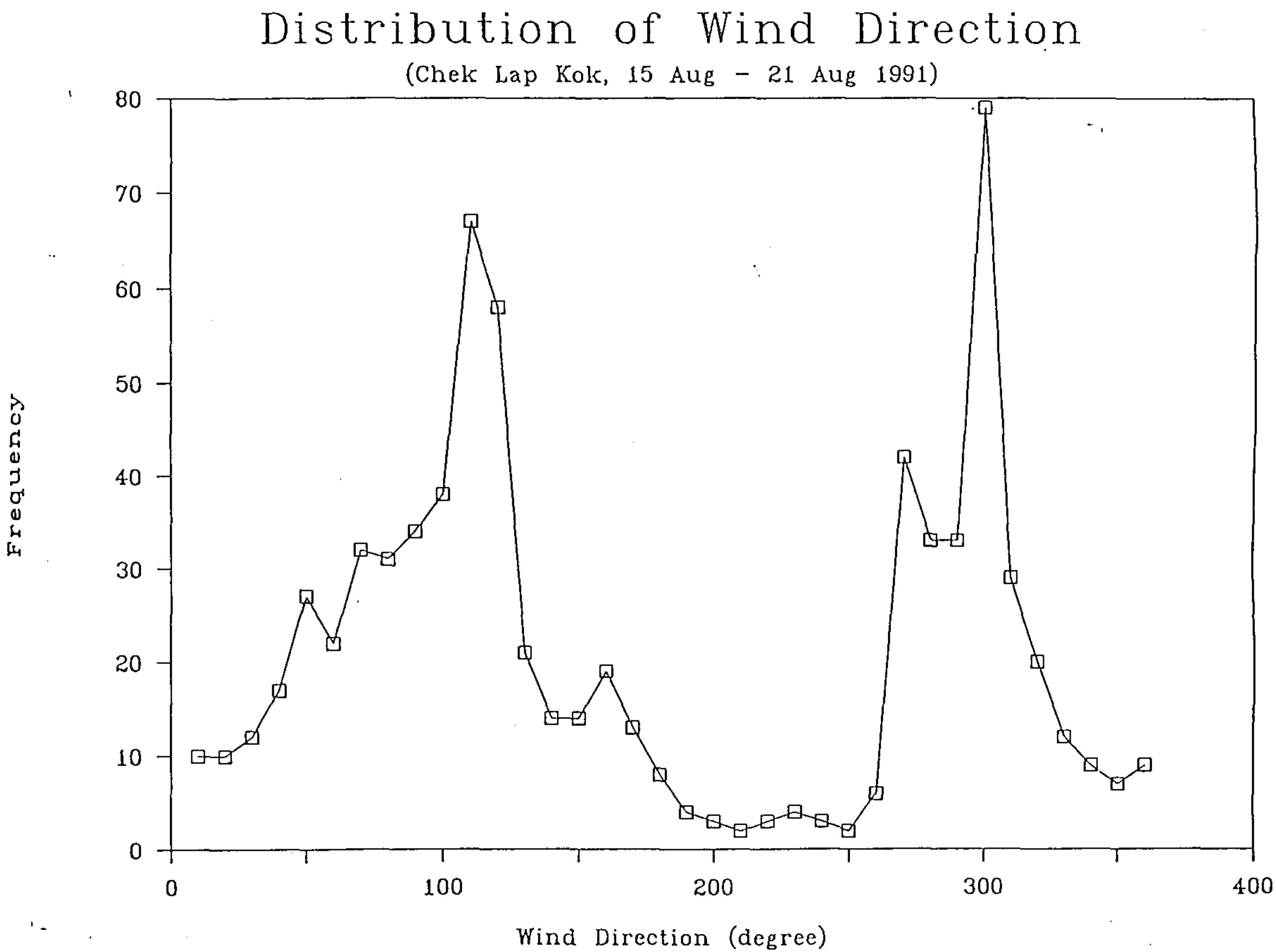
Figure V1/A25

Distribution of Ten-Minute Averaged Winds for Chek Lap Kok, August, 1989





Distribution of Wind Direction
(Chek Kok Lap, 8 Aug - 14 Aug 1991)
Frequency
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
0
100
200
300
400
Wind Direction (degree)


Distribution of Wind Direction
(Chek Lap Kok, 15 Aug - 21 Aug 1991)
Frequency
0
10
20
30
40
50
60
70
80
0
100
200
300
400
Wind Direction (degree)

Distribution of Wind Direction

(Chek Lap Kok, 22 Aug - 28 Aug 1991)

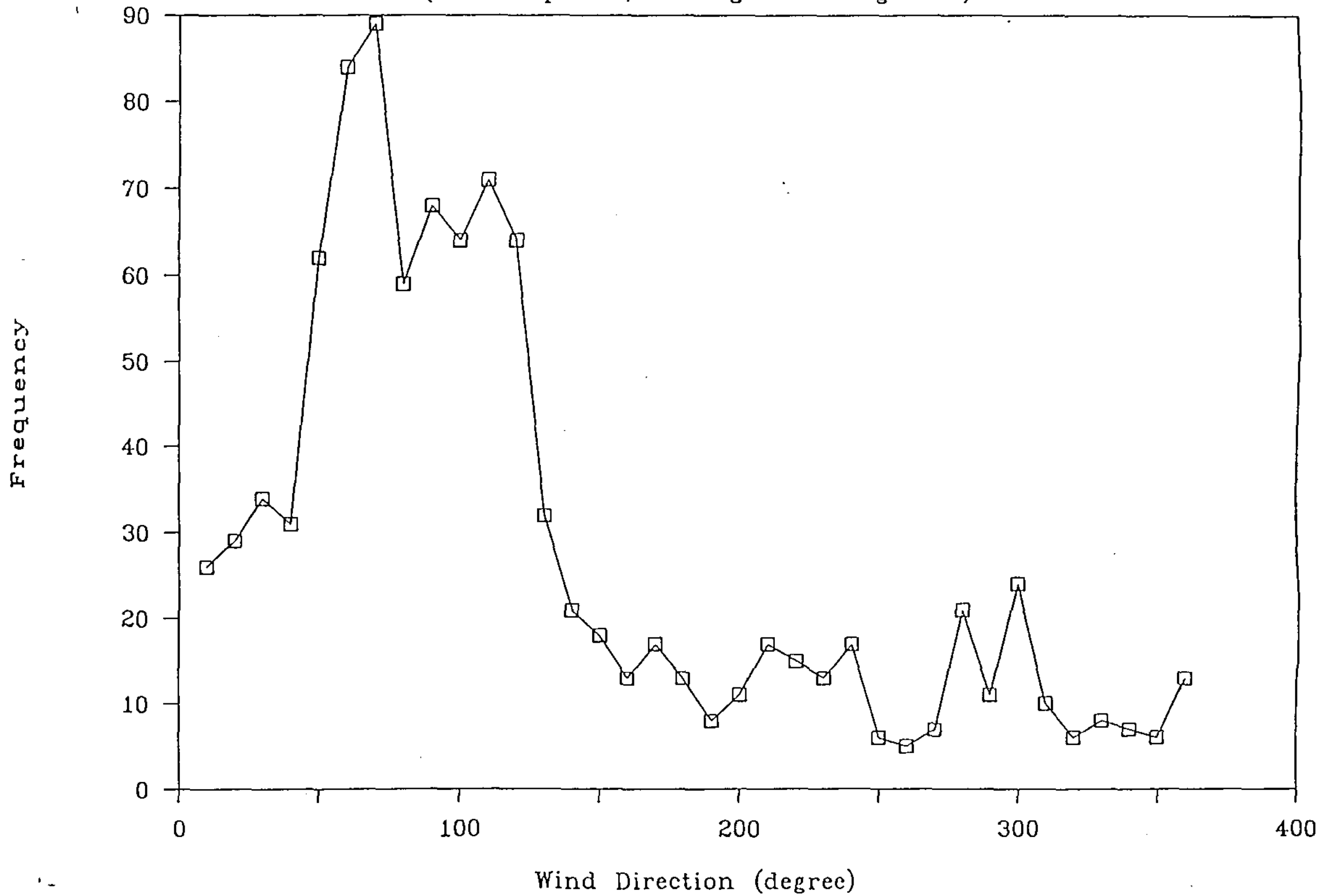
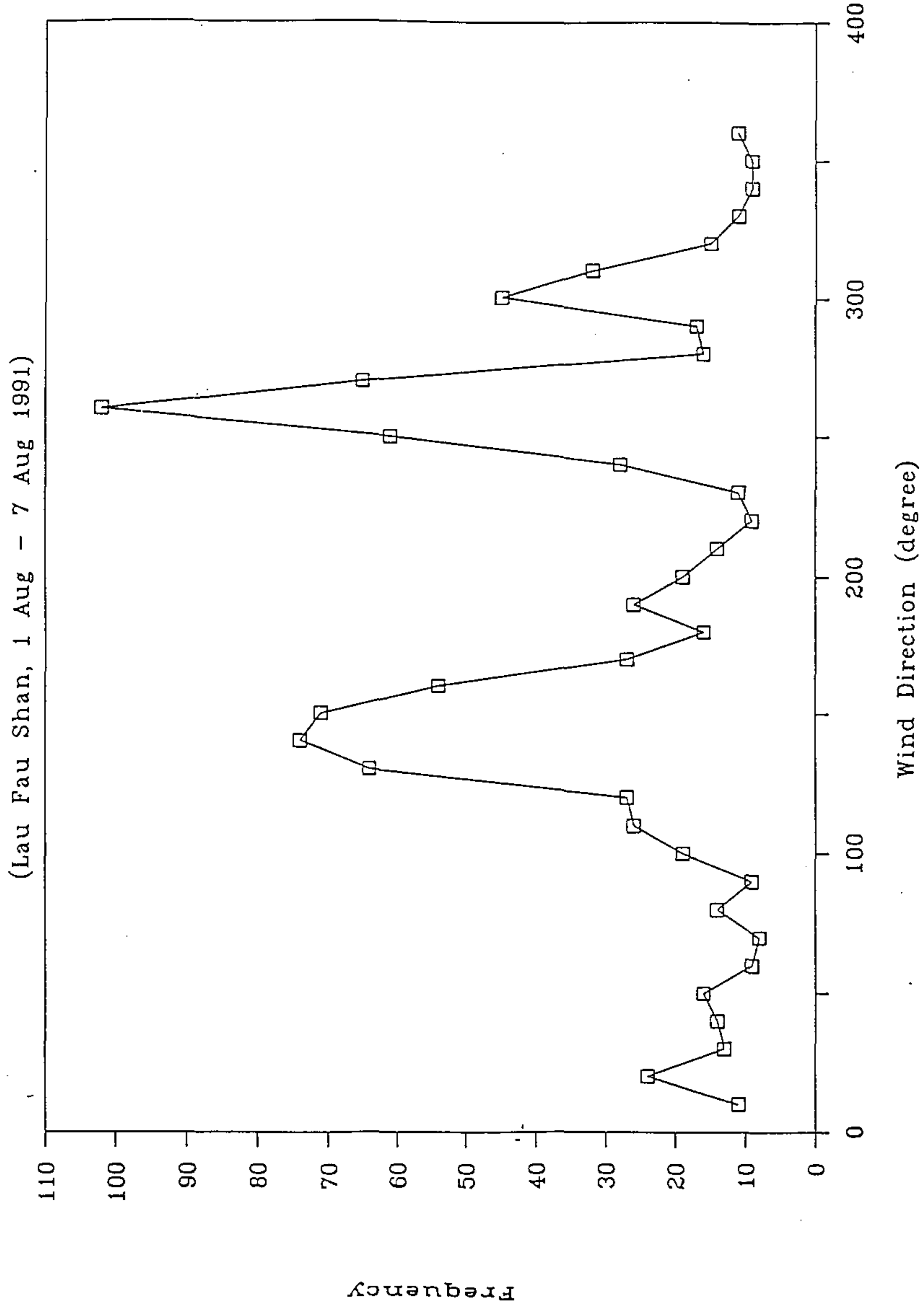
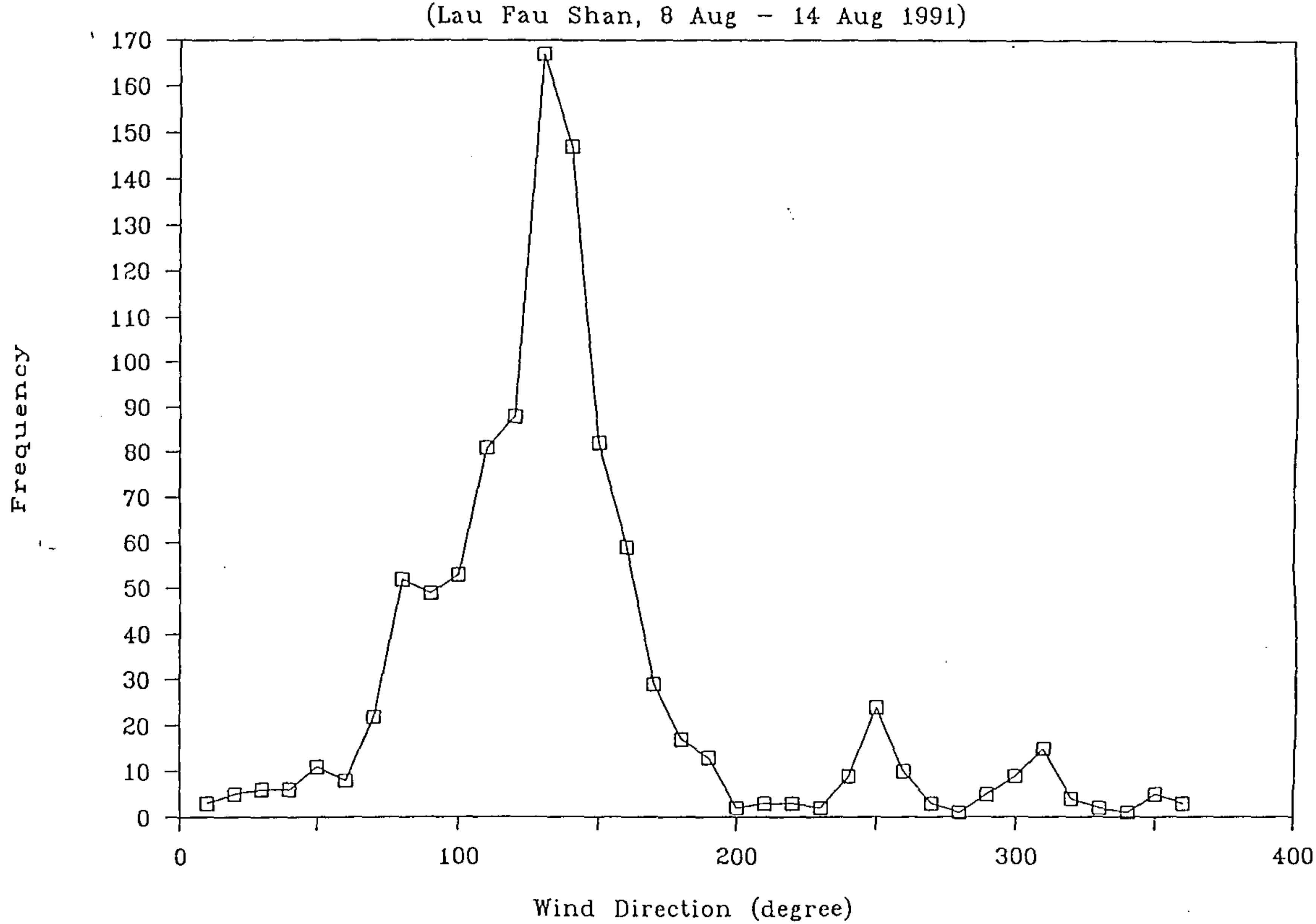


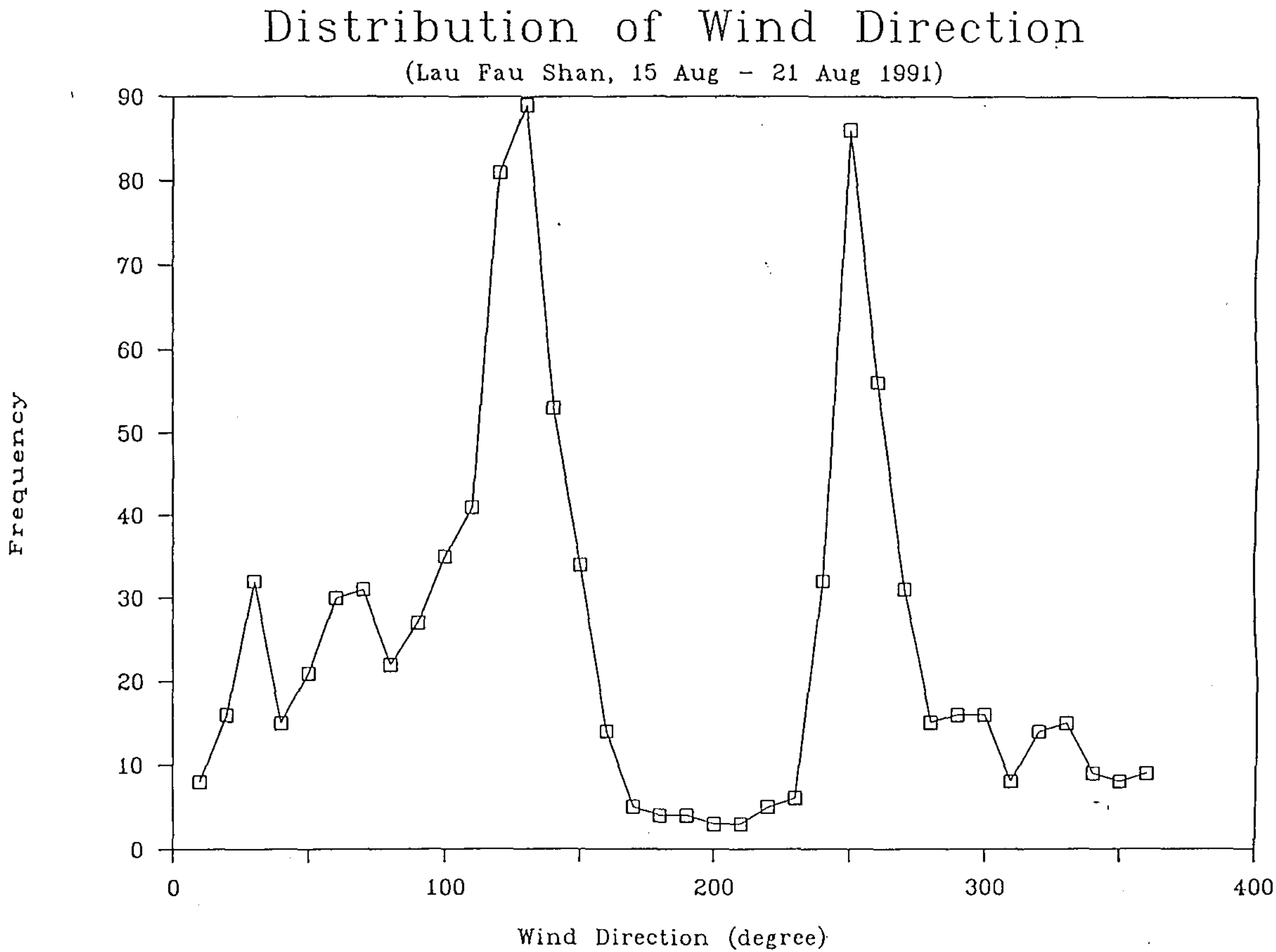
Figure V1/A26

Distribution of Ten-Minute Averaged Winds for Lau Fau Shan, August, 1989



Distribution of Wind Direction




Distribution of Wind Direction
(Lau Fau Shan, 15 Aug - 21 Aug 1991)
Frequency
Wind Direction (degree)
0
10
20
30
40
50
60
70
80
90
0
100
200
300
400

Distribution of Wind Direction

(Lau Fau Shan, 22 Aug - 28 Aug 1991)

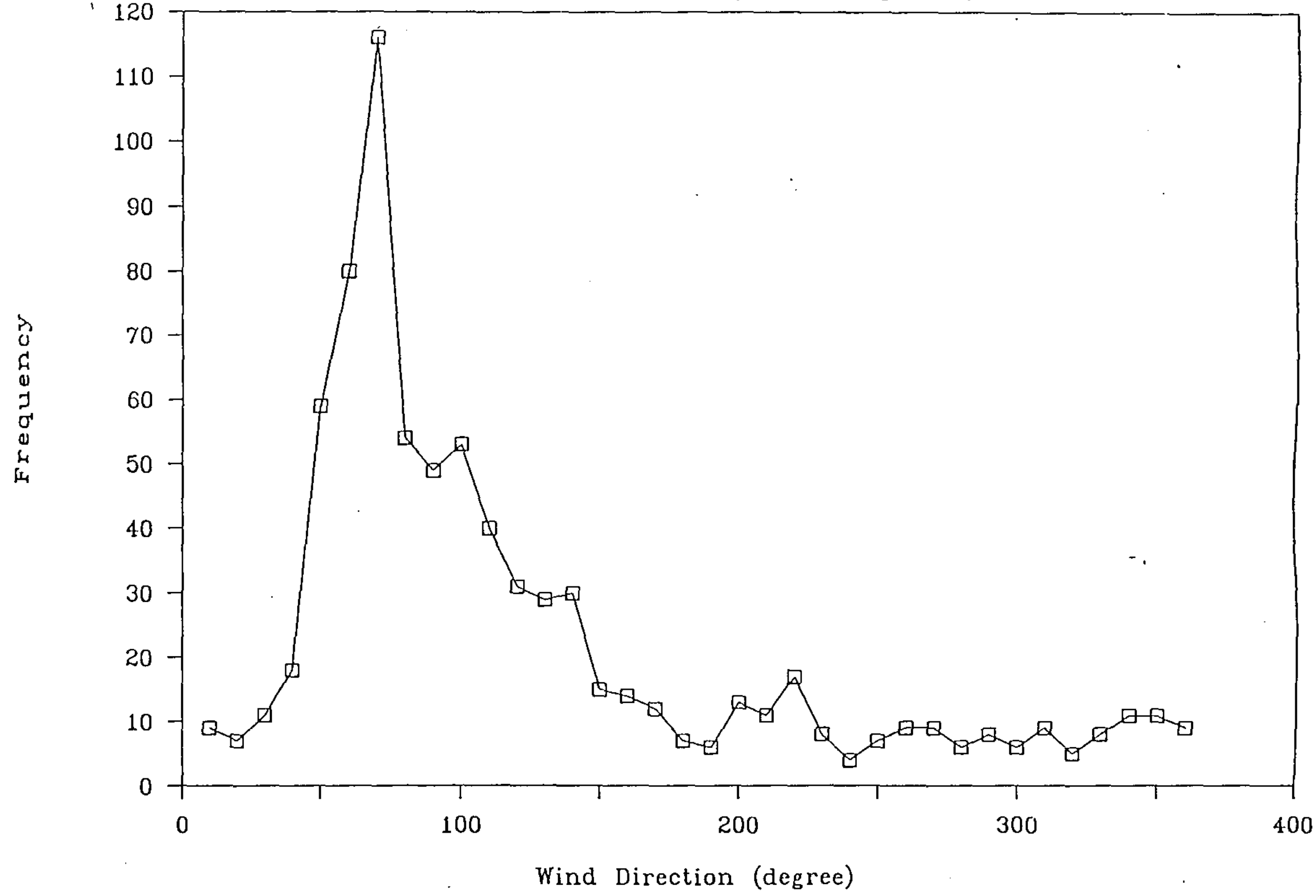
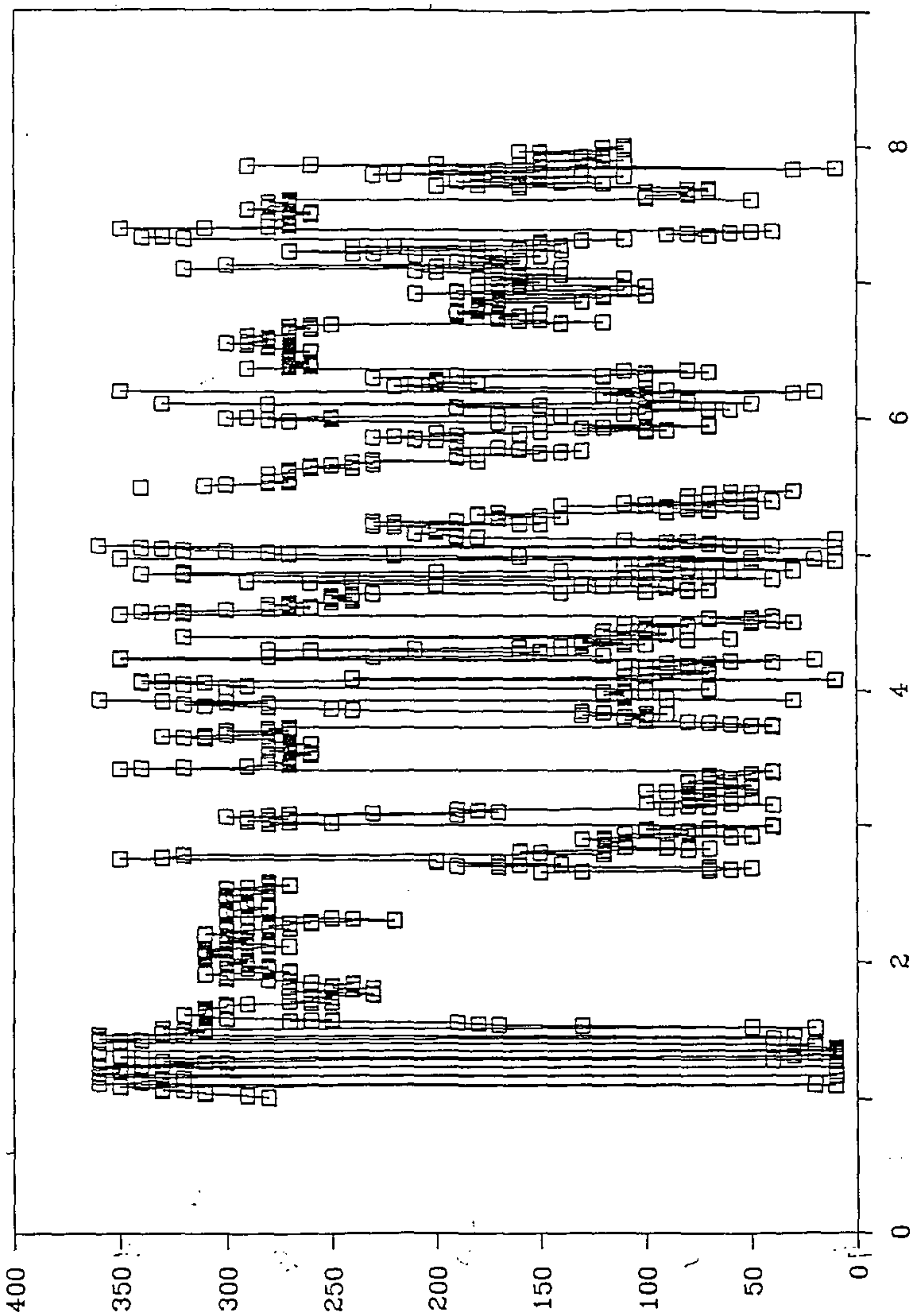
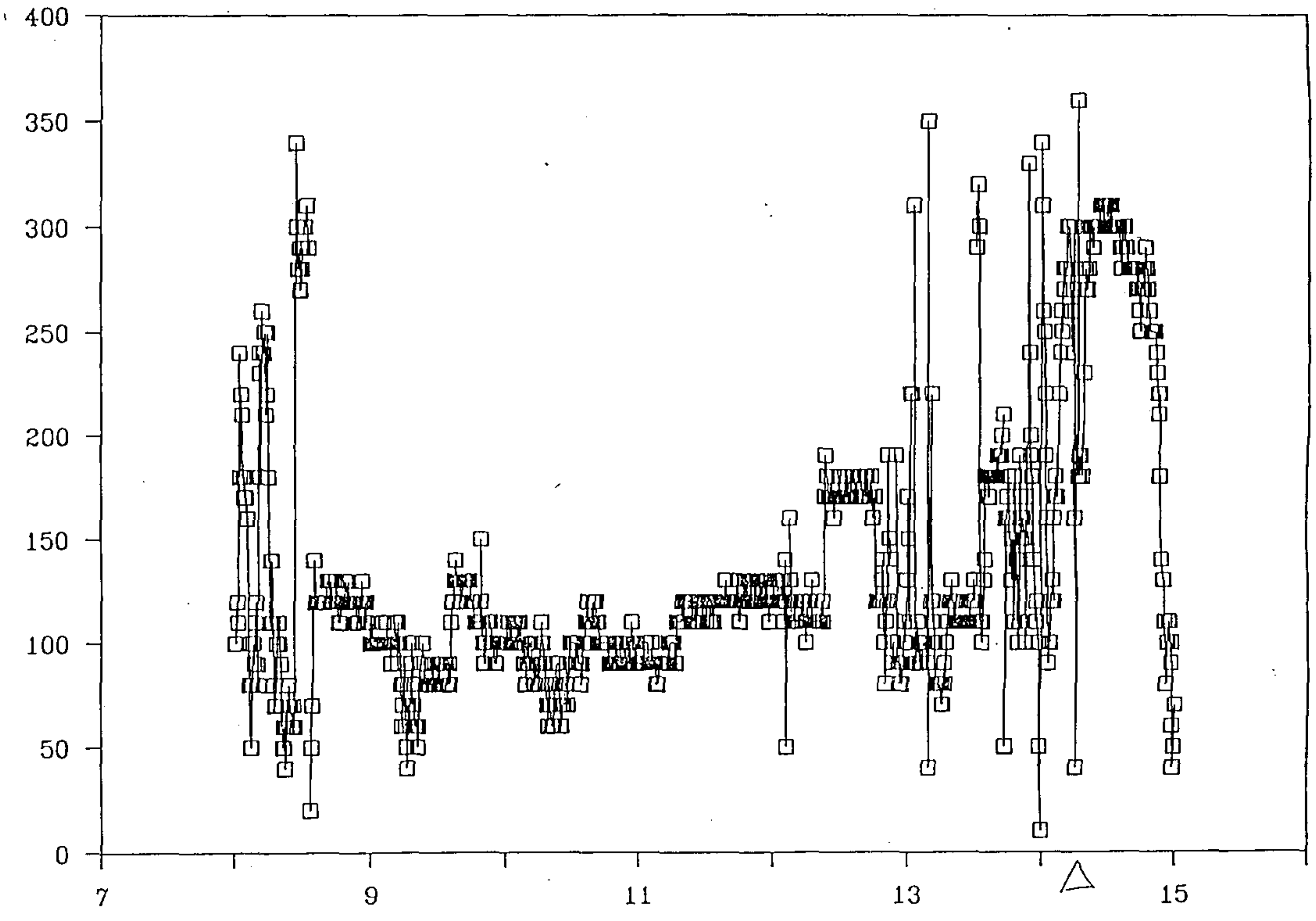
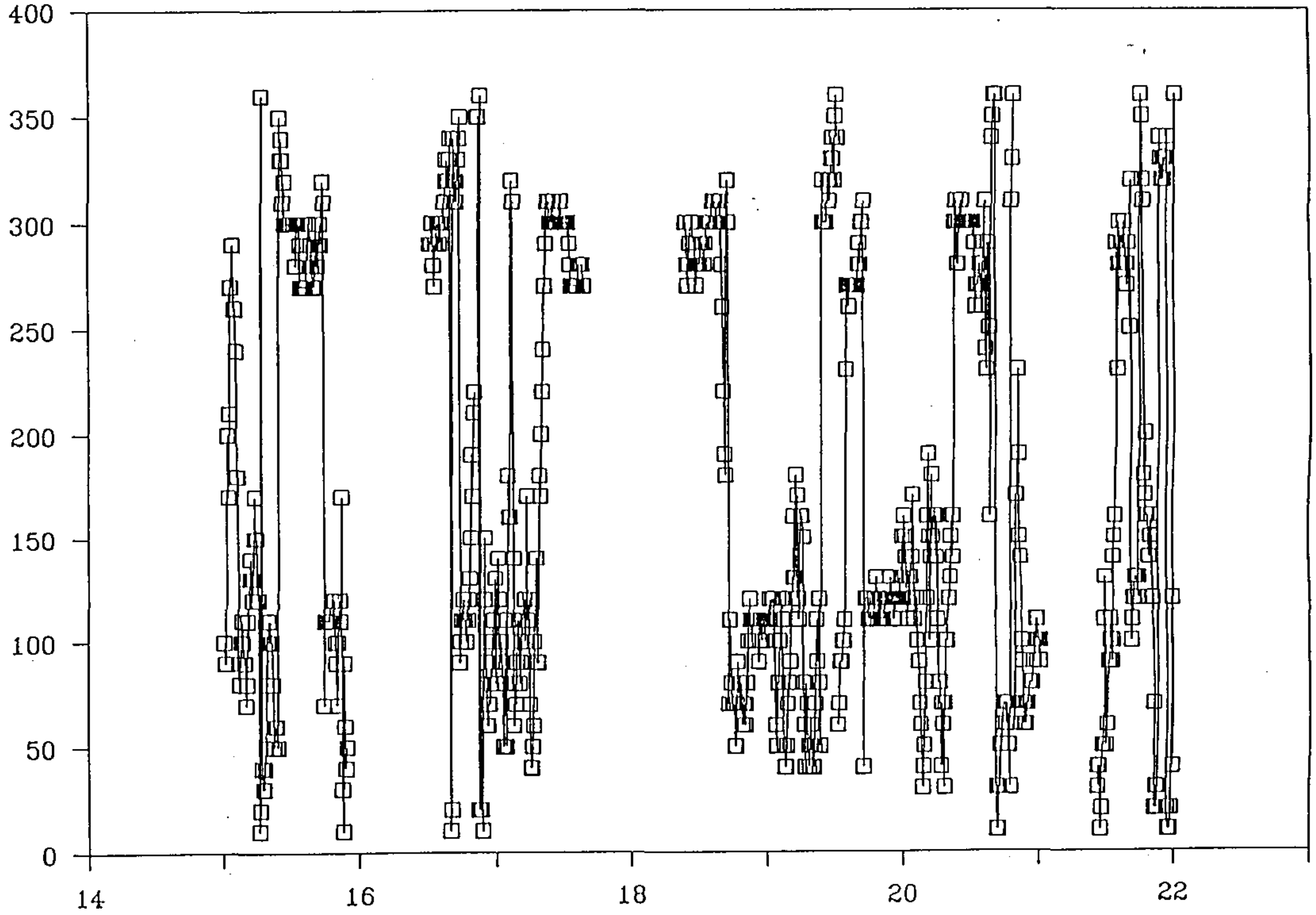


Figure V1/A27

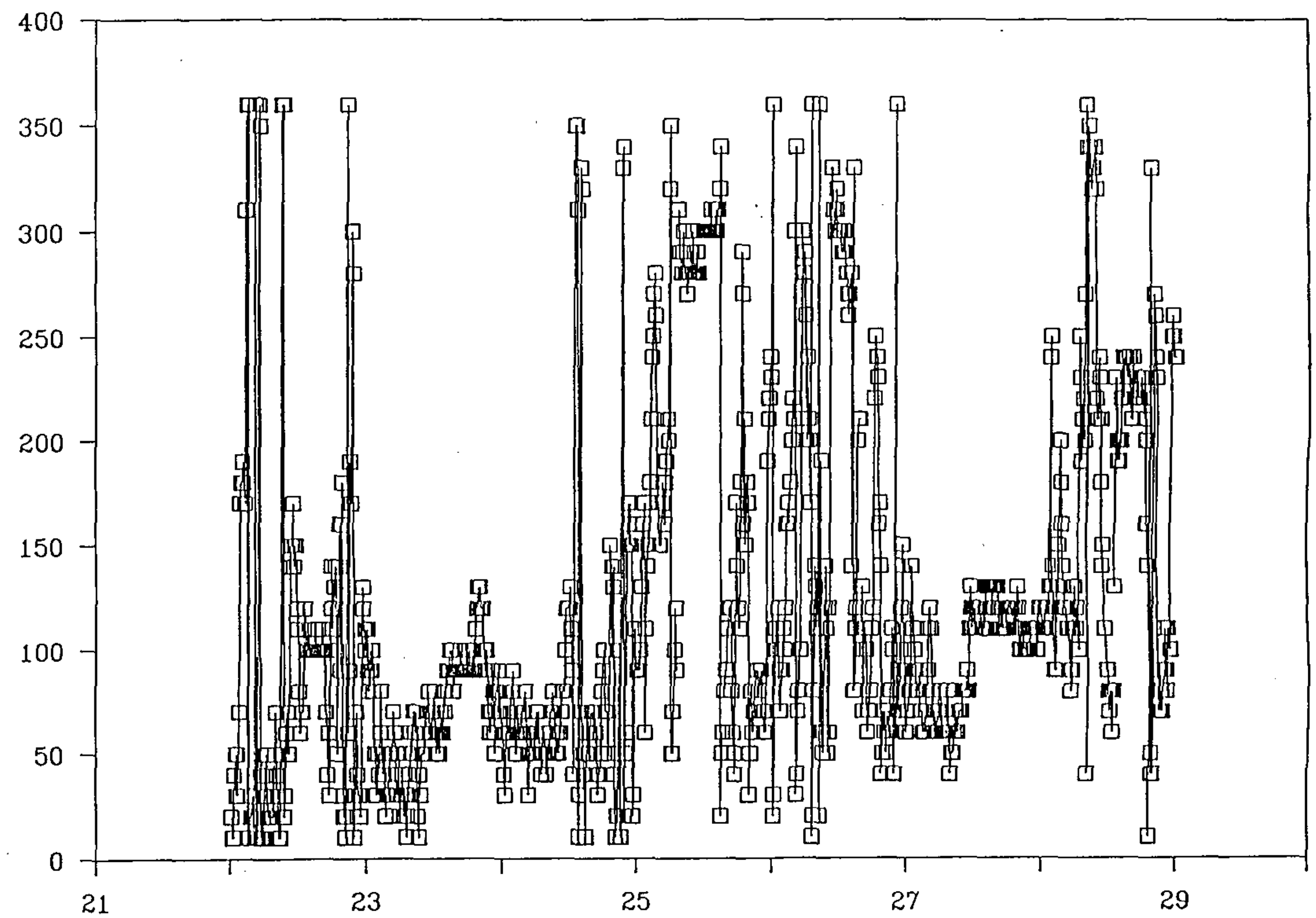
Variation of Winds (Ten-Minute Averages) for Chek Lap Kok, August, 1989




400
350
300
250
200
150
100
50
0
7
9
11
13
15
△



400
350
300
250
200
150
100
50
0
14
16
18
20
22


400
350
300
250
200
150
100
50
0
21
23
25
27
29

Variation of Wind Speed with Time

(Tuen Mun, 1 - 7 August 1989)

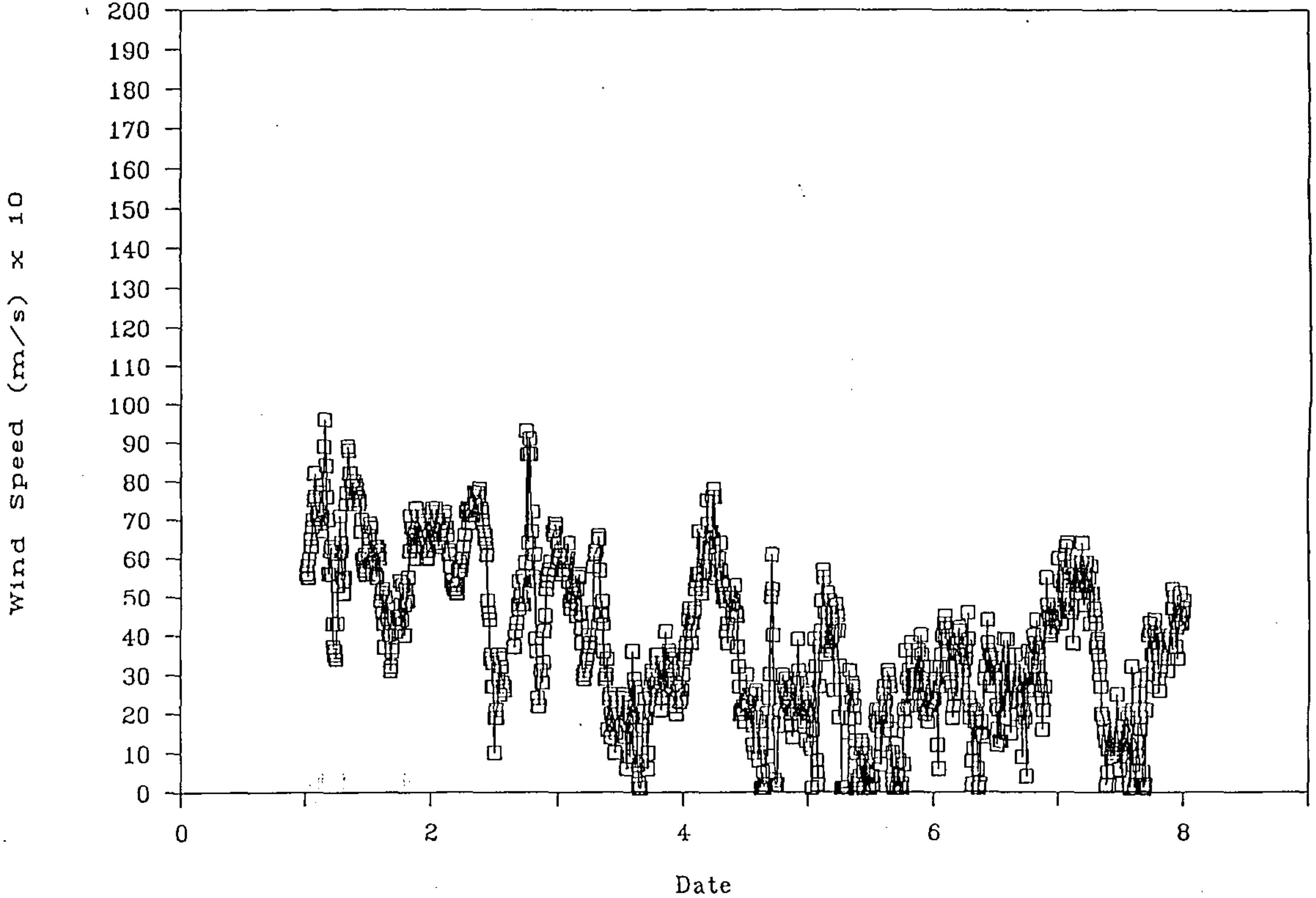
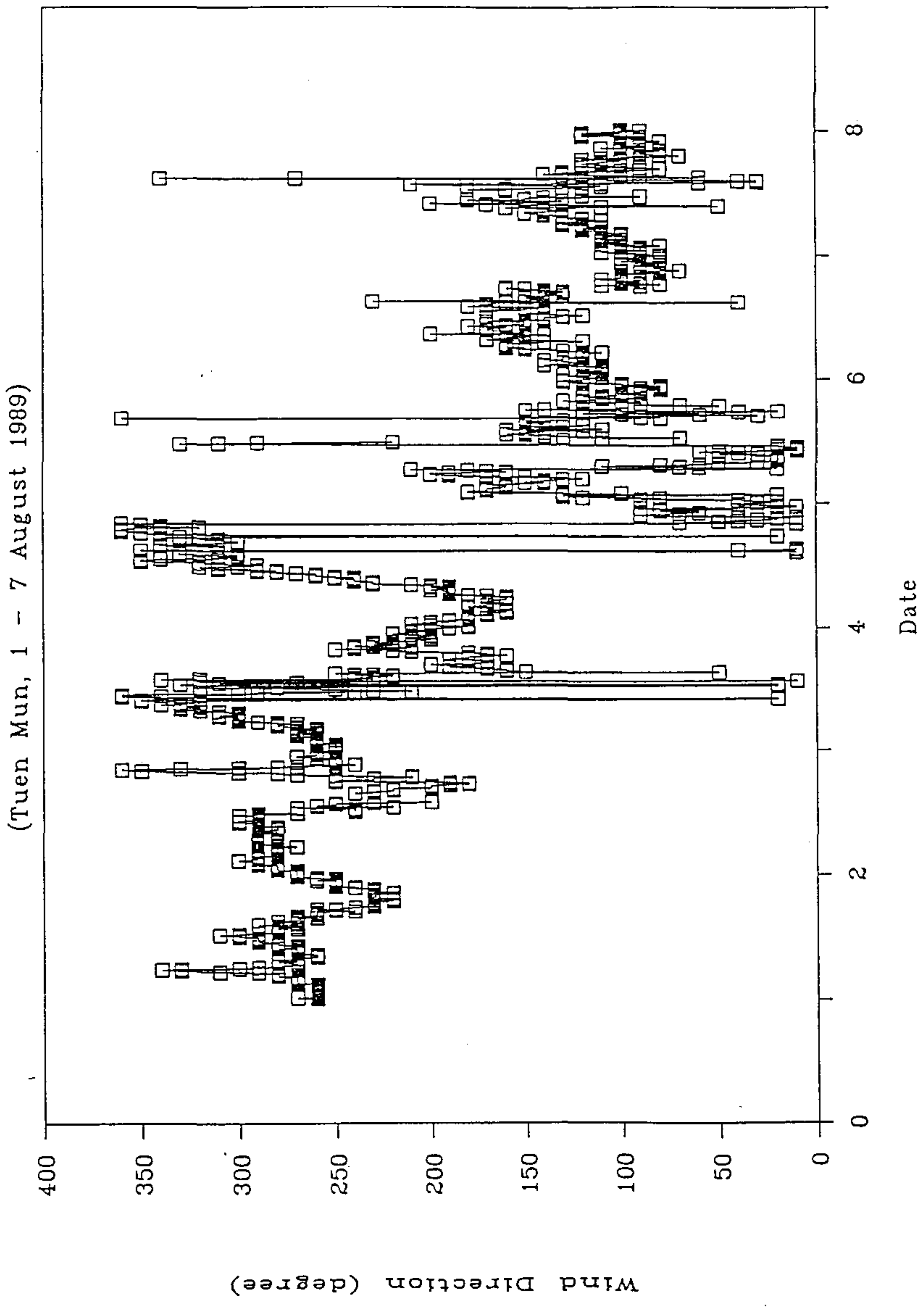


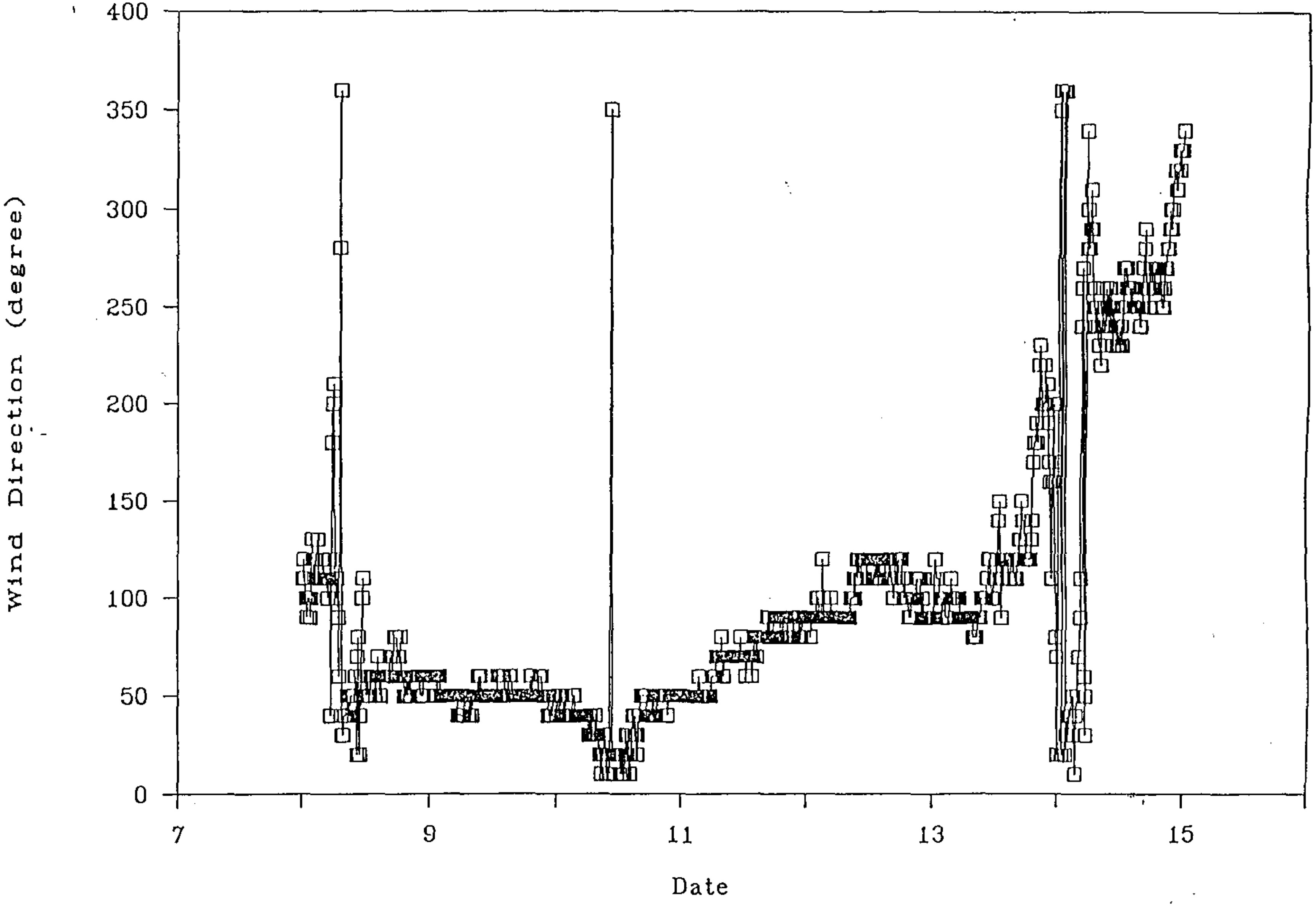
Figure V1/A28

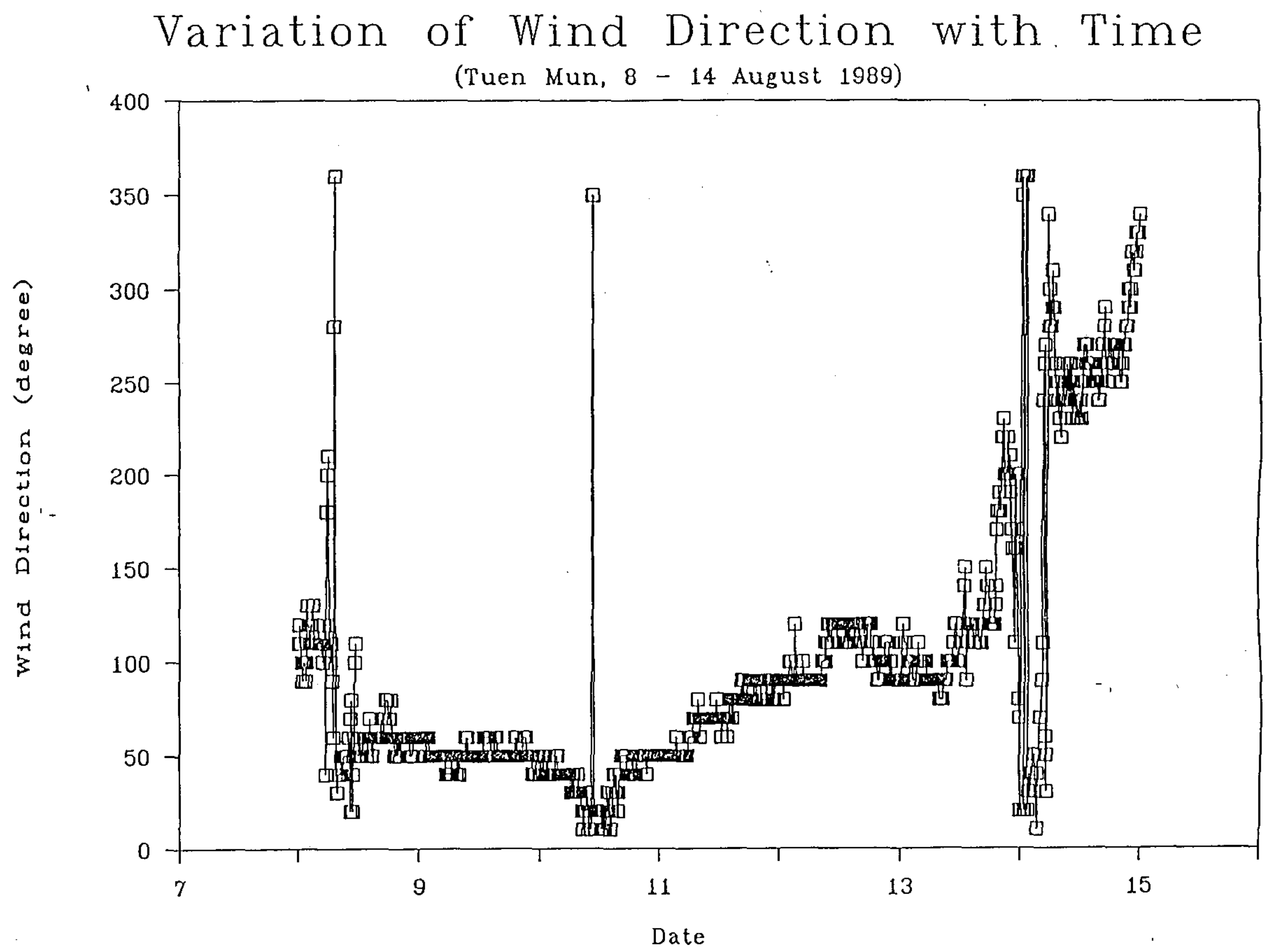
Variation of Winds (Ten-Minute Averages) for Tuen Mun



Variation of Wind Direction with Time

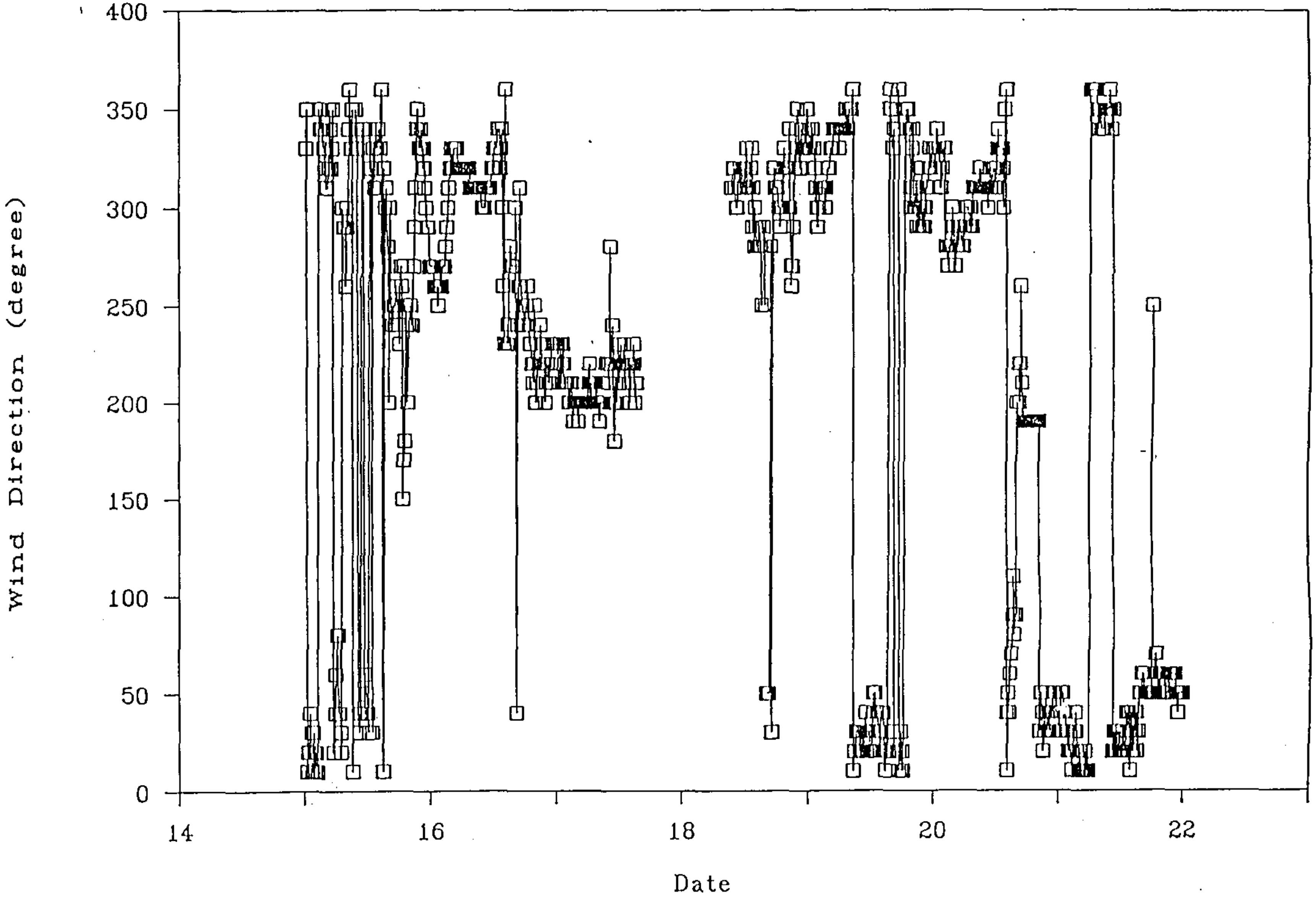
(Tuen Mun, 8 - 14 August 1989)

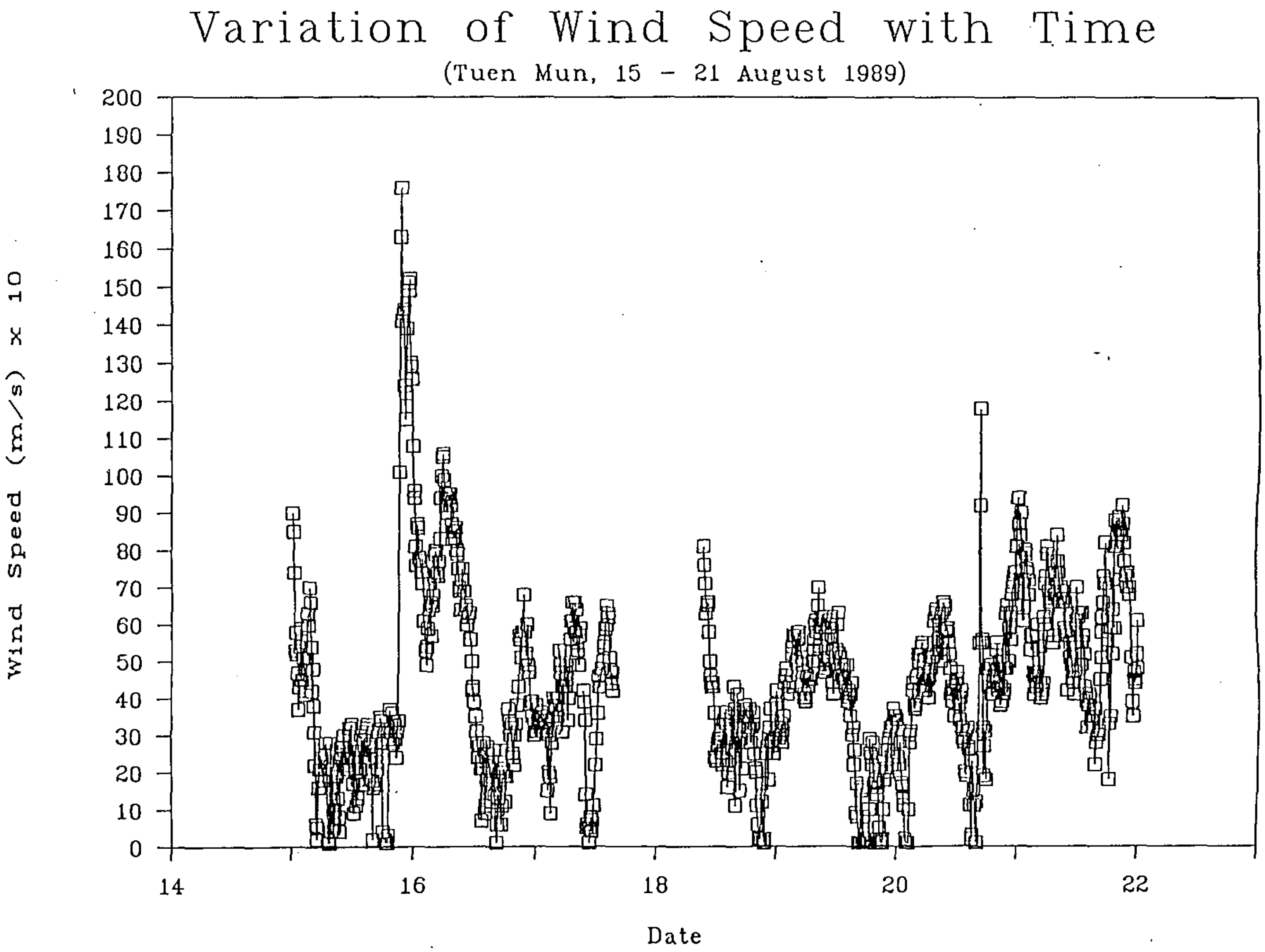



Variation of Wind Direction with Time
(Tuen Mun, 8 - 14 August 1989)
Wind Direction (degree)
400
350
300
250
200
150
100
50
0
7
9
11
13
15
Date

Variation of Wind Direction with Time

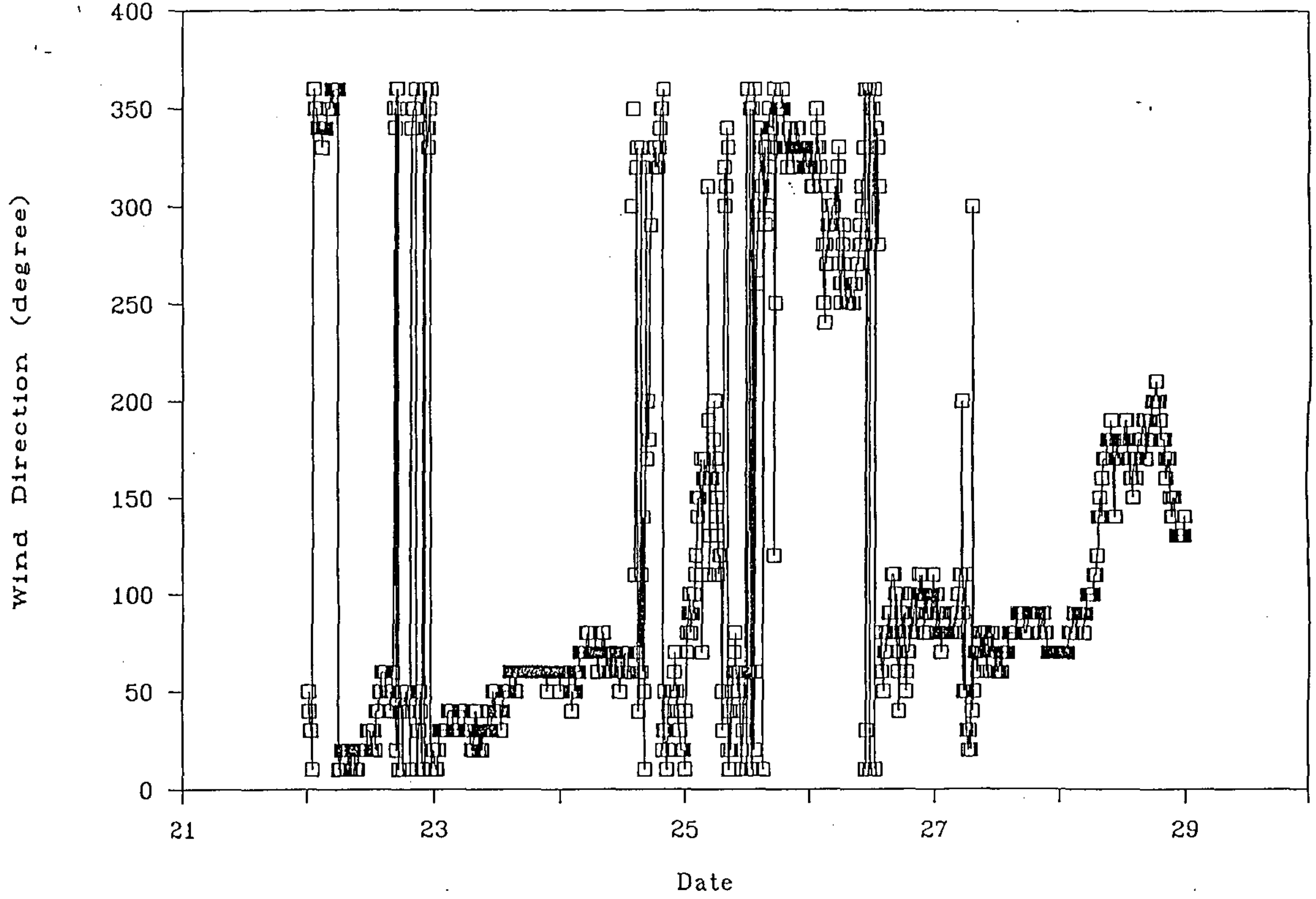
(Tuen Mun, 15 - 21 August, 1989)

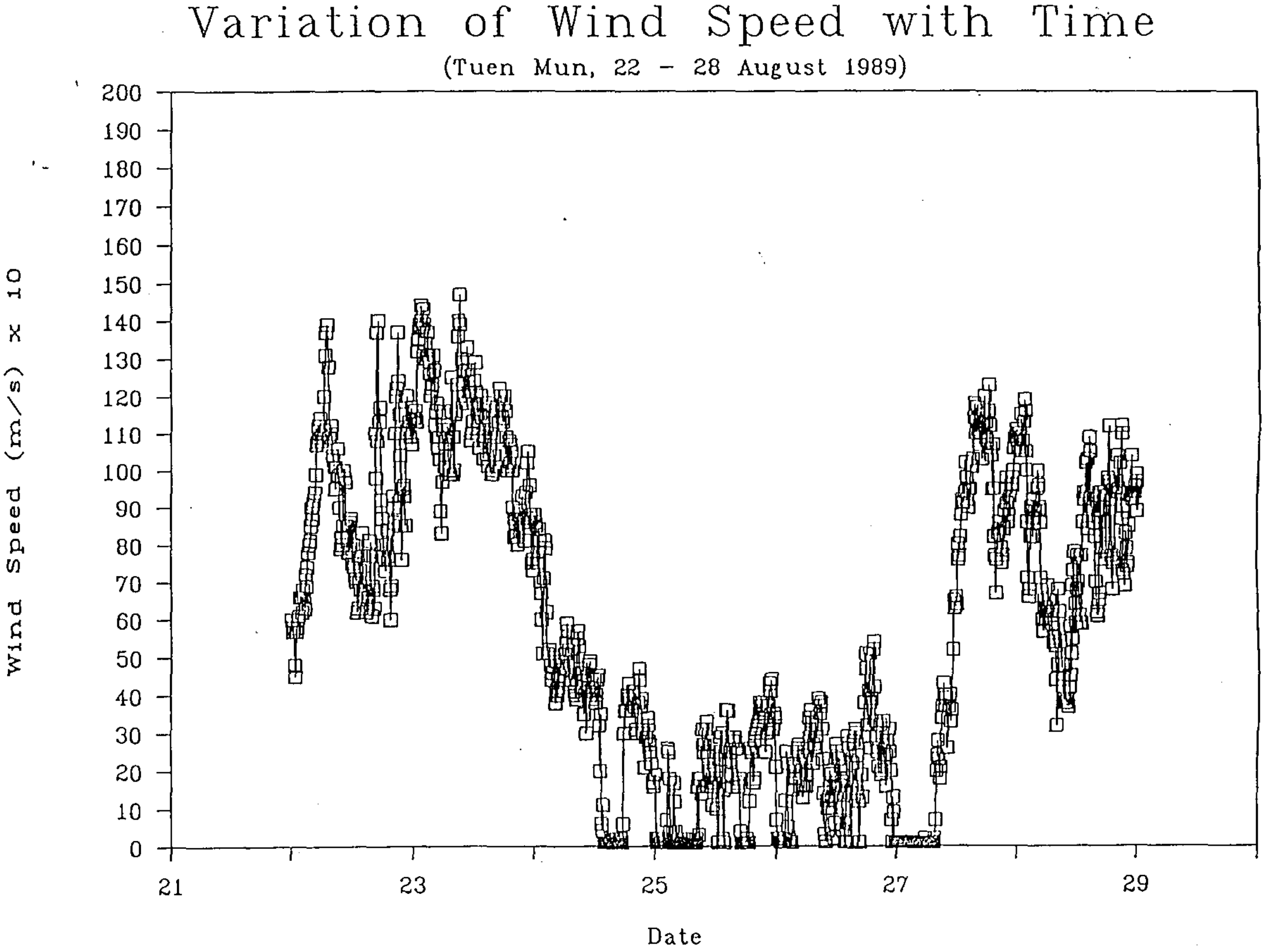


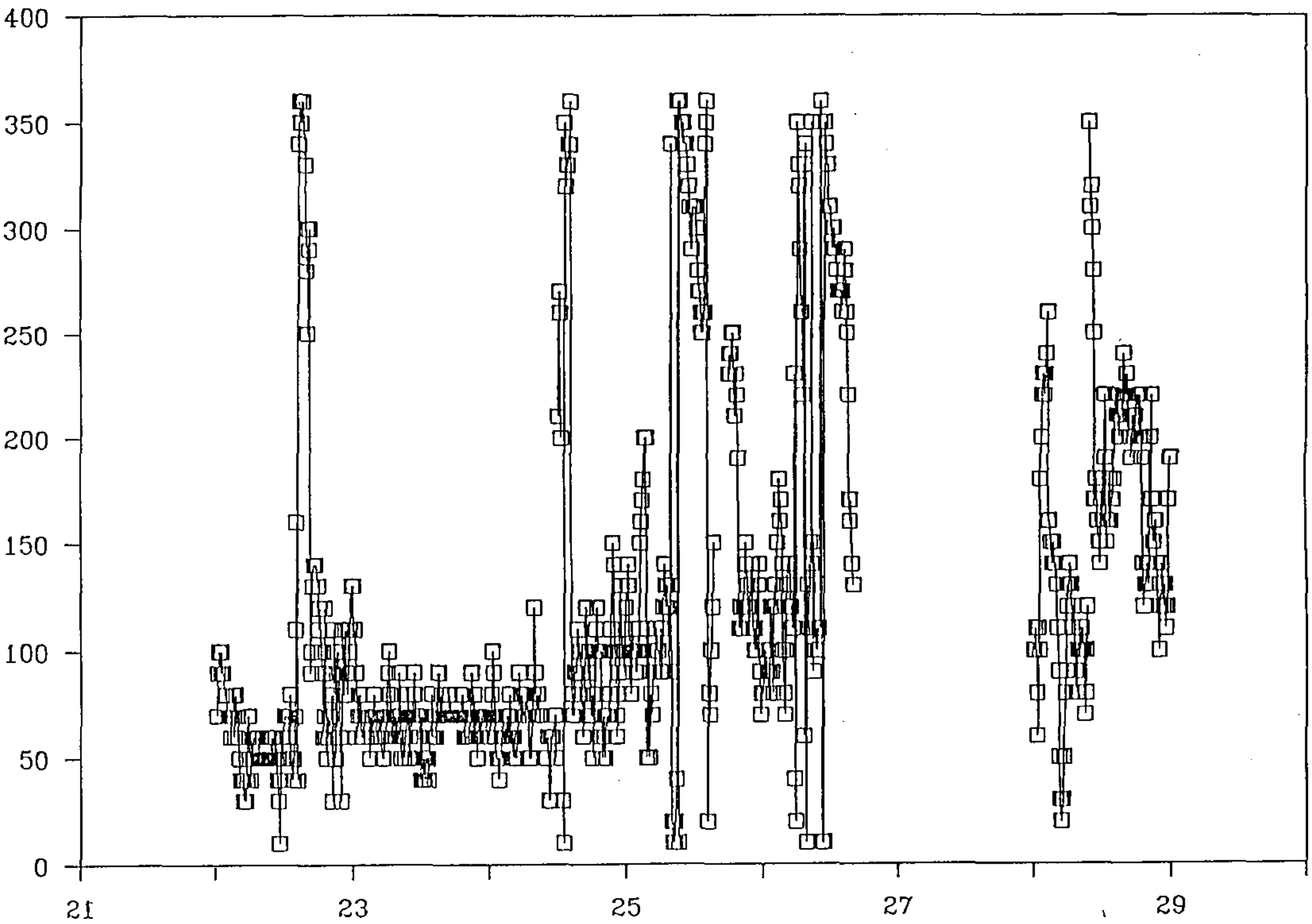

Variation of Wind Speed with Time
(Tuen Mun, 15 - 21 August 1989)
Wind Speed (m/s) x 10
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
14
16
18
20
22
Date

Variation of Wind Direction with Time

(Tuen Mun, 22 - 28 August 1989)



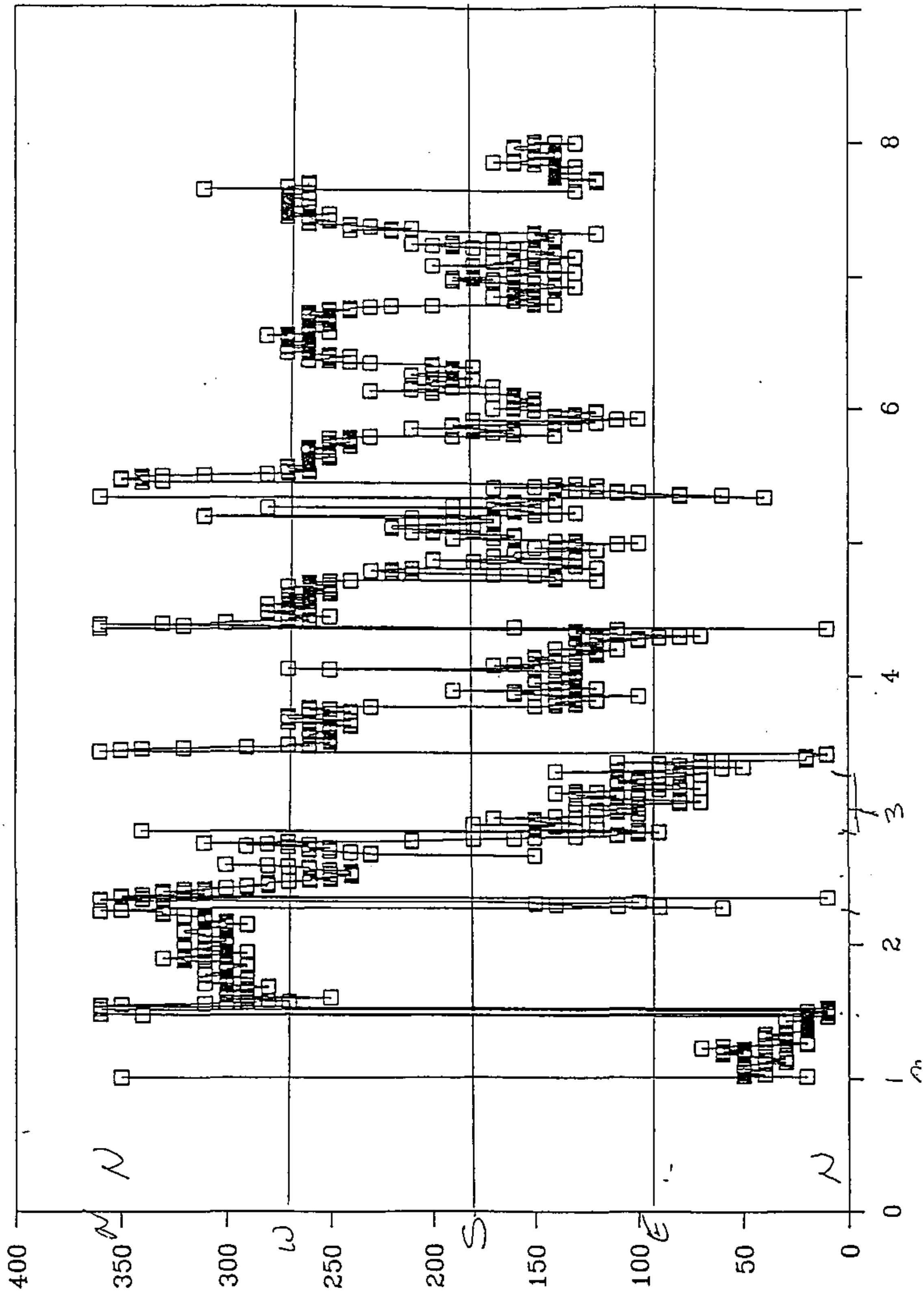

Variation of Wind Speed with Time
(Tuen Mun, 22 - 28 August 1989)
Wind Speed (m/s) x 10
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200
21
23
25
27
29
Date

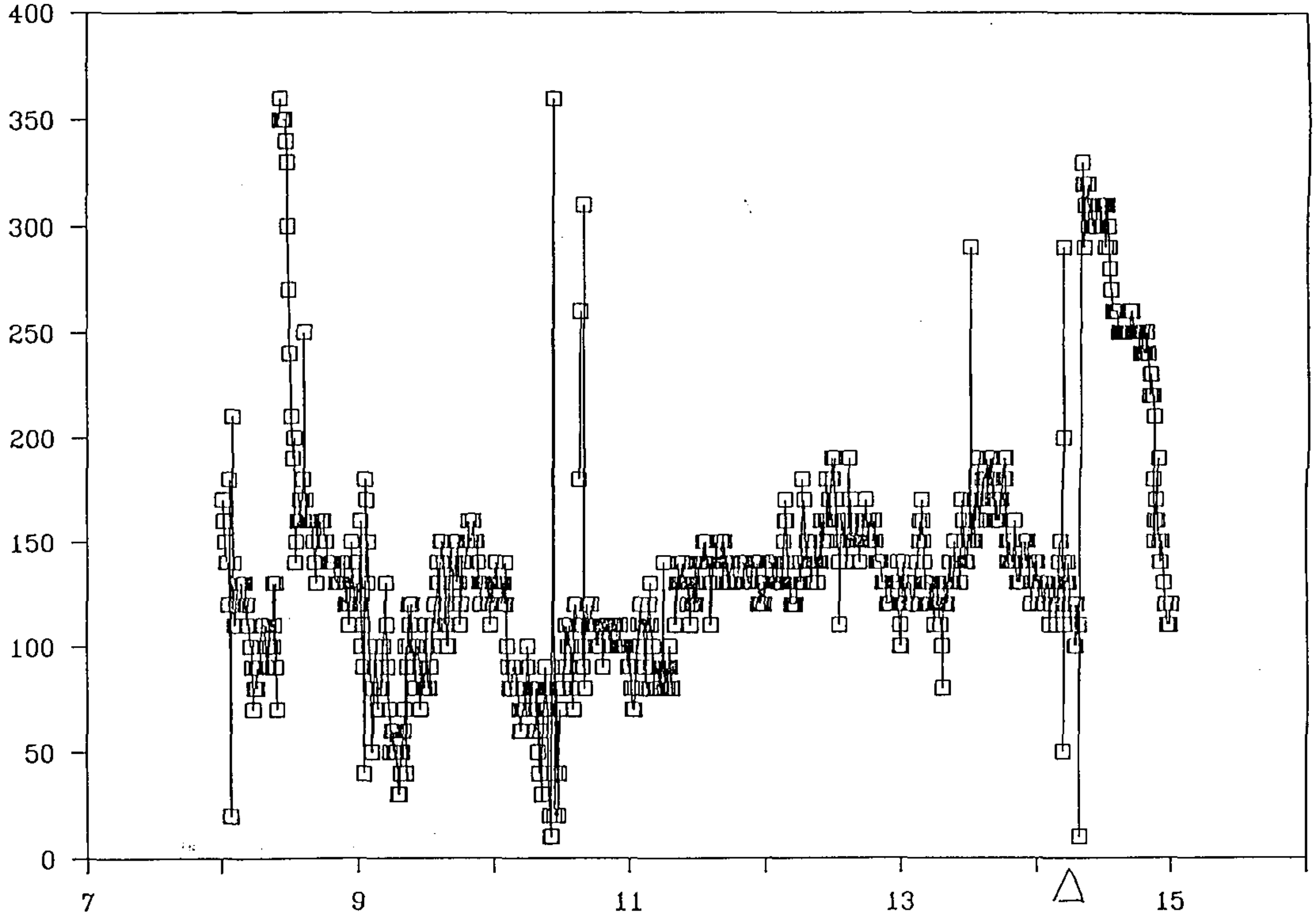


LFS

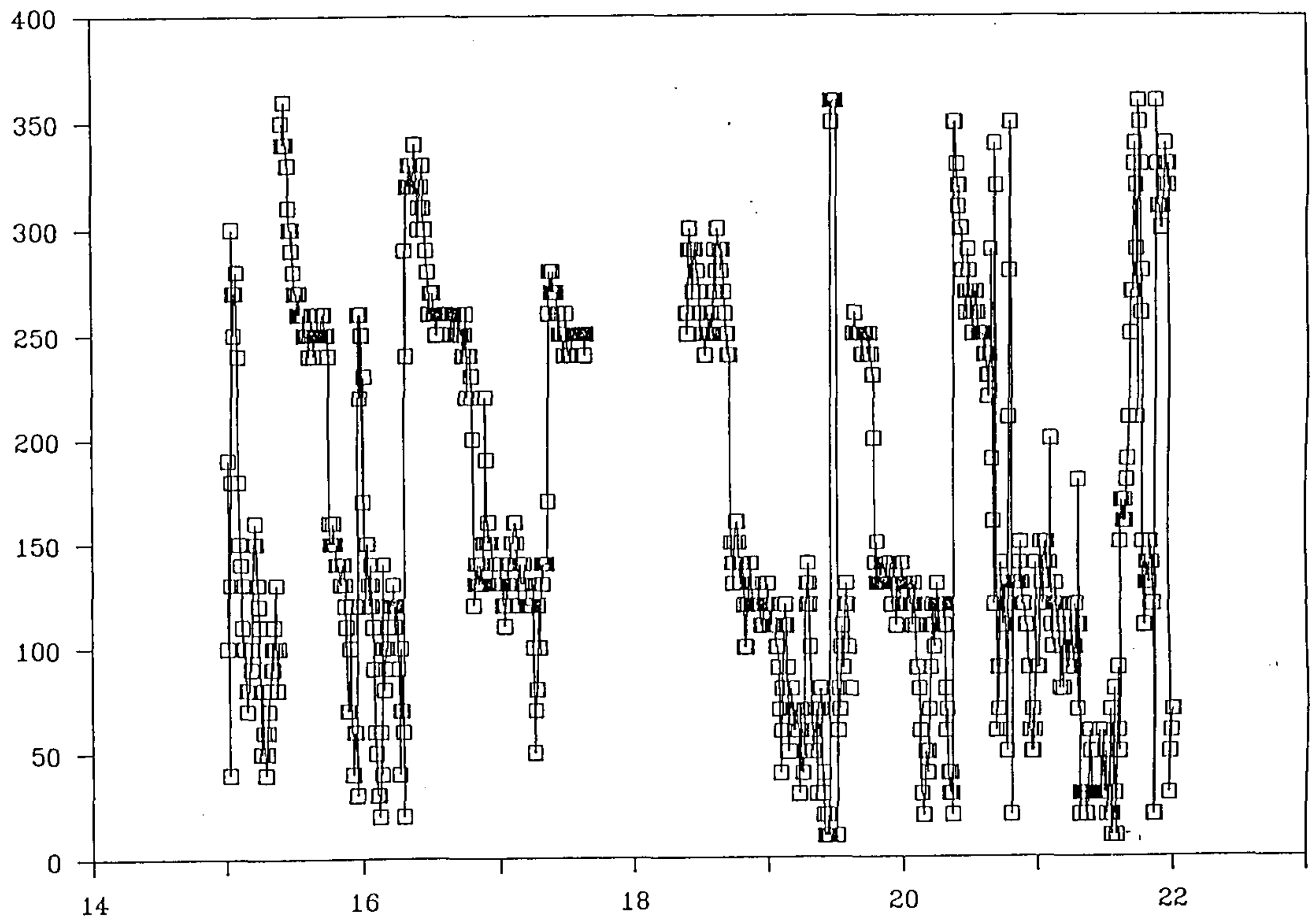
Figure V1/A29

Variation of Winds (Ten-Minute Averages) for Lau Fau Shan





LFS



400
350
300
250
200
150
100
50
0
14
16
18
20
22

Figure V1/A30

Variation of Wind Direction at Chek Lap Kok, 14 August 1989

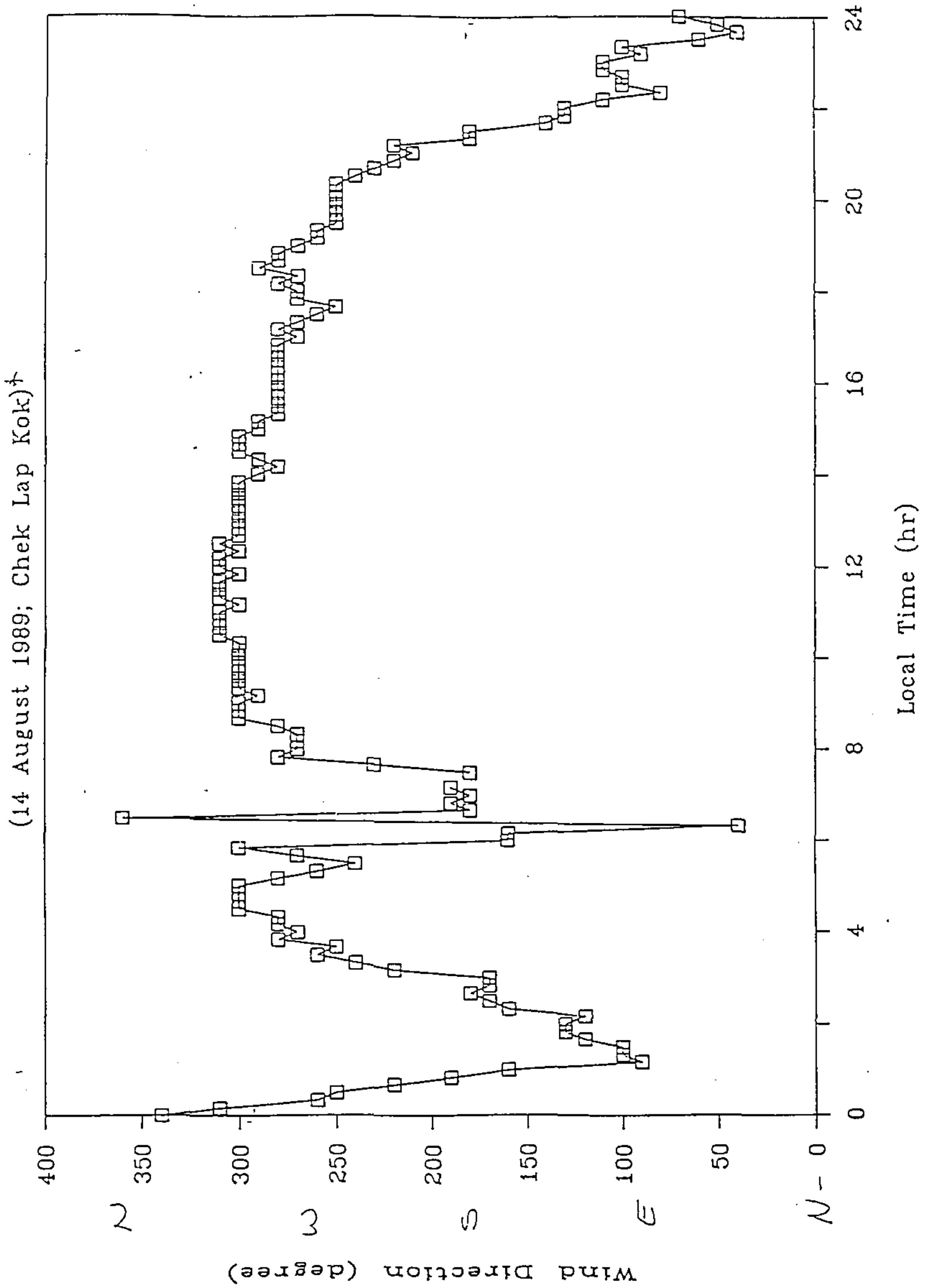


Figure V1/A31

Variation of Wind Direction 14 August 1989 at Lau Fau Shan

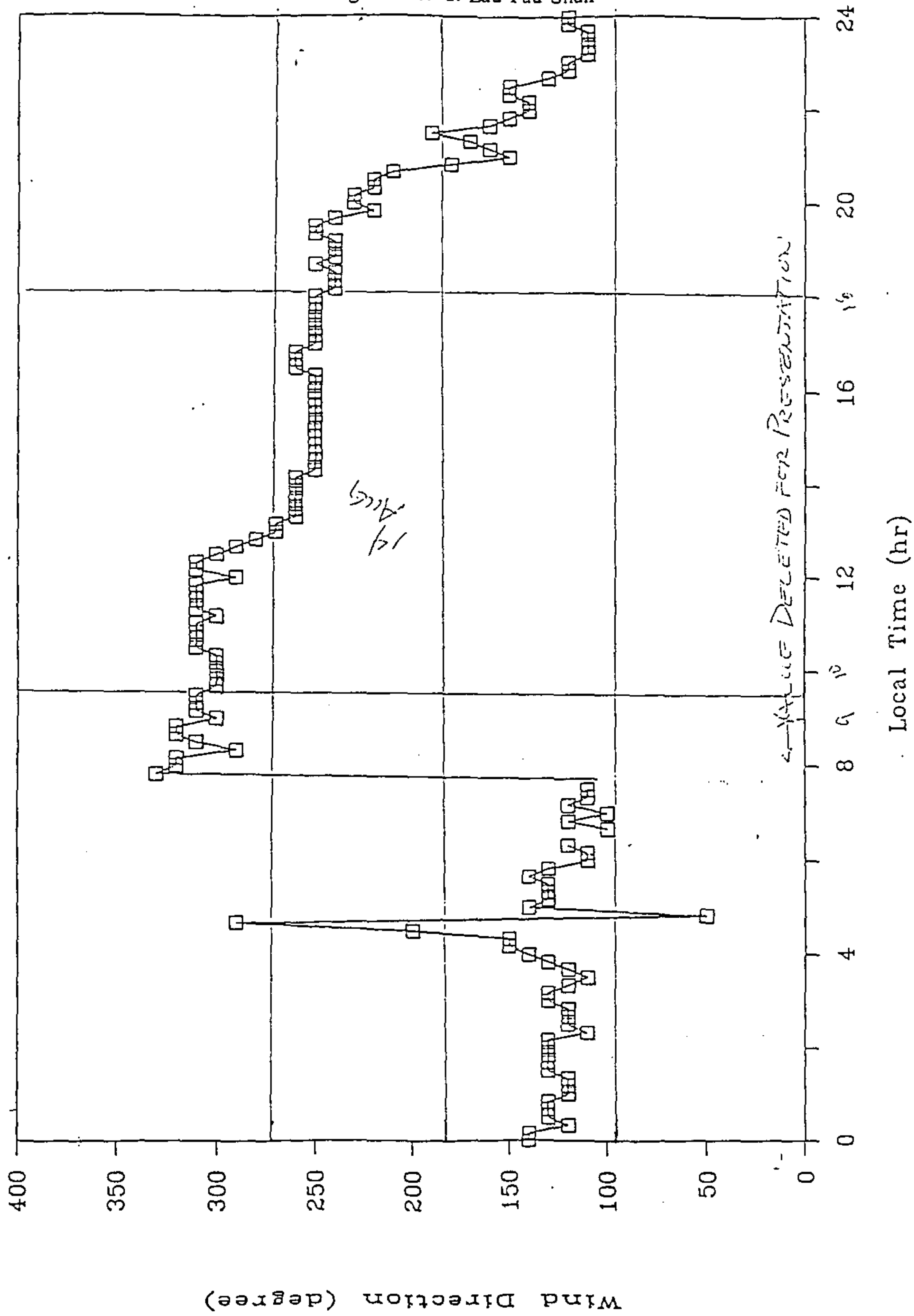
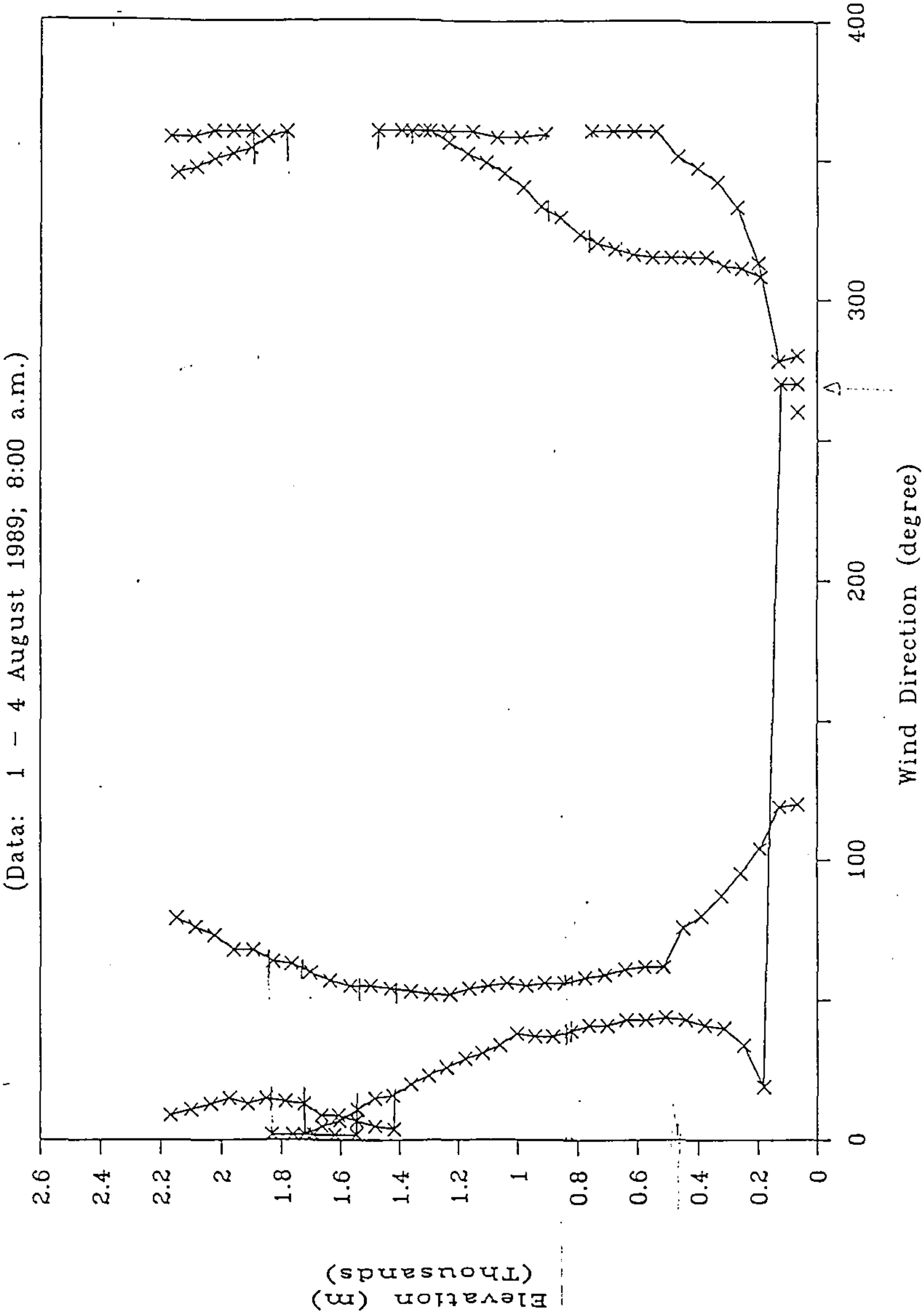
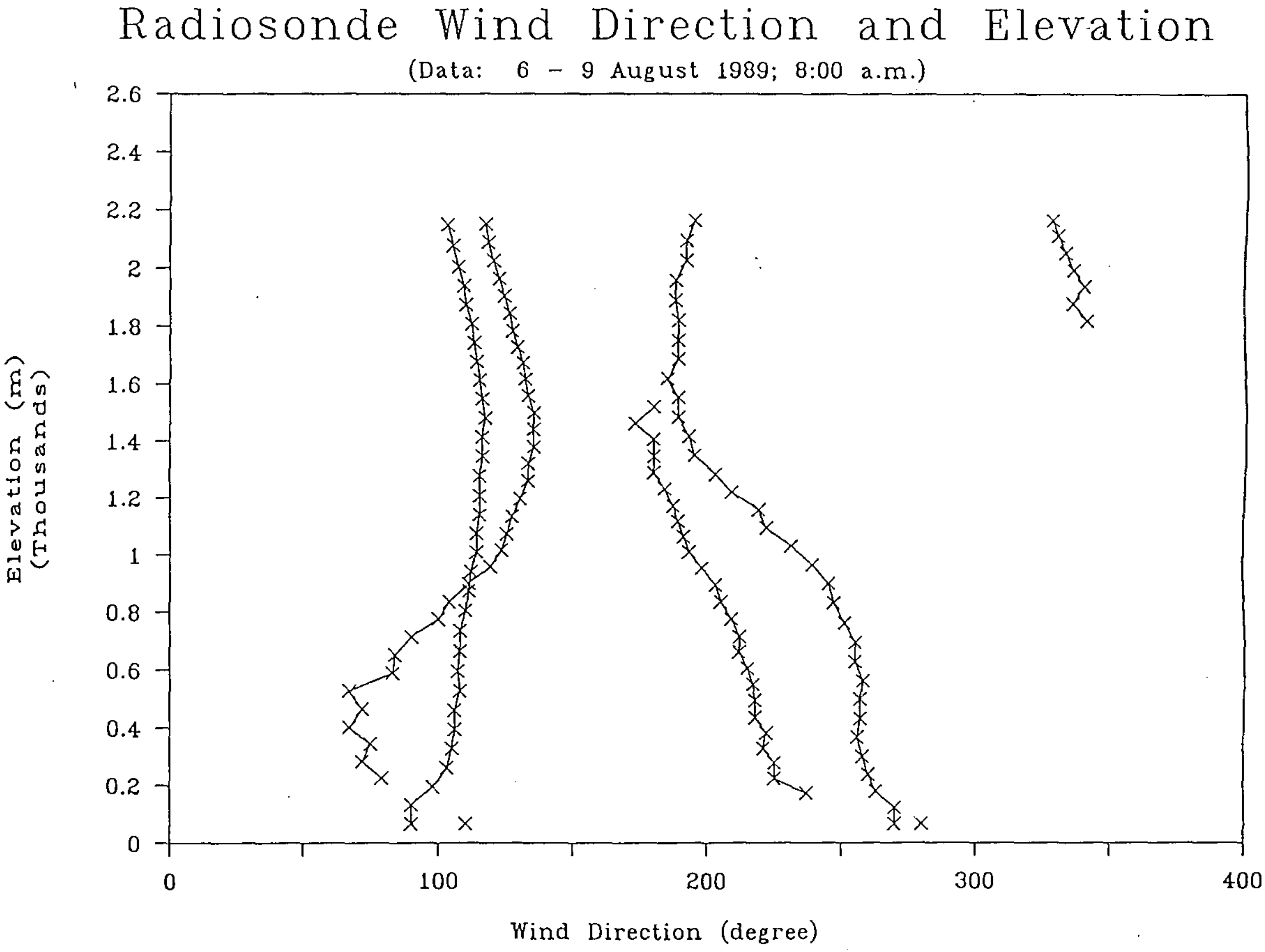
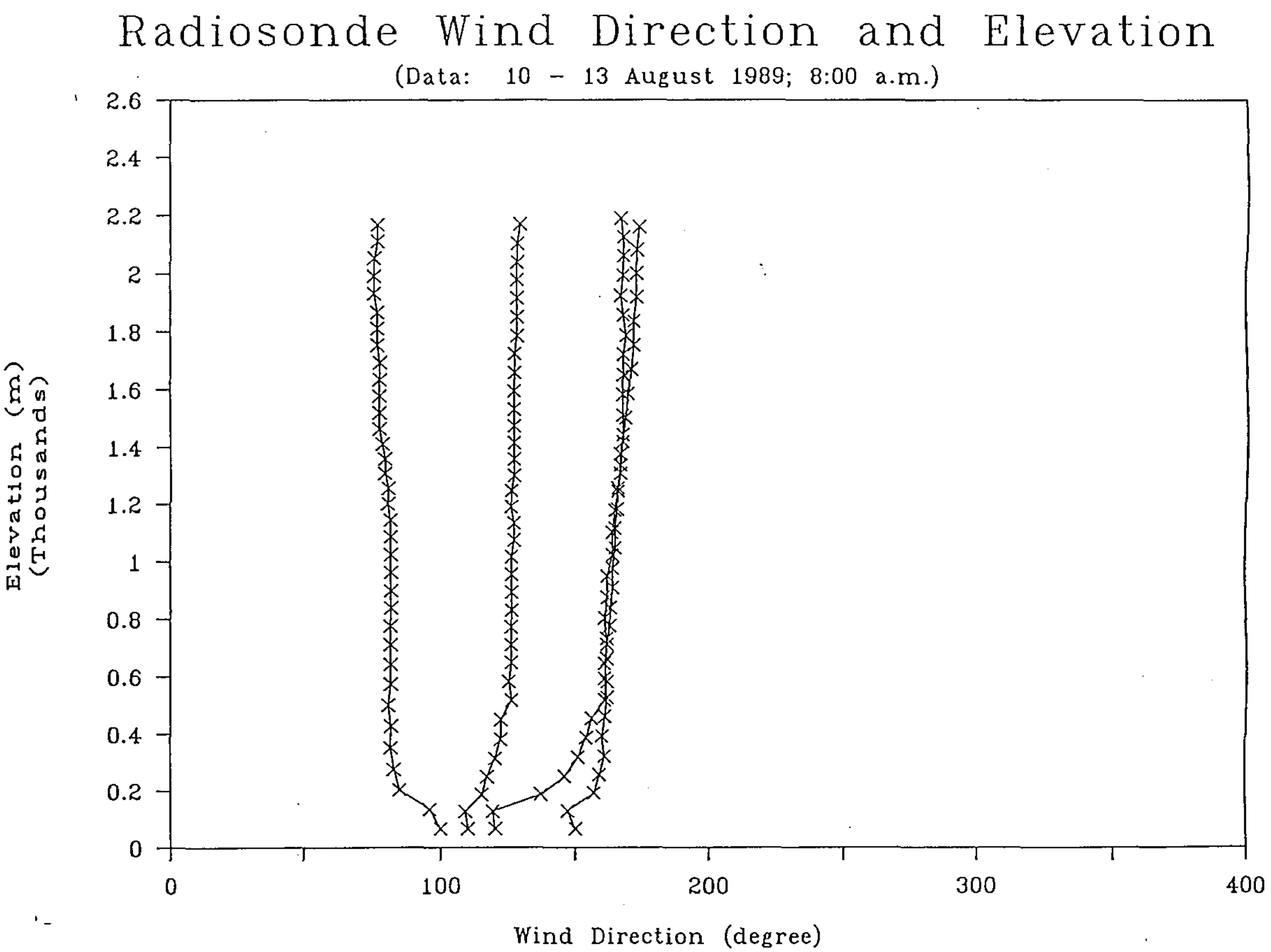


Figure V1/A32

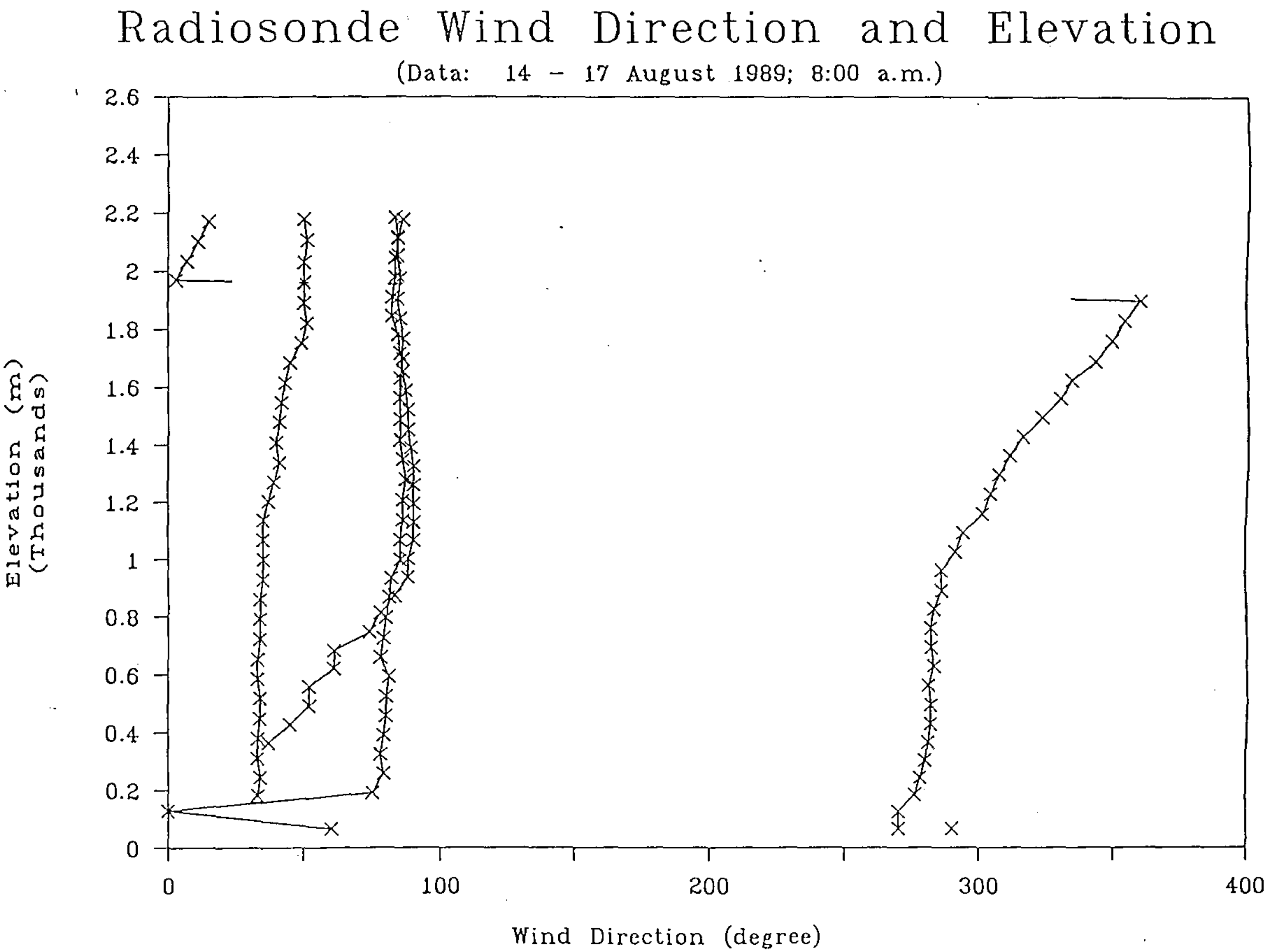
Radiosonde Wind Direction and Elevation for August, 1989 (Summaries 08:00 and 20:00)




Radiosonde Wind Direction and Elevation
(Data: 6 - 9 August 1989; 8:00 a.m.)
Elevation (m)
(Thousands)
2.6
2.4
2.2
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0
100
200
300
400
Wind Direction (degree)

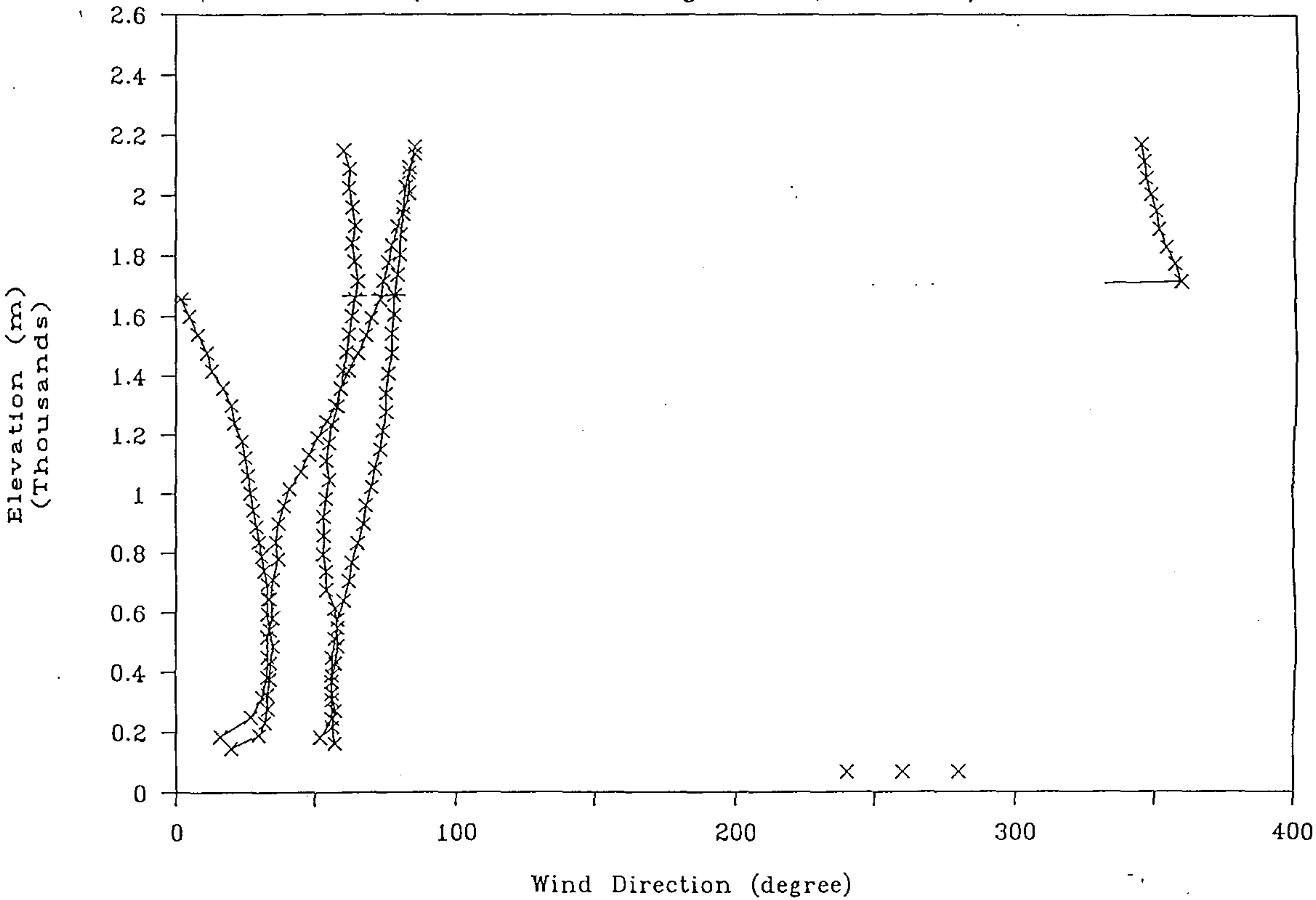


Radiosonde Wind Direction and Elevation
(Data: 10 - 13 August 1989; 8:00 a.m.)
Elevation (m) (Thousands)
2.6
2.4
2.2
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0
100
200
300
400
Wind Direction (degree)


Radiosonde Wind Direction and Elevation
(Data: 14 - 17 August 1989; 8:00 a.m.)
Elevation (m)
(Thousands)
2.6
2.4
2.2
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0
100
200
300
400
Wind Direction (degree)

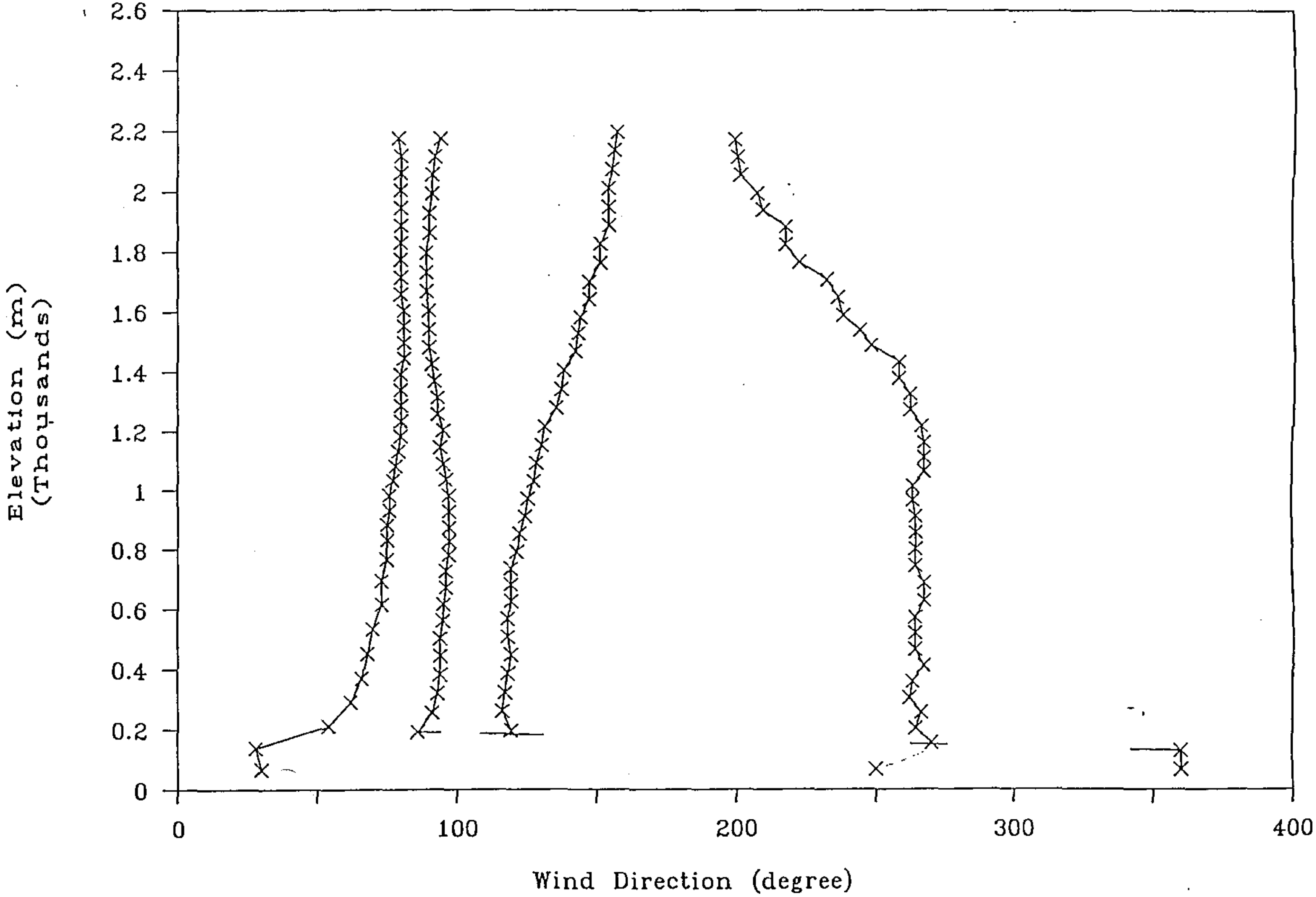
Radiosonde Wind Direction and Elevation

(Data: 18 - 21 August 1989; 8:00 a.m.)



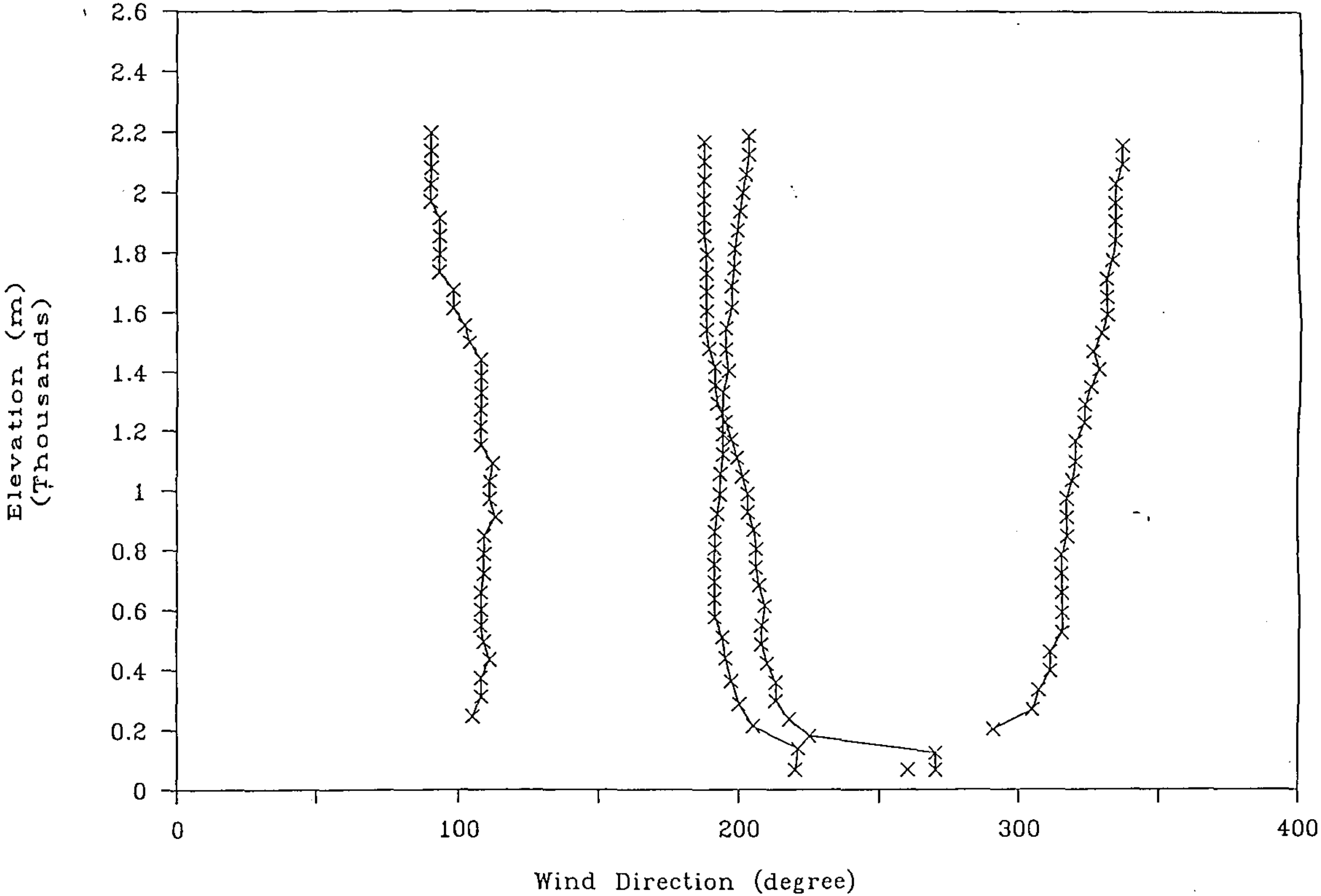
Radiosonde Wind Direction and Elevation

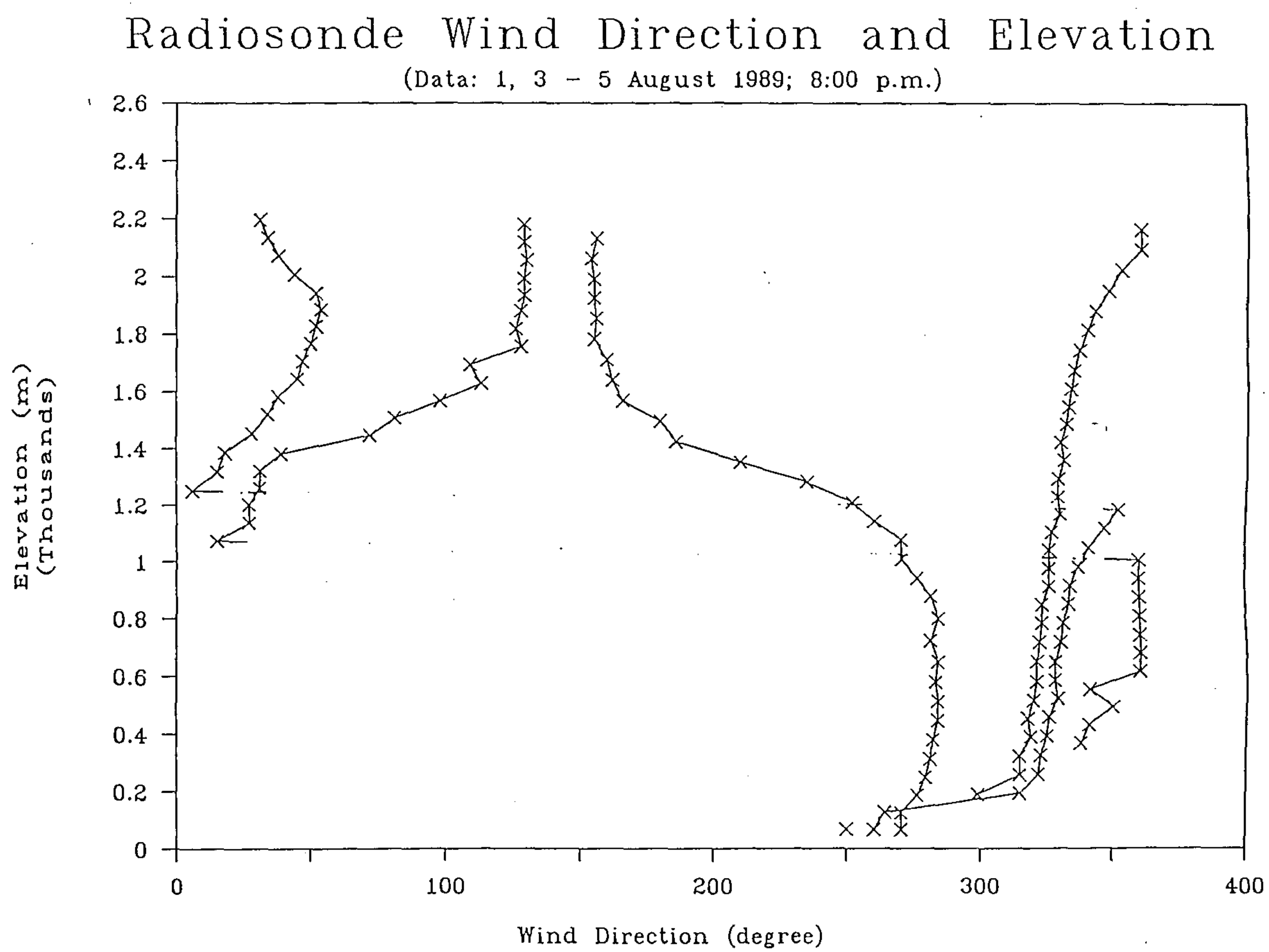
(Data: 22 - 25 August 1989; 8:00 a.m.)



Radiosonde Wind Direction and Elevation

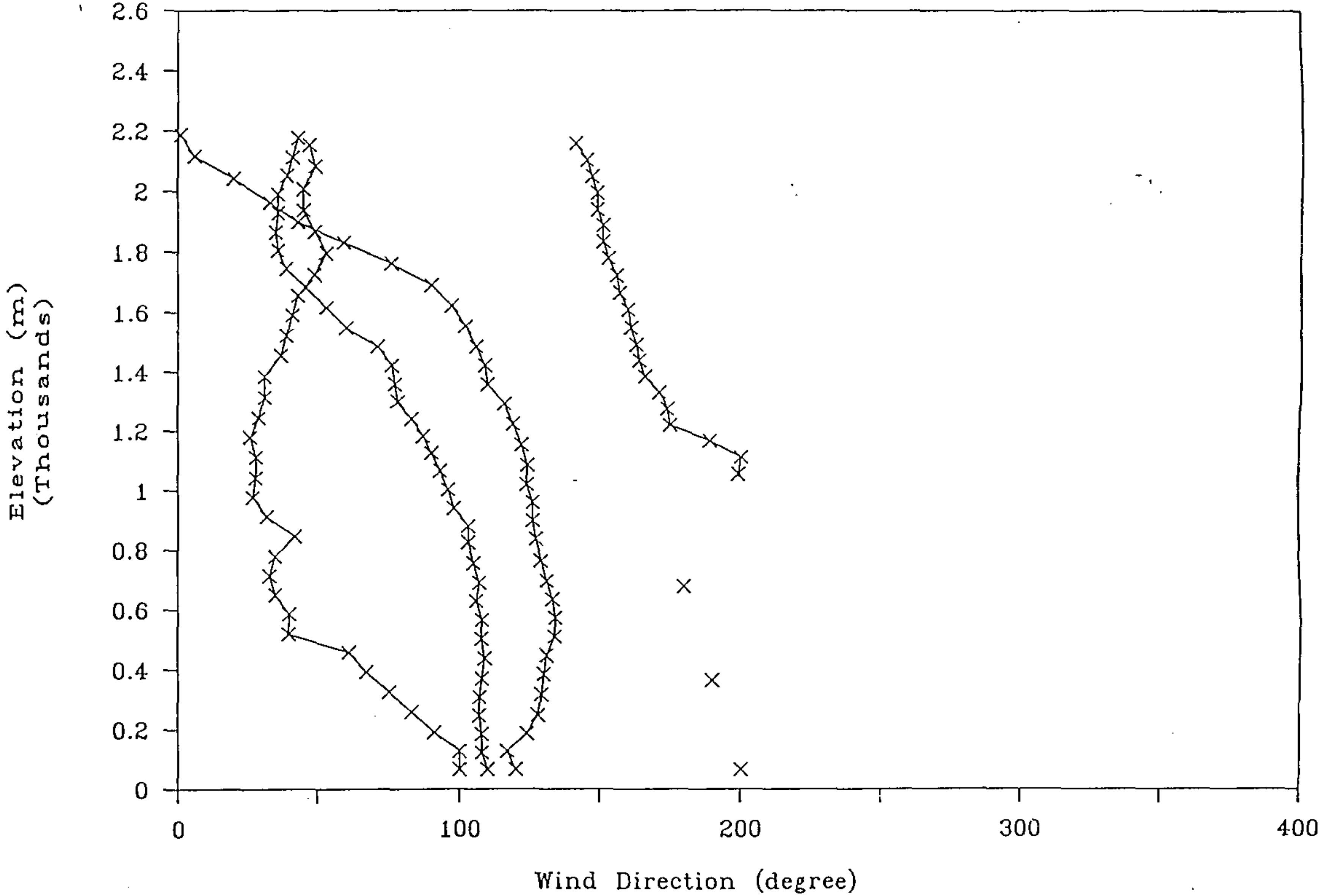
(Data: 26 - 29 August 1989; 8:00 a.m.)

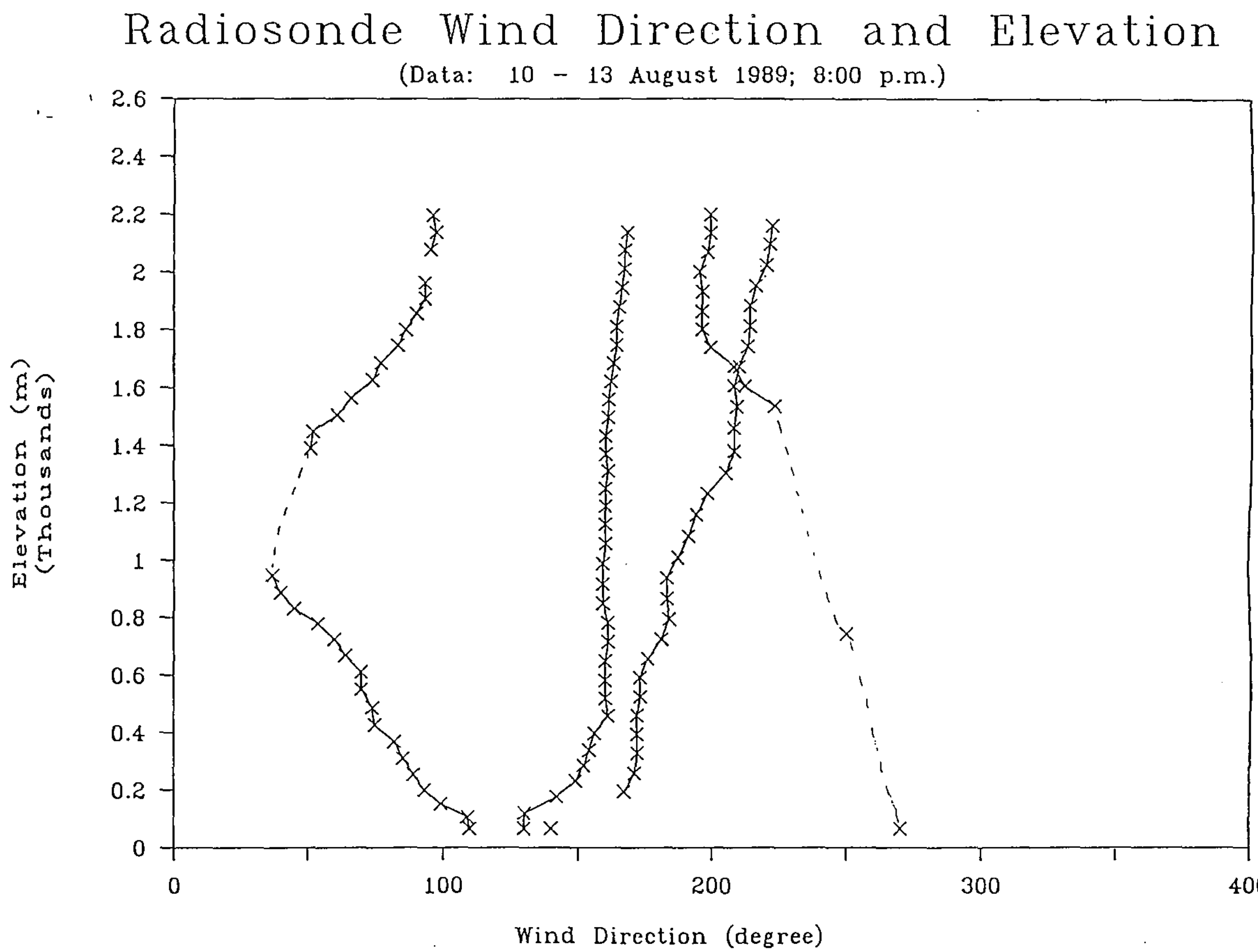



Radiosonde Wind Direction and Elevation
(Data: 1, 3 - 5 August 1989; 8:00 p.m.)
Elevation (m)
(Thousands)
2.6
2.4
2.2
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0
100
200
300
400
Wind Direction (degree)

Radiosonde Wind Direction and Elevation

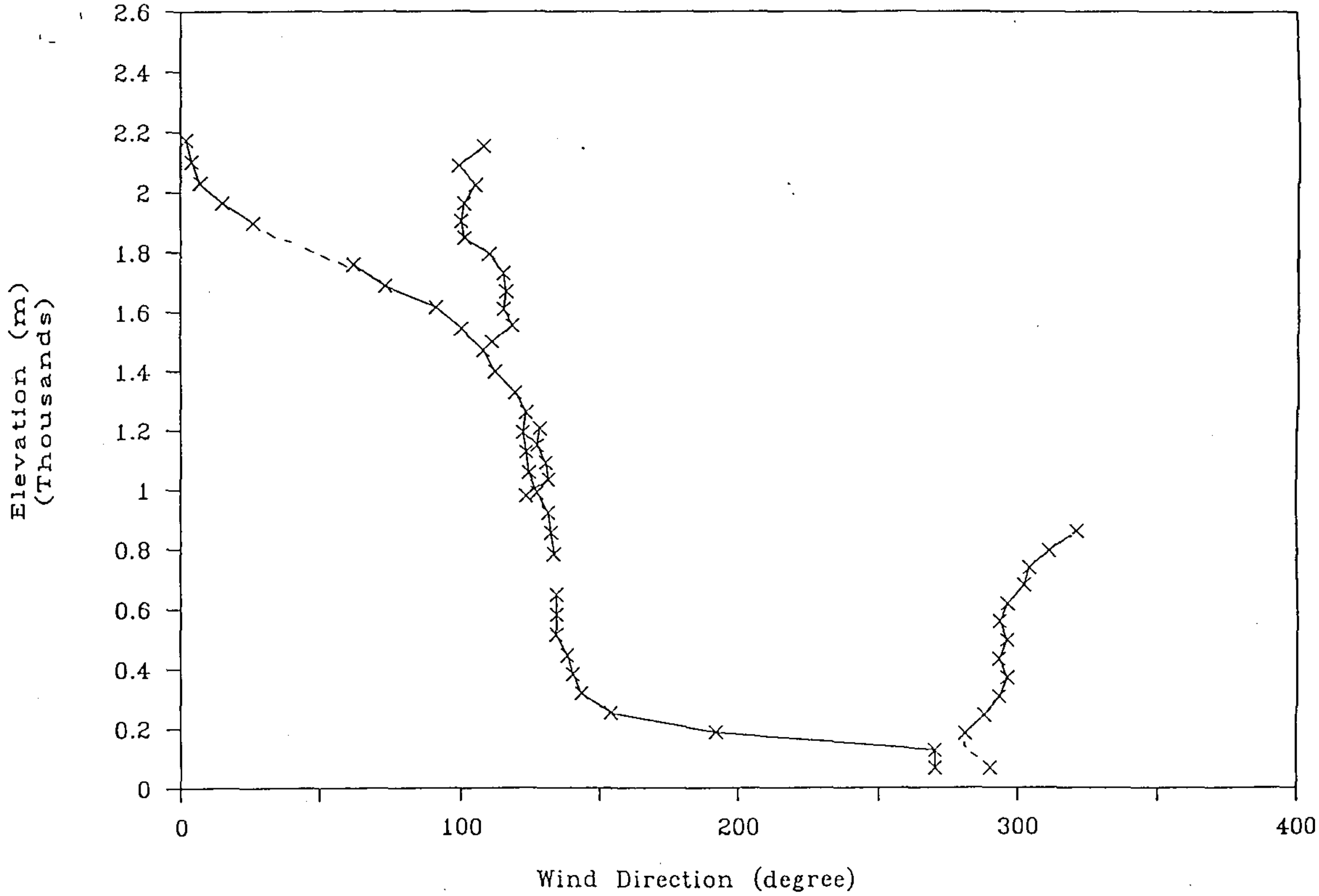
(Data: 6 - 9 August 1989; 8:00 p.m.)




Radiosonde Wind Direction and Elevation
(Data: 10 - 13 August 1989; 8:00 p.m.)
Elevation (m) (Thousands)
2.6
2.4
2.2
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0
100
200
300
400
Wind Direction (degree)

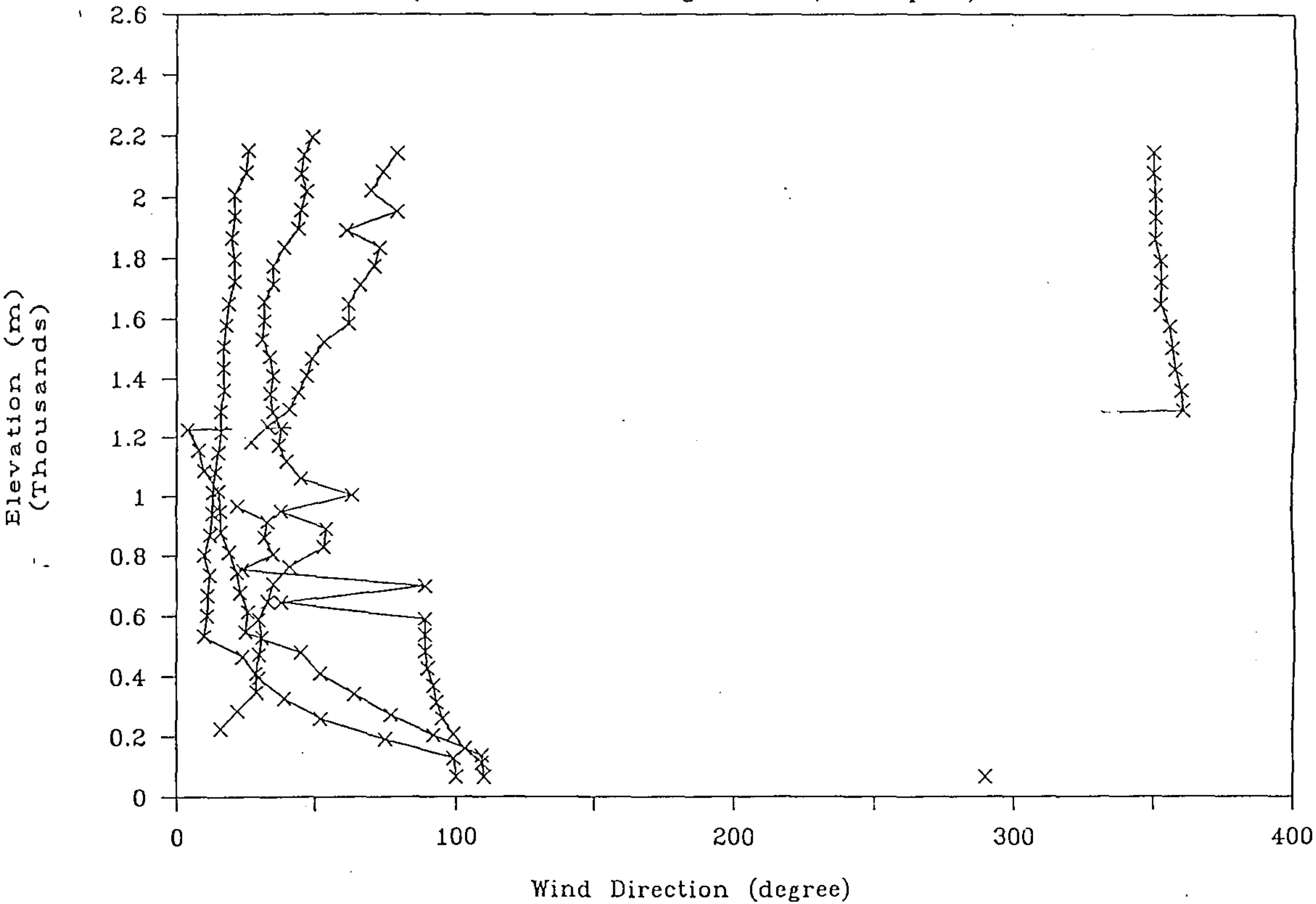
Radiosonde Wind Direction and Elevation

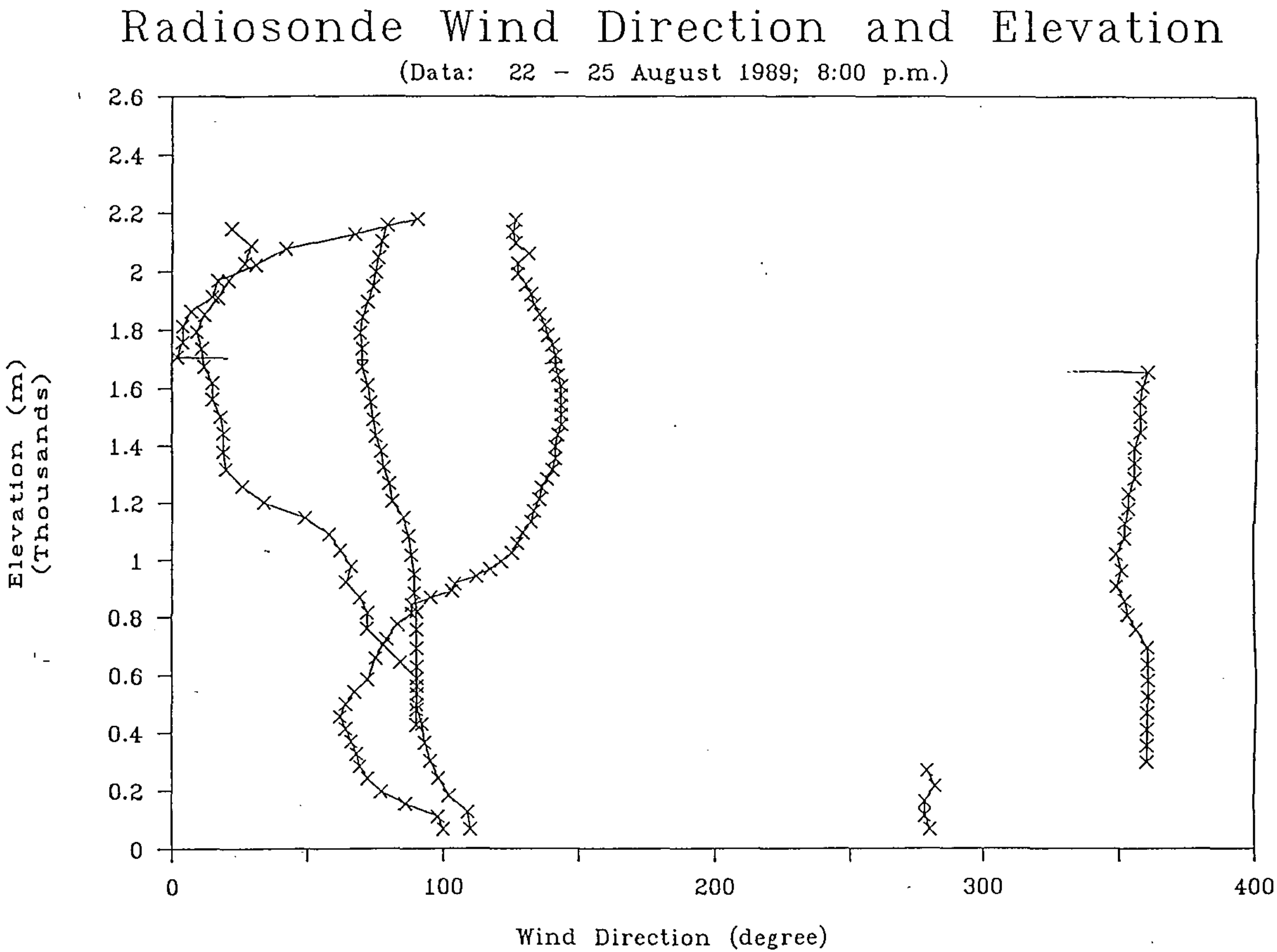
(Data: 14 - 16 August 1989; 8:00 p.m.)



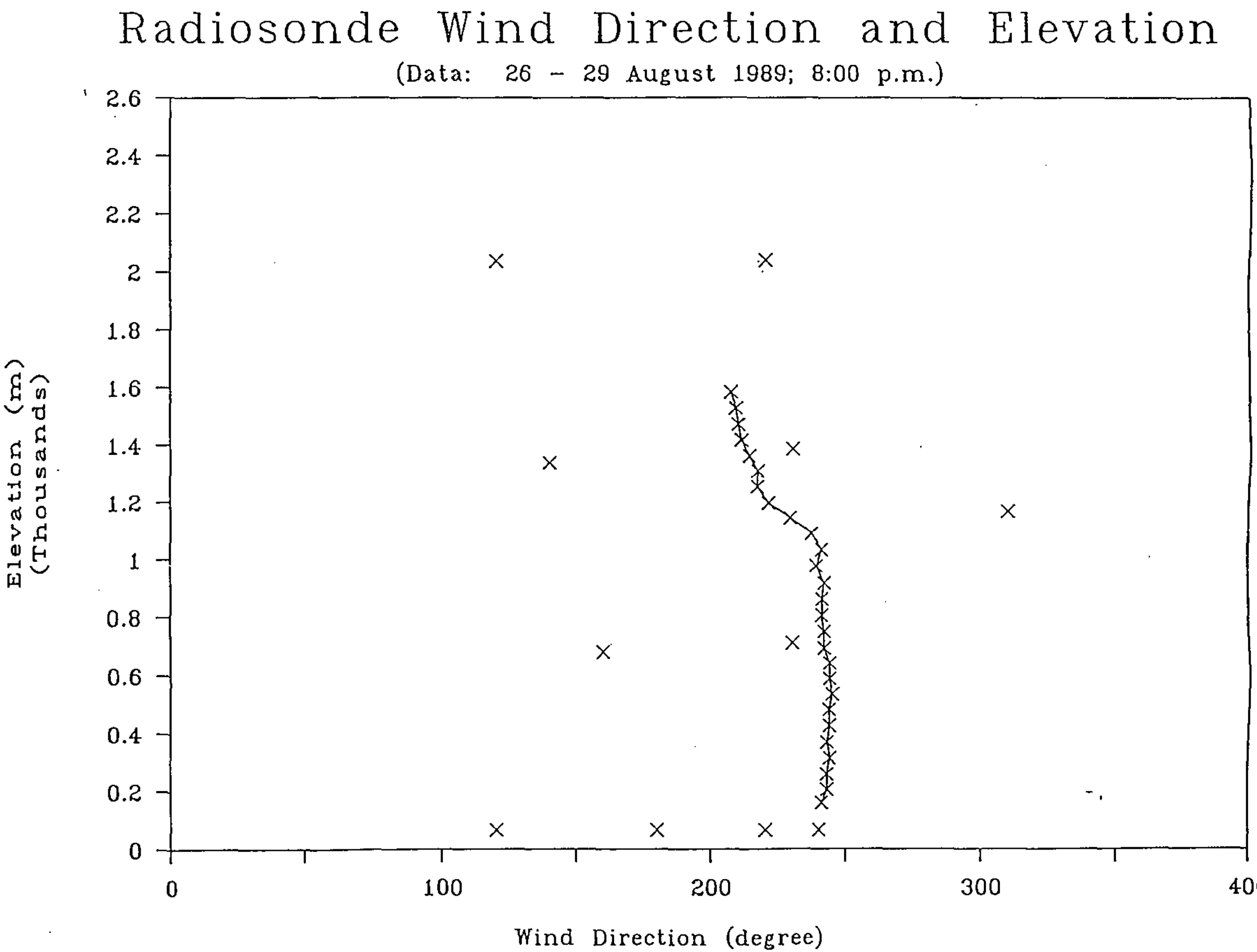
Radiosonde Wind Direction and Elevation

(Data: 18 - 21 August 1989; 8:00 p.m.)





Radiosonde Wind Direction and Elevation
(Data: 22 - 25 August 1989; 8:00 p.m.)
Elevation (m)
(Thousands)
2.6
2.4
2.2
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0
100
200
300
400
Wind Direction (degree)



Radiosonde Wind Direction and Elevation
(Data: 26 - 29 August 1989; 8:00 p.m.)
Elevation (m)
(Thousands)
2.6
2.4
2.2
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0
100
200
300
400
Wind Direction (degree)

Figure V1/A33

Wind Direction vs Elevation (Radiosonde Data from King's Park, 1989/08/13,08:00)

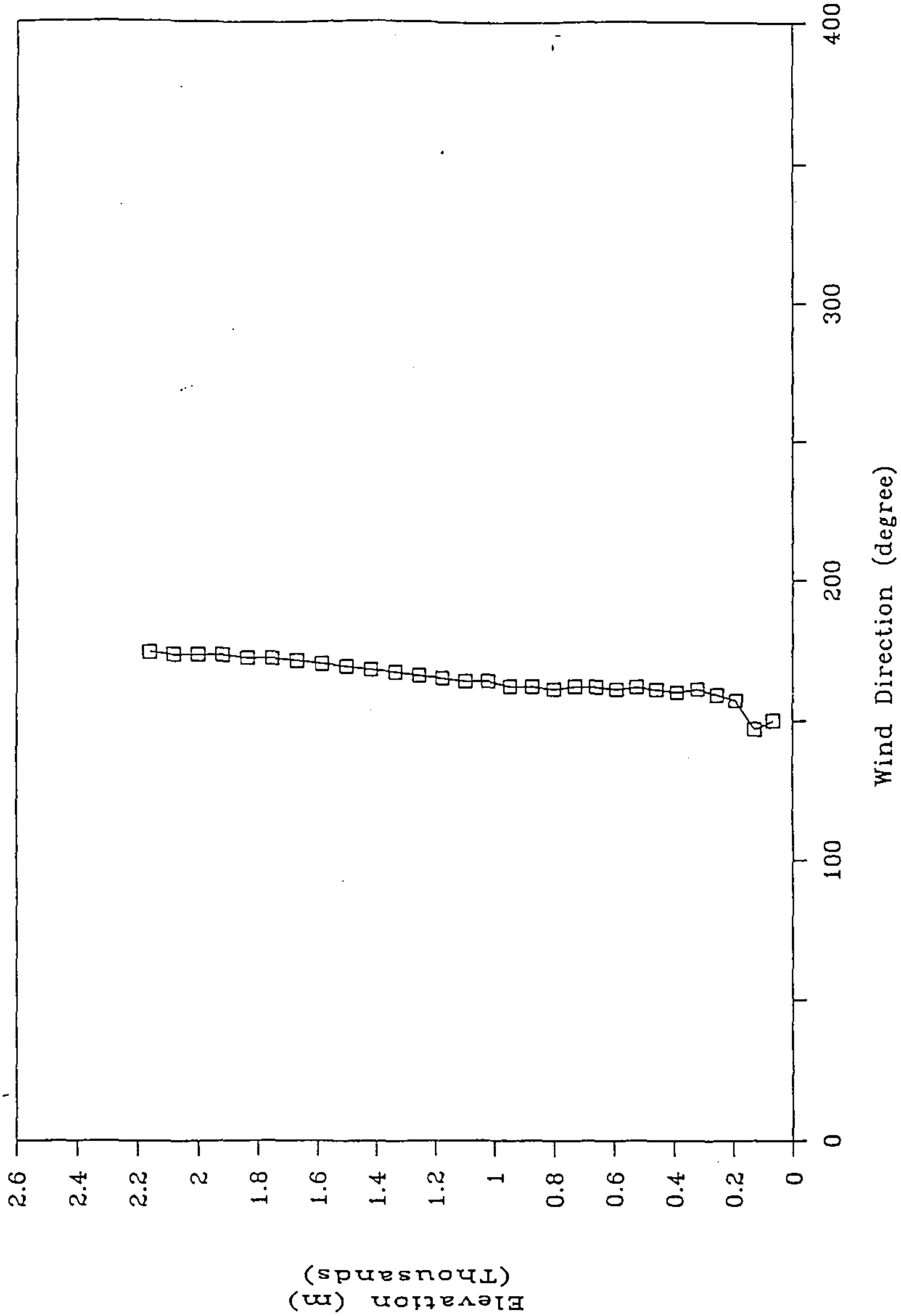


Figure V1/A34

Wind Direction vs Elevation (Radiosonde Data from King's Park, 1989/08/13,20:00)

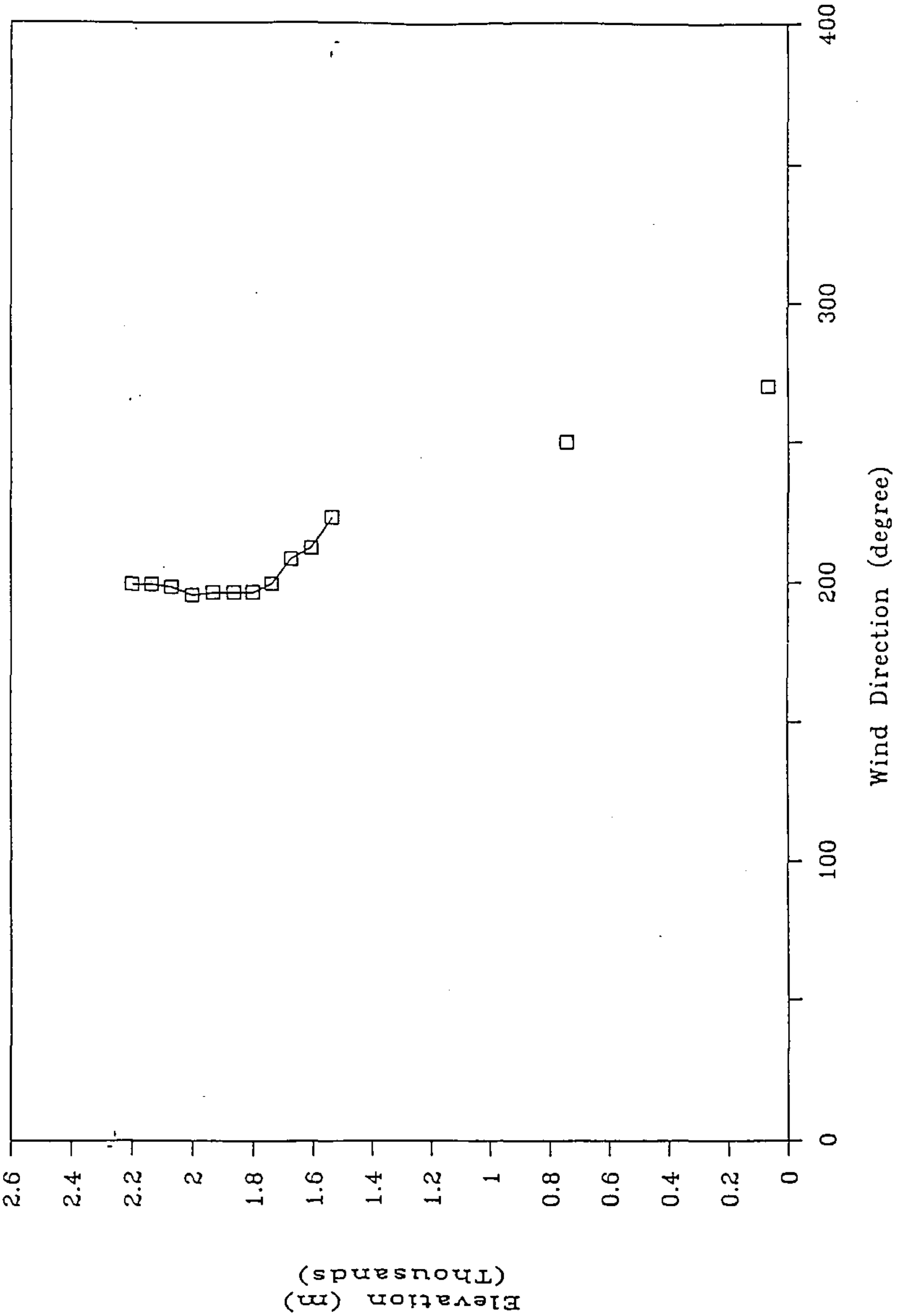


Figure V1/A35

Wind Direction vs Elevation (Radiosonde Data from King's Park, 1989/08/14,08:00)

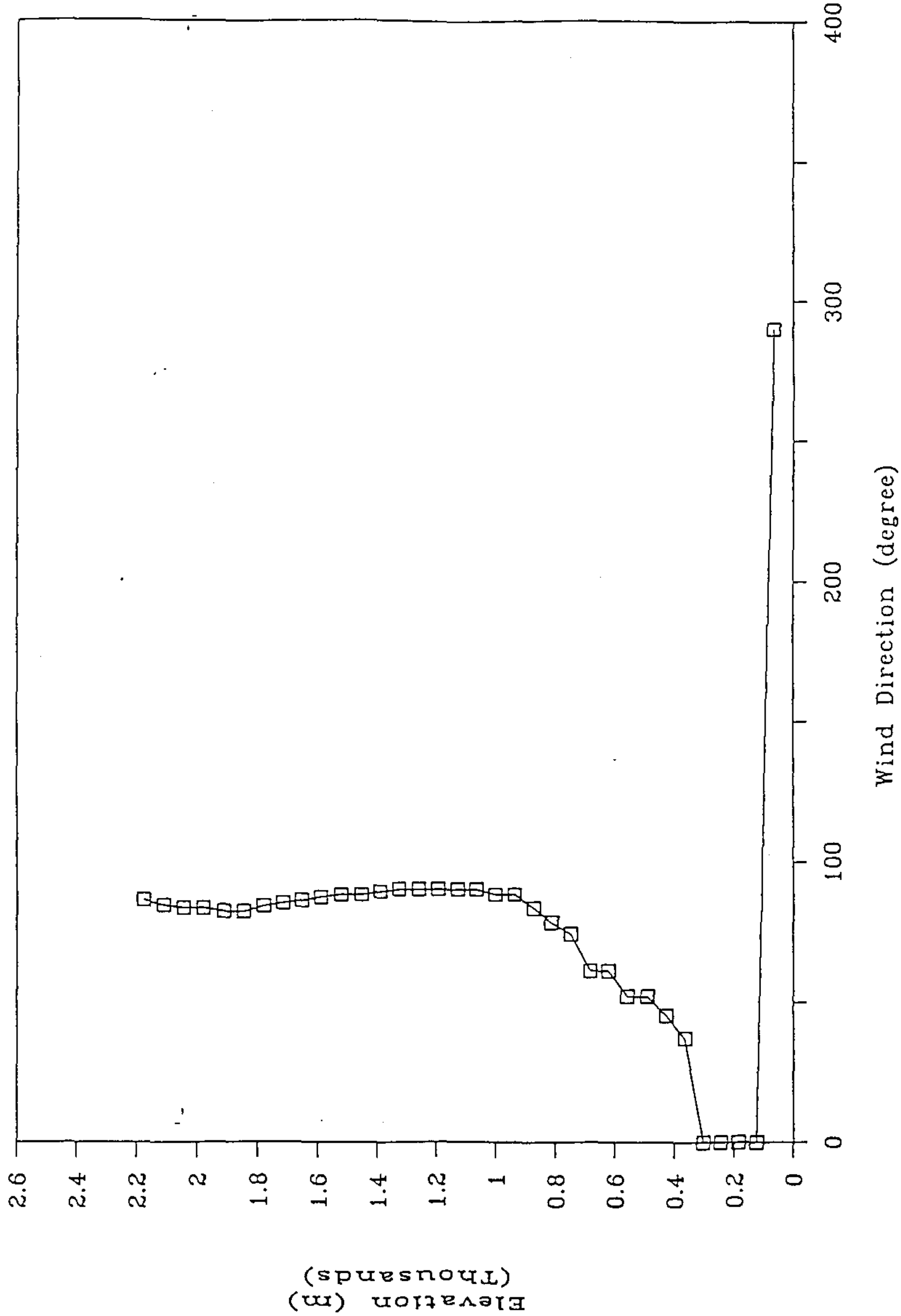


Figure V1/A36

Wind Direction vs Elevation (Radiosonde Data from King's Park, 1989/08/14,20:00)

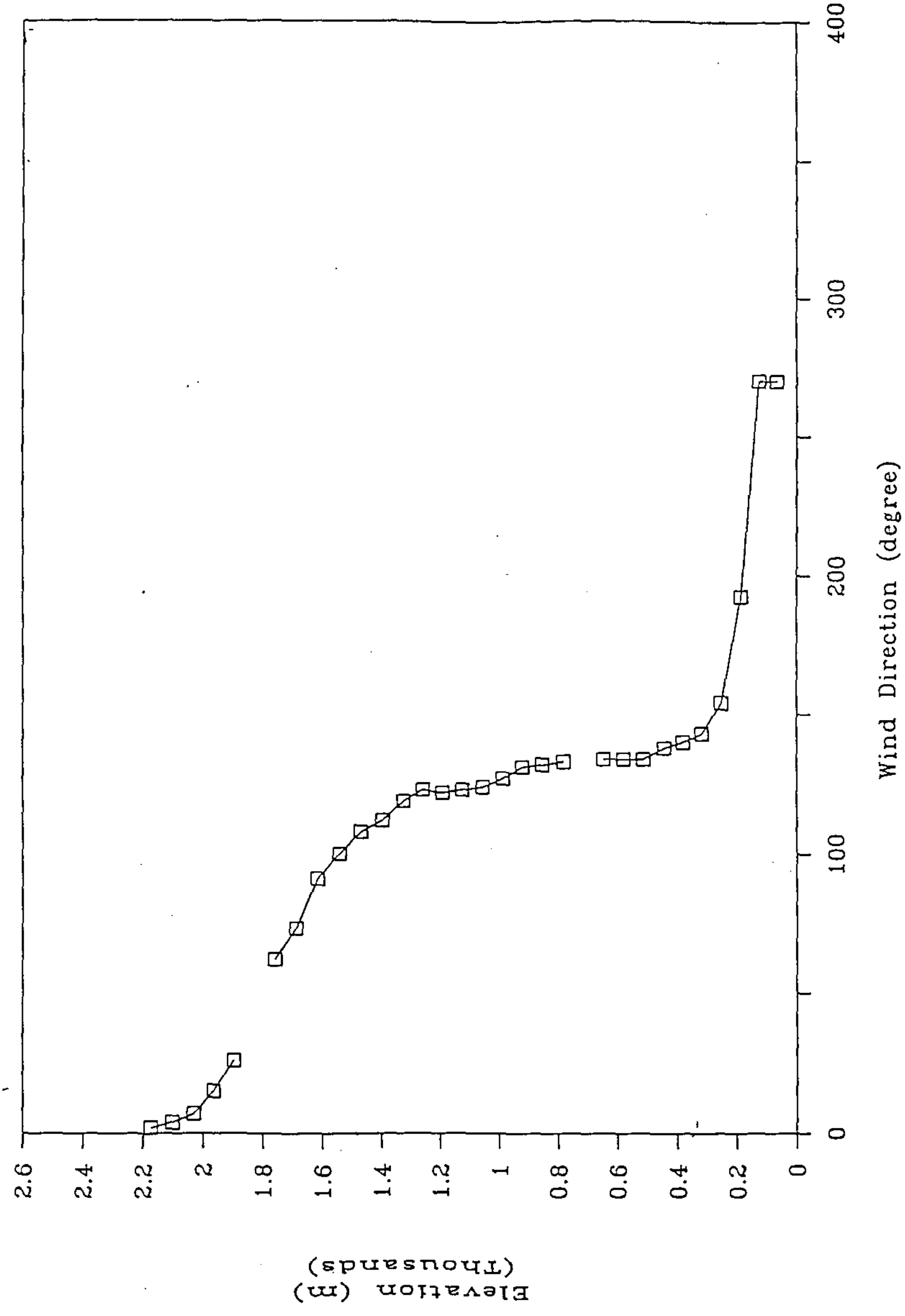


Figure V1/A37

Wind Direction vs Elevation (Radiosonde Data from King's Park, 1989/08/15,08:00)

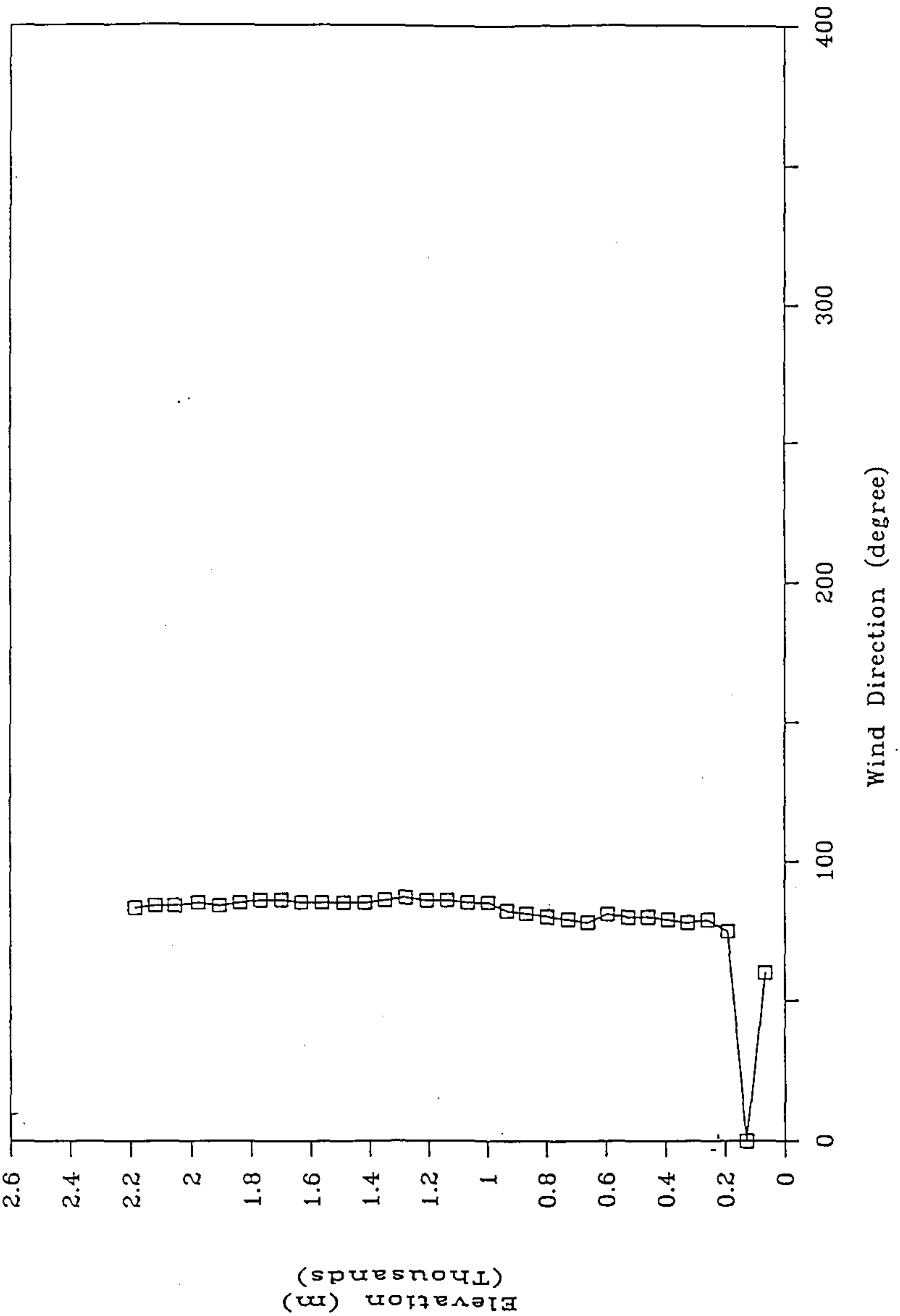


Figure V1/A38

Annual Rainfall Distribution for Hong Kong

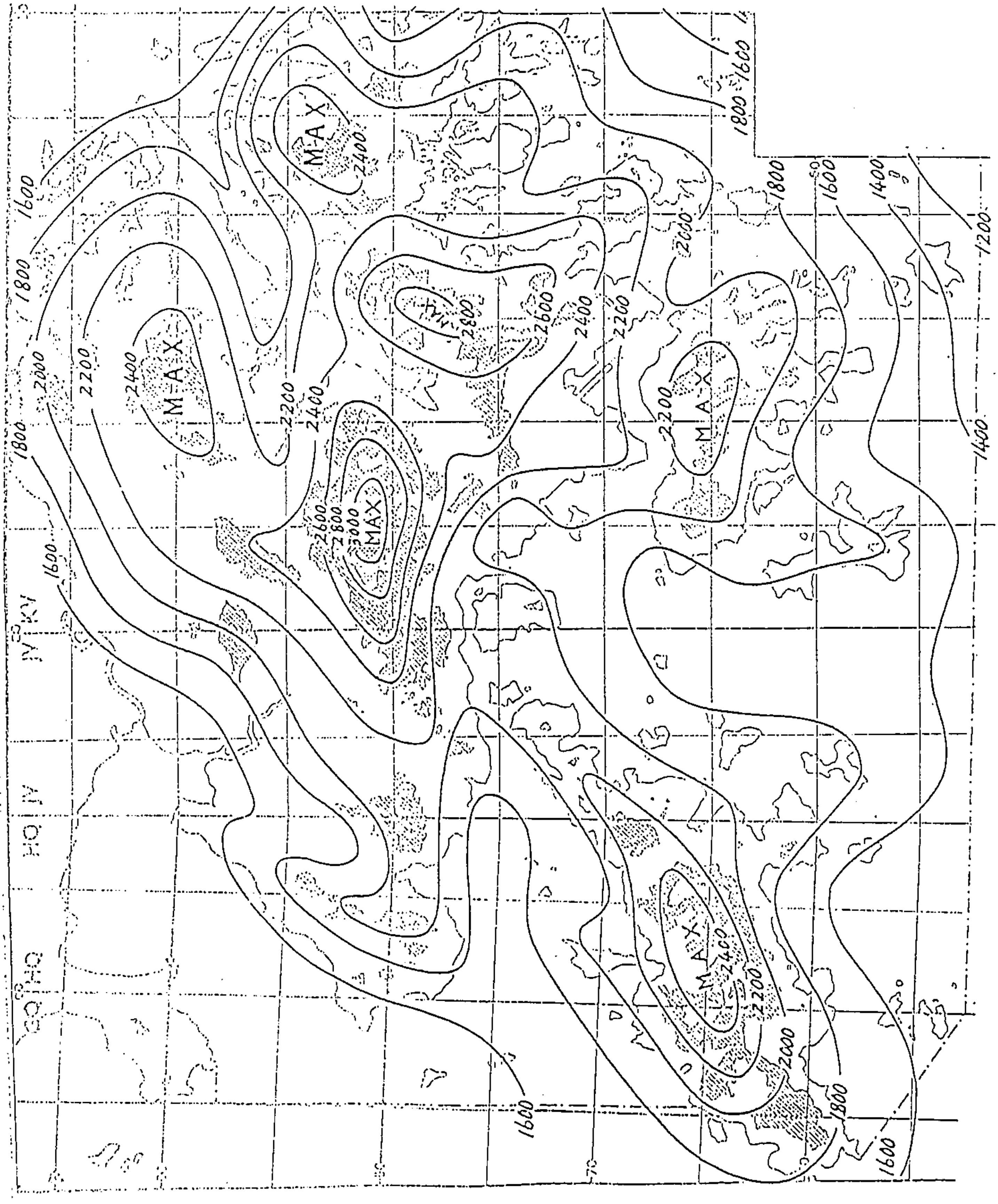


Figure V1/A39

Rainfall Gauging Stations in Western New Territories

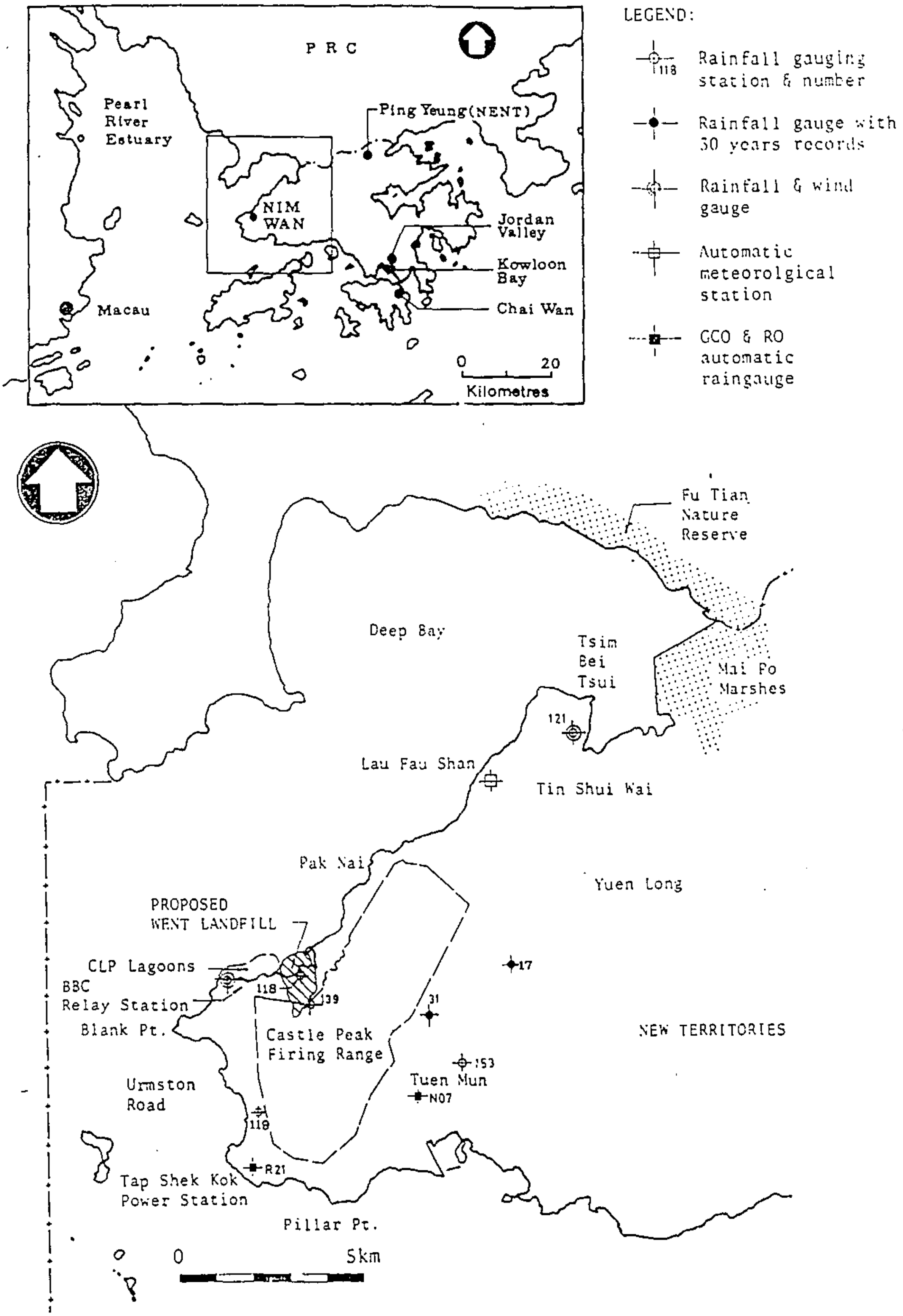


Figure V1/A40

Plotted Mean Rainfall and Mean Potential Evapotranspiration by Month

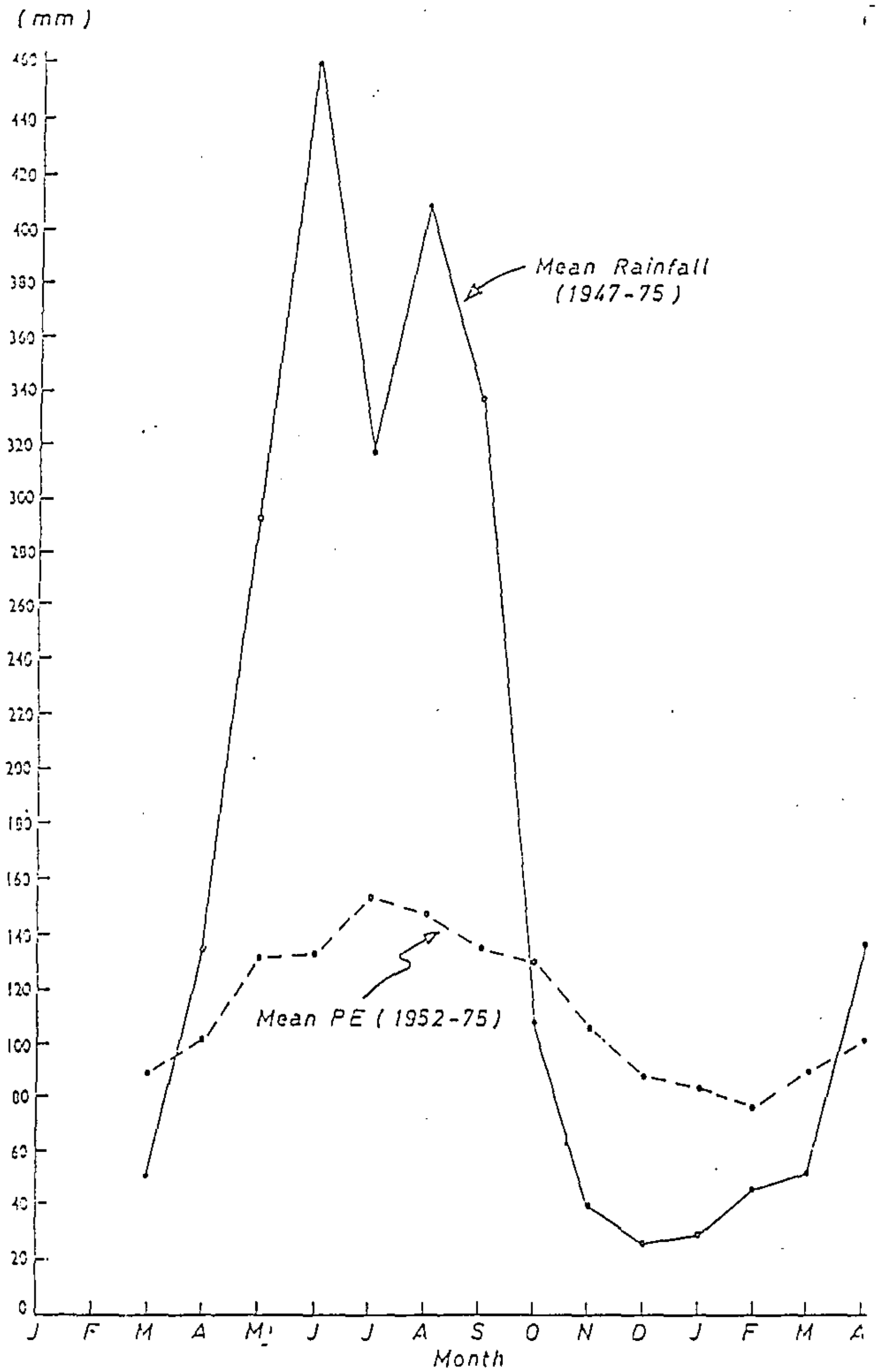


Figure V1/A41

Plotted Mean Evapotranspiration and Pan Evaporation by Month

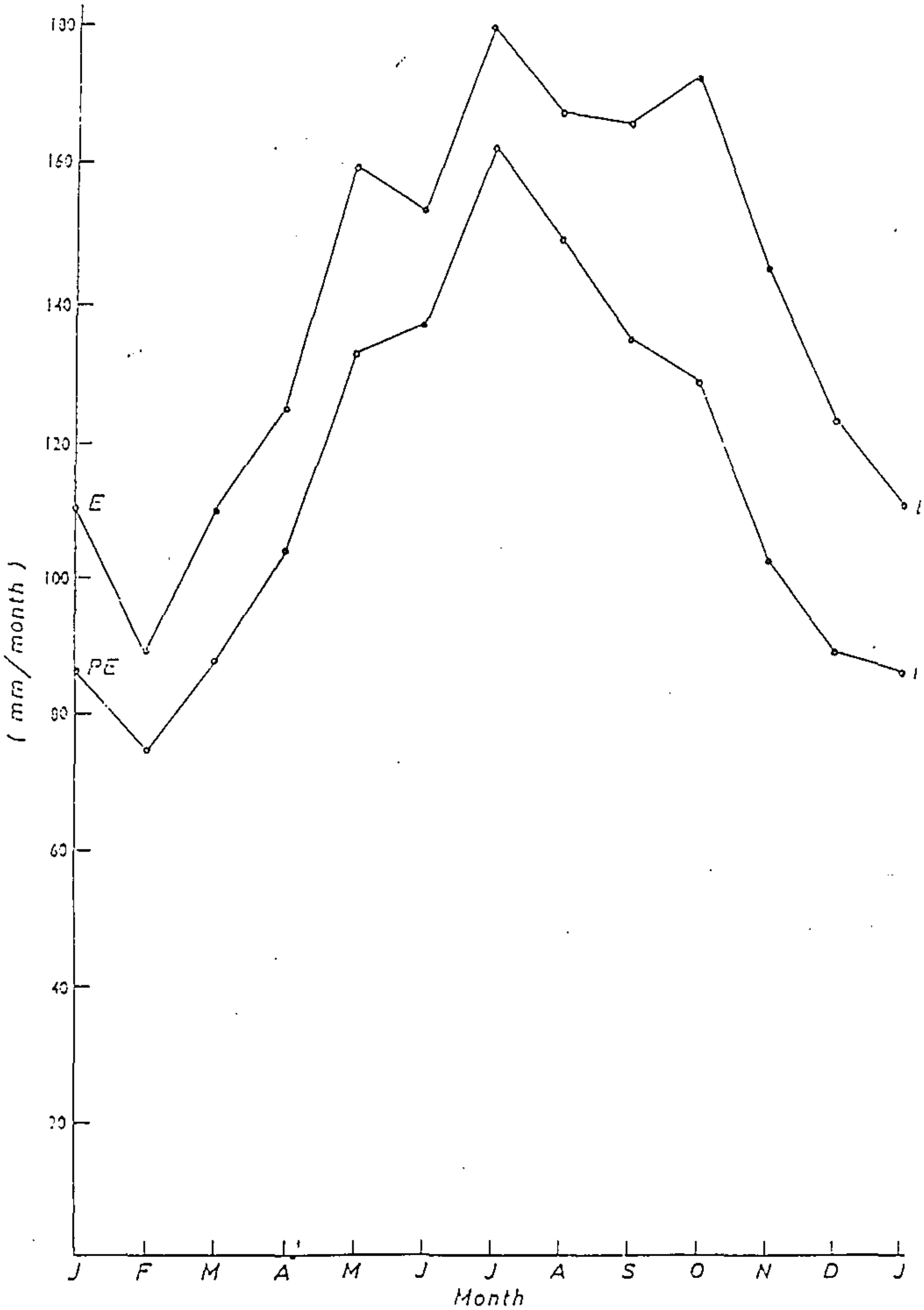


Figure V1/A42

Monthly Rainfalls at Shen Zhen (SEZ, PRC)

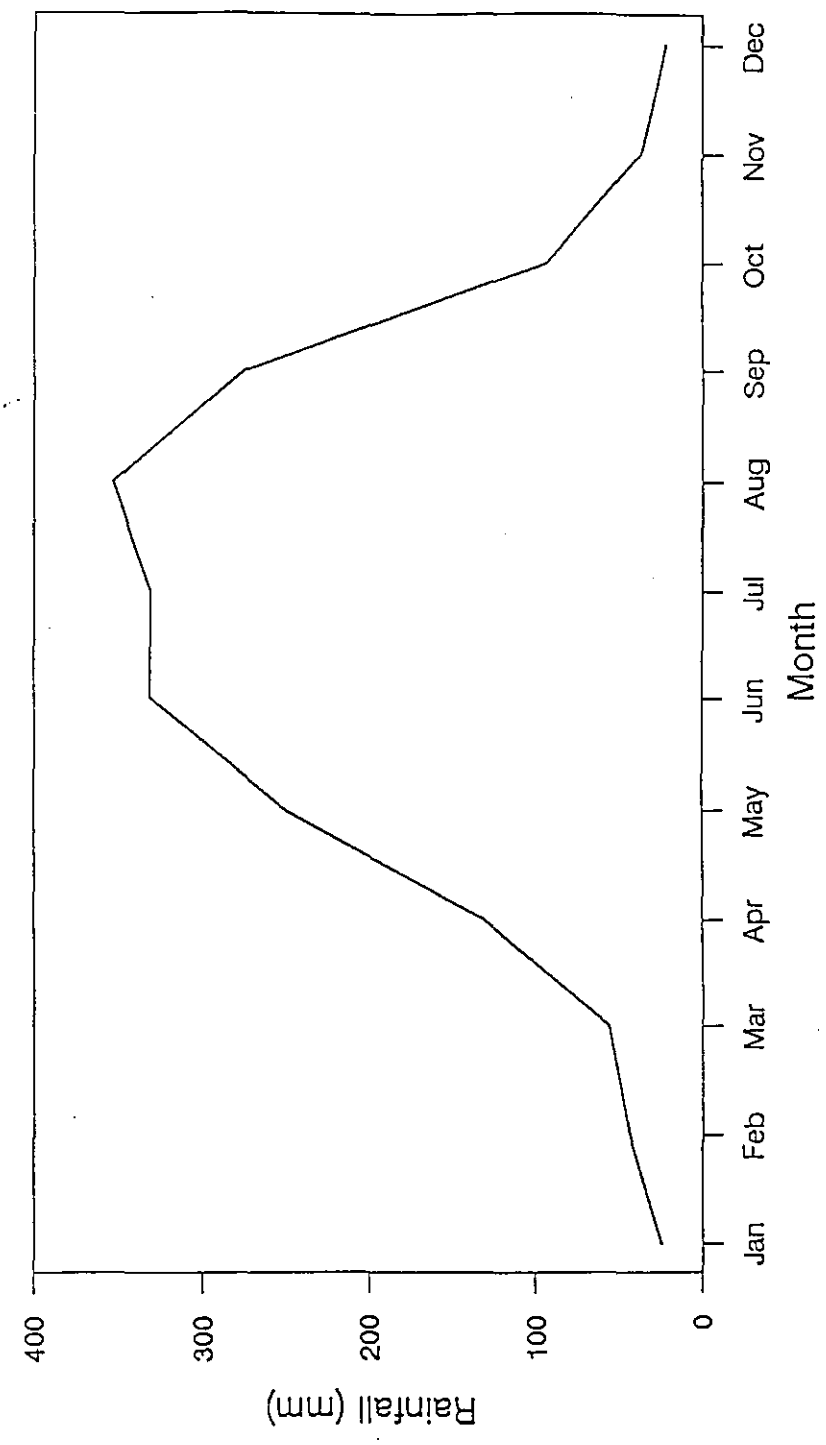


Figure V1/A43

Averaged Number of Rainy Days in Shen Zhen (SEZ, PRC)

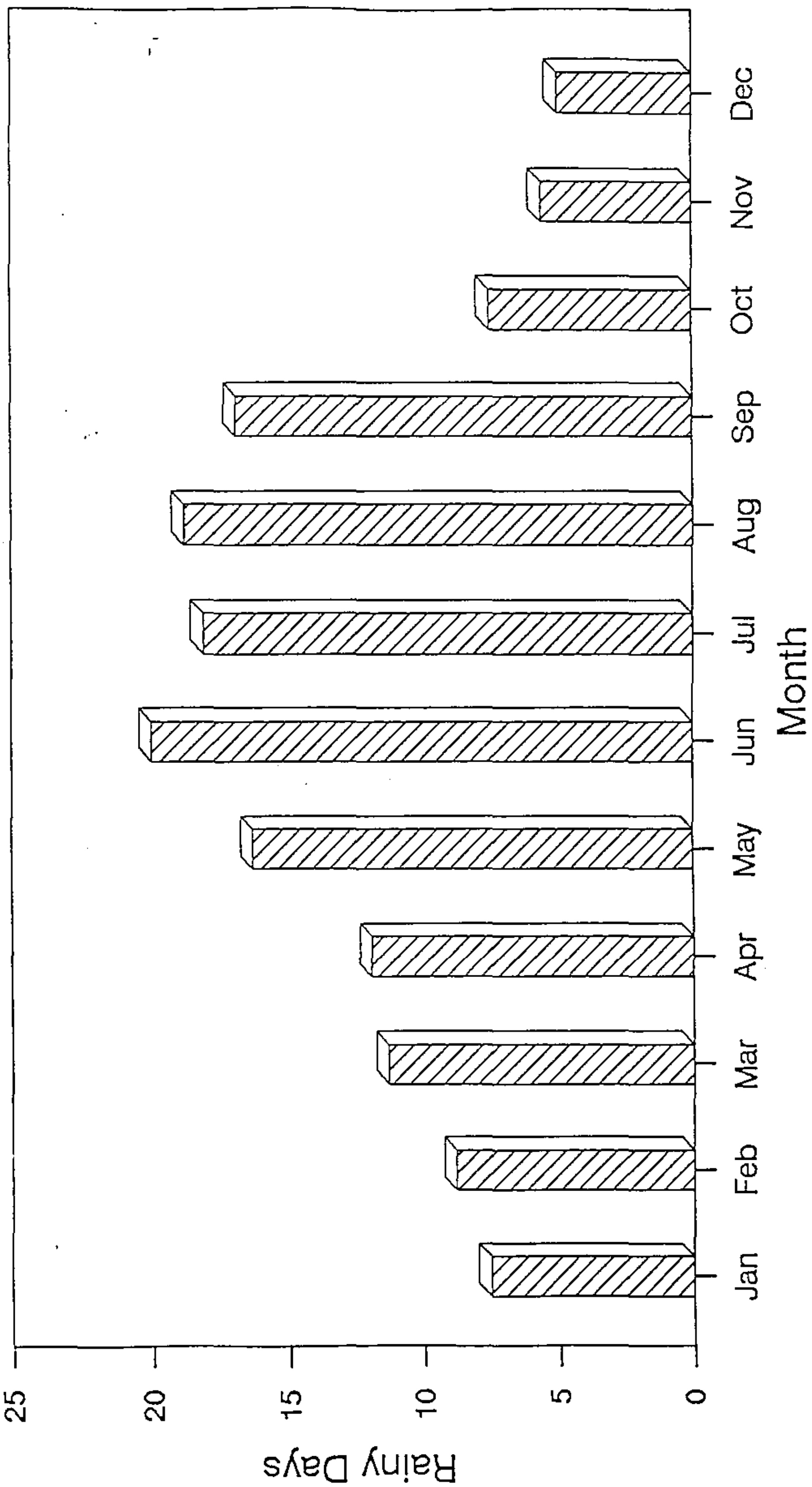


Figure V1/A44

Monthly Frequency of Storm Rainfalls at Shen Zhen (SEZ, PRC)

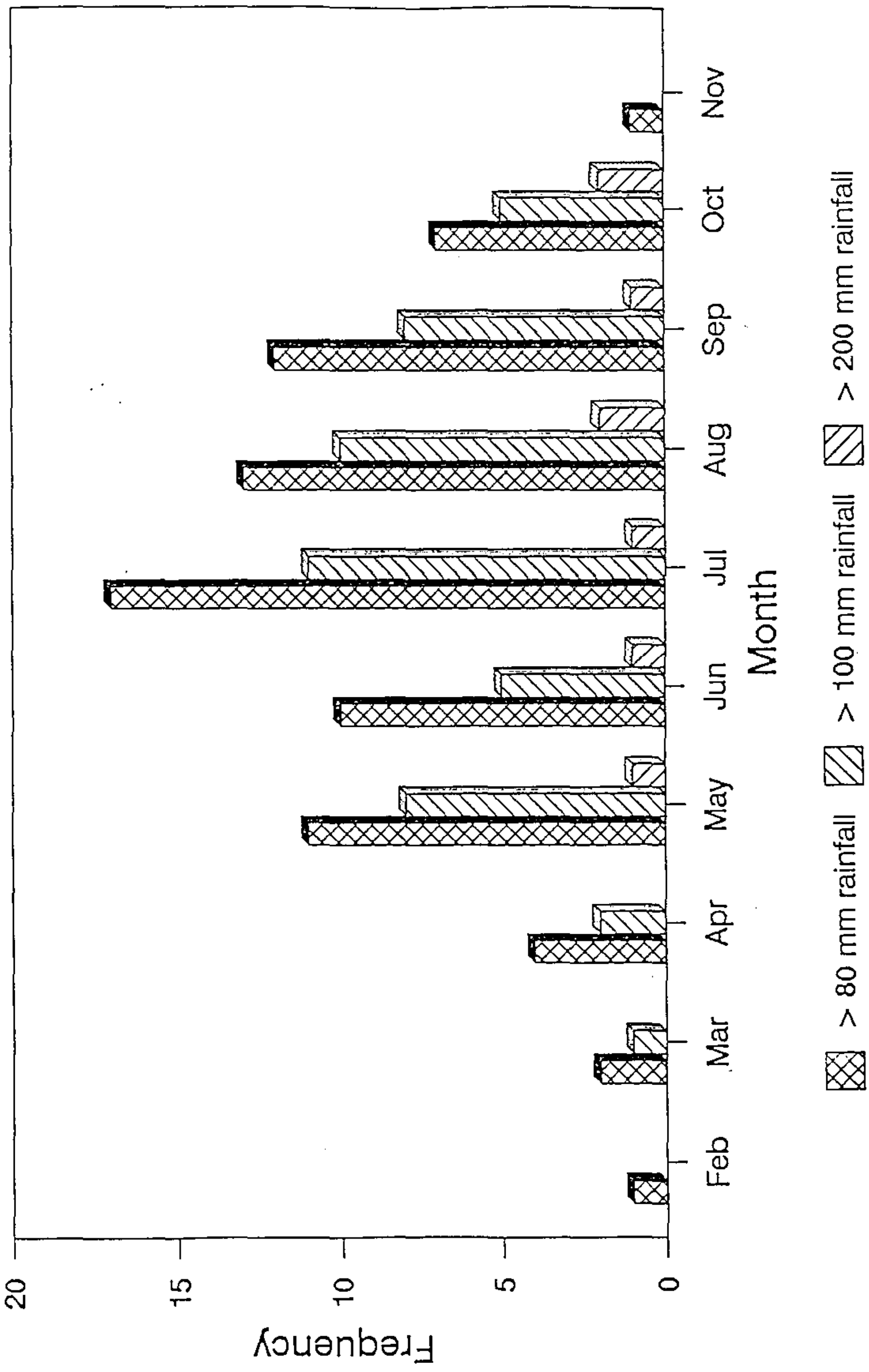


Figure V1/A45

Monthly Averaged Number of Typhoons affecting Shen Zhen (SEZ, PRC)

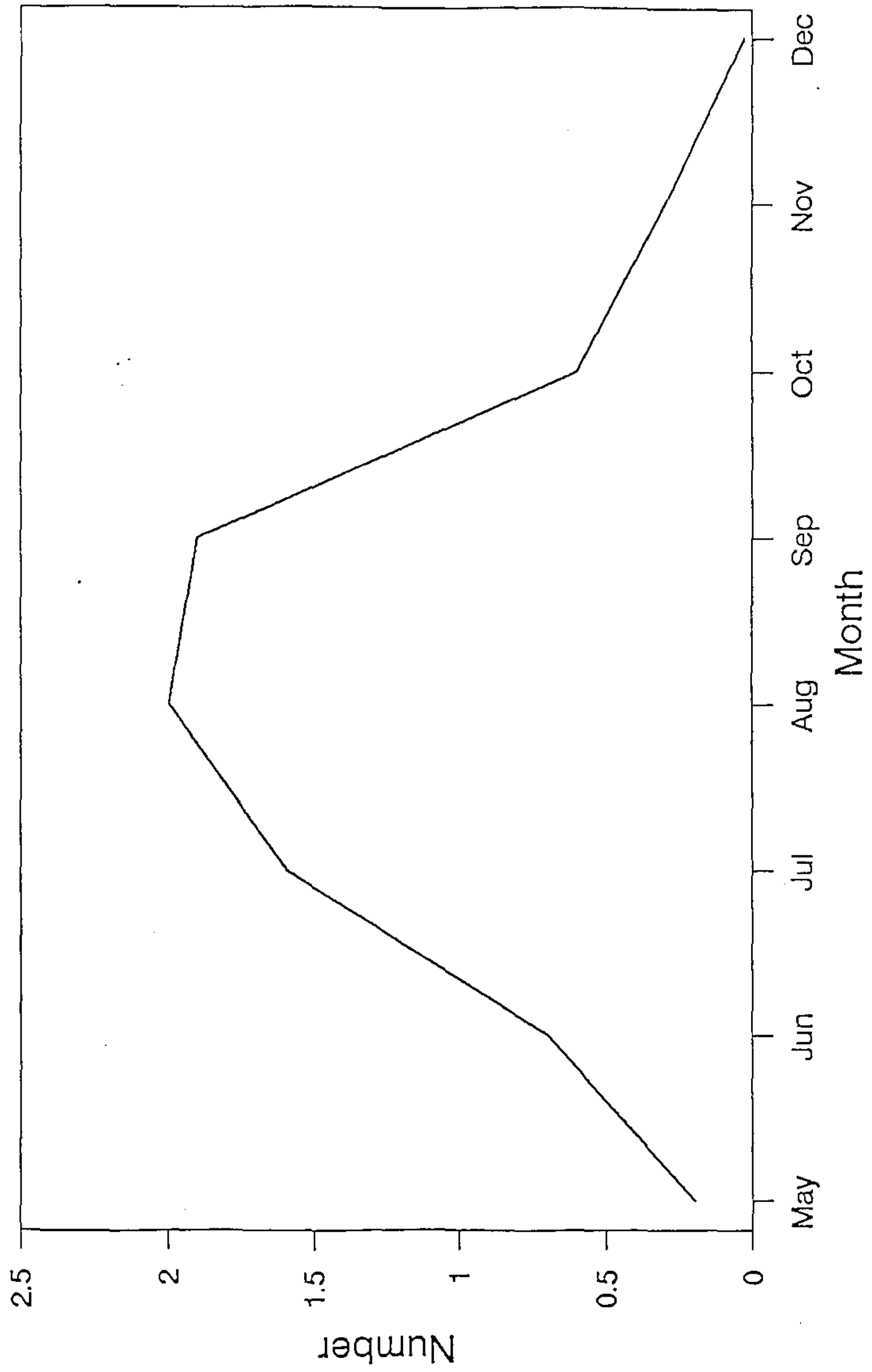


Figure V1/A46

Percentage of Foggy Days in Shen Zhen (SEZ, PRC)

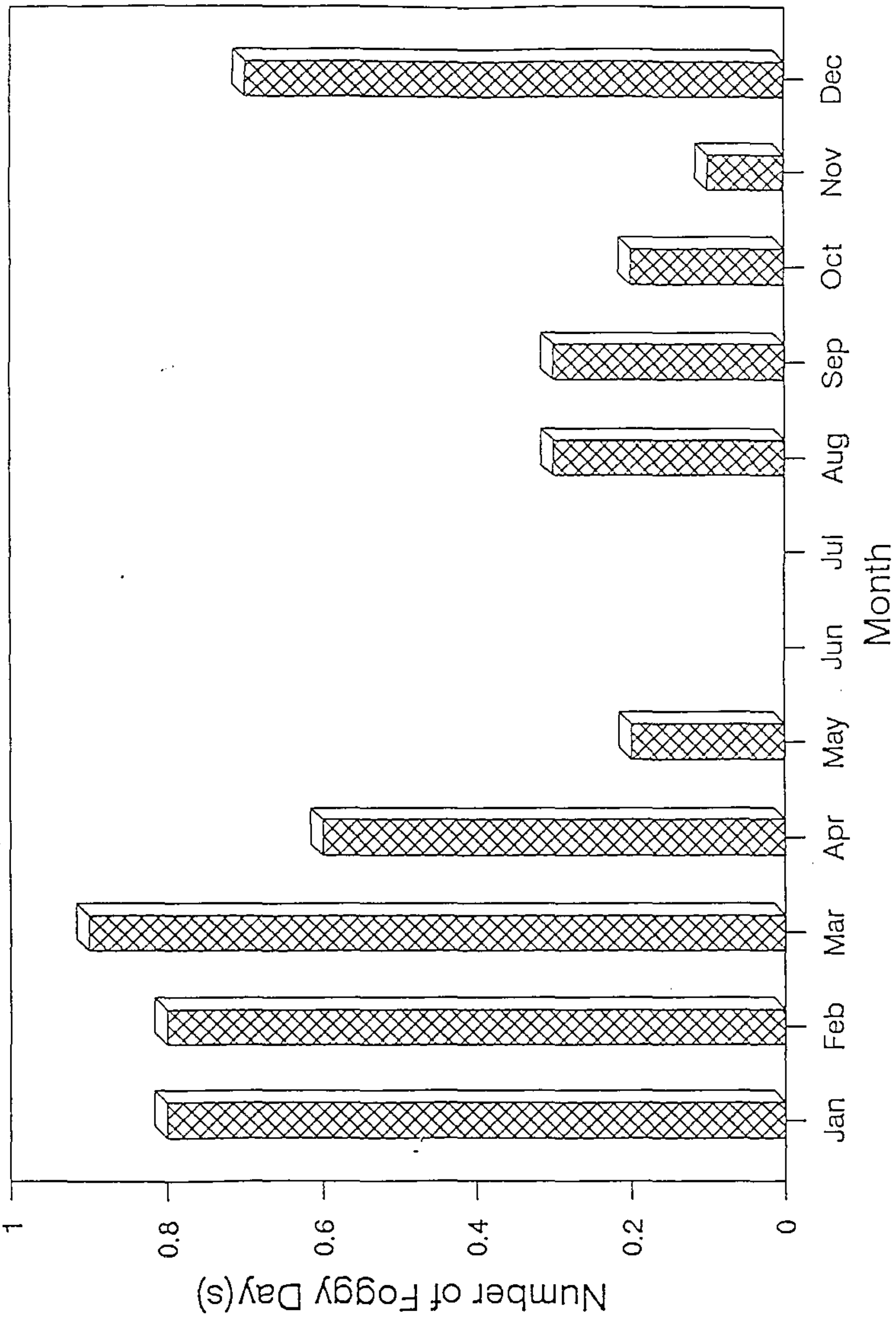


Figure V1/A47

Monthly Means of Solar Radiation in Hong Kong and Shen Zhen

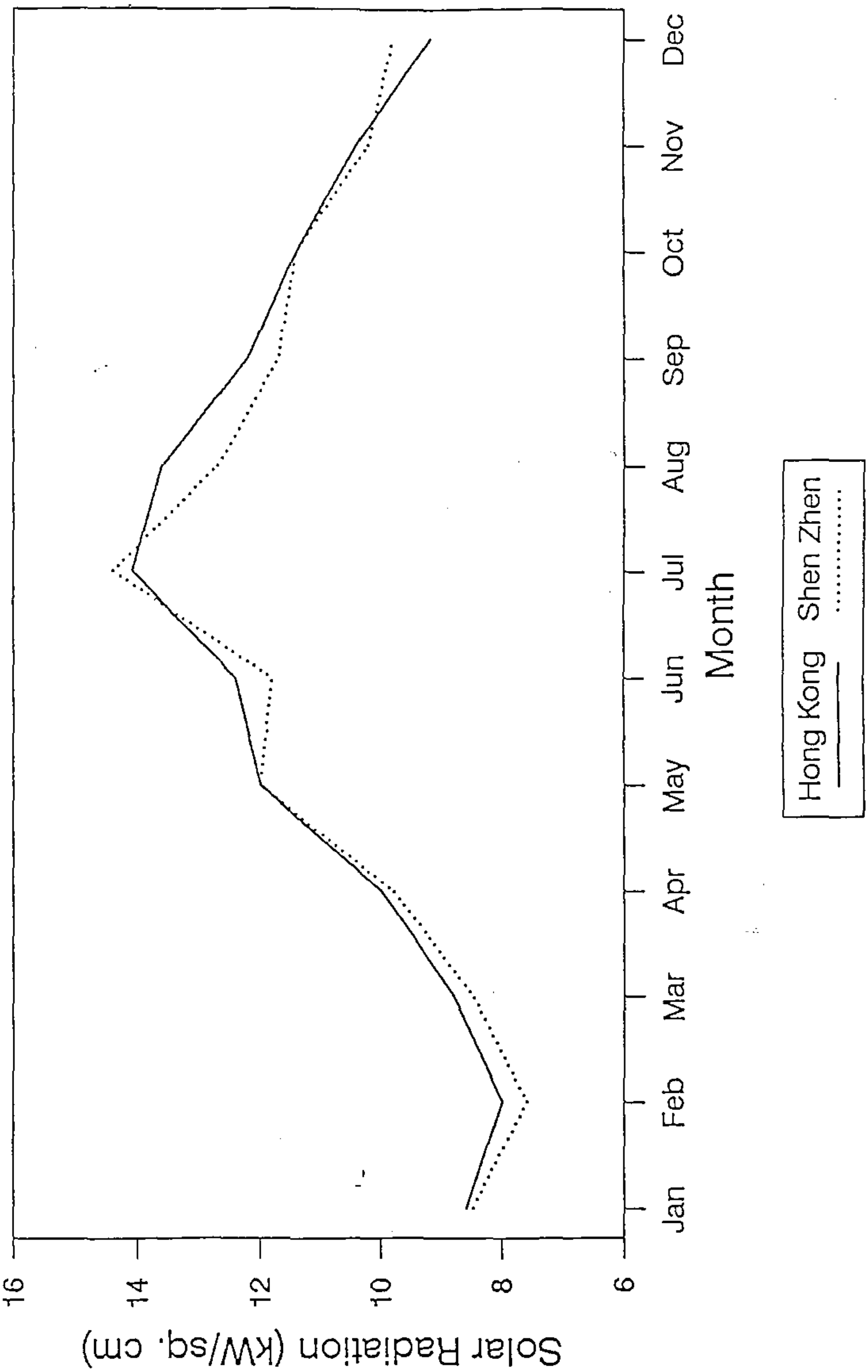


Figure V1/A48

Monthly Hours and Percentage of Sunshine in Shen Zhen

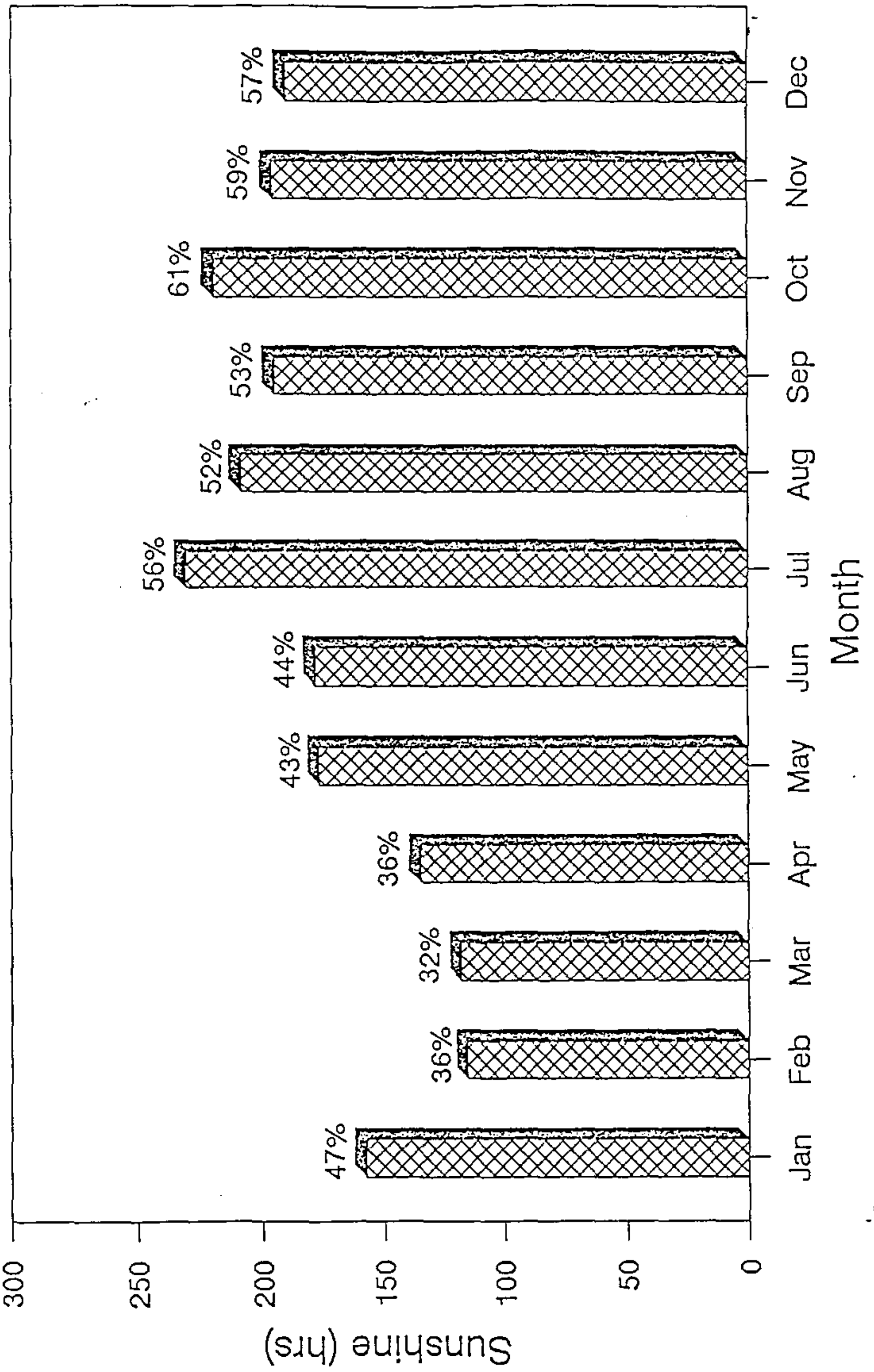


Figure V1/A49

Monthly Means of General Meteorological Conditions at King's Park, Hong Kong

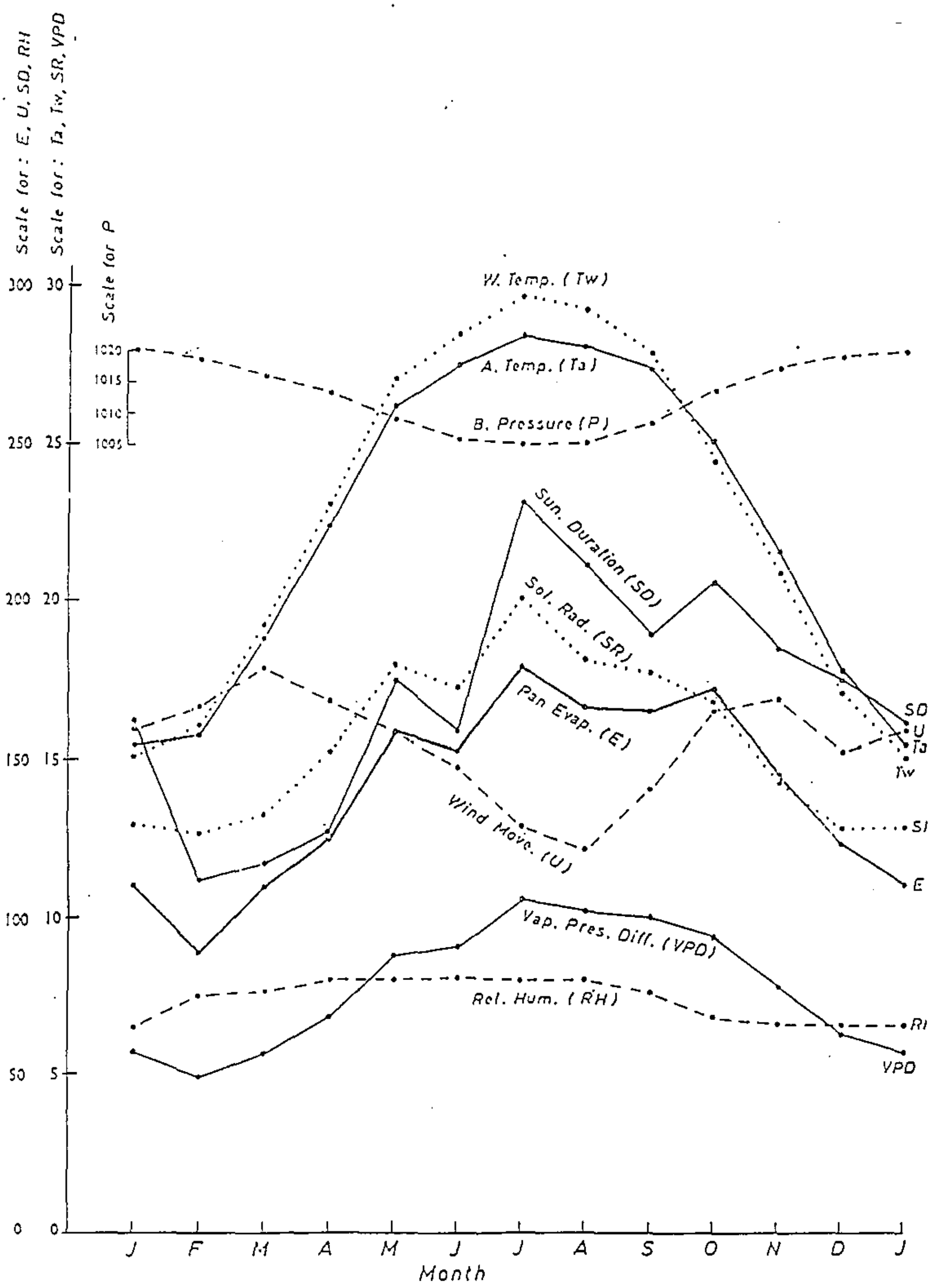
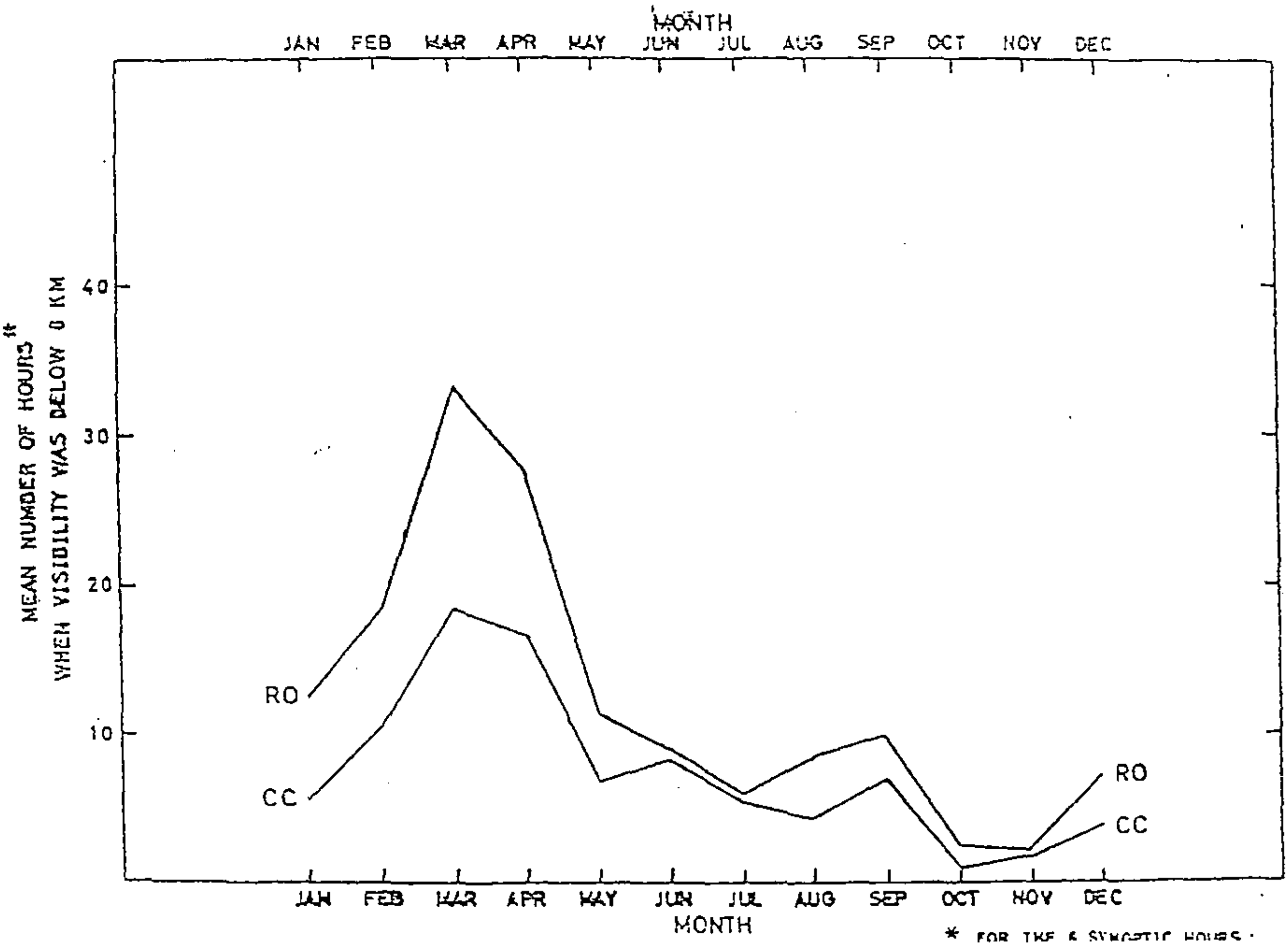


Figure V1/A50

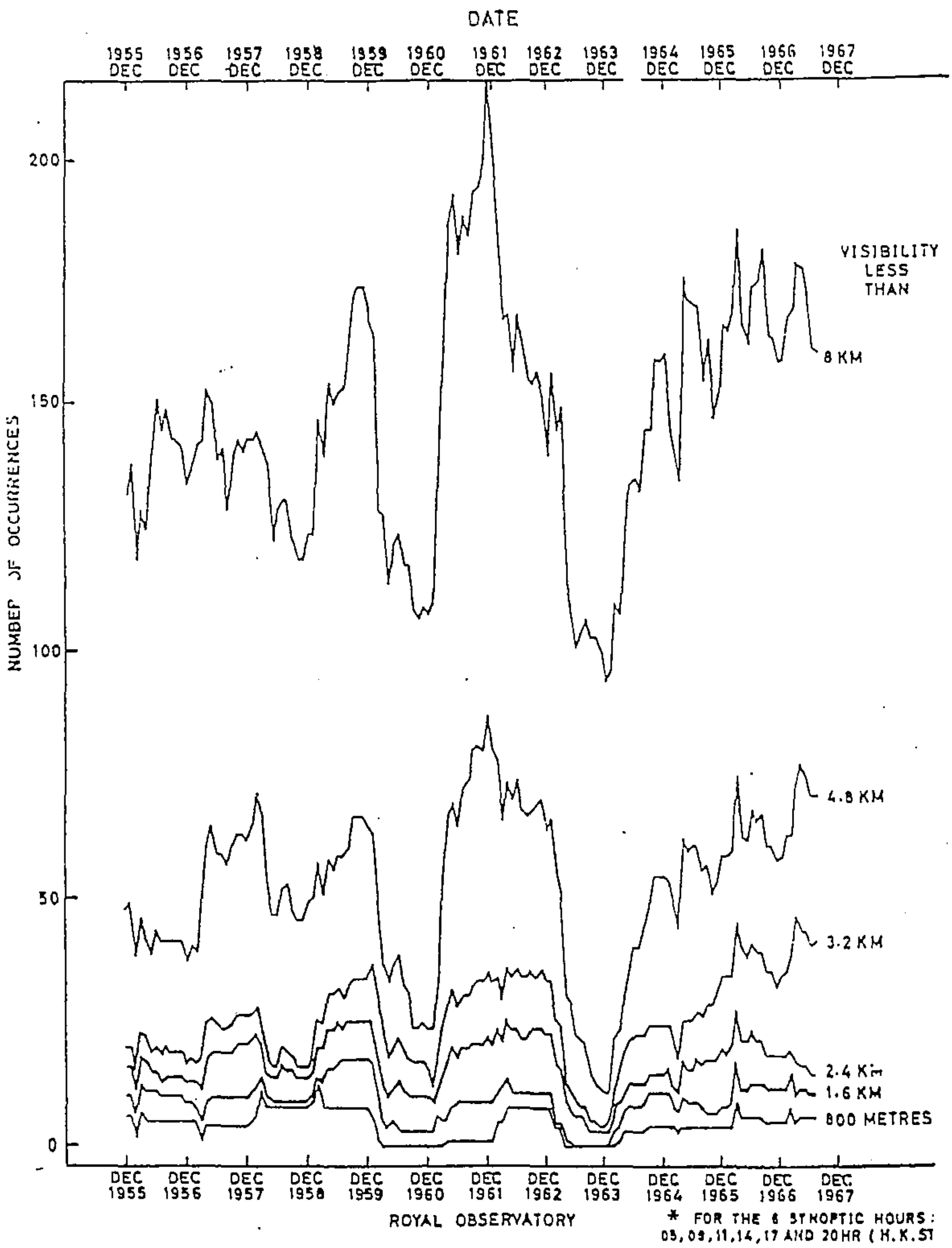
Monthly Mean Number of Hours of Impaired Visibility (< 8000m)



* FOR THE 6 SYNOPTIC HOURS: 05,08,11,14,17 AND 20HR (H.K.ST.T.)

Figure V1/A51

12-Month Running Number of Impaired Visibility at the Royal Observatory



ANNEX V1/B

AIR QUALITY DATA

V1/B1

DATA COLLECTION

V1/B1 AIR QUALITY MONITORING PROGRAMME

China Light and Power Company is setting up a network of monitoring stations to measure air quality and meterological parameters. The information obtained will be used for:

- establishing background air quality at sensitive receptors, as an input to the assessment and for calibrating the numerical and wind tunnel modelling work;
- establishing the dispersion climatology at Lung Kwu Chau to provide inputs to the numerical and physical modelling exercises;
- monitoring air quality at key receptors, into the future, as the development proceeds, so that impacts can be monitored and compared with predictions.

Some of the stations in the network, along the Tuen Mun valley, have been active for some time, to monitor impacts of Castle Peak emissions. Three new stations have been established specifically for the purposes of the EIA study to include short term monitoring for 12 months, to supplement the existing network. These include one station on the north Lantau coast (Tung Chung), one at Lau Fau Shan, and one at Black Point. A planned monitoring station at the Butterfly Estate in Tuen Mun will also provide useful information to the study if the data become available in time.

Meteorological data such as precipitation, solar radiation and atmospheric turbulence will be measured at Lung Kwu Chau to obtain the required climatology input to the dispersion modelling. Details of the network and the parameters being measured are provided in Table V1/B1(a).

Most of the parameters measured, except the particulate levels and acid deposition, will be recorded by data logger for further analysis. It is expected that monthly time series reports showing the average pollutant concentrations over the months will be presented in the KIR when the data become available. The monthly report will also highlight any readings which exceed the air quality objectives.

Table V1/B1(a)
Proposed Air Quality Monitoring Network

Monitoring Stations	SO_2	NO_2/NO_x	O_3	TSP	RSP	Acid Deposition	Wind Speed	Wind Direction
				Parameters to be measured				
<u>Existing Sites</u>								
Au Tau	x	x		x	x		x	x
Hung Shui Kin	x						x	x
Tuen Mun	x	x		x	x		x	x
<u>Short Term Monitoring Sites</u>								
Lau Fau Shan	x	x	x	x	x	x	x	x
Black Point	x	x		x	x	x	x	x
Tung Chung	x	x	x	x	x	x	x	x
<u>Planned Monitoring Site</u>								
Butterfly Estate	x	x					x	x

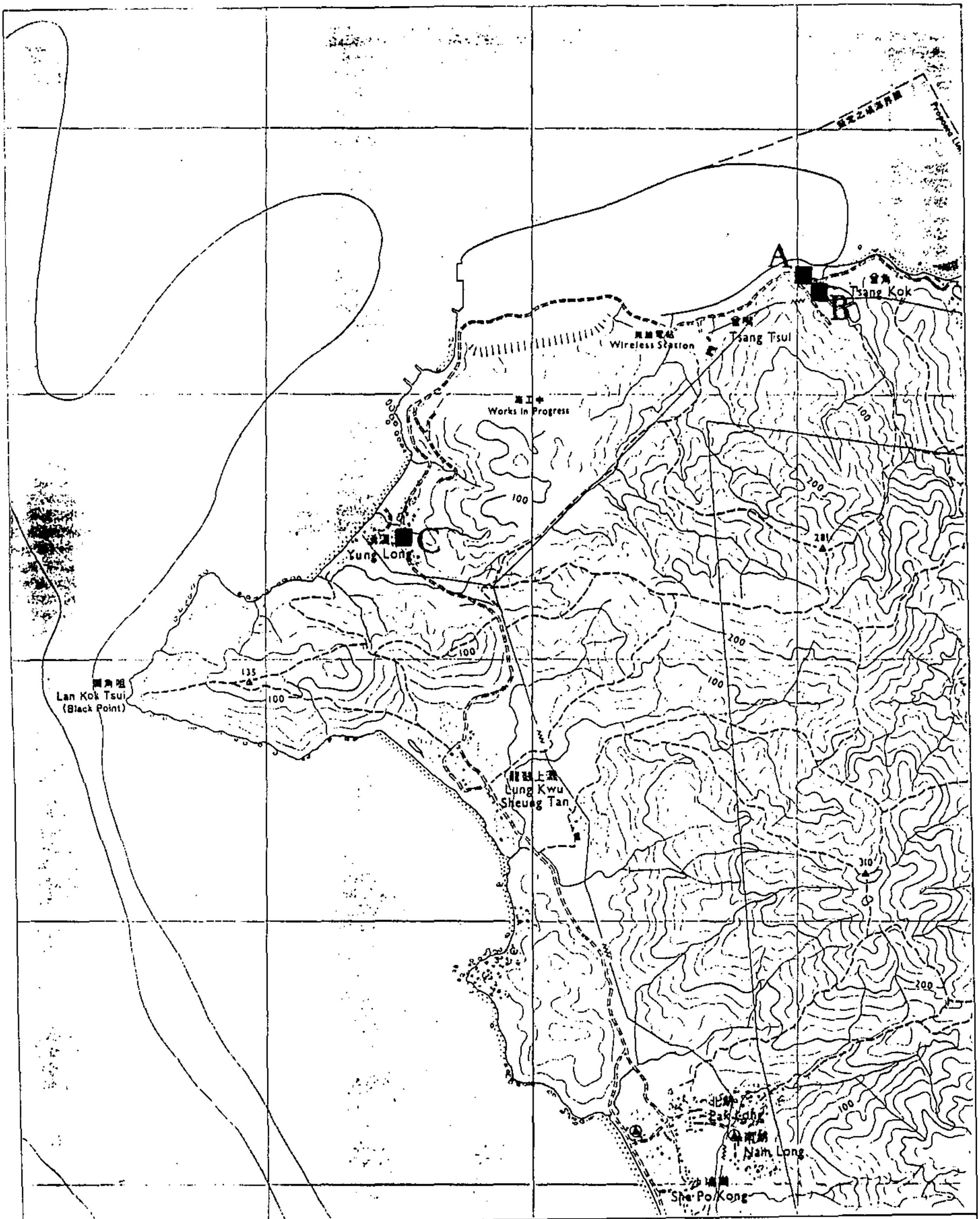


Figure V1/B3 (a) Location of air monitoring stations

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V1/B2

EPD RECORDED DATA

Table V1/B2(a)
Annual Average Concentration of SO_2 at Six Sites in Hong Kong
$\mu g/m^3$

Station	1985	1986	1987	1988	1989
Kwun Tong	57	27	71	56	36
Sham Shui Po	21	17	15	21	12
Causeway Bay	19	18	26	23	16
Tsim Sha Tsui	50	49	35	53	42
Central/Western	12	17	15	19	16
Junk Bay	26	19	15	9	7
Average	**31**	**25**	**30**	**30**	**22**

Table V1/B2(b)
Annual Average Concentration of NO_2 at Six Sites in Hong Kong
$\mu g/m^3$

Station	1985	1986	1987	1988	1989
Kwun Tong	118	117	74	93	60
Sham Shui Po	–	–	–	–	47
Causeway Bay	–	–	–	–	40
Tsim Sha Tsui	–	–	–	–	–
Central/Western	56	67	63	32	60
Junk Bay	38	55	40	21	12
Average	**71**	**80**	**59**	**49**	**44**

Table V1/B2(c)
Annual Average Concentration of O_3 at Two Sites in Hong Kong
$\mu g/m^3$

Station	1985	1986	1987	1988	1989
Central/Western	25	23	21	19	15
Junk Bay	46	44	34	40	52
Average	**36**	**34**	**28**	**30**	**34**

Table V1/B2(d)
Annual Average Concentration of TSP at Six Sites in Hong Kong
$\mu g/m^3$

Station	**1985**	**1986**	**1987**	**1988**	**1989**
Kwun Tong	90	102	120	143	121
Sham Shui Po	82	95	99	119	109
Causeway Bay	77	96	110	110	87
Tsim Sha Tsui	65	89	90	95	77
Central/Western	70	89	90	102	84
Junk Bay	62	85	90	104	77
Average	**74**	**93**	**100**	**112**	**93**

Table V1/B2(e)
Annual Average Concentration of RSP at Six Sites in Hong Kong
$\mu g/m^3$

Station	**1985**	**1986**	**1987**	**1988**	**1989**
Kwun Tong	52	59	66	74	58
Sham Shui Po	50	61	61	65	61
Causeway Bay	46	58	67	66	54
Tsim Sha Tsui	42	60	63	59	52
Central/Western	43	57	68	71	53
Junk Bay	28	48	53	63	45
Average	**44**	**57**	**63**	**66**	**54**

Table V1/B2(f)
Daily Averages and Hourly Maximum Concentrations of SO_2 and NO_2 at a Remote Site Adjacent to the High Island Reservoir, $\mu g/m^{-3}$

Pollutant	Month	Monthly Average	Daily[1] Average	Hourly[2] Maximum
SO_2	June	10	2 to 5	4 to 270
	July	16	6 to 42	11 to 158
	August	16	4 to 60	7 to 280
NO_2	June	6	2 to 22	3 to 43
	July	8	2 to 18	3 to 59
	August	10	3 to 29	4 to 136

1 Range of daily averages for each month
2 Range of hourly maxima occurring for each day throughout each month

Table V1/B2(g)
Short-Term Concentrations of SO_2 and NO_2 at Hung Shui Kiu, $\mu g/m^3$

	SO_2		NO_2	
	April	November	April	November
Monthly Mean	29	30	36	32
Hourly Maximum[1]	110–130	139–198	97–106	80–90
Daily Maximum[1]	28–55	41–60	44–58	38–43

1 Range of the three highest measured values

V1/B3

CLP RECORDED DATA

Table V1/B3(a)
Annual Average Concentration of SO_2 at Four Sites in North West New Territories measured by CLP

Time \ Sites	Tuen Mun	Hung Shui Kiu	Au Tau	San Hui	Average
1983	25.5	31.6	25.3	37.6	30.0
1984	13.5	12.7	19.6	37.0	20.7
1985	20.5	19.1	8.7	16.5	16.2
1986	28.4	24.1	7.9	37.5	24.5
1987	24.0	26.9	3.1	24.3	19.6
1988	27.2	22.7	7.8	16.8	18.6
1989	33.5	25.5	38.6	*	32.5

* – Measurements of SO_2 at the San Hui substation were stopped in September 1989 due to demolition works. A new location has been found and measurements will resume shortly.

Table V1/B3(b)
Annual Dust Deposition measured around Tsang Tsui Ash Lagoon ($mg/m^2/day$)

Time (yr) \ Site	A	B	C
1987	42.7	38.6	85.0
1988	42.1	44.0	51.0
1989	80.5	62.5	81.6

Table V1/B3(c)
24 hr respirable suspended particulate (RSP) Concentrations measured at site B from November, 1989 to August, 1990

Month	Monthly average ($\mu g/m^3$)
November 1989	75 ± 23
December 1989	111 ± 46
January 1990	59 ± 25
February 1990	61 ± 41
March 1990	75 ± 42
April 1990	57 ± 73
May 1990	43 ± 13
June 1990	101 ± 99
July 1990	68 ± 14
August 1990	59 ± 14

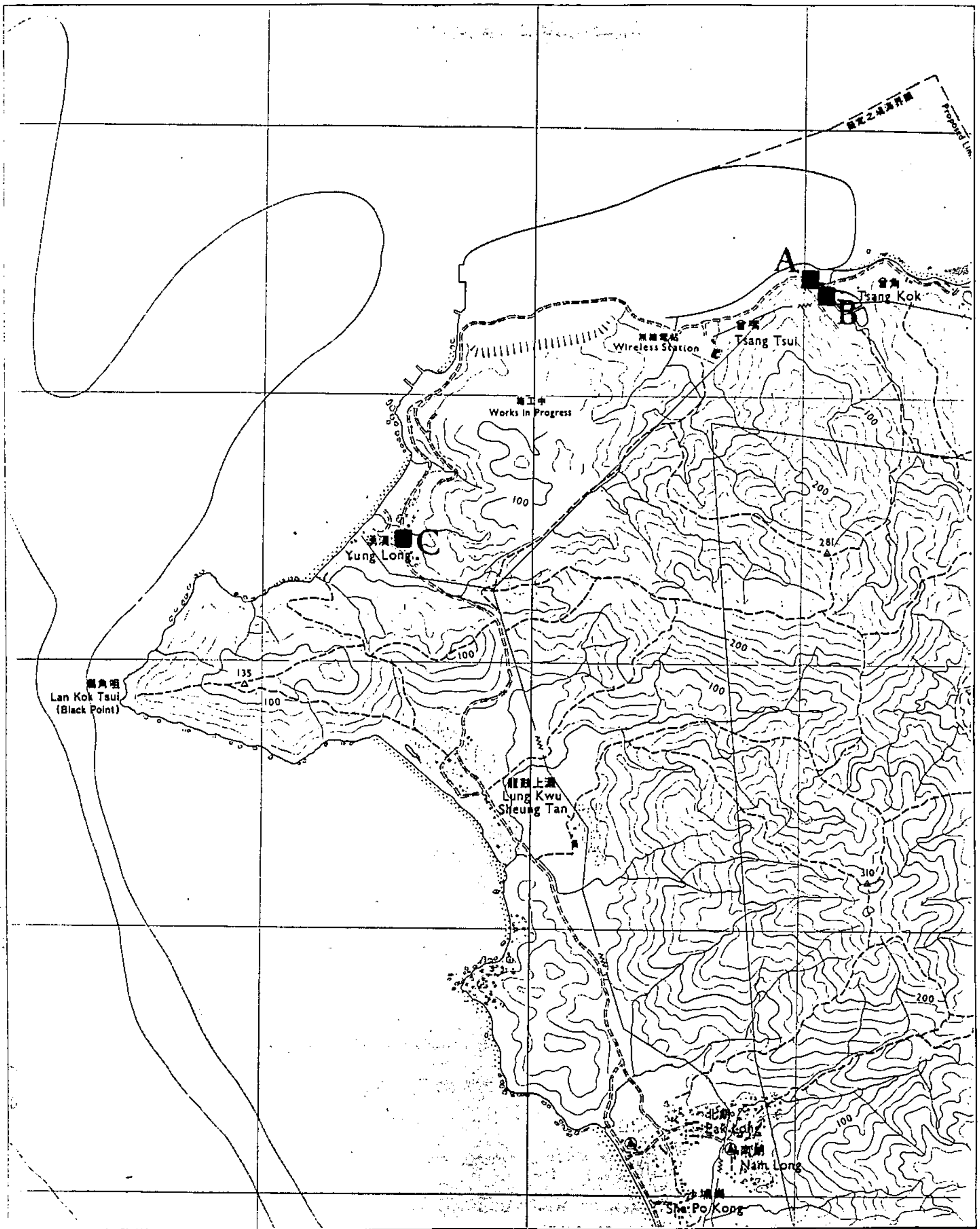

Figure V1/B3 (a) Location of air monitoring stations

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ANNEX V1/C

MARINE WATER QUALITY AND SEDIMENT DATA

V1/C1

CLP MARINE WATER QUALITY AND SEDIMENT DATA

C1. DATA COLLECTION AND PROCESSING TECHNIQUES

C1.1 Introduction

Data contained in this Annex come from two sources:

- EPD routine marine water quality and sediment sampling;
- CLP's LTPS - specific sampling programme.

The EPD data is presented first, followed by the results of the CLP survey (October to December 1990) which is programmed to continue until September 1991.

C1.2 CLP sample point locations and frequencies

C1.2.1 As indicated in Section V1/3.1, part of the extensive data gathering programme for the IAR involves the monthly collection of water quality and marine sediment samples from a total of eighteen sites in the vicinity of Black Point and Deep Bay. Sampling and analysis for a total of 41 determinands are carried out by CLP using appropriate quality assurance laboratory techniques. Validation is also achieved by carrying out replicate analysis of samples and occasionally by using an independent laboratory. The sampling and analysis programme has been organised to provide the necessary data. It is intended, however, that the programme should be flexible and capable of responding to additional requirements. Similarly, if project development renders some aspects of the programme redundant, these may be discontinued.

Current sample point locations are presented in Figures V1/C1(a). The different points are suited to different methods of accurate location:

- o The marine buoys (B1 to B7) are marked and can thus be located.
- o The near field sites (N1 to N5 and CPA/CSYO[1]) are located by means of district reference points and specified distances.
- o The far field sites (F1 to F5) are located by means of two selected reference points and two specified compass bearings.

C1.2.2 Analysis

CLP's analytical procedures are outlined briefly in the section that follows. Further information is contained in the CLP report "Black Point Baseline Environmental Study: Water Quality".

The main reference source is "Standard Methods for the Examination of Water and Wastewater 1989" 17th Ed. published by APHA AWWA and WPCF. The method numbers quoted in the text below refer to this publication and indicate that working procedures at CLP comply with the specified recommendations. Where considered relevant, notes have been provided on the limitations of the measurement techniques and should be considered when interpreting the data.

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[1] Castle Peak 'A' Coal Stockyard Outfall.

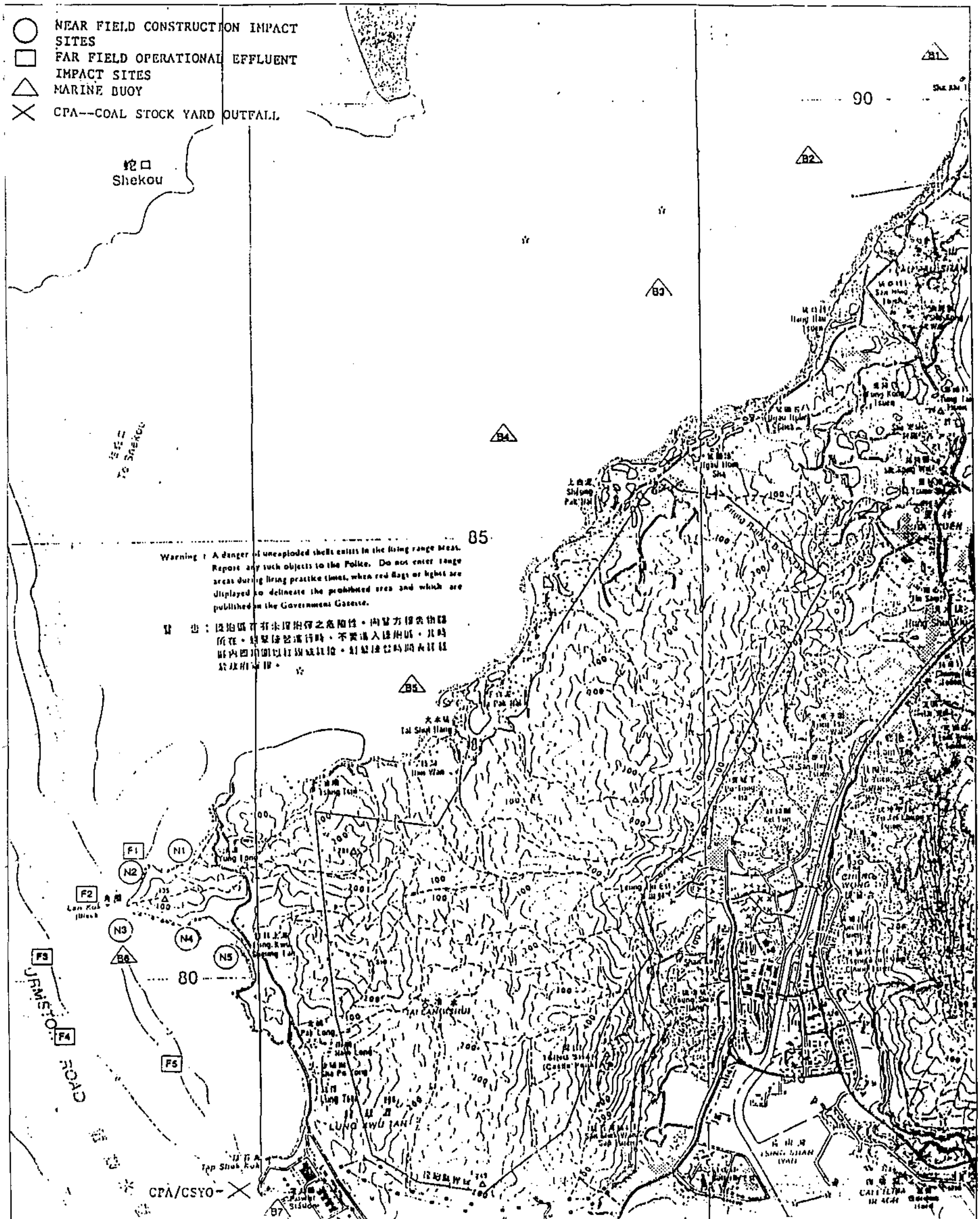

Figure V1/C1(a) **CLP Marine Water Quality and Sediment Monitoring Stations**

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A. METHODS OF MEASUREMENT ON SEA WATER SAMPLES

- **TEMPERATURE : Method 2250B**

In situ measurements are conducted using an NBA Multi-parameter System Model TDS-7 with thermistor temperature sensor.

Results are reported to ±0.1°C.

- **pH : Method 4500-H^+**

In situ measurements are conducted with glass electrodes using an NBA Multi-parameter System Model TDS-7 having automatic temperature compensation facility.

Results are reported to ±0.1 pH unit.

- **SALINITY : Method 2520B**

In situ measurements are carried out by conductivity using an NBA Multi-parameter System Model TDS-7.

After temperature compensation, the results are reported to ±1 g per kg.

- **DISSOLVED OXYGEN : Method 4500-0G**

In situ measurements are conducted by membrane electrode using a NBA Multi-parameter System Model TDS-7.

After compensation for temperature and salinity, results are reported to ±0.1 mg per litre.

- **CHLORINE (RESIDUAL) : free chlorine + mono - and dichloramine by Method 4550-Cl^-G**

In situ measurements are carried out using colour disc comparator.

Note: Method 4550-CL^-G actually measures bromine concentration but records it as chlorine, due to the presence of bromide. Chlorine cannot exist freely in seawater because of the following reaction :

$$Cl_2 + 2Br^- \rightarrow 2CL^- + Br_2$$

Results are reported to ±0.1 mg Cl_2 per litre.

- **TURBIDITY : Method 2130B**

Turbidity is measured using Hach Turbidimeter Model Ratio/XR.
Results are reported to ±0.1 NTU
(Nephelometric Turbidity Units)

- **CONDUCTIVITY : Method 2510B**

Conductivity is measured in situ using a conductivity meter; Schott Gerate Model CG858.

Results are reported to ±0.1 mS per cm.
The instrument is calibrated against a standard solution of potassium chloride.

o TOTAL SUSPENDED SOLIDS DRIED AT 103 - 105°C : Method 2540D

Measurements are made by drawing a volume of seawater sample through a glass fibre filter (GFA/47mm), the suspended solids are then dried and weighed on an analytical balance capable of reading to 0.00001 gms.

Results are reported to ±1 mg per litre.

o OXYGEN DEMAND (BIOCHEMICAL) : Method 5210B

The sample is placed in a full air-tight BOD bottle and incubated at 20 + 1°C for 5 days. The Biochemical Oxygen Demand is derived from the initial and subsequent measurement of dissolved oxygen. Dissolved oxygen is measured by the membrane electrode method with temperature compensation. The option of using a nitrification inhibitor is not adopted. Therefore, measurements are a combination of both carbonaceous and nitrogenous oxygen demands.

Results are reported to ±1 mg per litre.

o OIL AND GREASE : METHOD 5520C

In contrast to the alternative Method 5520B, the method of choice includes in the measurement any volatile contaminants such as light petroleum distillates.

Calibration is carried out against a standard typical turbine oil and results are reported to ±0.02mg per litre.

o SULPHATE : Method 4500-SO_4^{2-}E Turbidity Method

To include some particulate sulphate, analysis is applied to unfiltered samples. This however will not include particulates of gypsum ($CaSO_4 . 2H_2O$), the product of the most widely used fuel gas desulphurisation process, by virtue of the fact that gypsum is not taken into solution by the acetic acid buffer specified in Method 4500-SO_4^{2-}E. Turbidity meter (Model Hach Ration/XR) is used to compare the sulphate turbidity with a calibration curve prepared from Sulphate Standards).

Results are reported to ±10 mg per litre.

o PHOSPHORUS : Method 4500-P B.5 Persulphate Digestion followed by 4500-P E Ascorbic Acid

Analysis is applied to unfiltered samples and includes the preliminary sulphuric acid - nitric acid digestion step of Method 4500-P B.5 Persulate Digestion in order to determine "Total Phosphorus" in subsequent measurements by Method 4500-PE.

Results are reported to ±10 ug per litre.

Note: It is unlikely that this procedure would include the measurement of aryl phosphate esters which are employed as turbine hydraulic fire resistant fluids. These are exceptionally insert materials which would not be easily converted to ionic ortho-phosphate by the acid digestion treatment.

o CHLORIDE : Method 4500-CL^-B

This titrimetric method includes also bromide and iodide in the measurement as equivalent chloride concentrations. Because of the very low ratios of bromide and iodide to chloride concentrations in normal seawater however, the interference can be considered insignificant.

The option of using hydrogen peroxide to remove any interference by sulphides, sulfites or thiosulphates has been adopted. The latter two anions are potential contaminants that may be present in certain flue gas desulphurisation process effluents.

Results are reported to ±0.1g Cl^- per litre.

o **BICARBONATE : Method 4500–CO_2C**

The titrimetric method is used by titration of samples to pH 8.3 using pH meter (method 4500–H^+).

o **NITROGEN (NITRATE) : Method 4500–NO_3^-E**

The method involves the reduction of nitrate on unfiltered samples to nitrite which is then determined colorimetrically. Any nitrite ions already in the sample are therefore included in the measurement as nitrate equivalent concentrations.

Results are reported to ±0.02 mg NO_3^- per litre.

Note: Determinations of nitrate in seawater by all the "classical" methods are difficult because of sample stability questions resulting from the biochemically interconvertible nature of the $NH_3/NO_2^-/NO_3^-$/Organic–N system and the high probability that interfering species will be present. The results therefore should be useful as a semi–quantitative technique for indicating relative changes in concentrations but should be considered of doubtful value for applications where absolute measurements of NO_3^-/NO_2^- concentrations are required.

o **NITROGEN (AMMONIA) : CLP derived Method for the analysis of Ammonia**

Indophenol colorimetric method

This method is an improvement of the APHA method 4500–NH_3 D and 4500–NH_3 H. It uses hypochlorite in a sodium citrate buffer, ethanolic phenol solution and aqueous nitroprusside calatyst to form indophenol.

Results will be reported to ±0.01 ppm NH_3–N. (0.01mg NH_3–N per litre).

Notes: (i) The comments made in the Note for Nitrogen (Nitrate) above, are equally applicable here. The water samples are analysed unfiltered.

(ii) If experience shows that comparable results are obtained without its use, the distillation step may be omitted from the procedure.

o **NITROGEN (ORGANIC) : Method 4500–N_{org} B**

followed by CLP derived method for the analysis of ammonia

Sulphuric acid/Potassium sulphate/Mercuric sulphate digestion followed by Indophenol colorimetric ammonia determination (as above).

Digestion (4500–N_{org} B) is carried out on unfiltered samples to convert the organic nitrogen to ammonium prior to measurement by the same method as used for Nitrogen (ammonia).

o **ORGANIC CARBON (TOTAL) : Method 5310 C**

The sample will be analyzed without prior filtration by ASTRO model 1850 TOC analyser.

The option of using mercuric nitrate additions to remove chloride interference will be adopted (possibly together with some sample dilution).
For the anticipated samples, homogenisation to reduce the particle size of suspended material should be unnecessary.

The measurement procedure is for "non-purgeable organic carbon" which means that inorganic carbonates, dissolved CO_2 etc. are eliminated as potential sources of interference.

Results are reported to ±0.1 C per litre.

Note: The method as described above provides an estimate of the total organic content of the sample. In this respect, it can be considered supplementary to BOD data which is an empirical measure of that portion of the organic content which is oxidisable under the standard conditions of the BOD test.

o **ANIONIC SURFACTANTS AS MBAS : Method 512B**

Measurements are made on filtered samples to remove particulate interference*.
Results are reported to ±50 ug MBAS[1] as LAS per litre.

The method is calibrated against the most widely used anionic surfactant, linear alkylbenzene sulphonate (LAS).

Hydrogen peroxide is used to minimise any sulphide interference.

Note : This is useful empirical method for estimating levesl of pollution by anionic surfactant types of detergents, but in using the data, the presence of other MABS must always be borne in mind. Positive interfering substances are manifold, both man-made and natural, including organic sulphonate, phenols and inorganic chlorides. Negative interference can result from cationic surfactants and other cationic materials.

The measurement does not include soaps (i.e. alkali salts of $C_{10} - C_{20}$ fatty acids) which are, strictly speaking, also anionic surfactants.

---

* – The MBAS method includes three successive extractions from the acidified aqueous medium (containing excess methylene blue) into the chloroform, followed by an aqueous backwash. Measurement of the resulting blue colour in the chloroform is carried out using the Hibachi 220S Spectrophotometer (at 652um).

1 – MBAS means Methylene Blue Activated Substances

o **METALS : Al, Fe, Ni, Cu, Zn, Cd, Pb, Se, Hg, Cr, Mn, As**

Trace metals exist in seawater at extremely low concentrations ($\mu g/1$). Therefore, specialised techniques and "clean 1ab" working conditions are required[1]. Detailed working and validation procedures have been developed at CLP Scientific Services Laboratories, as follows:

(i) Al, Fe, Ni, Cu, Zn; Extraction/concentration by Chelex-100 resin followed by ICP-AES measurement (Method 3120). Detection limits in seawater are: 25, 1, 5, 5 and 1.25 $\mu g/1$ respectively.

(ii) Cd, Pb; Extraction/concentration by Chelex-100 resin, measurement by electrothermal-AAS with Zeeman background correction (Method 3500). Detection limits are 0.05 $\mu g/1$ for each metal.

(iii) Mn, Cr, by direct graphite furnance AAS with Zeeman background correction (Method 3500). The detection limits are 2.0 and 0.5 respectively.

(iv) As and Se; by continuous hydride generation-AAS (Method 3114 C). The detection limits are 1 and 0.5$\mu g/l$ respectively.

(v) Hg; by cold vapour-AAS (Method 3500). The detection limit is 2 $\mu g/l$.

o **OTHER METALS : Method 3030 and CLP Report SSB/C/R/04-84**

These will be determined as "Acid-extractable Metals". (Method 3030, paragraph C and Method 3030D). Of the various standard arbitrary classifications available, it is this category which is of most significance to pollution monitoring because this is the species group which is potentially bioavailable.

a) Na, Mg, K, Ca (Methods 3500-Na, 3500-Mg, 3500K and 3500-Ca).

Calibration using external standards is validated against the internal standards method.

o **CHLOROPHYLL 'a' : Method 10200 H**

UV method with acetone extraction

Samples are, analysed immediately upon receipt to prevent significant change. If storage of samples is unavailable, the required volume of samples is filtered upon collection through a GF/C glass fibre filter and the filter frozen until analysed. Analysis involves direct U.V. measurement on a acetone extracted sample.

For the purpose of this study, it has been deemed unnecessary to include the step to correct for interference by pheophytin 'a' (10200H, 4b) which is in any case a derivative of chlorophyll 'a'.

Results will be reported as mg/m^3 Chlorophyll 'a'.

---

1 "Total Recoverable Metals" have been determined on seawater and marine sediment samples as defined by the US-EPA (Metals of Chemical Analysis of Waters and Wastes 1971).

o **ESCHERICHIA COLI : Method ref. DOE (1983)**

The Bacteriological Examination of Drinking Water Supplies 1982, Sec. 7.8 & 7.9.

This method involves membrane filtration using lauryl sulphate and an in-situ urease test.

Results are reported to ± CFU E. coli per 100ml.

o **FAECAL COLIFORM : Method 9221 C**

The membrane filtration method using M-FC broth is employed.

Results are reported to ±1 CFU Faecal Coliform per 100ml.

B. METHODS OF MEASUREMENTS ON SEDIMENT SAMPLES

o **METALS : Al, Fe, Ni, Cu, Zn, Cd, Pb, Mn, Cr, As, Se, Hg**

Trace measurements are carried out by ICP-AES or GF-AAS with Zeeman background correction, on sediment samples by ASTM D3974-81 Standard Practice B.

Trace metals were extracted from sediment samples using acid digestion techniques (ASTM D3974-81).

This extraction method provides a useful indication of existing levels of "unnatural" pollution and represents potentially bioavailable metals.

Samples are collected, analysed and reported in duplicate as a control on data quality because of the high likelihood of errors by sample contamination and other complexities when quantifying very low concentration levels.

o **Eh**

This represents the redox potential of the marine sediments. A potentiometric method is employed using platinum electrodes paired with reference electrodes. Results are reported to ± mv.

o **GRAIN SIZE**

Samples of marine sediment are sieved through Standard Size Sieves and the weight of sample collected at each stage in each sieve is recorded after drying.
Results are reported to ±0.1%.

o **SULPHIDE : CLP derived method for the analysis of sulphide - Report No. SSB/C/R06-87) followed by Method 4500-S^2-D.**

Wet samples are diluted with pure water and then reacted with acid. The hydrogen sulphide liberated is purged by nitorgen and trapped by 0.02N NaOH solution, and finally quantified by methylene blue method (4500-S^{2-}D).

Parallel tests of moisture content are carried out for conversion from wet weight basis to dry weight basis.

Results are reported to ±0.01 ppm S (on dry weight basis).

o **NITROGEN (ORGANIC) TOTAL KJELDAHL NITROGEN : Method 4500-N_{org} B**

followed by CLP derived Method for the analysis of Ammonia

A sample of wet sediment is digested (with a little water) by the Labconco Rapid-digestor as for seawater samples. The resulting digest is then distilled, using the Labconco Rapidstill, for 8 min into 50ml 0.04N H_2SO_4. The resulting solution is diluted to 100ml (or a suitable volume) and tested for ammonia by the same method as that used for seawater.

Results will be reported to ±0.01ppm NH_3–N Total Kjeldahl Nitrogen (on a dry weight basis).

o **TOTAL RECOVERABLE PHOSPHORUS : Method ASTM D4183-82**

Dry the sample at 110°C to constant weight. Powder and weigh 0.5g into a silica or porcelain cruicible. Heat at 550°C for 2 hours. Cool and transfer to a 100ml flask. Add 50ml 0.1N hydrochloric acid, shake for 16 hours. Decant 10ml supernatant into a 15ml centrifuge tube and clarify by centrifuging. The resulting clear solution is ten fold diluted with water and analysed as for seawater.

Results will be reported to ± 0.01ppm P (on a dry weight basis).

o **SULPHATE : Method BS1377:1975**

Dry the sample at 75-80°C to constant weight. Powder and weigh 2g into a 500ml beaker. Add 200ml of 10% hydrochloric acid and boil for 5 mins. Use a watch glass to cover the beaker. After 5 mins., add 3ml Bromine water followed by Ammonia solution until the solution shows precipitation and smells of ammonia. Filter and collect the filtrate in a beaker. Put the filter paper to a beaker, add 20ml 10% hydrochloric acid and stir until all the precipitates are transferred into solution. Remove and wash the filter paper with pure water into the beaker. Boil and add ammonia solution to precipitate the sesquioxides. Filter and combine the filtrate into the beaker containing the washings from the first precipitator.

Neutralize the combined filtrate with hydrochloric acid or ammonia solution and test for sulphate as for seawater.

Result as Total sulphate ± 50ppm.

This method would include $CaSO_4$ (gypsum).

o **ORGANIC CARBON (TOTAL) : Method 5310C**

Persulphate - UV oxidation method

The measurement will be of "non-purgeable organic carbon". The samples will be treated with acid to remove any inorganic carbon as CO_2 and dried at 100°C. The resulting sample will be analysed using a T.O.C. analyser by directly placing the sample in the furance.

Results will be reported to ± 0.1ppm C (on a dry weight basis).

Tables V1/C1 (a) – (c)

CLP MARINE WATER QUALITY AND SEDIMENT SURVEY ANALYTICAL RESULTS: October to December 1990

Key to Tables:

1. S – monthly sample taken just below surface of seawater
2. M – monthly sample taken at mid-depth of seawater when depth is more than 10 metres
3. L – monthly sample taken just above the seabed when the depth of seawater is more than 5 metres
4. O – sample of oysters taken at three monthly intervals
5. BS – monthly sample of benthic sediment
6. CPA/CSYO – Castle Peak 'A' Station, Coal Stock Yard Outfall
7. Sediment Fe & Al as % wt/wt
8. Grain size on separate sheet
9. Sediment analysis on unsieved samples
10. Tests conducted by Wasserbel: # 25, 26, 27, 28
11. Faecal coliform/E. coli for sediment CFU/ kg

OCTOBER 1990

PARAMETER		Near field construction impact monitoring sites				
		N1	N2	N3	N4	N5
		S	S	S	S	S
1. pH	(pH unit)	7.7	7.8	7.8	7.8	7.7
2. Temperature	('C)	23	23	23	23	23
3. Turbidity	(NTU)	1.3	1.7	1.7	4.1	4.3
4. Conductivity	(ms cm-1)	46.7	49.7	45.7	46.2	46.5
5. Salinity	(g Kg-1)	28	29	27	28	28
6. Dissolved oxygen	(mgl-1)	7.9	7.5	7.2	7.4	7.3
7. TSS	(mg l-1)	2	7.1	2.3	1.6	7
8. BOD (5 day)	(mg l-1)					
9. Eh	(mV)					
10. Organic carbon	(mg l-1)					
11. Grain size	(%)					
12. Grease and oil	(mg l-1)	0.2	0.3	0.05	0.15	0.25
13. Sulphates	(mg l-1)					
14. Bicarbonates	(mg l-1)					
15. Phosphorus	(mg l-1)					
16. Nitrate-N	(mg l-1)					
17. Ammonia-N	(mg l-1)					
18. Organic-N	(mg l-1)					
19. Chlorophyll 'A'	(mg l-1)					
20. Chloride	(mg l-1)					
21. Bromide	(mg l-1)					
22. Total sulphide	(mg l-1)					
23. Chlorine	(mg l-1)					
24. Detergents	(mg l-1)					
25. Magnesium	(mg l-1)					
26. Calcium	(mg l-1)					
27. Potassium	(mg l-1)					
28. Sodium	(mg l-1)					
29. Cadmium	(ug l-1)					
30. Mercury	(ug l-1)					
31. Chromium	(ug l-1)					
32. Copper	(ug l-1)					
33. Lead	(ug l-1)					
34. Nickel	(ug l-1)					
35. Zinc	(ug l-1)					
36. Arsenic	(ug l-1)					
37. Manganese	(ug l-1)					
38. Selenium	(ug l-1)					
39. Iron	(ug l-1)					
40. Aluminium	(ug l-1)					
41. Fecal coliform	CFU/100ml					

Table VI/C1 (a)
CLP MARINE WATER QUALITY AND SEDIMENT SURVEY: October 1990

ERL (Asia) Ltd.
11th Floor, Hecny Tower
9 Chatham Road,
Tsimshatsui,
Kowloon, HONG KONG
ERL

PARAMETER	Far field operational effluent impact monitoring sites				
	F 1		F 2		
	S	BS	S	L	BS
1. pH (pH unit)	7.8		7.8	7.8	
2. Temperature ('C)	23		23	23	
3. Turbidity (NTU)	4.6		4.3	1.8	
4. Conductivity (ms cm-1)	49.6		49.9	49.9	
5. Salinity (g Kg-1)	30		30	30	
6. Dissolved oxygen (mgl-1)	7		7.5	7.4	
7. TSS (mg l-1)	3.1		6.3	4	
8. BOD (5 day) (mg l-1)	1		1	1	
9. Eh (mV)		-66			-60
10. Organic carbon (mg l-1)	4		4		
11. Grain size (%)					
12. Grease and oil (mg l-1)	0.2		0.2		
13. Sulphates (mg l-1)	2100		1900	2200	
14. Bicarbonates (mg l-1)	6		6	6	
15. Phosphorus (mg l-1)	0.19		0.18	0.18	
16. Nitrate-N (mg l-1)	0.06		0.05	0.05	
17. Ammonia-N (mg l-1)	0.01		0.03	<0.02	
18. Organic-N (mg l-1)	0.1		0.11	0.11	
19. Chlorophyll 'A' (mg l-1)	1.7		1.5	1.5	
20. Chloride (mg l-1)	15000		14000	14000	
21. Bromide (mg l-1)	63		60	60	
22. Total sulphide (mg l-1)	<0.01		<0.01	<0.01	
23. Chlorine (mg l-1)	<0.1		<0.1	<0.1	
24. Detergents (mg l-1)	<0.05		<0.05	<0.05	
25. Magnesium (mg l-1)	946				
26. Calcium (mg l-1)	310				
27. Potassium (mg l-1)	359				
28. Sodium (mg l-1)	7817				
29. Cadmium (ug l-1)	0.54	0.01			
30. Mercury (ug l-1)		<0.2			
31. Chromium (ug l-1)	0.8	0.4			
32. Copper (ug l-1)	< 5	1.1			
33. Lead (ug l-1)	0.9	20			
34. Nickel (ug l-1)	< 5	1			
35. Zinc (ug l-1)	13	5			
36. Arsenic (ug l-1)	< 1	0.1			
37. Manganese (ug l-1)	20	27			
38. Selenium (ug l-1)	< 1	<0.05			
39. Iron (ug l-1)	222	0.1			
40. Aluminium (ug l-1)	208	0.03			
41. Fecal coliform CFU/100ml	3000	5000	500	300	2500

Table VI/C1 (a)
CLP MARINE WATER QUALITY AND SEDIMENT SURVEY: October 1990

ERL (Asia) Ltd.
11th Floor, Hecny Tower
9 Chatham Road,
Tsimshatsui,
Kowloon, HONG KONG

ERL

PARAMETER		Far field operational effluent impact monitoring sites				
		F 3				F 4
		S	M	L	BS	S
1. pH	(pH unit)	7.9	7.8	7.8		7.8
2. Temperature	('C)	23	23	23		23
3. Turbidity	(NTU)	3.3	1.1	1.1		3.8
4. Conductivity	(ms cm-1)	49.7	45.8	45.9		49
5. Salinity	(g Kg-1)	30	29	29		29
6. Dissolved oxygen	(mgl-1)	7.4	7.1	7		7.2
7. TSS	(mg l-1)	3	2	1		1
8. BOD (5 day)	(mg l-1)	1	1	1		2
9. Eh	(mV)				-40	
10. Organic carbon	(mg l-1)	4	3	3		4
11. Grain size	(%)					
12. Grease and oil	(mg l-1)	0.1	0.05	0.05		0.05
13. Sulphates	(mg l-1)	1900	2200	2200		2200
14. Bicarbonates	(mg l-1)	6	6	6		6
15. Phosphorus	(mg l-1)	0.16	0.16	0.16		0.13
16. Nitrate-N	(mg l-1)	0.07	0.07	0.07		0.05
17. Ammonia-N	(mg l-1)	0.03	0.02	0.02		<0.02
18. Organic-N	(mg l-1)	0.09	0.09	0.09		0.09
19. Chlorophyll 'A'	(mg l-1)	1.4	1.1	0.8		2.1
20. Chloride	(mg l-1)	15000	15000	16000		14000
21. Bromide	(mg l-1)	59	59	59		56
22. Total sulphide	(mg l-1)	<0.01	<0.01	<0.01		<0.01
23. Chlorine	(mg l-1)	<0.1	<0.1	<0.1		<0.1
24. Detergents	(mg l-1)	<0.05	<0.05	<0.05		<0.05
25. Magnesium	(mg l-1)					
26. Calcium	(mg l-1)					
27. Potassium	(mg l-1)					
28. Sodium	(mg l-1)					
29. Cadmium	(ug l-1)					
30. Mercury	(ug l-1)					
31. Chromium	(ug l-1)					
32. Copper	(ug l-1)					
33. Lead	(ug l-1)					
34. Nickel	(ug l-1)					
35. Zinc	(ug l-1)					
36. Arsenic	(ug l-1)					
37. Manganese	(ug l-1)					
38. Selenium	(ug l-1)					
39. Iron	(ug l-1)					
40. Aluminium	(ug l-1)					
41. Fecal coliform	CFU/100ml	780	750	700	3000	2100

Table VI/C1 (a)
CLP MARINE WATER QUALITY AND SEDIMENT SURVEY: October 1990

ERL (Asia) Ltd.
11th Floor, Hecny Tower
9 Chatham Road,
Tsimshatsui,
Kowloon, HONG KONG
ERL

PARAMETER	Far field operational effluent impact monitoring sites				
	F 4			F 5	
	M	L	BS	S	L
1. pH (pH unit)	7.8	7.9		7.7	7.7
2. Temperature ('C)	23	23		23	23
3. Turbidity (NTU)	1.1	1.1		4	2
4. Conductivity (ms cm-1)	48.9	48.9		49.8	49.8
5. Salinity (g Kg-1)	29	29		30	30
6. Dissolved oxygen (mgl-1)	7.2	7.2		7.2	7.2
7. TSS (mg l-1)	2	1		4	1
8. BOD (5 day) (mg l-1)	1	1		1	1
9. Eh (mV)			-100		
10. Organic carbon(mg l-1)	3	3		3	3
11. Grain size (%)					
12. Grease and oil(mg l-1)	0.05	0.05		0.05	0.05
13. Sulphates (mg l-1)	2500	2500		2300	2400
14. Bicarbonates (mg l-1)	6	6		6	6
15. Phosphorus (mg l-1)	0.13	0.13		0.1	0.1
16. Nitrate-N (mg l-1)	0.05	0.05		0.05	0.05
17. Ammonia-N (mg l-1)	<0.02	<0.02		<0.02	<0.02
18. Organic-N (mg l-1)	0.09	0.09		0.07	0.07
19. Chlorophyll 'A'(mg l-1)	1.4	1.4		2	1
20. Chloride (mg l-1)	16000	16000		15000	16000
21. Bromide (mg l-1)	56	56		61	61
22. Total sulphide(mg l-1)	<0.01	<0.01		<0.01	<0.01
23. Chlorine (mg l-1)	<0.1	<0.1		<0.1	<0.1
24. Detergents (mg l-1)	<0.05	<0.05		<0.05	<0.05
25. Magnesium (mg l-1)					
26. Calcium (mg l-1)					
27. Potassium (mg l-1)					
28. Sodium (mg l-1)					
29. Cadmium (ug l-1)					
30. Mercury (ug l-1)					
31. Chromium (ug l-1)					
32. Copper (ug l-1)					
33. Lead (ug l-1)					
34. Nickel (ug l-1)					
35. Zinc (ug l-1)					
36. Arsenic (ug l-1)					
37. Manganese (ug l-1)					
38. Selenium (ug l-1)					
39. Iron (ug l-1)					
40. Aluminium (ug l-1)					
41. Fecal coliformCFU/100ml	2100	2500	4000	1800	1500

Table VI/C1 (a)
CLP MARINE WATER QUALITY AND SEDIMENT SURVEY: October 1990

ERL (Asia) Ltd.
11th Floor, Hecny Tower
9 Chatham Road,
Tsimshatsui,
Kowloon, HONG KONG
ERL

PARAMETER		Marine buoys and operational effluent impact monitoring sites			
	F 5	B 1			B 2
	BS	S	BS	O	O
1. pH (pH unit)		7.8			
2. Temperature ('C)		23			
3. Turbidity (NTU)		3.5			
4. Conductivity (ms cm-1)		48.7			
5. Salinity (g Kg-1)		29			
6. Dissolved oxygen (mgl-1)		7.8			
7. TSS (mg l-1)		3			
8. BOD (5 day) (mg l-1)		1			
9. Eh (mV)	-50		-76		
10. Organic carbon(mg l-1)		4			
11. Grain size (%)					
12. Grease and oil(mg l-1)		0.05			
13. Sulphates (mg l-1)		2000			
14. Bicarbonates (mg l-1)		6			
15. Phosphorus (mg l-1)		0.25			
16. Nitrate-N (mg l-1)		0.08			
17. Ammonia-N (mg l-1)		0.02			
18. Organic-N (mg l-1)		0.16			
19. Chlorophyll 'A'(mg l-1)		2.2			
20. Chloride (mg l-1)		14000			
21. Bromide (mg l-1)		60			
22. Total sulphide(mg l-1)		<0.01	250		
23. Chlorine (mg l-1)		<0.1			
24. Detergents (mg l-1)		0.01			
25. Magnesium (mg l-1)		731			
26. Calcium (mg l-1)		356			
27. Potassium (mg l-1)		419			
28. Sodium (mg l-1)		8000			
29. Cadmium (ug l-1)		<0.05	0.11		
30. Mercury (ug l-1)			0.3		
31. Chromium (ug l-1)		0.7	15		
32. Copper (ug l-1)		< 5	61		
33. Lead (ug l-1)		1.1	80		
34. Nickel (ug l-1)		< 5	15		
35. Zinc (ug l-1)		10	65		
36. Arsenic (ug l-1)		1	0.3		
37. Manganese (ug l-1)		26	345		
38. Selenium (ug l-1)		< 1	<0.05		
39. Iron (ug l-1)		313	1		
40. Aluminium (ug l-1)		196	0.4		
41. Fecal coliformCFU/100ml	3000	250	3000		

Table VI/C1 (a)
CLP MARINE WATER QUALITY AND SEDIMENT SURVEY: October 1990

ERL (Asia) Ltd.
11th Floor, Hecny Tower
9 Chatham Road,
Tsimshatsui,
Kowloon, HONG KONG
ERL

PARAMETER	Marine buoys and operational effluent impact monitoring sites				
	B 3	B 4			B 5
	O	S	BS	O	O
1. pH (pH unit)		7.8			
2. Temperature ('C)		23			
3. Turbidity (NTU)		3.4			
4. Conductivity (ms cm-1)		48.3			
5. Salinity (g Kg-1)		29			
6. Dissolved oxygen (mgl-1)		7.7			
7. TSS (mg l-1)		7			
8. BOD (5 day) (mg l-1)		1			
9. Eh (mV)			14		
10. Organic carbon(mg l-1)		3			
11. Grain size (%)					
12. Grease and oil(mg l-1)		0.2			
13. Sulphates (mg l-1)		2200			
14. Bicarbonates (mg l-1)		6			
15. Phosphorus (mg l-1)		0.21			
16. Nitrate-N (mg l-1)		0.08			
17. Ammonia-N (mg l-1)		0.02			
18. Organic-N (mg l-1)		0.13			
19. Chlorophyll 'A'(mg l-1)		1.7			
20. Chloride (mg l-1)		14000			
21. Bromide (mg l-1)		62			
22. Total sulphide(mg l-1)		<0.01			
23. Chlorine (mg l-1)		<0.1			
24. Detergents (mg l-1)		0.01			
25. Magnesium (mg l-1)		742			
26. Calcium (mg l-1)		334			
27. Potassium (mg l-1)		430			
28. Sodium (mg l-1)		9083			
29. Cadmium (ug l-1)		<0.05	0.06		
30. Mercury (ug l-1)			0.2		
31. Chromium (ug l-1)		0.9	14		
32. Copper (ug l-1)		< 5	62		
33. Lead (ug l-1)		0.7	24		
34. Nickel (ug l-1)		< 5	23		
35. Zinc (ug l-1)		8.3	49		
36. Arsenic (ug l-1)		< 1	0.5		
37. Manganese (ug l-1)		29	435		
38. Selenium (ug l-1)		< 1	<0.05		
39. Iron (ug l-1)		429	2		
40. Aluminium (ug l-1)		362	0.4		
41. Fecal coliformCFU/100ml		360	2800		

Table VI/C1 (a)
CLP MARINE WATER QUALITY AND SEDIMENT SURVEY: October 1990

ERL (Asia) Ltd.
11th Floor, Hecny Tower
9 Chatham Road,
Tsimshatsui,
Kowloon, HONG KONG
ERL

PARAMETER		Marine buoys and operational effluent impact monitoring sites				
		B 6				
		S	BS	O		
1. pH	(pH unit)	7.8				
2. Temperature	('C)	23				
3. Turbidity	(NTU)	4				
4. Conductivity	(ms cm-1)	46.8				
5. Salinity	(g Kg-1)	29				
6. Dissolved oxygen	(mgl-1)	7.3				
7. TSS	(mg l-1)	4				
8. BOD (5 day)	(mg l-1)	1				
9. Eh	(mV)		-13			
10. Organic carbon	(mg l-1)	3				
11. Grain size	(%)					
12. Grease and oil	(mg l-1)	0.15				
13. Sulphates	(mg l-1)	2000				
14. Bicarbonates	(mg l-1)	6				
15. Phosphorus	(mg l-1)	0.12				
16. Nitrate-N	(mg l-1)	0.09				
17. Ammonia-N	(mg l-1)	<0.01				
18. Organic-N	(mg l-1)	0.1				
19. Chlorophyll 'A'	(mg l-1)	1.9				
20. Chloride	(mg l-1)	12000				
21. Bromide	(mg l-1)	51				
22. Total sulphide	(mg l-1)	<0.01				
23. Chlorine	(mg l-1)	<0.1				
24. Detergents	(mg l-1)	0.02				
25. Magnesium	(mg l-1)	838				
26. Calcium	(mg l-1)	359				
27. Potassium	(mg l-1)	359				
28. Sodium	(mg l-1)	8122				
29. Cadmium	(ug l-1)	<0.05	0.01			
30. Mercury	(ug l-1)		<0.2			
31. Chromium	(ug l-1)	0.7	4			
32. Copper	(ug l-1)	< 5	21			
33. Lead	(ug l-1)	0.5	12			
34. Nickel	(ug l-1)	< 5	3			
35. Zinc	(ug l-1)	7	16			
36. Arsenic	(ug l-1)	< 1	0.2			
37. Manganese	(ug l-1)	24	133			
38. Selenium	(ug l-1)	< 1	<0.05			
39. Iron	(ug l-1)	208	0.7			
40. Aluminium	(ug l-1)	192	0.1			
41. Facal coliform	CFU/100ml	300	2600			

Table VI/C1 (a)
CLP MARINE WATER QUALITY AND SEDIMENT SURVEY: October 1990

ERL (Asia) Ltd.
11th Floor, Hecny Tower
9 Chatham Road,
Tsimshatsui,
Kowloon, HONG KONG
ERL

PARAMETER		Marine buoys and operational effluent impact monitoring sites				
		B 7				
		S	M	L	BS	O
1. pH	(pH unit)	7.8	7.8	7.8		
2. Temperature	('C)	23	23	23		
3. Turbidity	(NTU)	5	3.5	1.1		
4. Conductivity	(ms cm-1)	47.7	45.9	46.5		
5. Salinity	(g Kg-1)	29	29	29		
6. Dissolved oxygen	(mgl-1)	7.7	7.6	7.4		
7. TSS	(mg l-1)	10	4	5		
8. BOD (5 day)	(mg l-1)	1	1	1		
9. Eh	(mV)				-260	
10. Organic carbon	(mg l-1)	4	3	4		
11. Grain size	(%)					
12. Grease and oil	(mg l-1)	0.05	0.05	0.05		
13. Sulphates	(mg l-1)	2400	2600	2800		
14. Bicarbonates	(mg l-1)	6	6	6		
15. Phosphorus	(mg l-1)	0.13	0.13	0.13		
16. Nitrate-N	(mg l-1)	0.05	0.08	0.08		
17. Ammonia-N	(mg l-1)	<0.01	<0.01	0.02		
18. Organic-N	(mg l-1)	0.12	0.12	0.12		
19. Chlorophyll 'A'	(mg l-1)	1.8	1.5	1.3		
20. Chloride	(mg l-1)	15000	13000	17000		
21. Bromide	(mg l-1)	67	65	66		
22. Total sulphide	(mg l-1)	<0.01	<0.01	<0.01		
23. Chlorine	(mg l-1)	<0.1	<0.1	<0.1		
24. Detergents	(mg l-1)	0.01	0.01	0.02		
25. Magnesium	(mg l-1)	878				
26. Calcium	(mg l-1)	340				
27. Potassium	(mg l-1)	373				
28. Sodium	(mg l-1)	8244				
29. Cadmium	(ug l-1)	<0.05			0.11	
30. Mercury	(ug l-1)				0.2	
31. Chromium	(ug l-1)	1.2			18	
32. Copper	(ug l-1)	< 5			90	
33. Lead	(ug l-1)	23			37	
34. Nickel	(ug l-1)	< 5			15	
35. Zinc	(ug l-1)	19			65	
36. Arsenic	(ug l-1)	< 1			0.7	
37. Manganese	(ug l-1)	21			675	
38. Selenium	(ug l-1)	< 1			<0.05	
39. Iron	(ug l-1)	174			1	
40. Aluminium	(ug l-1)	371			0.4	
41. Fecal coliform	CFU/100ml	1000	900	900	2500	

Table VI/C1 (a)
CLP MARINE WATER QUALITY AND SEDIMENT SURVEY: October 1990

ERL (Asia) Ltd.

11th Floor, Hecny Tower
9 Chatham Road,
Tsimshatsui,
Kowloon, HONG KONG

ERL

PARAMETER		CPA/CSYO		
		S	L	BS
1. pH	(pH unit)	7.9	7.8	
2. Temperature	('C)	23	23	
3. Turbidity	(NTU)	4.5	2.3	
4. Conductivity	(ms cm-1)	47.5	46.7	
5. Salinity	(g Kg-1)	29	29	
6. Dissolved oxygen	(mgl-1)	7.4	7.4	
7. TSS	(mg 1-1)	10	7	
8. BOD (5 day)	(mg 1-1)	1	1	
9. Eh	(mV)			-270
10. Organic carbon	(mg 1-1)	3	3	
11. Grain size	(%)			
12. Grease and oil	(mg 1-1)	0.15	0.15	
13. Sulphates	(mg 1-1)	2400	2500	
14. Bicarbonates	(mg 1-1)	6	6	
15. Phosphorus	(mg 1-1)	0.15	0.15	
16. Nitrate-N	(mg 1-1)	0.04	0.05	
17. Ammonia-N	(mg 1-1)	<0.01	<0.01	
18. Organic-N	(mg 1-1)	0.1	0.1	
19. Chlorophyll 'A'	(mg 1-1)	1.2	1.9	
20. Chloride	(mg 1-1)	16000	15000	
21. Bromide	(mg 1-1)	69	67	
22. Total sulphide	(mg 1-1)	<0.01	<0.01	
23. Chlorine	(mg 1-1)	<0.1	<0.1	
24. Detergents	(mg 1-1)	0.01	0.01	
25. Magnesium	(mg 1-1)	1027		
26. Calcium	(mg 1-1)	374		
27. Potassium	(mg 1-1)	392		
28. Sodium	(mg 1-1)	9221		
29. Cadmium	(ug 1-1)	<0.05		0.17
30. Mercury	(ug 1-1)			<0.2
31. Chromium	(ug 1-1)	1.1		19
32. Copper	(ug 1-1)	< 5		83
33. Lead	(ug 1-1)	10.5		21
34. Nickel	(ug 1-1)	< 5		17
35. Zinc	(ug 1-1)	10		71
36. Arsenic	(ug 1-1)	< 1		0.6
37. Manganese	(ug 1-1)	26		509
38. Selenium	(ug 1-1)	< 1		<0.05
39. Iron	(ug 1-1)	416		1
40. Aluminium	(ug 1-1)	349		0.4
41. Fecal coliform	CFU/100ml	1000		2700

Table VI/C1 (a)
CLP MARINE WATER QUALITY AND SEDIMENT SURVEY: October 1990

ERL (Asia) Ltd.

11th Floor, Hecny Tower
9 Chatham Road,
Tsimshatsui,
Kowloon, HONG KONG

ERL

NOVEMBER 1990

PARAMETER		Near field construction impact monitoring sites				
		N1	N2	N3	N4	N5
		S	S	S	S	S
1. pH	(pH unit)	8.2	8.2	8.2	8.2	8.3
2. Temperature	('C)	22.6	22.7	22.6	23.1	22.8
3. Turbidity	(NTU)	5.6	5.2	2.5	7.8	6
4. Conductivity	(ms cm-1)	47.8	42.8	42.9	42.8	43.4
5. Salinity	(g Kg-1)	31	31	31	39	39
6. Dissolved oxygen	(mgl-1)	8.4	7.8	7.9	7.8	8.3
7. TSS	(mg l-1)	2	2	2	2	3
8. BOD (5 day)	(mg l-1)					
9. Eh	(mV)					
10. Organic carbon	(mg l-1)					
11. Grain size	(%)					
12. Grease and oil	(mg l-1)	0.26	0.82	0.04	0.12	0.05
13. Sulphates	(mg l-1)	2800	2800	2500	2700	2600
14. Bicarbonates	(mg l-1)					
15. Phosphorus	(mg l-1)					
16. Nitrate-N	(mg l-1)					
17. Ammonia-N	(mg l-1)					
18. Organic-N	(mg l-1)					
19. Chlorophyll 'A'	(mg l-1)					
20. Chloride	(mg l-1)	18000	18000	17000	18000	18000
21. Bromide	(mg l-1)					
22. Total sulphide	(mg l-1)					
23. Chlorine	(mg l-1)					
24. Detergents	(mg l-1)					
25. Magnesium	(mg l-1)					
26. Calcium	(mg l-1)					
27. Potassium	(mg l-1)					
28. Sodium	(mg l-1)					
29. Cadmium	(ug l-1)					
30. Mercury	(ug l-1)					
31. Chromium	(ug l-1)					
32. Copper	(ug l-1)					
33. Lead	(ug l-1)					
34. Nickel	(ug l-1)					
35. Zinc	(ug l-1)					
36. Arsenic	(ug l-1)					
37. Manganese	(ug l-1)					
38. Selenium	(ug l-1)					
39. Iron	(ug l-1)					
40. Aluminium	(ug l-1)					
41. Facal coliform	CFU/100ml					

Table VI/C1 (b)
CLP MARINE WATER QUALITY AND SEDIMENT SURVEY: November 1990

ERL (Asia) Ltd.
11th Floor, Hecny Tower
9 Chatham Road,
Tsimshatsui,
Kowloon, HONG KONG
ERL

PARAMETER		Far field operational effluent impact monitoring sites				
		F 1		F 2		
		S	BS	S	L	BS
1. pH	(pH unit)	8.2		8.5	8.1	
2. Temperature	('C)	22.7		22.5	22.6	
3. Turbidity	(NTU)	4.9		2.8	8.3	
4. Conductivity	(ms cm-1)	43.3		43.5	43.5	
5. Salinity	(g Kg-1)	31		30	31	
6. Dissolved oxygen	(mgl-1)	7.8		7.8	7.5	
7. TSS	(mg 1-1)	2		2	2	
8. BOD (5 day)	(mg 1-1)			1	1	
9. Eh	(mV)		-90			-86
10. Organic carbon	(mg 1-1)		2.7			2.8
11. Grain size	(%)					
12. Grease and oil	(mg 1-1)	<0.01		0.14	0.14	
13. Sulphates	(mg 1-1)	2400	2800	2900	2700	2700
14. Bicarbonates	(mg 1-1)	11		10	10	
15. Phosphorus	(mg 1-1)	0.1	4.5	0.15	0.09	3.9
16. Nitrate-N	(mg 1-1)	0.01	2.2	0.03	0.01	1.9
17. Ammonia-N	(mg 1-1)	0.05	110	0.06	0.06	110
18. Organic-N	(mg 1-1)	0.06		0.07	0.07	
19. Chlorophyll 'A'	(mg 1-1)	1.53		0.86	1.76	
20. Chloride	(mg 1-1)	17000		17000	17000	
21. Bromide	(mg 1-1)	85		78	80	
22. Total sulphide	(mg 1-1)	<0.01	22	<0.01	<0.01	66
23. Chlorine	(mg 1-1)	<0.1		<0.1	<0.1	
24. Detergents	(mg 1-1)	<0.05				
25. Magnesium	(mg 1-1)					
26. Calcium	(mg 1-1)					
27. Potassium	(mg 1-1)					
28. Sodium	(mg 1-1)					
29. Cadmium	(ug 1-1)		0.14			0.14
30. Mercury	(ug 1-1)		<0.2			0.2
31. Chromium	(ug 1-1)		16			16
32. Copper	(ug 1-1)		67			69
33. Lead	(ug 1-1)		35			34
34. Nickel	(ug 1-1)		16			17
35. Zinc	(ug 1-1)		54			60
36. Arsenic	(ug 1-1)		0.7			0.7
37. Manganese	(ug 1-1)		530			628
38. Selenium	(ug 1-1)		<0.05			<0.05
39. Iron	(ug 1-1)		1			1
40. Aluminium	(ug 1-1)		0.3			0.3
41. Facal coliform	CFU/100ml	400	5000	700	800	4800

Table VI/C1 (b)
CLP MARINE WATER QUALITY AND SEDIMENT SURVEY: November 1990

ERL (Asia) Ltd.
11th Floor, Hecny Tower
9 Chatham Road,
Tsimshatsui,
Kowloon, HONG KONG

ERL

PARAMETER	Far field operational effluent impact monitoring sites				
	F 3				F 4
	S	M	L	BS	S
1. pH (pH unit)	8.2	8.1	8.1		8.3
2. Temperature ('C)	22.5	22.5	22.5		22.3
3. Turbidity (NTU)	1.8	1.4	0.8		2.4
4. Conductivity (ms cm-1)	42.9	42.7	43.2		43.3
5. Salinity (g Kg-1)	30	30	31		30
6. Dissolved oxygen (mgl-1)	8.3	8	7.8		8.7
7. TSS (mg l-1)	2	2	2		2
8. BOD (5 day) (mg l-1)	1	< 1	< 1		1
9. Eh (mV)					
10. Organic carbon(mg l-1)					
11. Grain size (%)					
12. Grease and oil(mg l-1)	<0.01	<0.01			0.11
13. Sulphates (mg l-1)	2600	2400	2500		2500
14. Bicarbonates (mg l-1)	10	10	11		10
15. Phosphorus (mg l-1)	0.1	0.1	0.01		0.12
16. Nitrate-N (mg l-1)	0.03	0.03	0.02		0.03
17. Ammonia-N (mg l-1)	0.06	0.05	0.04		0.06
18. Organic-N (mg l-1)	0.06	0.06	0.06		0.07
19. Chlorophyll 'A'(mg l-1)	0.98	1.01	0.76		1.23
20. Chloride (mg l-1)	17000	17000	18000		18000
21. Bromide (mg l-1)	84	86	73		91
22. Total sulphide(mg l-1)	<0.01	<0.01	<0.01		<0.01
23. Chlorine (mg l-1)	<0.1	<0.1	<0.1		<0.1
24. Detergents (mg l-1)	<0.05	<0.05	<0.05		<0.05
25. Magnesium (mg l-1)					
26. Calcium (mg l-1)					
27. Potassium (mg l-1)					
28. Sodium (mg l-1)					
29. Cadmium (ug l-1)	<0.05				<0.05
30. Mercury (ug l-1)					
31. Chromium (ug l-1)	1.4				1.4
32. Copper (ug l-1)	< 5				< 5
33. Lead (ug l-1)	0.32				0.33
34. Nickel (ug l-1)	< 5				< 5
35. Zinc (ug l-1)	4.3				7.3
36. Arsenic (ug l-1)	< 1				< 1
37. Manganese (ug l-1)	12				13
38. Selenium (ug l-1)	< 1				< 1
39. Iron (ug l-1)	146				128
40. Aluminium (ug l-1)	113				172
41. Facal coliformCFU/100ml	440	1400	400	9000	250

Table VI/C1 (b)
CLP MARINE WATER QUALITY AND SEDIMENT SURVEY: November 1990

ERL (Asia) Ltd.
11th Floor, Hecny Tower
9 Chatham Road,
Tsimshatsui,
Kowloon, HONG KONG
ERL

PARAMETER	Far field operational effluent impact monitoring sites				
	F 4			F 5	
	M	L	BS	S	L
1. pH (pH unit)	8.1	8.1		7.9	8.1
2. Temperature ('C)	22.4	22.5		21.5	22.5
3. Turbidity (NTU)	2.3	3		2.2	2.2
4. Conductivity (ms cm-1)	43.6	43.3		43.7	43.6
5. Salinity (g Kg-1)	30	21		31	31
6. Dissolved oxygen (mgl-1)	8.2	7.8		7.5	7.5
7. TSS (mg l-1)	2	2		2	2
8. BOD (5 day) (mg l-1)	1	1		1	< 1
9. Eh (mV)			-94		
10. Organic carbon(mg l-1)			2.7		
11. Grain size (%)					
12. Grease and oil(mg l-1)	0.11			0.11	0.11
13. Sulphates (mg l-1)	2600	2600	1700	2700	2800
14. Bicarbonates (mg l-1)	10	11		10	11
15. Phosphorus (mg l-1)	0.11	0.1	21	0.11	0.11
16. Nitrate-N (mg l-1)	0.03	0.02	1.7	0.02	0.02
17. Ammonia-N (mg l-1)	0.05	0.06	64	0.06	0.08
18. Organic-N (mg l-1)	0.05	0.06		0.07	0.07
19. Chlorophyll 'A'(mg l-1)	0.86	0.85		1.22	0.89
20. Chloride (mg l-1)	18000	18000		17000	18000
21. Bromide (mg l-1)		82		84	82
22. Total sulphide(mg l-1)	<0.01	<0.01	99	<0.01	<0.01
23. Chlorine (mg l-1)	<0.1	<0.1		<0.1	<0.1
24. Detergents (mg l-1)	<0.05	<0.05		<0.05	<0.05
25. Magnesium (mg l-1)					
26. Calcium (mg l-1)					
27. Potassium (mg l-1)					
28. Sodium (mg l-1)					
29. Cadmium (ug l-1)			0.12		
30. Mercury (ug l-1)			<0.2		
31. Chromium (ug l-1)			12		
32. Copper (ug l-1)			49		
33. Lead (ug l-1)			21		
34. Nickel (ug l-1)			14		
35. Zinc (ug l-1)			40		
36. Arsenic (ug l-1)			0.5		
37. Manganese (ug l-1)			387		
38. Selenium (ug l-1)			<0.05		
39. Iron (ug l-1)			1		
40. Aluminium (ug l-1)			0.2		
41. Facal coliformCFU/100ml	1200	4700	21000	290	400

Table VI/C1 (b)
CLP MARINE WATER QUALITY AND SEDIMENT SURVEY: November 1990

ERL (Asia) Ltd.
11th Floor, Hecny Tower
9 Chatham Road,
Tsimshatsui,
Kowloon, HONG KONG
ERL

PARAMETER		F 5	B 1			B 2
			Marine buoys and operational effluent impact monitoring sites			
		BS	S	BS	O	O
1. pH	(pH unit)		8.1			
2. Temperature	('C)		20.6			
3. Turbidity	(NTU)		2			
4. Conductivity	(ms cm-1)		41.1			
5. Salinity	(g Kg-1)		24			
6. Dissolved oxygen	(mgl-1)		7.7			
7. TSS	(mg l-1)		2			
8. BOD (5 day)	(mg l-1)		1			
9. Eh	(mV)	-54		-86		
10. Organic carbon	(mg l-1)	3.2		3.4		
11. Grain size	(%)					
12. Grease and oil	(mg l-1)		0.03			
13. Sulphates	(mg l-1)	2000	2100	2600		
14. Bicarbonates	(mg l-1)		11			
15. Phosphorus	(mg l-1)	7.8	1.1	11		
16. Nitrate-N	(mg l-1)	1.5	0.2	2.1		
17. Ammonia-N	(mg l-1)	65	2.5	180		
18. Organic-N	(mg l-1)		0.62			
19. Chlorophyll 'A'	(mg l-1)		4.52			
20. Chloride	(mg l-1)		14000			
21. Bromide	(mg l-1)		72			
22. Total sulphide	(mg l-1)	1	<0.01			
23. Chlorine	(mg l-1)		<0.1			
24. Detergents	(mg l-1)		<0.05			
25. Magnesium	(mg l-1)		742			
26. Calcium	(mg l-1)		367			
27. Potassium	(mg l-1)		426			
28. Sodium	(mg l-1)		8086			
29. Cadmium	(ug l-1)	0.07	0.06	0.36		
30. Mercury	(ug l-1)	0.2		0.2		
31. Chromium	(ug l-1)	17	2.1	18		
32. Copper	(ug l-1)	77	< 5	86		
33. Lead	(ug l-1)	34	0.75	38		
34. Nickel	(ug l-1)	25	< 5	17		
35. Zinc	(ug l-1)	54	7.5	133		
36. Arsenic	(ug l-1)	1	1	0.6		
37. Manganese	(ug l-1)	516	116	414		
38. Selenium	(ug l-1)	<0.05	< 1	<0.05		
39. Iron	(ug l-1)	2	167	1		
40. Aluminium	(ug l-1)	0.4	179	0.3		
41. Facal coliform	CFU/100ml	14000	2900	2000		

Table VI/C1 (b)
CLP MARINE WATER QUALITY AND SEDIMENT SURVEY: November 1990

ERL (Asia) Ltd.
11th Floor, Hecny Tower
9 Chatham Road,
Tsimshatsui,
Kowloon, HONG KONG
ERL

PARAMETER		Marine buoys and operational effluent impact monitoring sites				
		B 3	B 4			B 5
		O	S	BS	O	O
1. pH	(pH unit)		8.1			
2. Temperature	('C)		21.3			
3. Turbidity	(NTU)		0.6			
4. Conductivity	(ms cm-1)		42.5			
5. Salinity	(g Kg-1)		27			
6. Dissolved oxygen	(mgl-1)		7.8			
7. TSS	(mg 1-1)		2			
8. BOD (5 day)	(mg 1-1)		< 1			
9. Eh	(mV)			-68		
10. Organic carbon	(mg 1-1)			3.1		
11. Grain size	(%)					
12. Grease and oil	(mg 1-1)		0.07	0.07		
13. Sulphates	(mg 1-1)		2300	2300		
14. Bicarbonates	(mg 1-1)		11			
15. Phosphorus	(mg 1-1)		0.25	6.8		
16. Nitrate-N	(mg 1-1)		0.12	1.7		
17. Ammonia-N	(mg 1-1)		0.46	97		
18. Organic-N	(mg 1-1)		0.19			
19. Chlorophyll 'A'	(mg 1-1)		1.66			
20. Chloride	(mg 1-1)		16000			
21. Bromide	(mg 1-1)		70			
22. Total sulphide	(mg 1-1)		<0.01	3		
23. Chlorine	(mg 1-1)		<0.1			
24. Detergents	(mg 1-1)		<0.05			
25. Magnesium	(mg 1-1)		796			
26. Calcium	(mg 1-1)		371			
27. Potassium	(mg 1-1)		411			
28. Sodium	(mg 1-1)		8902			
29. Cadmium	(ug 1-1)		<0.05	0.08		
30. Mercury	(ug 1-1)			0.2		
31. Chromium	(ug 1-1)		1.5	12		
32. Copper	(ug 1-1)		< 5	41		
33. Lead	(ug 1-1)		0.38	33		
34. Nickel	(ug 1-1)		< 5	14		
35. Zinc	(ug 1-1)		5.4	52		
36. Arsenic	(ug 1-1)		< 1	0.5		
37. Manganese	(ug 1-1)		38	360		
38. Selenium	(ug 1-1)		< 1	<0.05		
39. Iron	(ug 1-1)		91	1		
40. Aluminium	(ug 1-1)		118	0.3		
41. Facal coliform	CFU/100ml		200	2000		

Table VI/C1 (b)
CLP MARINE WATER QUALITY AND SEDIMENT SURVEY: November 1990

ERL (Asia) Ltd.
11th Floor, Hecny Tower
9 Chatham Road,
Tsimshatsui,
Kowloon, HONG KONG

ERL

PARAMETER	Marine buoys and operational effluent impact monitoring sites				
	B 6				
	S	BS	O		
1. pH (pH unit)	8.3				
2. Temperature ('C)	22.7				
3. Turbidity (NTU)	6.9				
4. Conductivity (ms cm-1)	43.3				
5. Salinity (g Kg-1)	31				
6. Dissolved oxygen (mgl-1)	7.9				
7. TSS (mg l-1)	2				
8. BOD (5 day) (mg l-1)	1				
9. Eh (mV)		-99			
10. Organic carbon(mg l-1)		2.1			
11. Grain size (%)					
12. Grease and oil(mg l-1)	0.09				
13. Sulphates (mg l-1)	2500	2600			
14. Bicarbonates (mg l-1)	11				
15. Phosphorus (mg l-1)	0.09	8.4			
16. Nitrate-N (mg l-1)	0.02	2			
17. Ammonia-N (mg l-1)	0.06	180			
18. Organic-N (mg l-1)	0.07				
19. Chlorophyll 'A'(mg l-1)	1.9				
20. Chloride (mg l-1)	18000				
21. Bromide (mg l-1)	78				
22. Total sulphide(mg l-1)	<0.01	210			
23. Chlorine (mg l-1)	<0.1				
24. Detergents (mg l-1)	<0.05				
25. Magnesium (mg l-1)	1027				
26. Calcium (mg l-1)	385				
27. Potassium (mg l-1)	425				
28. Sodium (mg l-1)	9954				
29. Cadmium (ug l-1)	<0.05	0.16			
30. Mercury (ug l-1)		0.2			
31. Chromium (ug l-1)	2.4	14			
32. Copper (ug l-1)	< 5	66			
33. Lead (ug l-1)	0.61	35			
34. Nickel (ug l-1)	< 5	16			
35. Zinc (ug l-1)	8	55			
36. Arsenic (ug l-1)	< 1	0.7			
37. Manganese (ug l-1)	19	526			
38. Selenium (ug l-1)	< 1	<0.05			
39. Iron (ug l-1)	245	1			
40. Aluminium (ug l-1)	257	0.3			
41. Facal coliformCFU/100ml	1300	5000			

Table VI/C1 (b)
CLP MARINE WATER QUALITY AND SEDIMENT SURVEY: November 1990

ERL (Asia) Ltd.

11th Floor, Hecny Tower
9 Chatham Road,
Tsimshatsui,
Kowloon, HONG KONG

ERL

PARAMETER	Marine buoys and operational effluent impact monitoring sites				
	B 7				
	S	M	L	BS	O
1. pH (pH unit)	8.2	8.2	8.2		
2. Temperature ('C)	22.6	22.7	22.7		
3. Turbidity (NTU)	6.8	1.3	9.7		
4. Conductivity (ms cm-1)	43.3	43.4	43.3		
5. Salinity (g Kg-1)	31	31	31		
6. Dissolved oxygen (mgl-1)	7.7	7.8	7.9		
7. TSS (mg l-1)	2	2	2		
8. BOD (5 day) (mg l-1)	1	1	1		
9. Eh (mV)				-140	
10. Organic carbon(mg l-1)				2.8	
11. Grain size (%)					
12. Grease and oil(mg l-1)	<0.01	<0.01	<0.01		
13. Sulphates (mg l-1)	2500	2600	2700	2000	
14. Bicarbonates (mg l-1)	11	11	11		
15. Phosphorus (mg l-1)	0.14	0.12	0.15	11	
16. Nitrate-N (mg l-1)	0.05	0.04	0.06	1.9	
17. Ammonia-N (mg l-1)	0.07	0.07	0.07	280	
18. Organic-N (mg l-1)	0.06	0.05	0.06		
19. Chlorophyll 'A'(mg l-1)	1.46	1.38	1.35		
20. Chloride (mg l-1)	18000	18000	18000		
21. Bromide (mg l-1)	73	85	71		
22. Total sulphide(mg l-1)	<0.01	<0.01	<0.01	1200	
23. Chlorine (mg l-1)	<0.1	<0.1	<0.1		
24. Detergents (mg l-1)	<0.05	<0.05	<0.05		
25. Magnesium (mg l-1)	1108				
26. Calcium (mg l-1)	400				
27. Potassium (mg l-1)	486				
28. Sodium (mg l-1)	11298				
29. Cadmium (ug l-1)	<0.05			0.18	
30. Mercury (ug l-1)				0.2	
31. Chromium (ug l-1)	2.8			21	
32. Copper (ug l-1)	< 5			96	
33. Lead (ug l-1)	0.56			41	
34. Nickel (ug l-1)	< 5			19	
35. Zinc (ug l-1)	5			68	
36. Arsenic (ug l-1)	< 1			1.1	
37. Manganese (ug l-1)	24			716	
38. Selenium (ug l-1)	< 1			<0.05	
39. Iron (ug l-1)	232			1	
40. Aluminium (ug l-1)	231			0.4	
41. Facal coliformCFU/100ml	560	310	550	2700	

Table VI/C1 (b)
CLP MARINE WATER QUALITY AND SEDIMENT SURVEY: November 1990

ERL (Asia) Ltd.

11th Floor, Hecny Tower
9 Chatham Road,
Tsimshatsui,
Kowloon, HONG KONG

ERL

PARAMETER		Marine buoys and operational effluent impact monitoring sites		
		CPA/CSYO		
		S	L	BS
1. pH	(pH unit)	8.1	8.1	
2. Temperature	('C)	22.6	22.6	
3. Turbidity	(NTU)	7.8	7	
4. Conductivity	(ms cm-1)	44	44	
5. Salinity	(g Kg-1)	31	31	
6. Dissolved oxygen	(mgl-1)	7.7	7.7	
7. TSS	(mg l-1)	2	2	
8. BOD (5 day)	(mg l-1)	1	< 1	
9. Eh	(mV)			-90
10. Organic carbon	(mg l-1)			2.9
11. Grain size	(%)			
12. Grease and oil	(mg l-1)	0.18	0.18	
13. Sulphates	(mg l-1)	2700	2600	2900
14. Bicarbonates	(mg l-1)	10	11	
15. Phosphorus	(mg l-1)	0.1	0.11	5.5
16. Nitrate-N	(mg l-1)	0.06	0.07	2
17. Ammonia-N	(mg l-1)	0.07	0.07	210
18. Organic-N	(mg l-1)	0.06	0.06	
19. Chlorophyll 'A'	(mg l-1)	3.72	1.35	
20. Chloride	(mg l-1)	18000	18000	
21. Bromide	(mg l-1)	81	85	
22. Total sulphide	(mg l-1)	<0.01	<0.01	1000
23. Chlorine	(mg l-1)	<0.1	<0.1	
24. Detergents	(mg l-1)	<0.05	<0.05	
25. Magnesium	(mg l-1)	1027		
26. Calcium	(mg l-1)	404		
27. Potassium	(mg l-1)	425		
28. Sodium	(mg l-1)	10137		
29. Cadmium	(ug l-1)	<0.05		0.15
30. Mercury	(ug l-1)			0.2
31. Chromium	(ug l-1)	2.7		19
32. Copper	(ug l-1)	< 5		90
33. Lead	(ug l-1)	0.67		46
34. Nickel	(ug l-1)	< 5		18
35. Zinc	(ug l-1)	6.8		65
36. Arsenic	(ug l-1)	< 1		0.8
37. Manganese	(ug l-1)	30		545
38. Selenium	(ug l-1)	< 1		<0.05
39. Iron	(ug l-1)	308		1
40. Aluminium	(ug l-1)	300		0.4
41. Facal coliform	CFU/100ml	790	530	3000

Table VI/C1 (b)
CLP MARINE WATER QUALITY AND SEDIMENT SURVEY: November 1990

ERL (Asia) Ltd.
11th Floor, Hecny Tower
9 Chatham Road,
Tsimshatsui,
Kowloon, HONG KONG

ERL

DECEMBER 1990

PARAMETER	Near field construction impact monitoring sites				
	N1	N2	N3	N4	N5
	S	S	S	S	S
1. pH (pH unit)	7.8	7.9	7.9	7.9	7.9
2. Temperature ('C)	19.8	19.8	19.8	20.3	20
3. Turbidity (NTU)	0.6	2	0.8	1.2	1.7
4. Conductivity (ms cm-1)	50	53.3	47.7	47.3	47.1
5. Salinity (g Kg-1)	28	28	28	29	28
6. Dissolved oxygen (mgl-1)	7.5	8.5	8.2	9.2	9.4
7. TSS (mg l-1)	2	2	2	2	2
8. BOD (5 day) (mg l-1)	1	1	1	1	1
9. Eh (mV)					
10. Organic carbon(mg l-1)					
11. Grain size (%)					
12. Grease and oil(mg l-1)	0.28	0.46	<0.01	<0.01	<0.01
13. Sulphates (mg l-1)	2750	2310	2450	2300	2290
14. Bicarbonates (mg l-1)					
15. Phosphorus (mg l-1)					
16. Nitrate-N (mg l-1)					
17. Ammonia-N (mg l-1)					
18. Organic-N (mg l-1)					
19. Chlorophyll 'A'(mg l-1)					
20. Chloride (mg l-1)					
21. Bromide (mg l-1)					
22. Total sulphide(mg l-1)					
23. Chlorine (mg l-1)					
24. Detergents (mg l-1)					
25. Magnesium (mg l-1)					
26. Calcium (mg l-1)					
27. Potassium (mg l-1)					
28. Sodium (mg l-1)					
29. Cadmium (ug l-1)					
30. Mercury (ug l-1)					
31. Chromium (ug l-1)					
32. Copper (ug l-1)					
33. Lead (ug l-1)					
34. Nickel (ug l-1)					
35. Zinc (ug l-1)					
36. Arsenic (ug l-1)					
37. Manganese (ug l-1)					
38. Selenium (ug l-1)					
39. Iron (ug l-1)					
40. Aluminium (ug l-1)					
41. Facal coliformCFU/100ml					

Table VI/C1 (c)
CLP MARINE WATER QUALITY AND SEDIMENT SURVEY: December 1990

ERL (Asia) Ltd.
11th Floor, Hecny Tower
9 Chatham Road,
Tsimshatsui,
Kowloon, HONG KONG
ERL

PARAMETER	Far field operational effluent impact monitoring sites				
	F 1		F 2		
	S	BS	S	L	BS
1. pH (pH unit)	7.9		7.9	7.9	
2. Temperature ('C)	19.9		19.7	19.8	
3. Turbidity (NTU)	3.5		0.5	0.6	
4. Conductivity (ms cm-1)	49.6		48.6	49.5	
5. Salinity (g Kg-1)	28		28	31	
6. Dissolved oxygen (mgl-1)	8.2		8.4	8.8	
7. TSS (mg l-1)	1		1	1	
8. BOD (5 day) (mg l-1)	1		1	<1	
9. Eh (mV)		-73			-175
10. Organic carbon(mg l-1)					
11. Grain size (%)					
12. Grease and oil(mg l-1)	<0.01		0.26		
13. Sulphates (mg l-1)	2250	2770	2480	2470	1880
14. Bicarbonates (mg l-1)	8		8	8	
15. Phosphorus (mg l-1)					
16. Nitrate-N (mg l-1)	<0.5		<0.5	<0.5	
17. Ammonia-N (mg l-1)					
18. Organic-N (mg l-1)					
19. Chlorophyll 'A'(mg l-1)					
20. Chloride (mg l-1)	16600		16800	16900	
21. Bromide (mg l-1)					
22. Total sulphide(mg l-1)					
23. Chlorine (mg l-1)	<0.1		<0.1	<0.1	
24. Detergents (mg l-1)					
25. Magnesium (mg l-1)					
26. Calcium (mg l-1)					
27. Potassium (mg l-1)					
28. Sodium (mg l-1)					
29. Cadmium (ug l-1)					
30. Mercury (ug l-1)					
31. Chromium (ug l-1)					
32. Copper (ug l-1)					
33. Lead (ug l-1)					
34. Nickel (ug l-1)					
35. Zinc (ug l-1)					
36. Arsenic (ug l-1)					
37. Manganese (ug l-1)					
38. Selenium (ug l-1)					
39. Iron (ug l-1)					
40. Aluminium (ug l-1)					
41. Facal coliformCFU/100ml	10700	8000	800	2000	7000

Table VI/C1 (c)
CLP MARINE WATER QUALITY AND SEDIMENT SURVEY: December 1990

ERL (Asia) Ltd.

11th Floor, Hecny Tower
9 Chatham Road,
Tsimshatsui,
Kowloon, HONG KONG

ERL

PARAMETER	Far field operational effluent impact monitoring sites				
	F 3				F 4
	S	M	L	BS	S
1. pH (pH unit)	7.9	7.9	8		8
2. Temperature ('C)	19.9	19.8	19.8		20
3. Turbidity (NTU)	1.5	4.6	6.2		8.3
4. Conductivity (ms cm-1)	48.8	48.8	51.2		49.7
5. Salinity (g Kg-1)	28	30	30		28
6. Dissolved oxygen (mgl-1)	8.5	8.2	8		8.7
7. TSS (mg l-1)	1	1	1		1
8. BOD (5 day) (mg l-1)	1	<1	<1		1
9. Eh (mV)				-190	
10. Organic carbon(mg l-1)					
11. Grain size (%)					
12. Grease and oil(mg l-1)	0.03				<0.01
13. Sulphates (mg l-1)	2640	2600	2730	2260	2410
14. Bicarbonates (mg l-1)	7	8	7		6
15. Phosphorus (mg l-1)					
16. Nitrate-N (mg l-1)	<0.5	<0.5	<0.5		<0.5
17. Ammonia-N (mg l-1)					
18. Organic-N (mg l-1)					
19. Chlorophyll 'A'(mg l-1)					
20. Chloride (mg l-1)	16700	16800	17400		16800
21. Bromide (mg l-1)					
22. Total sulphide(mg l-1)					
23. Chlorine (mg l-1)	<0.1	<0.1	<0.1		<0.1
24. Detergents (mg l-1)					
25. Magnesium (mg l-1)	1077				1154
26. Calcium (mg l-1)	390				387
27. Potassium (mg l-1)	400				511
28. Sodium (mg l-1)	8559				8889
29. Cadmium (ug l-1)	<0.05				<0.05
30. Mercury (ug l-1)					
31. Chromium (ug l-1)	1.7				1.5
32. Copper (ug l-1)	< 5				< 5
33. Lead (ug l-1)	0.71				0.56
34. Nickel (ug l-1)	< 5				< 5
35. Zinc (ug l-1)	4.7				7.2
36. Arsenic (ug l-1)	< 1				< 1
37. Manganese (ug l-1)	14				11
38. Selenium (ug l-1)	< 1				< 1
39. Iron (ug l-1)	94				107
40. Aluminium (ug l-1)	67				80
41. Facal coliformCFU/100ml	2800	3600	4200	5000	3000

Table VI/C1 (c)
CLP MARINE WATER QUALITY AND SEDIMENT SURVEY: December 1990

ERL (Asia) Ltd.
11th Floor, Hecny Tower
9 Chatham Road,
Tsimshatsui,
Kowloon, HONG KONG

PARAMETER	Far field operational effluent impact monitoring sites				
	F 4			F 5	
	M	L	BS	S	L
1. pH (pH unit)	8	8		8	8
2. Temperature ('C)	19.7	19.8		20	19.8
3. Turbidity (NTU)	4.7	4.5		3	5.6
4. Conductivity (ms cm-1)	49	51.1		48.5	49.7
5. Salinity (g Kg-1)	29	30		28	30
6. Dissolved oxygen (mgl-1)	8.4	8.4		8.5	8.4
7. TSS (mg l-1)	1	2		2	2
8. BOD (5 day) (mg l-1)	<1	<1		1	1
9. Eh (mV)			-129		
10. Organic carbon(mg l-1)					
11. Grain size (%)					
12. Grease and oil(mg l-1)					
13. Sulphates (mg l-1)	2490	2620	1980	2370	2430
14. Bicarbonates (mg l-1)	8	8		6	7
15. Phosphorus (mg l-1)					
16. Nitrate-N (mg l-1)	<0.5	<0.5		<0.5	<0.5
17. Ammonia-N (mg l-1)					
18. Organic-N (mg l-1)					
19. Chlorophyll 'A'(mg l-1)					
20. Chloride (mg l-1)	17400	17700		15900	17000
21. Bromide (mg l-1)					
22. Total sulphide(mg l-1)					
23. Chlorine (mg l-1)	<0.1	<0.1		<0.1	<0.1
24. Detergents (mg l-1)					
25. Magnesium (mg l-1)					
26. Calcium (mg l-1)					
27. Potassium (mg l-1)					
28. Sodium (mg l-1)					
29. Cadmium (ug l-1)					
30. Mercury (ug l-1)					
31. Chromium (ug l-1)					
32. Copper (ug l-1)					
33. Lead (ug l-1)					
34. Nickel (ug l-1)					
35. Zinc (ug l-1)					
36. Arsenic (ug l-1)					
37. Manganese (ug l-1)					
38. Selenium (ug l-1)					
39. Iron (ug l-1)					
40. Aluminium (ug l-1)					
41. Facal coliformCFU/100ml	4000	3200		2000	3000

Table VI/C1 (c)
CLP MARINE WATER QUALITY AND SEDIMENT SURVEY: December 1990

ERL (Asia) Ltd.
11th Floor, Hecny Tower
9 Chatham Road,
Tsimshatsui,
Kowloon, HONG KONG

ERL

PARAMETER		Marine buoys and operational effluent impact monitoring sites			
	F 5	B 1			B 2
	BS	S	BS	O	O
1. pH (pH unit)		7.9			
2. Temperature ('C)		19			
3. Turbidity (NTU)		0.7			
4. Conductivity (ms cm-1)		47			
5. Salinity (g Kg-1)		27			
6. Dissolved oxygen (mgl-1)		9			
7. TSS (mg 1-1)		2			
8. BOD (5 day) (mg 1-1)		1			
9. Eh (mV)	-160		-166		
10. Organic carbon(mg 1-1)					
11. Grain size (%)					
12. Grease and oil(mg 1-1)		0.29			
13. Sulphates (mg 1-1)	2280	2250	1780		
14. Bicarbonates (mg 1-1)		8			
15. Phosphorus (mg 1-1)					
16. Nitrate-N (mg 1-1)		<0.5			
17. Ammonia-N (mg 1-1)					
18. Organic-N (mg 1-1)					
19. Chlorophyll 'A'(mg 1-1)					
20. Chloride (mg 1-1)		16800			
21. Bromide (mg 1-1)					
22. Total sulphide(mg 1-1)					
23. Chlorine (mg 1-1)		<0.1			
24. Detergents (mg 1-1)					
25. Magnesium (mg 1-1)		1015			
26. Calcium (mg 1-1)		388			
27. Potassium (mg 1-1)		480			
28. Sodium (mg 1-1)		8667			
29. Cadmium (ug 1-1)		0.15			
30. Mercury (ug 1-1)					
31. Chromium (ug 1-1)		1.1			
32. Copper (ug 1-1)		< 5			
33. Lead (ug 1-1)		1.2			
34. Nickel (ug 1-1)		< 5			
35. Zinc (ug 1-1)		9.6			
36. Arsenic (ug 1-1)		< 1			
37. Manganese (ug 1-1)		50			
38. Selenium (ug 1-1)		< 1			
39. Iron (ug 1-1)		60			
40. Aluminium (ug 1-1)		56			
41. Facal coliformCFU/100ml	15000	1200	4000		

Table VI/C1 (c)
CLP MARINE WATER QUALITY AND SEDIMENT SURVEY: December 1990

ERL (Asia) Ltd.

11th Floor, Hecny Tower
9 Chatham Road,
Tsimshatsui,
Kowloon, HONG KONG

ERL

PARAMETER	Marine buoys and operational effluent impact monitoring sites				
	B 3	B 4			B 5
	O	S	BS	O	O
1. pH (pH unit)		8.2			
2. Temperature ('C)		19			
3. Turbidity (NTU)		0.7			
4. Conductivity (ms cm-1)		47			
5. Salinity (g Kg-1)		28			
6. Dissolved oxygen (mgl-1)		8.3			
7. TSS (mg l-1)		2			
8. BOD (5 day) (mg l-1)		1			
9. Eh (mV)			-183		
10. Organic carbon(mg l-1)					
11. Grain size (%)					
12. Grease and oil(mg l-1)		1.01			
13. Sulphates (mg l-1)		2310	2170		
14. Bicarbonates (mg l-1)		3			
15. Phosphorus (mg l-1)					
16. Nitrate-N (mg l-1)		<0.5			
17. Ammonia-N (mg l-1)					
18. Organic-N (mg l-1)					
19. Chlorophyll 'A'(mg l-1)					
20. Chloride (mg l-1)		16500			
21. Bromide (mg l-1)					
22. Total sulphide(mg l-1)					
23. Chlorine (mg l-1)		<0.1			
24. Detergents (mg l-1)					
25. Magnesium (mg l-1)		1108			
26. Calcium (mg l-1)		380			
27. Potassium (mg l-1)		422			
28. Sodium (mg l-1)		8222			
29. Cadmium (ug l-1)		0.13			
30. Mercury (ug l-1)					
31. Chromium (ug l-1)		1.4			
32. Copper (ug l-1)		< 5			
33. Lead (ug l-1)		0.66			
34. Nickel (ug l-1)		< 5			
35. Zinc (ug l-1)		4.9			
36. Arsenic (ug l-1)		< 1			
37. Manganese (ug l-1)		20			
38. Selenium (ug l-1)		< 1			
39. Iron (ug l-1)		68			
40. Aluminium (ug l-1)		66			
41. Facal coliformCFU/100ml		400	5000		

Table VI/C1 (c)
CLP MARINE WATER QUALITY AND SEDIMENT SURVEY: December 1990

ERL (Asia) Ltd.
11th Floor, Hecny Tower
9 Chatham Road,
Tsimshatsui,
Kowloon, HONG KONG

ERL

PARAMETER	Marine buoys and operational effluent impact monitoring sites				
	B 6				
	S	BS	O		
1. pH (pH unit)	8.1				
2. Temperature ('C)	19.7				
3. Turbidity (NTU)	1.5				
4. Conductivity (ms cm-1)	50.2				
5. Salinity (g Kg-1)	30				
6. Dissolved oxygen (mgl-1)	8.8				
7. TSS (mg 1-1)	2				
8. BOD (5 day) (mg 1-1)	1				
9. Eh (mV)		-132			
10. Organic carbon(mg 1-1)					
11. Grain size (%)					
12. Grease and oil(mg 1-1)	<0.01				
13. Sulphates (mg 1-1)	2360	1900			
14. Bicarbonates (mg 1-1)	6				
15. Phosphorus (mg 1-1)					
16. Nitrate-N (mg 1-1)	<0.5				
17. Ammonia-N (mg 1-1)					
18. Organic-N (mg 1-1)					
19. Chlorophyll 'A'(mg 1-1)					
20. Chloride (mg 1-1)	17600				
21. Bromide (mg 1-1)					
22. Total sulphide(mg 1-1)					
23. Chlorine (mg 1-1)	<0.1				
24. Detergents (mg 1-1)					
25. Magnesium (mg 1-1)	1123				
26. Calcium (mg 1-1)	385				
27. Potassium (mg 1-1)	498				
28. Sodium (mg 1-1)	9333				
29. Cadmium (ug 1-1)	<0.05				
30. Mercury (ug 1-1)					
31. Chromium (ug 1-1)	1.6				
32. Copper (ug 1-1)	< 5				
33. Lead (ug 1-1)	0.81				
34. Nickel (ug 1-1)	< 5				
35. Zinc (ug 1-1)	4.4				
36. Arsenic (ug 1-1)	< 1				
37. Manganese (ug 1-1)	29				
38. Selenium (ug 1-1)	< 1				
39. Iron (ug 1-1)	124				
40. Aluminium (ug 1-1)	76				
41. Facal coliformCFU/100ml	1600	7000			

Table VI/C1 (c)
CLP MARINE WATER QUALITY AND SEDIMENT SURVEY: December 1990

ERL (Asia) Ltd.
11th Floor, Hecny Tower
9 Chatham Road,
Tsimshatsui,
Kowloon, HONG KONG
ERL

PARAMETER		Marine buoys and operational effluent impact monitoring sites				
		B 7				
		S	M	L	BS	O
1. pH	(pH unit)	8	7.8	8		
2. Temperature	('C)	20.5	19.9	19		
3. Turbidity	(NTU)	1.5	0.3	2.6		
4. Conductivity	(ms cm-1)	51.2	50	51.5		
5. Salinity	(g Kg-1)	30	31	31		
6. Dissolved oxygen	(mgl-1)	9.1	8.2	8.1		
7. TSS	(mg l-1)	2	2	2		
8. BOD (5 day)	(mg l-1)	2	1	1		
9. Eh	(mV)				-70	
10. Organic carbon	(mg l-1)					
11. Grain size	(%)					
12. Grease and oil	(mg l-1)	0.13				
13. Sulphates	(mg l-1)	2550	2640	2490	2600	
14. Bicarbonates	(mg l-1)	7	12	6		
15. Phosphorus	(mg l-1)					
16. Nitrate-N	(mg l-1)	<0.5	<0.5	<0.5		
17. Ammonia-N	(mg l-1)					
18. Organic-N	(mg l-1)					
19. Chlorophyll 'A'	(mg l-1)					
20. Chloride	(mg l-1)	17910	18100	18000		
21. Bromide	(mg l-1)					
22. Total sulphide	(mg l-1)					
23. Chlorine	(mg l-1)	<0.1	<0.1	<0.1		
24. Detergents	(mg l-1)					
25. Magnesium	(mg l-1)	1123				
26. Calcium	(mg l-1)	398				
27. Potassium	(mg l-1)	556				
28. Sodium	(mg l-1)	8889				
29. Cadmium	(ug l-1)	<0.05				
30. Mercury	(ug l-1)					
31. Chromium	(ug l-1)	1.5				
32. Copper	(ug l-1)	< 5				
33. Lead	(ug l-1)	0.81				
34. Nickel	(ug l-1)	< 5				
35. Zinc	(ug l-1)	6.1				
36. Arsenic	(ug l-1)	< 1				
37. Manganese	(ug l-1)	16				
38. Selenium	(ug l-1)	< 1				
39. Iron	(ug l-1)	77				
40. Aluminium	(ug l-1)	60				
41. Facal coliform	CFU/100ml	5000	8400	8400	15000	

Table VI/C1 (c)
CLP MARINE WATER QUALITY AND SEDIMENT SURVEY: December 1990

ERL (Asia) Ltd.
11th Floor, Hecny Tower
9 Chatham Road,
Tsimshatsui,
Kowloon, HONG KONG

ERL

PARAMETER	Marine buoys and operational effluent impact monitoring sites		
	CPA/CSYO		
	S	L	BS
1. pH (pH unit)	8.1	7.8	
2. Temperature ('C)	20.2	19.9	
3. Turbidity (NTU)	2.1	0.8	
4. Conductivity (ms cm-1)	51.1	52	
5. Salinity (g Kg-1)	30	31	
6. Dissolved oxygen (mgl-1)	9.1	8.5	
7. TSS (mg 1-1)	2	2	
8. BOD (5 day) (mg 1-1)	2	1	
9. Eh (mV)			-164
10. Organic carbon(mg 1-1)			
11. Grain size (%)			
12. Grease and oil(mg 1-1)	<0.01		
13. Sulphates (mg 1-1)	2600	2500	3130
14. Bicarbonates (mg 1-1)	5	11	
15. Phosphorus (mg 1-1)			
16. Nitrate-N (mg 1-1)	<0.5	<0.5	
17. Ammonia-N (mg 1-1)			
18. Organic-N (mg 1-1)			
19. Chlorophyll 'A'(mg 1-1)			
20. Chloride (mg 1-1)	18000	18100	
21. Bromide (mg 1-1)			
22. Total sulphide(mg 1-1)			
23. Chlorine (mg 1-1)	<0.1	<0.1	
24. Detergents (mg 1-1)			
25. Magnesium (mg 1-1)	1231		
26. Calcium (mg 1-1)	402		
27. Potassium (mg 1-1)	547		
28. Sodium (mg 1-1)	10167		
29. Cadmium (ug 1-1)	<0.05		
30. Mercury (ug 1-1)			
31. Chromium (ug 1-1)	1.6		
32. Copper (ug 1-1)	< 5		
33. Lead (ug 1-1)	0.78		
34. Nickel (ug 1-1)	< 5		
35. Zinc (ug 1-1)	7.8		
36. Arsenic (ug 1-1)	< 1		
37. Manganese (ug 1-1)	19		
38. Selenium (ug 1-1)	< 1		
39. Iron (ug 1-1)	105		
40. Aluminium (ug 1-1)	97		
41. Facal coliformCFU/100ml	3200	800	9000

Table VI/C1 (c)
CLP MARINE WATER QUALITY AND SEDIMENT SURVEY: December 1990

ERL (Asia) Ltd.
11th Floor, Hecny Tower
9 Chatham Road,
Tsimshatsui,
Kowloon, HONG KONG

ERL

V1/C2

EPD MARINE WATER QUALITY DATA

C2.1 EPD sample point locations and frequencies

The locations of EPD sample points for marine water quality are presented in Figures V1/C2(a) and (b). Sediment sampling points are presented in Figures V1/C3(a) and (b). Sediment samples have been taken approximately once per year since 1987. Water quality samples are taken approximately 12 times per year.

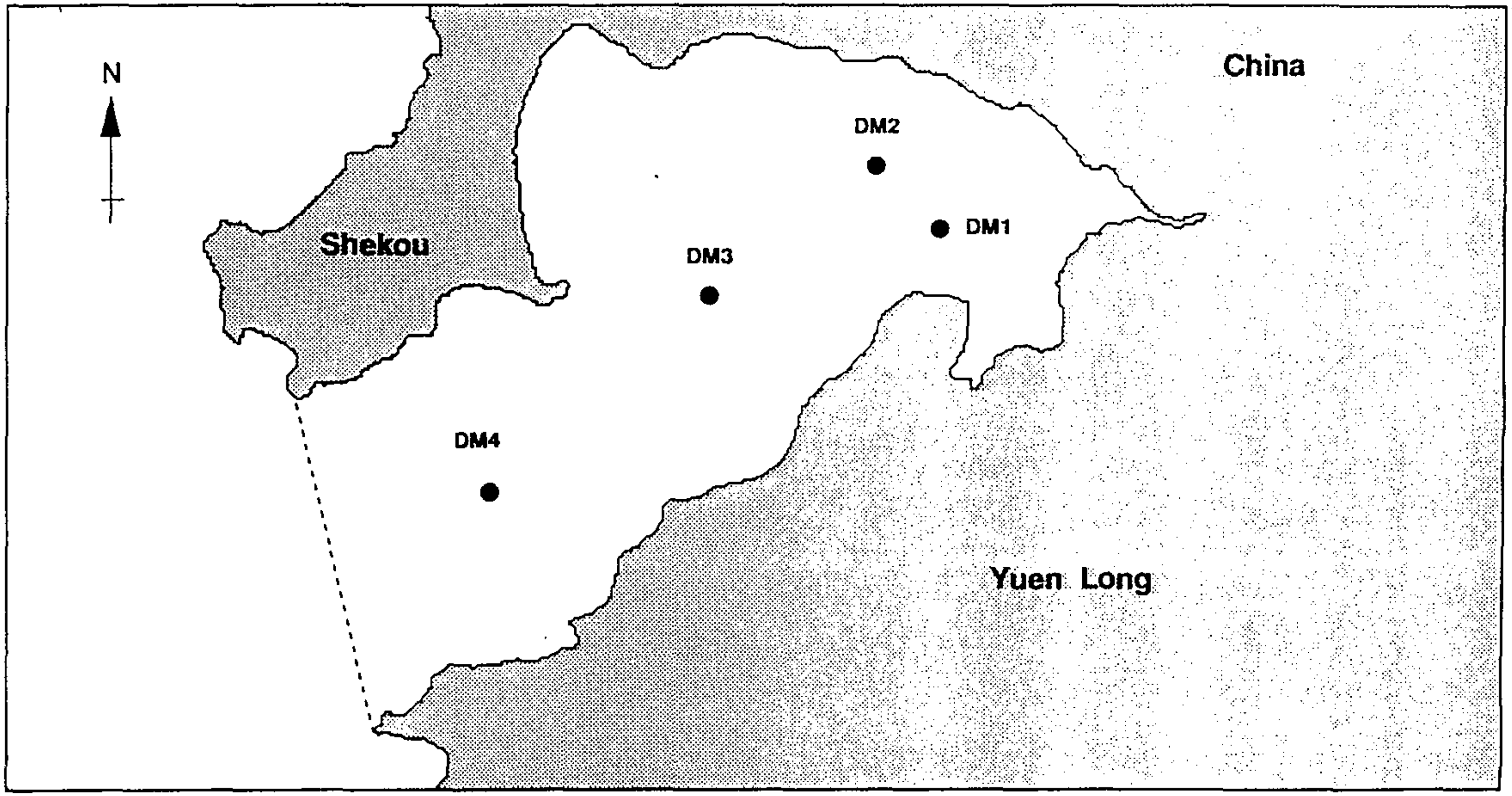

Figure V1/C2 (a) General Marine Water Quality Monitoring Stations in Deep Bay Water control Zone

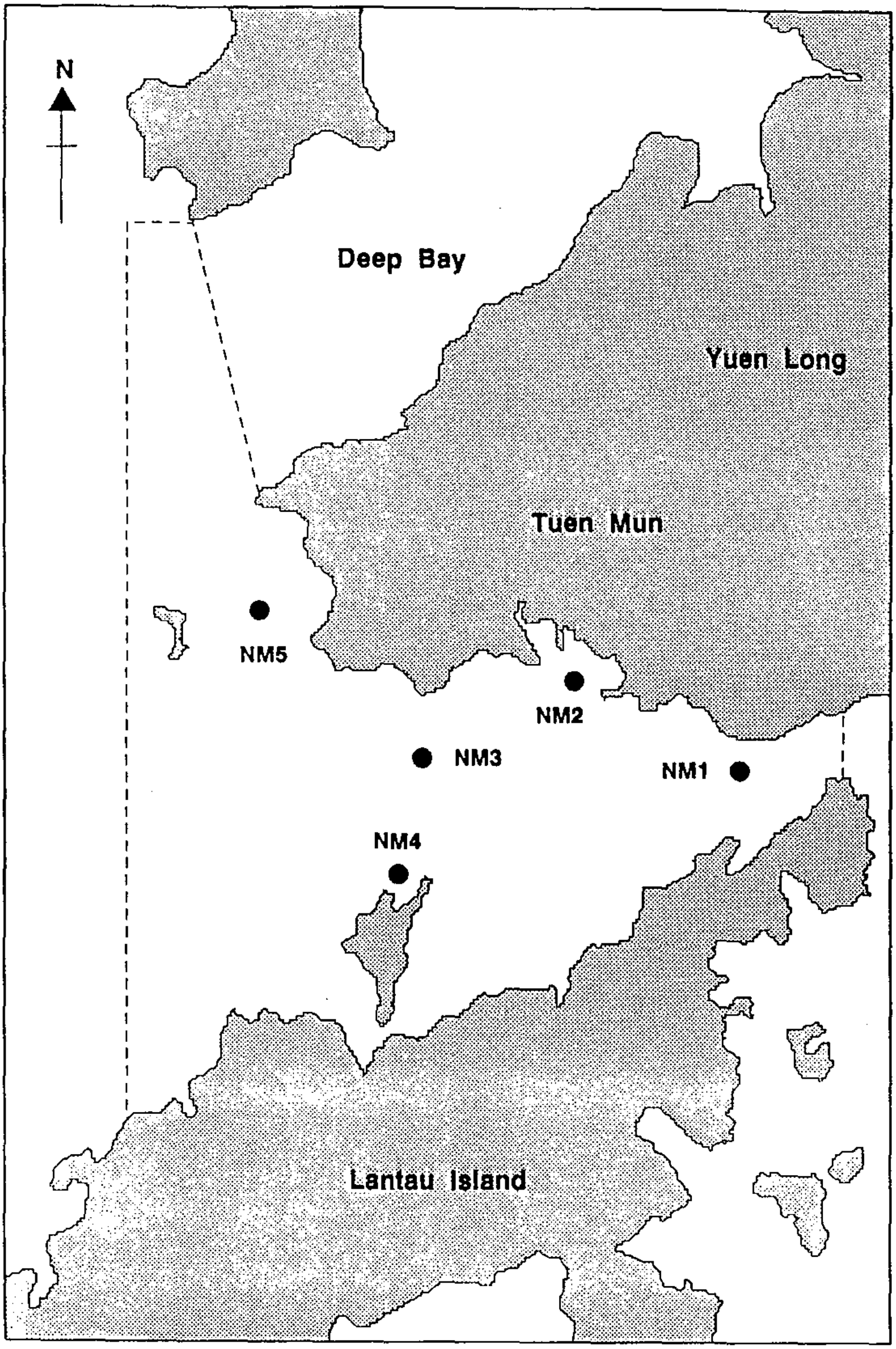

Figure V1/C2 (b) **General Marine Water Quality Monitoring Stations in North Western Waters**

Tables V1/C2 (a) - (h)

EPD MARINE WATER QUALITY SURVEY ANALYTICAL RESULTS: 1987 to 1990

Key to Tables - Water Quality

BOD	:	Biochemical oxygen demand (5 days)
COND	:	Conductivity
DO	:	Dissolved oxygen
SD	:	Secchi disc
TEMP	:	Temperature
TURB	:	Turbidity
CHY	:	Chlorophyll - a
FC	:	Faecal coliform
PHAE	:	Phaepigment
SIL	:	Silicon
SS	:	Suspended Solids (Total)
TC	:	Total coliform
E. COLI	:	Escherichia coli
TVS	:	Total volatile solids
$NH_4 - N$	:	Ammonium nitrogen
$NO_2 - N$	:	Nitrite nitrogen
$NO_3 - N$	:	Nitrate nitrogen
$PO_4 - P$	:	Phosphate (inorganic)
TKNS	:	Total kjeldahl nitrogen soluble
TPS	:	Total phosphate soluble
TKN (S + P)	:	Total kjeldahl nitrogen (soluble + particulate)
TP (S + P)	:	Total phosphate (soluble + particulate)

DEEP BAY

DATE	TIME	BOD5 (MG/L) 0001	COND (UMHO/CM) 0003	DO (MG/L) 0004	DO(%SAT) (%) 0005	PH 0011	SALINITY (%) 0015	SD (METRE) 0016	TEMP Degree C 0020	TURB (NTU) 0025
12/02/87	1245	0.787	432.667	7.329	95.299	8.250	28.296	0.899	19.033	4.100
30/04/87	1225	2.319	351.000	7.355	107.750	8.199	23.725		24.700	5.600
11/06/87	1147	1.929	335.000	5.910	81.949	7.969	20.800		25.650	4.650
11/09/87	1122	0.765	359.100	5.475	78.000	7.830	21.570		27.250	15.500
13/10/87	1215	0.860	335.200	9.300	139.000	7.830	19.250		28.900	12.000
28/12/87	1245	0.670	397.500	7.145	91.550	8.080	30.155	0.400	18.350	57.500
22/01/88	1224	0.720	401.200	6.600	84.600	7.960	29.470		18.600	6.000
25/02/88	1130	0.895		7.185	90.500	8.001	26.200		17.150	4.700
11/03/88	1146	0.230	391.750	7.700	92.700	7.901	30.835		16.300	3.700
14/04/88	1417	0.710	375.250	6.720	84.000	7.805	27.805		18.150	14.500
20/05/88	1200	1.570	255.900	6.490	98.650	8.280	14.830	1.000	27.250	7.250
07/06/88	1125	0.715	376.250	5.955	86.700	8.043	22.510		27.950	9.450
14/07/88	1225	0.600	350.967	4.580	66.433	7.963	21.083	0.800	27.667	19.667
08/08/88	1200	1.660	289.000	6.465	93.550	8.260	16.750	0.500	29.300	17.750
12/09/88	1325	1.415	277.450	7.630	106.200	8.238	15.655	0.900	27.150	10.000
10/10/88	1120	1.205	482.450	7.265	105.650	8.484	30.300	1.900	25.250	2.950
24/11/88	1150	0.500	402.350	7.045	90.650		28.325		19.150	19.250
09/12/88	1130	1.390	389.200	7.650	94.700	8.143	28.810		17.400	39.500
13/01/89	1125	0.775	358.200	6.755	81.600	8.233	26.575		16.500	23.000
17/02/89	1145	0.660	343.900	8.415	98.150	8.155	25.265	0.900	15.200	10.500
14/03/89	1200	0.885	389.600	7.520	93.150	8.295	28.200	1.200	17.400	9.200
14/04/89	1210	0.250	312.167	6.717	85.367	8.096	20.947		21.500	16.833
12/05/89	1600	0.175	275.150	7.210	100.375	8.206	16.195	1.000	27.650	11.000
12/06/89	1120	1.047	221.333	5.037	65.067	8.438	11.527	1.200	25.933	15.300
20/07/89	1125	0.895	311.350	5.775	81.250	8.445	17.885		27.450	15.500
18/08/89	1435	2.315	357.450	5.645	83.700	8.650	20.720	0.400	29.650	32.000
18/09/89	1130	0.625	448.400	4.475	66.250	8.437	27.505	1.000	27.650	23.250
16/10/89	1140	0.975	454.000	5.655	82.550	8.292	28.270	0.600	26.250	11.800
13/11/89	1145	0.425	336.600	8.180	110.050	8.409	21.065	0.800	24.000	15.500
11/12/89	1140	1.300	415.150	7.055	91.100	8.392	30.125	0.300	19.200	11.500
12/01/90	1200	0.435	382.275	6.645	78.700	8.105	28.050	1.000	18.715	29.250
12/02/90	1150	0.435	377.490	8.445	95.590	8.050	28.985	0.500	16.810	29.250
16/03/90	1220	0.520	334.265	6.590	77.420	8.155	24.310	1.400	18.495	6.500
17/04/90	1140	0.270	321.255	6.190	77.065	8.195	21.935	1.000	21.060	7.250
14/05/90	1140	0.785	288.760	6.330	86.115	8.355	17.675	1.200	25.165	4.500
15/06/90	1110	0.475	291.090	7.315	106.015	8.300	17.405	1.000	27.910	7.000
13/07/90	1220	0.405	176.468	6.845	101.203	8.561	9.474	1.000	29.420	261.000
10/08/90	1125	0.615				8.068	16.500	0.800		13.500
25/09/90	1530	1.105	385.205	6.945	103.753	8.210	22.352	1.600	29.262	7.500

Table VI/C2 (a) **EPD Water Quality Data of Deep Bay. Station – DM4. Depth – Average. Period between 1/1/87 and 30/9/90.**

ERL

DATE	TIME	CHY (MG/M**3) 0002	FC (NO/100ML) 0006	PHAE (MG/L) 0012	SIL (MG/L) 0017	SS (MG/L) 0018	TC (NO/100ML) 0019	E.COLI (NO/100ML) 0029	TVS (MG/L) 0033
12/02/87	1245	0.399	0.000	0.199L	1.399	4.000		0.000	1.500
30/04/87	1225	8.199	1.000	7.300	1.100	6.500		0.000	1.000
11/06/87	1147	10.000	9.000	1.800	4.899	3.000		8.000	1.000
11/09/87	1122	1.900	480.000	0.200L	3.900	2.500		450.000	1.500
13/10/87	1215	5.500	310.000	0.200	5.800	3.500		230.000	1.500
28/12/87	1245	1.000	8.000	1.200	2.000	110.000		8.000	21.000
22/01/88	1224	1.000	510.000	0.200L	1.800	10.000	160.000	480.000	5.000
25/02/88	1130	1.100	0.000	1.000	1.000	9.500	0.000	0.000	4.000
11/03/88	1146	1.100	0.000	0.200	1.900	12.000	0.000	0.000	5.500
14/04/88	1417	1.100	52.000	0.500	2.100	7.000	120.000	48.000	1.500
20/05/88	1200	5.900	4.000	4.200	4.500	1.500	2.000	4.000	1.500
07/06/88	1125	4.000	2.000	1.300	3.400	2.500	0.000	2.000	1.000
14/07/88	1225	3.200	590.000	1.300	5.300	11.000	330.000	530.000	3.500
08/08/88	1200	13.000	10.000	6.500	4.700	11.000	0.000	6.000	2.000
12/09/88	1325	40.000		5.300	4.700	6.500			2.000
10/10/88	1120	5.700	0.000	9.500	0.490	5.000	6.000	0.000	2.500
24/11/88	1150	1.100	49.000	0.500	2.700	20.000	2.000	44.000	4.500
09/12/88	1130	9.200	40.000	1.400	1.200	27.000	26.000	38.000	5.000
13/01/89	1125		12.000					10.000	
17/02/89	1145	1.100	20.000	0.600	3.100	15.000		20.000	5.000
14/03/89	1200	1.900	4.000	0.300	2.000	6.500		4.000	2.500
14/04/89	1210	1.600	180.000	1.200	4.100	5.500		180.000	1.500
12/05/89	1600	4.200	2.000	1.100	4.900	2.500		2.000	1.000
12/06/89	1120	10.000	190.000	2.500	5.100	3.500		190.000	1.000
20/07/89	1125	1.300	7.000	0.500	5.300	6.500		6.000	1.000
18/08/89	1435	13.000	10.000	2.900	2.400	12.000		10.000	3.000
18/09/89	1130	0.900	139.000	1.600	2.000	17.000		133.000	3.000
16/10/89	1140	1.300	7.000	1.300	2.200	8.500		7.000	2.000
13/11/89	1145	7.200	18.000	1.200	0.920	13.000		15.000	2.500
11/12/89	1140	4.000	4.000	0.500	1.700	13.000		4.000	3.000
12/01/90	1200	3.700	4.000	0.200L	2.200	14.000		4.000	2.500
12/02/90	1150	12.000	4.000	0.400	1.200	16.000		4.000	3.000
16/03/90	1220	0.200L	5.000	0.500	3.000	5.000		4.000	1.000
17/04/90	1140	0.500	216.000	0.200L	3.900	6.500		216.000	1.500
14/05/90	1140	5.300	20.000	4.200	3.500	4.500		10.000	1.500
15/06/90	1110		64.000					34.000	
13/07/90	1220	0.200	138.000	0.400	5.400	11.000		116.000	2.000
10/08/90	1125		58.000					44.000	
25/09/90	1530		38.000					18.000	

Table VI/C2 (a) EPD Water Quality Data of Deep Bay. Station – DM4. Depth – Average. Period between 1/1/87 and 30/9/90.

ERL

DATE	TIME	NH4-N (MG/L) 0008	NO2-N (MG/L) 0009	NO3-N (MG/L) 0010	PO4-P (MG/L) 0014	TKNS (MG/L) 0022	TPS (MG/L) 0024	TKN(S+P) (MG/L) 0026	TP(S+P) (MG/L) 0027
12/02/87	1245	0.140	0.078	0.193	0.043	0.279	0.063	0.370	0.076
30/04/87	1225	0.018	0.020	0.455	0.090	0.335	0.100	0.470	0.120
11/06/87	1147	0.030	0.010	0.055	0.105	0.190	0.120	0.270	0.250
11/09/87	1122	0.032	0.008	0.325	0.042	0.255	0.050	0.325	0.080
13/10/87	1215	0.120	0.160	0.590	0.110	0.350	0.120	0.440	0.140
28/12/87	1245	0.345	0.037	0.430	0.130	0.800	0.330	0.920	0.435
22/01/88	1224	0.530	0.110	0.200	0.190	0.980	0.200	0.990	0.250
25/02/88	1130	0.073	0.019	0.098	0.015	0.445	0.030	0.495	0.035
11/03/88	1146	0.210	0.026	0.265	0.041	0.650	0.115	0.770	0.125
14/04/88	1417	0.140	0.013	0.250	0.054	0.840	0.120	1.040	0.140
20/05/88	1200	0.026	0.016	0.905	0.011	0.230	0.030	0.375	0.045
07/06/88	1125	0.012	0.019	0.620	0.019	0.475	0.030	0.575	0.055
14/07/88	1225	0.088	0.083	0.403	0.085	0.443	0.090	0.540	0.100
08/08/88	1200	0.121	0.077	0.750	0.075	0.280	0.080	0.475	0.130
12/09/88	1325	0.021	0.051	0.410	0.005	0.145	0.020	0.250	0.025
10/10/88	1120	0.039	0.030	0.082	0.016	0.095	0.020	0.215	0.030
24/11/88	1150	0.094	0.057	0.265	0.035	0.205	0.035	0.385	0.070
09/12/88	1130	0.110	0.028	0.170	0.047	0.200	0.050	0.280	0.080
17/02/89	1145	0.185	0.040	0.340	0.041	0.240	0.060	0.275	0.065
14/03/89	1200	0.135	0.023	0.290	0.015	0.395	0.025	0.550	0.040
14/04/89	1210	0.447	0.065	0.717	0.109	0.760	0.127	0.827	0.140
12/05/89	1600	0.045	0.028	1.320	0.026	0.365	0.030	0.485	0.035
12/06/89	1120	0.011	0.030	0.480	0.036	0.110	0.040	0.283	0.080
20/07/89	1125	0.052	0.084	0.415	0.037	0.395	0.045	0.430	0.060
18/08/89	1435	0.020	0.043	0.240	0.024	0.080	0.035	0.345	0.085
18/09/89	1130	0.180	0.030	0.135	0.037	0.345	0.045	0.410	0.060
16/10/89	1140	0.009	0.083	0.370	0.024	0.205	0.030	0.230	0.040
13/11/89	1145	0.081	0.026	0.170	0.015	0.315	0.020	0.440	0.060
11/12/89	1140	0.150	0.053	0.225	0.099	0.930	0.130	1.050	0.165
12/01/90	1200	0.338	0.062	0.335	0.094	0.620	0.105	0.735	0.115
12/02/90	1150	0.090	0.023	0.190	0.027	0.375	0.050	0.485	0.075
16/03/90	1220	0.150	0.140	0.910	0.044	0.460	0.060	0.465	0.110
17/04/90	1140	0.220	0.054	0.565	0.060	0.735	0.070	0.825	0.095
14/05/90	1140	0.087	0.044	0.715	0.020	0.530	0.035	1.180	0.075
13/07/90	1220	0.017	0.062	0.905	0.041	0.300	0.080	0.620	0.115

Table VI/C2 (a) **EPD Water Quality Data of Deep Bay. Station – DM4. Depth – Average. Period between 1/1/87 and 30/9/90.**

ERL

DATE	TIME	BOD5 (MG/L) 0001	COND (UMHO/CM) 0003	DO (MG/L) 0004	DO(%SAT) (%) 0005	PH 0011	SALINITY (%) 0015	SD (METRE) 0016	TEMP Degree C 0020	TURB (NTU) 0025
12/02/87	1245	1.360	413.000	7.669	100.199	8.270	26.920	0.899	19.199	5.000
30/04/87	1225	2.439	341.000	7.580	112.600	8.209	22.870		25.100	4.100
11/06/87	1147	1.729	300.000	6.790	93.199	7.949	18.300		25.800	4.500
11/09/87	1122	0.850	332.900	5.830	82.500	7.890	19.760		27.400	13.000
13/10/87	1215	0.860	335.200	9.300	139.000	7.830	19.250		28.900	12.000
28/12/87	1245	0.700	398.000	7.150	91.500	8.140	30.320	0.400	18.400	51.000
22/01/88	1224	0.720	401.200	6.600	84.600	7.960	29.470		18.600	6.000
25/02/88	1130	0.930		7.240	91.300	8.024	31.350		17.200	4.500
11/03/88	1146	0.310	391.700	7.750	93.400	7.895	30.810		16.900	2.800
14/04/88	1417	0.710	368.400	6.780	85.200	7.730	27.110		18.400	13.000
20/05/88	1200	2.140	244.300	7.070	108.600	8.350	14.080	1.000	27.600	7.000
07/06/88	1125	0.670	337.300	6.260	90.600	8.053	19.780		28.400	4.900
14/07/88	1225	0.750	310.400	4.860	70.000	7.960	17.830	0.800	28.500	15.000
08/08/88	1200	2.150	278.000	6.990	101.700	8.310	15.700	0.500	29.900	12.000
12/09/88	1325	1.880	240.000	9.370	131.900	8.549	12.700	0.900	28.600	10.000
10/10/88	1120	1.140	481.100	7.400	107.500	8.478	30.150	1.900	25.300	2.800
24/11/88	1150	0.580	391.600	7.130	91.600		27.430		19.200	16.500
09/12/88	1130	1.390	389.200	7.650	94.700	8.143	28.810		17.400	39.500
13/01/89	1125	0.720	358.000	6.710	81.200	8.232	26.560		16.500	24.000
17/02/89	1145	0.660	336.400	8.430	98.700	8.155	25.080	0.900	15.300	10.000
14/03/89	1200	1.150	374.600	7.840	96.800	8.320	26.900	1.200	17.500	8.000
14/04/89	1210	0.370	286.900	7.050	89.000	8.070	18.950		22.100	14.500
12/05/89	1600	0.300	225.800	7.650	106.700	8.293	12.640	1.000	28.600	9.000
12/06/89	1120	1.190	189.000	6.880	89.200	8.489	10.160	1.200	26.100	8.900
20/07/89	1125	0.980	299.800	5.930	83.100	8.450	17.100		27.700	11.000
18/08/89	1435	2.330	348.100	6.080	89.100	8.662	20.480	0.400	29.800	28.000
18/09/89	1130	0.700	448.900	4.390	65.400	8.438	27.510	1.000	27.800	12.500
16/10/89	1140	0.940	447.500	5.680	82.900	8.310	27.800	0.600	26.400	11.500
13/11/89	1145	0.410	335.100	7.930	107.000	8.411	20.930	0.800	24.200	16.000
11/12/89	1140	0.900	414.300	6.950	89.900	8.379	29.950	0.300	19.300	11.500
12/01/90	1200	0.500	378.270	6.810	80.980	8.110	27.600	1.000	18.900	20.000
12/02/90	1150	0.500	376.750	8.780	99.460	8.050	28.900	0.500	16.840	20.000
16/03/90	1220	0.520	323.350	6.790	80.240	8.130	23.270	1.400	18.780	6.000
17/04/90	1140	0.260	273.140	6.500	80.840	8.150	18.250	1.000	21.190	6.500
14/05/90	1140	1.310	279.640	6.330	86.640	8.310	16.860	1.200	25.490	5.000
15/06/90	1110	0.430	156.530	8.570	126.350	8.180	8.330	1.000	29.340	7.400
13/07/90	1220	0.340	173.326	7.008	103.652	8.573	9.286	1.000	29.448	22.000
10/08/90	1125	0.740				8.053	16.000	0.800		11.000
25/09/90	1530	1.340	380.289	7.366	110.311	8.238	21.972	1.600	29.402	6.000

Table VI/C2 (b) **EPD Water Quality Data of Deep Bay. Station – DM4. Depth – Surface. Period between 1/1/87 and 30/9/90.**

ERL

DATE	TIME	CHY (MG/M**3) 0002	FC (NO/100ML) 0006	PHAE (MG/L) 0012	SIL (MG/L) 0017	SS (MG/L) 0018	TC (NO/100ML) 0019	E.COLI (NO/100ML) 0029	TVS (MG/L) 0033
12/02/87	1245	0.466	7.000	0.633	1.166	5.333		6.500	2.000
30/04/87	1225	6.199	20.500	6.100	0.960	7.500		20.000	1.250
11/06/87	1147	11.000	14.000	1.050	4.700	3.000		11.000	1.250
11/09/87	1122	1.500	420.000	0.700	3.850	3.000		400.000	1.250
13/10/87	1215	5.500	310.000	0.200	5.800	3.500		230.000	1.500
28/12/87	1245	1.000	8.000	1.200	1.950	75.500		8.000	14.500
22/01/88	1224	1.000	510.000	0.200	1.800	10.000	160.000	480.000	5.000
25/02/88	1130	1.100	5.000	0.850	0.875	16.250	50.000	5.000	4.750
11/03/88	1146	1.300	3.000	0.450	1.550	19.500	0.000	3.000	8.750
14/04/88	1417	1.050	236.000	0.550	1.900	7.000	310.000	229.000	1.500
20/05/88	1200	4.100	6.000	2.800	4.400	2.500	1.000	5.000	1.250
07/06/88	1125	4.550	326.000	1.600	2.700	7.250	650.000	321.000	1.500
14/07/88	1225	1.500	660.000	1.900	4.367	15.167	623.333	603.333	3.167
08/08/88	1200	9.250	9.000	6.250	4.400	18.000	5.000	6.000	2.750
12/09/88	1325	22.650		4.250	3.950	7.250			2.000
10/10/88	1120	7.850	5.000	5.450	0.505	4.500	10.000	5.000	2.250
24/11/88	1150	1.050	128.500	0.350	2.500	19.500	6.000	117.000	3.750
09/12/88	1130	9.200	40.000	1.400	1.200	27.000	26.000	38.000	5.000
13/01/89	1125		15.000					14.000	
17/02/89	1145	1.150	14.000	0.850	3.050	11.000		13.000	4.000
14/03/89	1200	1.500	19.000	0.250	1.800	8.000		19.000	2.250
14/04/89	1210	1.000	273.333	0.800	3.633	10.833		270.000	1.833
12/05/89	1600	3.100	59.000	1.050	4.250	4.250		51.000	1.250
12/06/89	1120	10.333	180.000	1.933	4.767	23.167		174.667	2.500
20/07/89	1125	1.250	29.500	0.400	5.000	10.750		28.000	1.500
18/08/89	1435	12.000	10.000	3.450	2.250	14.500		10.000	3.000
18/09/89	1130	1.700	216.500	0.900	1.600	28.000		213.500	4.000
16/10/89	1140	1.550	5.500	0.750	2.200	8.750		5.500	2.750
13/11/89	1145	7.300	27.500	1.250	0.830	13.000		24.500	2.750
11/12/89	1140	5.350	4.500	1.000	1.650	19.000		4.500	4.500
12/01/90	1200	2.650	15.000	1.050	2.450	22.500		14.000	3.000
12/02/90	1150	6.900	15.000	0.300	1.200	17.500		14.000	2.750
16/03/90	1220	0.200	42.500	0.700	2.900	5.750		41.000	1.000
17/04/90	1140	0.500	163.000	0.200	3.550	8.250		162.500	1.750
14/05/90	1140	3.200	121.000	2.950	2.850	4.500		107.000	1.500
15/06/90	1110		164.000					146.000	
13/07/90	1220	0.250	301.000	2.100	7.500	52.000		290.000	5.250
10/08/90	1125		116.000					101.000	
25/09/90	1530		49.000					39.000	

Table VI/C2 (b) EPD Water Quality Data of Deep Bay. Station – DM4. Depth – Surface. Period between 1/1/87 and 30/9/90.

ERL

DATE	TIME	NH4-N (MG/L) 0008	NO2-N (MG/L) 0009	NO3-N (MG/L) 0010	PO4-P (MG/L) 0014	TKNS (MG/L) 0022	TPS (MG/L) 0024	TKN(S+P) (MG/L) 0026	TP(S+P) (MG/L) 0027
12/02/87	1245	0.199	0.097	0.160	0.039	0.369	0.060	0.399	0.070
30/04/87	1225	0.016	0.026	0.440	0.097	0.229	0.100	0.410	0.139
11/06/87	1147	0.029	0.010	0.051	0.100	0.199	0.119	0.360	0.119
11/09/87	1122	0.014	0.006	0.270	0.043	0.290	0.050	0.310	0.090
13/10/87	1215	0.120	0.160	0.590	0.110	0.350	0.120	0.440	0.140
28/12/87	1245	0.310	0.036	0.390	0.100	0.750	0.260	0.980	0.430
22/01/88	1224	0.530	0.110	0.200	0.190	0.980	0.200	0.990	0.250
25/02/88	1130	0.090	0.019	0.110	0.017	0.480	0.040	0.530	0.040
11/03/88	1146	0.260	0.027	0.330	0.041	0.670	0.110	0.670	0.130
14/04/88	1417	0.180	0.013	0.280	0.068	0.980	0.140	1.300	0.150
20/05/88	1200	0.028	0.015	0.920	0.011	0.240	0.030	0.410	0.050
07/06/88	1125	0.008	0.021	0.660	0.026	0.380	0.040	0.560	0.070
14/07/88	1225	0.120	0.100	0.490	0.130	0.480	0.130	0.580	0.140
08/08/88	1200	0.150	0.088	0.740	0.110	0.320	0.110	0.640	0.160
12/09/88	1325	0.020	0.047	0.440	0.005L	0.150	0.020L	0.320	0.030
10/10/88	1120	0.036	0.031	0.082	0.014	0.140	0.020	0.250	0.020
24/11/88	1150	0.067	0.058	0.290	0.030	0.150	0.030	0.260	0.050
09/12/88	1130	0.110	0.028	0.170	0.047	0.200	0.050	0.280	0.080
17/02/89	1145	0.180	0.039	0.340	0.054	0.220	0.060	0.270	0.060
14/03/89	1200	0.160	0.023	0.260	0.005	0.340	0.020	0.460	0.040
14/04/89	1210	0.510	0.085	0.970	0.140	0.870	0.160	0.930	0.180
12/05/89	1600	0.007	0.023	1.700	0.017	0.380	0.020	0.490	0.030
12/06/89	1120	0.011	0.033	0.510	0.033	0.130	0.040	0.280	0.050
20/07/89	1125	0.036	0.086	0.430	0.032	0.380	0.040	0.410	0.050
18/08/89	1435	0.007	0.034	0.170	0.023	0.080	0.030	0.350	0.080
18/09/89	1130	0.130	0.031	0.140	0.028	0.300	0.030	0.320	0.040
16/10/89	1140	0.009	0.082	0.370	0.024	0.230	0.030	0.240	0.040
13/11/89	1145	0.082	0.027	0.180	0.015	0.290	0.020	0.410	0.070
11/12/89	1140	0.160	0.052	0.220	0.120	1.000	0.140	1.100	0.190
12/01/90	1200	0.046	0.040	0.310	0.028	0.340	0.040	0.500	0.050
12/02/90	1150	0.110	0.023	0.190	0.030	0.390	0.050	0.580	0.080
16/03/90	1220	0.130	0.120	0.420	0.042	0.440	0.050	0.450	0.050
17/04/90	1140	0.260	0.073	0.710	0.080	0.910	0.090	0.990	0.120
14/05/90	1140	0.074	0.044	0.820	0.016	0.580	0.030	0.660	0.060
13/07/90	1220	0.015	0.060	0.840	0.048	0.300	0.060	0.370	0.070

Table VI/C2 (b) **EPD Water Quality Data of Deep Bay. Station – DM4. Depth – Surface. Period between 1/1/87 and 30/9/90.**

ERL

DATE	TIME	BOD5 (MG/L) 0001	COND (UMHO/CM) 0003	DO (MG/L) 0004	DO(%SAT) (%) 0005	PH 0011	SALINITY (%) 0015	SD (METRE) 0016	TEMP Degree C 0020	TURB (NTU) 0025
12/02/87	1245	0.940	440.000	7.239	93.899	8.250	28.629		19.000	3.800
14/07/88	1225	0.670	332.000	4.620	67.300	7.960	20.270		27.800	15.000
14/04/89	1210	0.240	354.000	6.530	84.400	8.076	23.660		21.500	12.000
12/06/89	1120	1.070	270.000	5.850	74.300	8.448	11.790		25.900	12.500

DATE	TIME	CHY (MG/M**3) 0002	FC (NO/100ML) 0006	PHAE (MG/L) 0012	SIL (MG/L) 0017	SS (MG/L) 0018	TC (NO/100ML) 0019	E.COLI (NO/100ML) 0029	TVS (MG/L) 0033
12/02/87	1245	0.399		0.699	1.100	5.000			2.000
14/07/88	1225	1.000	390.000	2.100	4.900	8.500	430.000	360.000	2.000
14/04/89	1210	0.500	140.000	1.000	4.000	7.000		130.000	1.500
12/06/89	1120	10.000	40.000	0.900	4.700	10.000		34.000	1.500

DATE	TIME	NH4-N (MG/L) 0008	NO2-N (MG/L) 0009	NO3-N (MG/L) 0010	PO4-P (MG/L) 0014	TKNS (MG/L) 0022	TPS (MG/L) 0024	TKN(S+P) (MG/L) 0026	TP(S+P) (MG/L) 0027
12/02/87	1245	0.130	0.097	0.289	0.050	0.229	0.060	0.380	0.070
14/07/88	1225	0.086	0.092	0.470	0.089	0.510	0.100	0.530	0.110
14/04/89	1210	0.540	0.074	0.830	0.120	0.760	0.140	0.890	0.150
12/06/89	1120	0.009	0.029	0.470	0.030	0.130	0.030	0.240	0.070

Table VI/C2 (c) EPD Water Quality Data of Deep Bay. Station – DM4. Depth – Middle. Period between 1/1/87 and 30/9/90.

ERL

DATE	TIME	BOD5 (MG/L) 0001	COND (UMHO/CM) 0003	DO (MG/L) 0004	DO(%SAT) (%) 0005	PH 0011	SALINITY (%) 0015	SD (METRE) 0016	TEMP Degree C 0020	TURB (NTU) 0025
12/02/87	1245	0.060	445.000	7.080	91.800	8.229	29.339		18.899	3.500
30/04/87	1225	2.199	361.000	7.129	102.899	8.189	24.579		24.300	7.100
11/06/87	1147	2.129	370.000	5.030	70.699	7.989	23.300		25.500	4.800
11/09/87	1122	0.680	385.300	5.120	73.500	7.770	23.380		27.100	18.000
28/12/87	1245	0.640	397.000	7.140	91.600	8.020	29.990		18.300	64.000
25/02/88	1130	0.860		7.130	89.700	7.978	21.050		17.100	4.900
11/03/88	1146	0.150	391.800	7.650	92.000	7.906	30.860		15.700	4.600
14/04/88	1417	0.710	382.100	6.660	82.800	7.880	28.500		17.900	16.000
20/05/88	1200	1.000	267.500	5.910	88.700	8.210	15.580		26.900	7.500
07/06/88	1125	0.760	415.200	5.650	82.800	8.032	25.240		27.500	14.000
14/07/88	1225	0.380	410.500	4.260	62.000	7.970	25.150		26.700	29.000
08/08/88	1200	1.170	300.000	5.940	85.400	8.210	17.800		28.700	23.500
12/09/88	1325	0.950	314.900	5.890	80.500	7.927	18.610		25.700	10.000
10/10/88	1120	1.270	483.800	7.130	103.800	8.489	30.450		25.200	3.100
24/11/88	1150	0.420	413.100	6.960	89.700		29.220		19.100	22.000
13/01/89	1125	0.830	358.400	6.800	82.000	8.233	26.590		16.500	22.000
17/02/89	1145	0.660	351.400	8.400	97.600	8.154	25.450		15.100	11.000
14/03/89	1200	0.620	404.600	7.200	89.500	8.270	29.500		17.300	10.400
14/04/89	1210	0.140	295.600	6.570	82.700	8.141	20.230		20.900	24.000
12/05/89	1600	0.050	324.500	6.770	94.050	8.119	19.750		26.700	13.000
12/06/89	1120	0.880	205.000	2.380	31.700	8.377	12.630		25.800	24.500
20/07/89	1125	0.810	322.900	5.620	79.400	8.440	18.670		27.200	20.000
18/08/89	1435	2.300	366.800	5.210	78.300	8.637	20.960		29.500	36.000
18/09/89	1130	0.550	447.900	4.560	67.100	8.435	27.500		27.500	34.000
16/10/89	1140	1.010	460.500	5.630	82.200	8.273	28.740		26.100	12.100
13/11/89	1145	0.440	338.100	8.430	113.100	8.407	21.200		23.800	15.000
11/12/89	1140	1.700	416.000	7.160	92.300	8.405	30.300		19.100	11.500
12/01/90	1200	0.370	386.280	6.480	76.420	8.100	28.500		18.530	38.500
12/02/90	1150	0.370	378.230	8.110	91.720	8.050	29.070		16.780	38.500
16/03/90	1220	0.520	345.180	6.390	74.600	8.180	25.350		18.210	7.000
17/04/90	1140	0.280	369.370	5.880	73.290	8.240	25.620		20.930	8.000
14/05/90	1140	0.260	297.880	6.330	85.590	8.400	18.490		24.840	4.000
15/06/90	1110	0.520	425.650	6.060	85.680	8.420	26.480		26.480	6.600
13/07/90	1220	0.470	179.609	6.682	98.754	8.548	9.661		29.392	500.000
10/08/90	1125	0.490				8.082	17.000			16.000
25/09/90	1530	0.870	390.121	6.523	97.194	8.181	22.732		29.122	9.000

Table VI/C2 (d) EPD Water Quality Data of Deep Bay. Station – DM4. Depth – Bottom. Period between 1/1/87 and 30/9/90.

ERL

DATE	TIME	CHY (MG/M**3) 0002	FC (NO/100ML) 0006	PHAE (MG/L) 0012	SIL (MG/L) 0017	SS (MG/L) 0018	TC (NO/100ML) 0019	E.COLI (NO/100ML) 0029	TVS (MG/L) 0033
12/02/87	1245	0.600	14.000	1.000	1.000	7.000		13.000	2.500
30/04/87	1225	4.199	40.000	4.899	0.820	8.500		40.000	1.500
11/06/87	1147	12.000	19.000	0.300	4.500	3.000		14.000	1.500
11/09/87	1122	1.100	360.000	1.200	3.800	3.500		350.000	1.000
28/12/87	1245	1.000	8.000	1.200	1.900	41.000		8.000	8.000
25/02/88	1130	1.100	10.000	0.700	0.750	23.000	100.000	10.000	5.500
11/03/88	1146	1.500	6.000	0.700	1.200	27.000	0.000	6.000	12.000
14/04/88	1417	1.000	420.000	0.600	1.700	7.000	500.000	410.000	1.500
20/05/88	1200	2.300	8.000	1.400	4.300	3.500	0.000	6.000	1.000
07/06/88	1125	5.100	650.000	1.900	2.000	12.000	1300.000	640.000	2.000
14/07/88	1225	0.300	1000.000	2.300	2.900	26.000	1110.000	920.000	4.000
08/08/88	1200	5.500	8.000	6.000	4.100	25.000	10.000	6.000	3.500
12/09/88	1325	5.300		3.200	3.200	8.000			2.000
10/10/88	1120	10.000	10.000	1.400	0.520	4.000	14.000	10.000	2.000
24/11/88	1150	1.000	208.000	0.200	2.300	19.000	10.000	190.000	3.000
13/01/89	1125		18.000					18.000	
17/02/89	1145	1.200	8.000	1.100	3.000	7.000		6.000	3.000
14/03/89	1200	1.100	34.000	0.200L	1.600	9.500		34.000	2.000
14/04/89	1210	0.900	500.000	0.200L	2.800	20.000		500.000	2.500
12/05/89	1600	2.000	116.000	1.000	3.600	6.000		100.000	1.500
12/06/89	1120	11.000	310.000	2.400	4.500	56.000		300.000	5.000
20/07/89	1125	1.200	52.000	0.300	4.700	15.000		50.000	2.000
18/08/89	1435	11.000	10.000	4.000	2.100	17.000		10.000	3.000
18/09/89	1130	2.500	294.000	0.200L	1.200	39.000		294.000	5.000
16/10/89	1140	1.800	4.000	0.200	2.200	9.000		4.000	3.500
13/11/89	1145	7.400	37.000	1.300	0.740	13.000		34.000	3.000
11/12/89	1140	6.700	5.000	1.500	1.600	25.000		5.000	6.000
12/01/90	1200	1.600	26.000	1.900	2.700	31.000		24.000	3.500
12/02/90	1150	1.800	26.000	0.200L	1.200	19.000		24.000	2.500
16/03/90	1220	0.200L	80.000	0.900	2.800	6.500		78.000	1.000
17/04/90	1140	0.500	110.000	0.200L	3.200	10.000		109.000	2.000
14/05/90	1140	1.100	222.000	1.700	2.200	4.500		204.000	1.500
15/06/90	1110		264.000					258.000	
13/07/90	1220	0.300	464.000	3.800	9.600	93.000		464.000	8.500
10/08/90	1125		174.000					158.000	
25/09/90	1530		60.000					60.000	

Table VI/C2 (d) EPD Water Quality Data of Deep Bay. Station – DM4. Depth – Bottom. Period between 1/1/87 and 30/9/90.

ERL

DATE	TIME	NH4-N (MG/L) 0008	NO2-N (MG/L) 0009	NO3-N (MG/L) 0010	PO4-P (MG/L) 0014	TKNS (MG/L) 0022	TPS (MG/L) 0024	TKN(S+P) (MG/L) 0026	TP(S+P) (MG/L) 0027
12/02/87	1245	0.090	0.040	0.130	0.039	0.240	0.070	0.330	0.089
30/04/87	1225	0.020	0.013	0.470	0.082	0.440	0.100	0.529	0.100
11/06/87	1147	0.030	0.010	0.059	0.110	0.180	0.120	0.180	0.380
11/09/87	1122	0.050	0.010	0.380	0.040	0.220	0.050	0.340	0.070
28/12/87	1245	0.380	0.038	0.470	0.160	0.850	0.400	0.860	0.440
25/02/88	1130	0.056	0.019	0.085	0.013	0.410	0.020	0.460	0.030
11/03/88	1146	0.160	0.025	0.200	0.040	0.630	0.120	0.870	0.120
14/04/88	1417	0.099	0.012	0.220	0.039	0.700	0.100	0.780	0.130
20/05/88	1200	0.024	0.017	0.890	0.011	0.220	0.030	0.340	0.040
07/06/88	1125	0.015	0.017	0.580	0.012	0.570	0.020L	0.590	0.040
14/07/88	1225	0.059	0.058	0.250	0.036	0.340	0.040	0.510	0.050
08/08/88	1200	0.091	0.066	0.760	0.040	0.240	0.050	0.310	0.100
12/09/88	1325	0.021	0.054	0.380	0.005L	0.140	0.020L	0.180	0.020
10/10/88	1120	0.042	0.029	0.082	0.017	0.050	0.020	0.180	0.040
24/11/88	1150	0.120	0.055	0.240	0.040	0.260	0.040	0.510	0.090
17/02/89	1145	0.190	0.040	0.340	0.028	0.260	0.060	0.280	0.070
14/03/89	1200	0.110	0.022	0.320	0.025	0.450	0.030	0.640	0.040
14/04/89	1210	0.290	0.037	0.350	0.067	0.650	0.080	0.660	0.090
12/05/89	1600	0.083	0.032	0.940	0.035	0.350	0.040	0.480	0.040
12/06/89	1120	0.013	0.029	0.460	0.044	0.070	0.050	0.330	0.120
20/07/89	1125	0.067	0.081	0.400	0.042	0.410	0.050	0.450	0.070
18/08/89	1435	0.032	0.051	0.310	0.024	0.080	0.040	0.340	0.090
18/09/89	1130	0.230	0.029	0.130	0.046	0.390	0.060	0.500	0.080
16/10/89	1140	0.009	0.083	0.370	0.023	0.180	0.030	0.220	0.040
13/11/89	1145	0.079	0.025	0.160	0.015	0.340	0.020L	0.470	0.050
11/12/89	1140	0.140	0.054	0.230	0.078	0.860	0.120	1.000	0.140
12/01/90	1200	0.630	0.083	0.360	0.160	0.900	0.170	0.970	0.180
12/02/90	1150	0.070	0.023	0.190	0.024	0.360	0.050	0.390	0.070
16/03/90	1220	0.170	0.160	1.400	0.046	0.480	0.070	0.480	0.170
17/04/90	1140	0.180	0.035	0.420	0.040	0.560	0.050	0.660	0.070
14/05/90	1140	0.100	0.043	0.610	0.024	0.480	0.040	1.700	0.090
13/07/90	1220	0.019	0.064	0.970	0.033	0.300	0.100	0.870	0.160

Table VI/C2 (d) EPD Water Quality Data of Deep Bay. Station – DM4. Depth – Bottom. Period between 1/1/87 and 30/9/90.

ERL

NORTH WESTERN WATERS

DATE	TIME	BOD5 (MG/L) 0001	COND (UMHO/CM) 0003	DO (MG/L) 0004	DO(%SAT) (%) 0005	PH 0011	SALINITY (%) 0015	SD (METRE) 0016	TEMP Degree C 0020	TURB (NTU) 0025
12/01/88	1115	1.020	419.300	5.790	75.300	8.060	31.000	2.100	18.900	5.000
24/03/88	1130	0.670	403.700	7.290	90.700	8.100	30.970	1.700	17.100	5.000
16/05/88	1215	0.380	418.800	5.690	80.700	8.126	26.780	1.300	25.200	16.100
15/07/88	1215	1.810	335.400	6.410	92.600	8.270	19.480	1.500	28.100	9.500
08/09/88	1300	0.570	77.700	5.840	77.100	8.183	3.840	1.000	28.500	14.800
22/11/88	1400	0.080	435.200	6.380	85.600	8.230	30.680	0.800	20.700	12.700
17/01/89	1220	0.540	416.900	7.030	88.800	8.195	31.990	1.500	17.100	6.500
28/03/89	1405	0.580	447.900	6.830	88.400	8.310	32.020	0.800	18.700	11.800
22/05/89	1305	0.550	340.000	6.540	89.300	8.253	20.040	1.200	25.000	7.800
24/07/89	1125	0.790	310.900	6.830	98.200	8.442	17.850	1.500	28.300	8.000
22/09/89	1110	0.310	359.100	5.240	75.300	8.330	21.220	0.800	28.200	12.200
20/11/89	1140	0.700	448.700	5.980	81.700	8.400	31.200	1.300	20.800	11.000
19/01/90	1300	0.810	402.050	6.790	78.910	8.130	30.310	2.400	17.830	3.900
23/03/90	1110	2.110	353.680	8.680	106.610	8.550	24.740	3.800	20.350	2.400
22/05/90	1130	1.350	386.170	8.690	119.880	8.780	24.190	1.400	25.470	4.400
23/07/90	1115	0.320	332.886	5.716	82.884	8.070	19.505	1.600	27.998	5.400
24/09/90	1120	0.840	347.160	5.977	88.797	8.780	19.686	1.000	29.136	6.000

Table VI/C2 (e) **EPD Water Quality Data of North Western Waters. Station – NM5. Depth – Average. Period between 1/1/88 and 30/9/90.**

ERL

DATE	TIME	CHY (MG/M**3) 0002	FC (NO/100ML) 0006	PHAE (MG/L) 0012	SIL (MG/L) 0017	SS (MG/L) 0018	TC (NO/100ML) 0019	E.COLI (NO/100ML) 0029	TVS (MG/L) 0033
12/01/88	1115	1.300		0.900	1.400	15.000	2550.000		5.500
24/03/88	1130	1.300		0.200	1.100	6.000	3000.000		1.500
16/05/88	1215	1.700	516.000	1.100	1.100	5.500	530.000	516.000	1.500
15/07/88	1215	2.500	22.000	3.900	3.600	4.000	10.000	15.000	2.500
08/09/88	1300	6.700		1.600	7.400	8.500			2.000
22/11/88	1400	1.700		0.200	1.900	11.000	29.000		2.500
17/01/89	1220	0.200	170.000	0.700	0.970	8.000		170.000	2.000
28/03/89	1405	0.700	640.000	0.800	0.950	10.000		640.000	1.000
22/05/89	1305	2.000	392.000	0.600	2.300	4.500		392.000	2.000
24/07/89	1125	6.200	6.000	1.100	3.800	4.500		3.000	1.500
22/09/89	1110	0.200	89.000	1.700	2.000	12.000		88.000	2.000
20/11/89	1140	1.000	1010.000	0.700	0.730	13.000		960.000	2.500
19/01/90	1300	2.600	0.000	0.200	1.300	1.500		0.000	1.500
23/03/90	1110	4.800	36.000	1.000	2.000	3.500		24.000	1.000
22/05/90	1130	8.000		1.900	0.620	6.500			1.500
23/07/90	1115		100.000					70.000	
24/09/90	1120		18.000					18.000	

Table VI/C2 (e) **EPD Water Quality Data of North Western Waters. Station – NM5. Depth – Average. Period between 1/1/88 and 30/9/90.**

ERL

DATE	TIME	NH4-N (MG/L) 0008	NO2-N (MG/L) 0009	NO3-N (MG/L) 0010	PO4-P (MG/L) 0014	TKNS (MG/L) 0022	TPS (MG/L) 0024	TKN(S+P) (MG/L) 0026	TP(S+P) (MG/L) 0027
12/01/88	1115	0.075	0.036	0.130	0.037	0.360	0.050	0.470	0.060
24/03/88	1130	0.097	0.004	0.110	0.024	0.530	0.040	0.790	0.040
16/05/88	1215	0.042	0.015	0.210	0.015	0.520	0.030	0.560	0.050
15/07/88	1215	0.110	0.032	0.310	0.017	0.330	0.040	0.440	0.050
08/09/88	1300	0.006	0.110	0.770	0.005	0.270	0.020	0.550	0.060
22/11/88	1400	0.120	0.042	0.170	0.030	0.170	0.030	0.230	0.040
17/01/89	1220	0.068	0.022	0.078	0.019	0.230	0.020	0.270	0.030
28/03/89	1405	0.110	0.014	0.083	0.020	0.240	0.020	0.290	0.020
22/05/89	1305	0.160	0.028	0.480	0.040	0.500	0.040	0.660	0.070
24/07/89	1125	0.011	0.089	0.410	0.038	0.100	0.040	0.210	0.050
22/09/89	1110	0.029	0.110	0.390	0.020	0.270	0.020	0.310	0.040
20/11/89	1140	0.093	0.023	0.079	0.017	0.400	0.020	0.510	0.050
19/01/90	1300	0.089	0.041	0.180	0.028	0.390	0.040	0.680	0.080
23/03/90	1110	0.150	0.027	0.440	0.026	0.310	0.040	0.550	0.060
22/05/90	1130	0.019	0.020	0.210	0.003	0.500	0.020	0.800	0.050

Table VI/C2 (e) **EPD Water Quality Data of North Western Waters. Station – NM5. Depth – Average. Period between 1/1/88 and 30/9/90.**

ERL

DATE	TIME	BOD5 (MG/L) 0001	COND (UMHO/CM) 0003	DO (MG/L) 0004	DO(%SAT) (%) 0005	PH 0011	SALINITY (%) 0015	SD (METRE) 0016	TEMP Degree C 0020	TURB (NTU) 0025
12/01/88	1115	1.020	419.300	5.790	75.300	8.060	31.000	2.100	18.900	5.000
24/03/88	1130	0.670	403.700	7.290	90.700	8.100	30.970	1.700	17.100	5.000
16/05/88	1215	0.380	418.800	5.690	80.700	8.126	26.780	1.300	25.200	16.100
15/07/88	1215	1.810	335.400	6.410	92.600	8.270	19.480	1.500	28.100	9.500
08/09/88	1300	0.570	77.700	5.840	77.100	8.183	3.840	1.000	28.500	14.800
22/11/88	1400	0.080	435.200	6.380	85.600	8.230	30.680	0.800	20.700	12.700
17/01/89	1220	0.540	416.900	7.030	88.800	8.195	31.990	1.500	17.100	6.500
28/03/89	1405	0.580	447.900	6.830	88.400	8.310	32.020	0.800	18.700	11.800
22/05/89	1305	0.550	340.000	6.540	89.300	8.253	20.040	1.200	25.000	7.600
24/07/89	1125	0.790	310.900	6.830	98.200	8.442	17.850	1.500	28.300	8.000
22/09/89	1110	0.310	359.100	5.240	75.300	8.330	21.220	0.800	28.200	12.200
20/11/89	1140	0.700	448.700	5.980	81.700	8.400	31.200	1.300	20.800	11.000
19/01/90	1300	0.810	402.050	6.790	78.910	8.130	30.310	2.400	17.830	3.900
23/03/90	1110	2.110	353.680	8.680	106.610	8.550	24.740	3.800	20.350	2.400
22/05/90	1130	1.350	386.170	8.690	119.880	8.780	24.190	1.400	25.470	4.400
23/07/90	1115	0.320	332.886	5.716	82.884	8.070	19.505	1.600	27.998	5.400
24/09/90	1120	0.840	347.160	5.977	88.797	8.780	19.686	1.000	29.136	6.000

Table VI/C2 (f) **EPD Water Quality Data of North Western Waters. Station – NM5. Depth – Surface. Period between 1/1/88 and 30/9/90.**

ERL

DATE	TIME	CHY (MG/M**3) 0002	FC (NO/100ML) 0006	PHAE (MG/L) 0012	SIL (MG/L) 0017	SS (MG/L) 0018	TC (NO/100ML) 0019	E.COLI (NO/100ML) 0029	TVS (MG/L) 0033
12/01/88	1115	1.300		0.900	1.400	15.000	2550.000		5.500
24/03/88	1130	1.300		0.200L	1.100	6.000	3000.000		1.500
16/05/88	1215	1.700	516.000	1.100	1.100	5.500	530.000	516.000	1.500
15/07/88	1215	2.500	22.000	3.900	3.600	4.000	10.000	15.000	2.500
08/09/88	1300	6.700		1.600	7.400	8.500			2.000
22/11/88	1400	1.700		0.200L	1.900	11.000	29.000		2.500
17/01/89	1220	0.200	170.000	0.700	0.970	8.000		170.000	2.000
28/03/89	1405	0.700	640.000	0.800	0.950	10.000		640.000	1.000
22/05/89	1305	2.000	392.000	0.600	2.300	4.500		392.000	2.000
24/07/89	1125	6.200	6.000	1.100	3.800	4.500		3.000	1.500
22/09/89	1110	0.200L	89.000	1.700	2.000	12.000		88.000	2.000
20/11/89	1140	1.000	1010.000	0.700	0.730	13.000		960.000	2.500
19/01/90	1300	2.600	0.000	0.200L	1.300	1.500		0.000	1.500
23/03/90	1110	4.800	36.000	1.000	2.000	3.500		24.000	1.000
22/05/90	1130	8.000		1.900	0.620	6.500			1.500
23/07/90	1115		100.000					70.000	
24/09/90	1120		18.000					18.000	

Table VI/C2 (f) **EPD Water Quality Data of North Western Waters. Station – NM5. Depth – Surface. Period between 1/1/88 and 30/9/90.**

ERL

DATE	TIME	NH4-N (MG/L) 0008	NO2-N (MG/L) 0009	NO3-N (MG/L) 0010	PO4-P (MG/L) 0014	TKNS (MG/L) 0022	TPS (MG/L) 0024	TKN(S+P) (MG/L) 0026	TP(S+P) (MG/L) 0027
12/01/88	1115	0.075	0.036	0.130	0.037	0.360	0.050	0.470	0.060
24/03/88	1130	0.097	0.004	0.110	0.024	0.530	0.040	0.790	0.040
16/05/88	1215	0.042	0.015	0.210	0.015	0.520	0.030	0.560	0.050
15/07/88	1215	0.110	0.032	0.310	0.017	0.330	0.040	0.440	0.050
08/09/88	1300	0.006	0.110	0.770	0.005L	0.270	0.020	0.550	0.060
22/11/88	1400	0.120	0.042	0.170	0.030	0.170	0.030	0.230	0.040
17/01/89	1220	0.068	0.022	0.078	0.019	0.230	0.020	0.270	0.030
28/03/89	1405	0.110	0.014	0.083	0.020	0.240	0.020	0.290	0.020
22/05/89	1305	0.160	0.028	0.480	0.040	0.500	0.040	0.660	0.070
24/07/89	1125	0.011	0.089	0.410	0.038	0.100	0.040	0.210	0.050
22/09/89	1110	0.029	0.110	0.390	0.020	0.270	0.020	0.310	0.040
20/11/89	1140	0.093	0.023	0.079	0.017	0.400	0.020	0.510	0.050
19/01/90	1300	0.089	0.041	0.180	0.028	0.390	0.040	0.680	0.080
23/03/90	1110	0.150	0.027	0.440	0.026	0.310	0.040	0.550	0.060
22/05/90	1130	0.019	0.020	0.210	0.003	0.500	0.020	0.800	0.050

Table VI/C2 (f) **EPD Water Quality Data of North Western Waters. Station – NM5. Depth – Surface. Period between 1/1/88 and 30/9/90.**

ERL

DATE	TIME	BOD5 (MG/L) 0001	COND (UMHO/CM) 0003	DO (MG/L) 0004	DO(%SAT) (%) 0005	PH 0011	SALINITY (%) 0015	SD (METRE) 0016	TEMP Degree C 0020	TURB (NTU) 0025
12/01/88	1115	0.980	415.000	5.450	70.200	8.040	30.960		18.500	4.500
24/03/88	1130	0.990	401.500	7.200	89.400	8.090	30.980		16.900	5.300
16/05/88	1215	0.440	428.000	5.610	79.100	8.121	27.590		24.900	30.700
15/07/88	1215	0.520	428.200	4.150	60.500	8.042	26.680		26.000	12.000
08/09/88	1300	0.510	436.500	3.360	47.500	8.005	28.630		24.200	24.100
22/11/88	1400	0.090	440.500	6.470	86.500	8.220	31.210		20.600	12.200
17/01/89	1220	0.180	407.700	7.050	87.200	8.198	31.960		16.200	5.000
28/03/89	1405	0.550	438.500	6.830	86.100	8.310	32.260		17.400	15.200
22/05/89	1305	0.530	350.000	6.510	88.900	8.257	20.880		24.800	7.800
24/07/89	1125	0.300	428.000	5.500	81.400	8.187	25.740		27.500	9.500
22/09/89	1110	0.290	434.500	4.700	70.700	8.320	26.330		28.000	18.000
20/11/89	1140	0.580	442.400	5.910	80.700	8.402	31.250		20.800	14.600
19/01/90	1300	0.910	405.970	6.340	73.750	8.210	30.610		17.880	4.200
23/03/90	1110	1.760	351.220	8.640	105.810	8.630	24.620		20.240	2.400
22/05/90	1130	0.810	413.090	8.640	118.070	8.750	26.480		24.940	3.600
23/07/90	1115	0.140	378.113	4.571	65.183	8.336	22.934		27.053	5.600
24/09/90	1120	0.740	444.386	5.636	83.130	8.192	26.643		28.447	9.000

Table VI/C2 (g) **EPD Water Quality Data of North Western Waters. Station – NM5. Depth – Middle. Period between 1/1/87 and 30/9/90.**

ERL

DATE	TIME	CHY (MG/M**3) 0002	FC (NO/100ML) 0006	PHAE (MG/L) 0012	SIL (MG/L) 0017	SS (MG/L) 0018	TC (NO/100ML) 0019	E.COLI (NO/100ML) 0029	TVS (MG/L) 0033
12/01/88	1115	1.300		0.700	1.300	6.500			3.500
24/03/88	1130	1.100		0.200L	1.100	5.000	1600.000		1.000
16/05/88	1215	0.400	1432.000	2.200	1.000	15.000	1420.000	1432.000	3.000
15/07/88	1215	0.600	94.000	0.500	2.800	5.500	90.000	62.000	2.500
08/09/88	1300	3.600		1.000	3.400	16.000			3.500
22/11/88	1400	1.000		0.200L	1.700	9.500	130.000		1.500
17/01/89	1220	0.400	290.000	0.300	0.970	7.000		280.000	1.500
28/03/89	1405	1.100	744.000	0.400	0.930	13.000		744.000	1.000
22/05/89	1305	1.400	416.000	1.100	2.200	2.500		416.000	1.500
24/07/89	1125	1.800	860.000	0.300	2.700	5.500		250.000	1.000
22/09/89	1110	0.200	216.000	0.900	1.700	18.000		216.000	3.000
20/11/89	1140	0.700	890.000	1.100	0.710	16.000		870.000	2.500
19/01/90	1300	1.400	310.000	0.200L	1.300	2.000		310.000	1.000
23/03/90	1110	1.600	130.000	0.600	1.600	1.000		120.000	1.000
22/05/90	1130	5.300		1.400	0.660	5.000			1.000
23/07/90	1115		50.000					40.000	
24/09/90	1120		1160.000					930.000	

Table VI/C2 (g) EPD Water Quality Data of North Western Waters. Station – NM5. Depth – Middle. Period between 1/1/88 and 30/9/90.

ERL

DATE	TIME	NH4-N (MG/L) 0008	NO2-N (MG/L) 0009	NO3-N (MG/L) 0010	PO4-P (MG/L) 0014	TKNS (MG/L) 0022	TPS (MG/L) 0024	TKN(S+P) (MG/L) 0026	TP(S+P) (MG/L) 0027
12/01/88	1115	0.082	0.027	0.130	0.020	0.340	0.030	0.440	0.060
24/03/88	1130	0.110	0.002	0.110	0.024	0.450	0.040	0.610	0.050
16/05/88	1215	0.038	0.015	0.190	0.015	0.450	0.050	0.560	0.050
15/07/88	1215	0.049	0.059	0.290	0.020	0.310	0.020	0.320	0.040
08/09/88	1300	0.010	0.063	0.290	0.005L	0.230	0.020L	0.530	0.060
22/11/88	1400	0.087	0.035	0.150	0.029	0.160	0.030	0.220	0.050
17/01/89	1220	0.076	0.022	0.076	0.020	0.220	0.020	0.220	0.030
28/03/89	1405	0.110	0.013	0.076	0.005	0.250	0.020L	0.410	0.030
22/05/89	1305	0.160	0.026	0.610	0.043	0.610	0.050	0.660	0.070
24/07/89	1125	0.036	0.057	0.250	0.033	0.180	0.050	0.330	0.060
22/09/89	1110	0.078	0.110	0.210	0.040	0.290	0.040	0.360	0.060
20/11/89	1140	0.120	0.020	0.076	0.038	0.160	0.050	0.360	0.060
19/01/90	1300	0.085	0.038	0.170	0.026	0.440	0.040	0.600	0.060
23/03/90	1110	0.200	0.020	0.300	0.054	0.420	0.050	0.430	0.050
22/05/90	1130	0.012	0.018	0.180	0.002L	0.620	0.040	0.700	0.070

Table VI/C2 (g) **EPD Water Quality Data of North Western Waters. Station – NM5. Depth – Middle. Period between 1/1/88 and 30/9/90.**

ERL

DATE	TIME	BOD5 (MG/L) 0001	COND (UMHO/CM) 0003	DO (MG/L) 0004	DO(%SAT) (%) 0005	PH 0011	SALINITY (%) 0015	SD (METRE) 0016	TEMP Degree C 0020	TURB (NTU) 0025
12/01/88	1115	1.200	414.500	6.200	79.700	8.040	30.990		18.400	3.800
24/03/88	1130	0.870	403.000	7.120	88.100	8.130	31.180		16.700	4.100
16/05/88	1215	0.390	444.700	5.520	77.300	8.136	28.970		24.600	28.800
15/07/88	1215	0.740	448.500	4.150	60.100	8.047	28.290		25.600	18.000
08/09/88	1300	0.530	471.800	3.100	44.500	8.114	31.870		23.300	29.300
22/11/88	1400	0.130	441.200	6.580	87.900	8.230	31.240		20.600	46.000
17/01/89	1220	0.380	407.700	7.160	88.400	8.188	32.000		16.100	15.000
28/03/89	1405	0.150	435.800	6.560	82.900	8.300	32.260		17.100	29.200
22/05/89	1305	0.430	387.000	6.280	85.300	8.262	23.980		24.600	7.400
24/07/89	1125	0.720	449.300	5.410	79.500	8.387	27.430		27.300	48.500
22/09/89	1110	0.360	468.100	4.660	70.700	8.322	28.340		28.000	11.600
20/11/89	1140	0.500	458.400	5.680	78.400	8.398	31.600		21.300	9.600
19/01/90	1300	0.820	411.640	6.580	76.800	8.240	30.990		18.000	3.800
23/03/90	1110	2.290	354.850	8.580	104.590	8.630	25.030		20.020	2.600
22/05/90	1130	0.680	446.180	8.560	116.000	8.680	29.180		24.440	6.900
23/07/90	1115	0.120	432.023	4.518	63.396	8.366	27.135		26.110	12.000
24/09/90	1120	0.900	467.475	4.945	72.953	8.196	28.230		28.378	29.000

Table VI/C2 (h) **EPD Water Quality Data of North Western Waters. Station – NM5. Depth – Bottom. Period between 1/1/88 and 30/9/90.**

ERL

DATE	TIME	CHY (MG/M**3) 0002	FC (NO/100ML) 0006	PHAE (MG/L) 0012	SIL (MG/L) 0017	SS (MG/L) 0018	TC (NO/100ML) 0019	E.COLI (NO/100ML) 0029	TVS (MG/L) 0033
12/01/88	1115	1.300		0.500	1.300	4.500			3.500
24/03/88	1130	1.000		0.200L	1.100	5.500	1600.000		1.500
16/05/88	1215	1.300	1324.000	1.700	0.880	12.000	50.000	1320.000	2.500
15/07/88	1215	2.300		1.300	1.700	11.000	110.000		2.000
08/09/88	1300	2.100		1.900	2.900	17.000			3.500
22/11/88	1400	0.800		0.400	1.600	36.000	60.000		4.500
17/01/89	1220	0.200	130.000	0.500	0.980	6.000		130.000	1.500
28/03/89	1405	1.000	508.000	0.200L	0.980	25.000		508.000	2.000
22/05/89	1305	0.900	520.000	0.200L	1.500	6.500		519.000	2.500
24/07/89	1125	1.800	3980.000	1.500	2.400	40.000		3820.000	4.500
22/09/89	1110	0.200L	190.000	2.100	1.700	19.000		180.000	3.000
20/11/89	1140	0.900	790.000	1.000	0.700	16.000		790.000	2.500
19/01/90	1300	2.200	150.000	0.200L	1.300	2.000		150.000	0.500L
23/03/90	1110	2.400	140.000	2.500	2.000	1.500		120.000	1.000
22/05/90	1130	2.900		2.700	0.480	13.000			2.000
23/07/90	1115		100.000					100.000	
24/09/90	1120		1140.000					1000.000	

Table VI/C2 (h) EPD Water Quality Data of North Western Waters. Station – NM5. Depth – Bottom. Period between 1/1/88 and 30/9/90.

ERL

DATE	TIME	NH4-N (MG/L) 0008	NO2-N (MG/L) 0009	NO3-N (MG/L) 0010	PO4-P (MG/L) 0014	TKNS (MG/L) 0022	TPS (MG/L) 0024	TKN(S+P) (MG/L) 0026	TP(S+P) (MG/L) 0027
12/01/88	1115	0.061	0.025	0.130	0.024	0.410	0.120	0.440	0.150
24/03/88	1130	0.110	0.003	0.110	0.021	0.560	0.040	0.850	0.040
16/05/88	1215	0.016	0.014	0.170	0.010	0.420	0.030	0.550	0.040
15/07/88	1215	0.047	0.048	0.150	0.014	0.330	0.020L	0.390	0.030
08/09/88	1300	0.005	0.056	0.240	0.005L	0.190	0.020	0.590	0.060
22/11/88	1400	0.069	0.031	0.140	0.024	0.250	0.060	0.350	0.060
17/01/89	1220	0.068	0.021	0.080	0.020	0.220	0.020	0.240	0.020
28/03/89	1405	0.130	0.015	0.075	0.011	0.230	0.020	0.390	0.040
22/05/89	1305	0.110	0.018	0.320	0.027	0.370	0.030	0.510	0.050
24/07/89	1125	0.042	0.043	0.210	0.025	0.210	0.040	0.340	0.070
22/09/89	1110	0.080	0.110	0.220	0.030	0.160	0.030	0.410	0.050
20/11/89	1140	0.110	0.023	0.080	0.040	0.110	0.040	0.370	0.070
19/01/90	1300	0.089	0.040	0.190	0.026	0.490	0.040	0.540	0.080
23/03/90	1110	0.140	0.025	0.390	0.024	0.400	0.050	0.440	0.050
22/05/90	1130	0.026	0.015	0.120	0.004	0.590	0.080	0.680	0.120

Table VI/C2 (h) **EPD Water Quality Data of North Western Waters. Station – NM5. Depth – Bottom. Period between 1/1/88 and 30/9/90.**

ERL

V1/C3

EPD MARINE SEDIMENT DATA

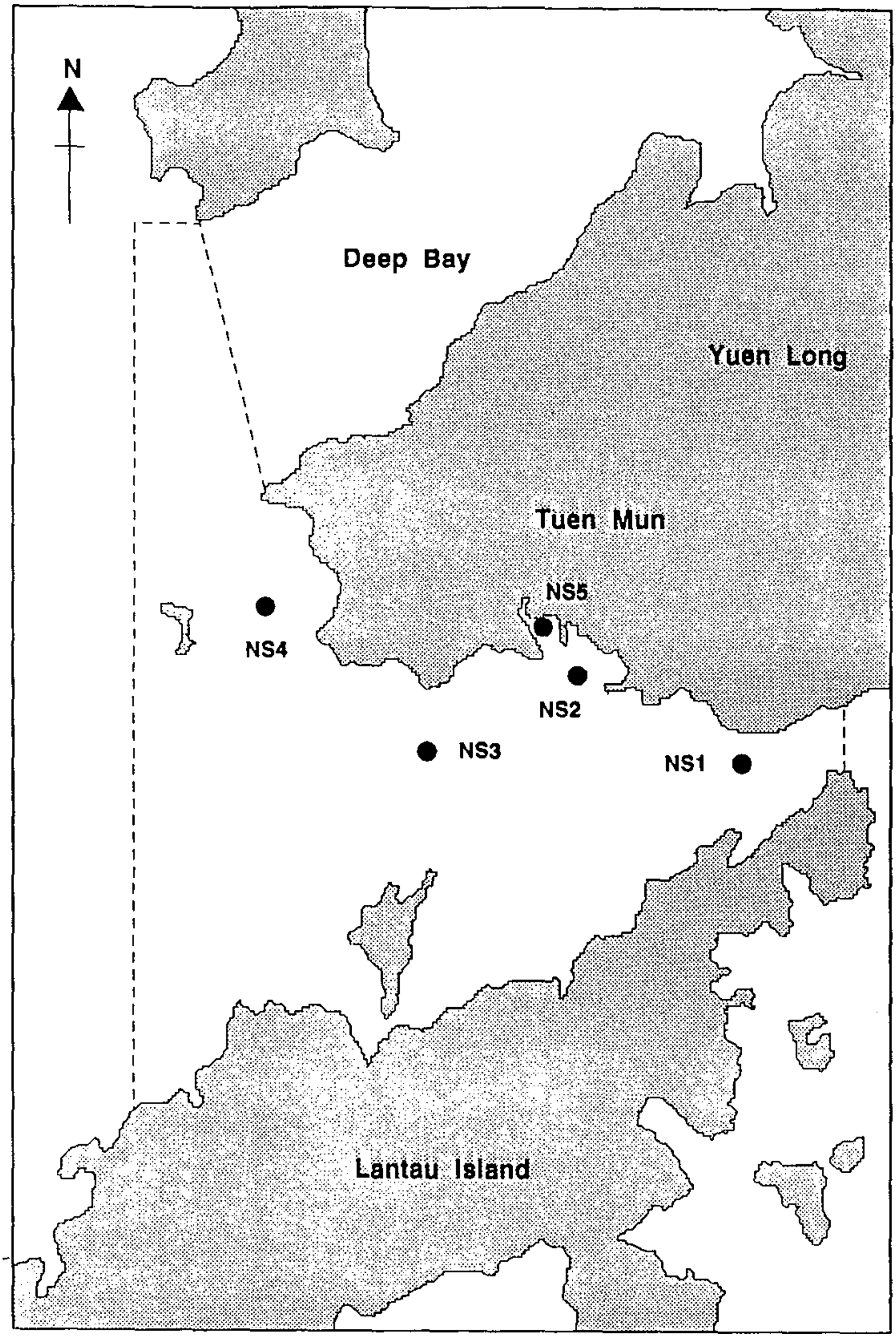

Figure V1/C3 (a) Bottom Sediment Monitoring Stations in North Western Waters

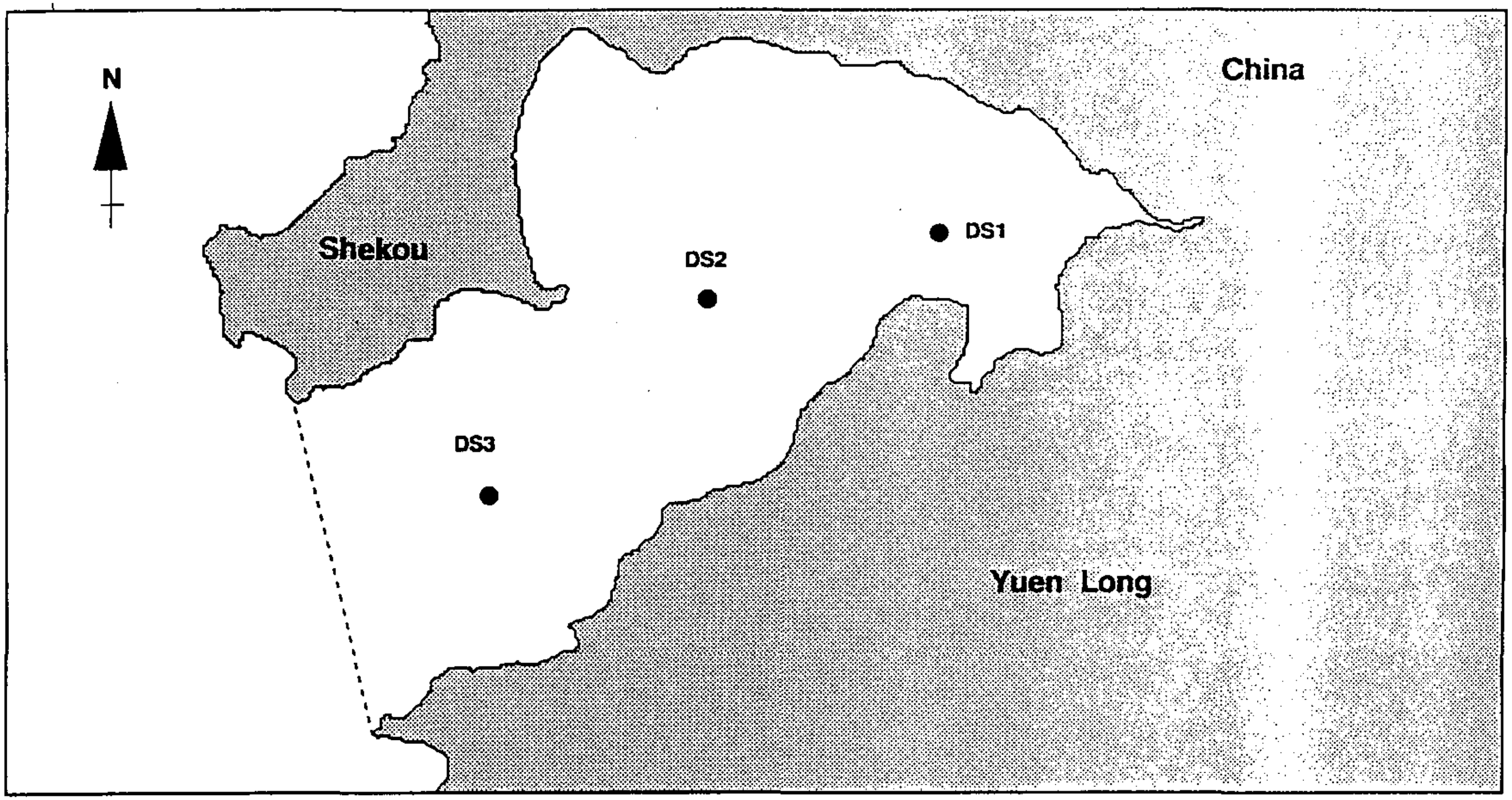

Figure V1/C3 (b) Bottom Sediment Monitoring Stations in Deep Bay Water Control Zone

Tables V1/C3 (a) - (e)

EPD SEDIMENT SURVEY
ANALYTICAL RESULTS: 1987 to 1989

GRAIN SIZE ANALYSIS

(i)

Date	< 63 um (%)	< 125 um (%)	< 250 um (%)	< 500 um (%)	< 1000 um (%)	< 2000 um (%)	< 4000 um (%)
870917							
880225							
880808	89.600	90.580	93.520	96.150	97.310	98.540	99.860
890529	86.950	91.030	93.670	95.730	96.990	98.590	100.000

(ii)

Date	< 63 um (%)	< 125 um (%)	< 250 um (%)	< 500 um (%)	< 1000 um (%)	< 2000 um (%)	< 4000 um (%)
870105							
870709							
880225							
880809	61.950	83.230	96.000	98.050	98.780	99.580	99.900
890529	38.300	54.570	75.080	80.270	85.300	91.540	97.440

Table V1/C3 (a) **EPD Sediment Analysis Results. Stations: (i) DS3 & (ii) NS4. Period: Between 01/01/87 and 31/12/89.**

ERL

Key to Tables - Sediments

$NH_3 - N$	:	Ammonia nitrogen
TKN/SP	:	Total kjeldahl nitrogen (soluble + particulate)
TP/SP	:	Total phosphate (soluble + particulate)
COD	:	Chemical oxygen demand
TVS	:	Total volatile solids
TS	:	Total solids
CN	:	Cyanide
S/SP	:	Sulphide (soluble + particulate)
SG	:	Specific gravity
TOC	:	Total organic carbon
As	:	Arsenic
B	:	Boron
Cd	:	Cadmium
Cr	:	Chromium
Cu	:	Copper
Fe	:	Iron
Hg	:	Mercury
Mn	:	Manganese
Ni	:	Nickel
Pb	:	Lead
Zn	:	Zinc
DWR	:	Dry-to-wet weight ratio
PCB	:	Polychlorinated biphenyls
PAH	:	Polycyclic aromatic hydrocarbons
Eh	:	Electrochemical potential

DEEP BAY

Date	NH3-N mg/kg	TKN/SP mg/kg	TP/SP mg/kg	COD mg/kg	TVS % w/w	T S % w/w	C N mg/kg	S/SP mg/kg	S.G.
880225	.140	810.000	380.000	16000.000	6.000	55.000	.030	.050	
880808	.300	740.000	460.000	16000.000	9.000	52.000	.050	8.100	2.584
890529	.040	670.000	330.000	24000.000	9.000	52.000	.010	27.000	2.320

Date	pH	TOC % w/w	As mg/kg	B mg/kg	Cd mg/kg	Cr mg/kg	Cu mg/kg	Fe mg/kg	Hg mg/kg
880225		1.000	11.000	3.300	.300	41.000	33.000	27000.000	.060
880808	8.100	1.300	10.000	5.400	.110	35.000	35.000	36000.000	.080
890529	7.900	1.500	11.000	15.000	7.000	27.000	30.000	30000.000	.120

Date	Mn mg/kg	Ni mg/kg	Pb mg/kg	Zn mg/kg	DWR w/w	PCBs ug/kg	PAHs ug/kg	Eh -ve
880225	860.000	19.000	33.000	78.000	.550	28.000	110.000	
880808	760.000	23.000	56.000	98.000	.520	6.600	82.000	276.000
890529	600.000	22.000	50.000	88.000	.520	44.000	34.000	242.000

Table V1/C3 (c) **EPD Sediment Analysis Results. Station: DS3. Type: < 63 μm. Period: Between 01/01/87 and 31/12/89.**

ERL

Date	NH3-N mg/kg	TKN/SP mg/kg	TP/SP mg/kg	COD mg/kg	TVS % w/w	T S % w/w	C N mg/kg	S/SP mg/kg	S.G.
870917	.200	2300.000	700.000	32000.000	4.000	61.000	.010	2.500	2.887
880225						51.000			2.421
880808	.200	390.000	260.000	13000.000	7.000	54.000	.020	.700	2.670
890529	.080	560.000	270.000	19000.000	9.500	49.000	.010	.640	2.320

Date	pH	TOC % w/w	As mg/kg	B mg/kg	Cd mg/kg	Cr mg/kg	Cu mg/kg	Fe mg/kg	Hg mg/kg
870917	8.400	.790	7.200	7.600	.080	28.000	18.000	52000.000	.210
880225	7.900								
880808	7.700	.990	3.900	23.000	.100	17.000	21.000	28000.000	.060
890529	7.700	1.400	10.000	13.000	3.100	24.000	32.000	31000.000	.080

Date	Mn mg/kg	Ni mg/kg	Pb mg/kg	Zn mg/kg	DWR w/w	PCBs ug/kg	PAHs ug/kg	Eh -ve
870917	750.000	13.000	47.000	84.000	.580	5.000	220.000	
880225								
880808	640.000	10.000	31.000	55.000	.540	65.000	85.000	276.000
890529	690.000	21.000	47.000	75.000	.490	7.600	280.000	242.000

Table V1/C3 (b) **EPD Sediment Analysis Results. Station: DS3. Type: Bulk. Period: Between 01/01/87 and 31/12/89.**

ERL

NORTH WESTERN WATERS

Date	NH3-N mg/kg	TKN/SP mg/kg	TP/SP mg/kg	COD mg/kg	TVS % w/w	T S % w/w	C N mg/kg	S/SP mg/kg	S.G.
870105	7.700	120.000	110.000	11000.000	59.000	630.000	.030		
870709	2.600	290.000	330.000	14000.000	6.000	45.000	.010	1.900	2.488
880225						65.000			2.380
880809	2.200	410.000	260.000	16000.000	6.500	53.000	.020	.490	2.696
890529	.100	470.000	310.000	15000.000	5.000	62.000	.010	5.100	2.490

Date	pH	TOC % w/w	As mg/kg	B mg/kg	Cd mg/kg	Cr mg/kg	Cu mg/kg	Fe mg/kg	Hg mg/kg
870105	8.300	.880	7.300	.560	.050	9.200	7.700	39000.000	.050
870709	7.400	.620	10.000	10.000	.060	35.000	43.000	62000.000	.060
880225	8.400								
880809	8.400	1.100	3.700	13.000	.170	18.000	29.000	26000.000	.130
890529	7.900	1.300	7.300	12.000	1.600	18.000	23.000	25000.000	.070

Date	Mn mg/kg	Ni mg/kg	Pb mg/kg	Zn mg/kg	DWR w/w	PCBs ug/kg	PAHs ug/kg	Eh -ve
870105	790.000	10.000	52.000	61.000	.630	5.000L		
870709	840.000	12.000	49.000	77.000	.450	5.000	30.000	
880225								
880809	530.000	11.000	31.000	63.000	.530	28.000	140.000	335.000
890529	470.000	16.000	37.000	57.000	.620	7.300	82.000	377.000

Table V1/C3 (d) **EPD Sediment Analysis Results. Station: NS4. Type: Bulk. Period: Between 01/01/87 and 31/12/89.**

ERL

Date	NH3-N mg/kg	TKN/SP mg/kg	TP/SP mg/kg	COD mg/kg	TVS % w/w	T S % w/w	C N mg/kg	S/SP mg/kg	S.G.
880225	.150	810.000	360.000	18000.000	9.000	53.000	.020	.020	
880809	.160	590.000	410.000	19000.000	8.500	56.000	.040	2.100	2.482
890529	.070	700.000	290.000	25000.000	7.000	62.000	.010	98.000	2.230

Date	pH	TOC % w/w	As mg/kg	B mg/kg	Cd mg/kg	Cr mg/kg	Cu mg/kg	Fe mg/kg	Hg mg/kg
880225		1.100	12.000	14.000	.340	41.000	44.000	30000.000	.410
880809	7.900	1.200	6.600	19.000	.110	30.000	40.000	30000.000	.120
890529	8.000	1.400	11.000	16.000	6.600	27.000	35.000	29000.000	.130

Date	Mn mg/kg	Ni mg/kg	Pb mg/kg	Zn mg/kg	DWR w/w	PCBs ug/kg	PAHs ug/kg	Eh -ve
880225	890.000	19.000	35.000	83.000	.530	16.000	260.000	
880809	630.000	18.000	46.000	82.000	.560	26.000	130.000	335.000
890529	530.000	22.000	50.000	85.000	.620	36.000	32.000	377.000

Table V1/C3 (e) **EPD Sediment Analysis Results. Station: NS4. Type: < 63 μm. Period: Between 01/01/87 and 31/12/89.**

ANNEX V1/D

GROUNDWATER QUALITY DATA

D1/1 GROUNDWATER QUALITY DATA

Available groundwater quality data for the area of Black Point consists of the results of a monitoring programme undertaken by CLP in connection with the development of their Ash Lagoons at Tsang Tsui.

Two boreholes were developed, one just to the south of the lagoons (A) and a second some 800m further inland (B). To minimise the risk of metallic contamination from the construction materials the boreholes were lined and capped with plastic.

Groundwater monitoring predates the operation of the lagoons by 6 months and continues upto the present time.

Samples were taken on a monthly basis, with four replicates being taken on each occasion.

Chemical analysis

The original choice of trace metals to be monitored included arsenic (As), cadmium (Cd), chromium (Cr), lead (Pb), molybdenum (Mo) and selenium (Se). These were determined as "Dissolved Metals", as defined by US EPA. The analysis method, using graphite furnace atomic absorption spectrometry (GF–AAS), was optimised and subjected to a validation study before use. As a result of this work, it was decided that measurements of salinity were also required because the technique was shown to be reliable for determining concentrations of Cd, Cr, Pb, Mo and Se only in samples with salinity equivalent to less than 60 mg/l^{-1} chloride. For arsenic determinations, the saline interference occurred at much lower concentrations. The method was therefore considered unsuitable for arsenic and an alternative hydride generation – AAS technique, previously validated for seawater analysis, was adopted.

The validation studies produced the following performance characteristics for the methods. These should be taken into account when using the analysis data for drawing environmental conclusions:

Metal	As	Cd	Cr	Pb	Mo	Se
Systematic error (% bias)	–2.0	–2.0	+2.0	+1.5	+1.0	+2.0
Precision (% r.s.d.)	–3.9	3.0	3.9	1.9	2.9	6.9
Detection limit (μg.1^{-1})	4.0	0.14	0.55	0.19	1.04	2.3

Other species are analysed as follows:

Boron (B) and sodium (Na); by plasma atomic emission spectrometry (ICP–AES), both with estimated detection limits of 0.5 mg.1^{-1}.

Chloride (Cl^-) and sulphate (SO_4^{2-}); by ion chromatography with estimated detection limits of 0.1 μg.1^{-1} and 0.5 μg.1^{-1} respectively.

Suspended solids (SS); by use of 0.45m membrane filter discs, with an estimated detection limit of 10 mg.1^{-1}.

pH; by use of a normal pH–meter with glass electrode.

Tables D1/1(a) and (b) present summary statistics of borehole groundwater analysis taken between September 1986 and August 1989.

Results

The levels of the recorded parameters are discussed briefly below:

The World Health Organisation (WHO) Guidelines for Drinking Water Quality were taken as the criteria against which to compare monitoring data.

o **Sodium (Na^+) and Chloride (Cl^-)**

For sodium and chloride, the WHO Drinking Water limits are based simply on aesthetic rather than health grounds. They are 200 $mg.1^{-1}$ and 250 $mg.1^{-1}$ respectively. All of the samples analysed were within these recommended control limits.

o **Arsenic (As)**

Concentrations of arsenic in all samples were shown to be below the 4 $\mu g.1^{-1}$ detection limit of the analysis method and therefore at least an order of magnitude below the WHO Limit of 50 $\mu g.1^{-1}$.

o **Cadmium (Cd)**

Data from the 1986–9 period indicated barely detectable levels of Cadmium. Recently, however, elevated cadmium levels, in excess of the WHO Guideline Limit for Drinking Water of 5 $\mu g/L^{-1}$ were found at Borehole–B (see Table D1/1(c)). Earlier results had indicated higher levels at Borehole–B than at Borehole–A. CLP have indicated their intention to give special attention to this situation.

o **Chromium (Cr)**

All samples showed concentrations of this element to be below the 0.55 $\mu g.1^{-1}$ detection limit of the analysis method and therefore at least two orders of magnitude below the WHO Guidelines Limit of 50 $\mu g.1^{-1}$.

o **Lead (Pb)**

Measurable concentrations of lead have occurred in a considerable proportion of the samples analysed throughout the monitoring period. As in the case of cadmium however, the evidence indicates a source other than the lagoons because such instances occurred much more frequently, and at higher concentrations, at the more distant Borehole–B. Similar levels of lead were also a regular feature of background measurements at Borehole–B made prior to operation of the lagoons. The instances of high lead levels do not correlate with high periods of salinity which tends to rule out ingress of seawater as the mode of transport.

All measured concentrations of lead were within the WHO Guidelines Limit of 50 $\mu g.1^{-1}$. Although some results from Borehole–B samples approached this limit.

o **Molybdenum**

All samples had concentrations which were below the 1 $\mu g/L^{-1}$ detection limit of the analytical method.

Borehole-A; before delivery of ash to the lagoons (September 1986 to February 1987)

Statistic	Metals ($\mu g.l^{-1}$)						Metals ($mg.l^{-1}$)		Anions ($mg.l^{-1}$)		SS ($mg.l^{-1}$)	pH
	As	Cd	Cr	Pb	Mo	Se	B	Na	Cl^-	SO_4^{2-}		
AVERAGE	-	-	-	0.4	-	-	-	38	48	9	-	Reject
HIGHEST	<DL	<DL	<DL	0.4	<DL	<DL	<DL	50	100	13	< DL	Reject
LOWEST	-	-	-	0.4	-	-	-	25	22	2	-	Reject
Number of results below detect. limit	18	18	18	16	18	18	18	0	0	0	18	0
Total number of results	18	18	18	18	18	18	18	8	16	16	18	16

Borehole-A; after delivery of ash to the lagoons (March 1987 to August 1989)

Statistic	Metals ($\mu g.l^{-1}$)						Metals ($mg.l^{-1}$)		Anions ($mg.l^{-1}$)		SS ($mg.l^{-1}$)	pH
	As	Cd	Cr	Pb	Mo	Se	B	Na	Cl^-	SO_4^{2-}		
AVERAGE	-	0.4	-	1.2	-	-	-	32	29	15	-	Reject
HIGHEST	<DL	0.7	<DL	4.0	<DL	<DL	<DL	138	73	52	< DL	Reject
LOWEST	-	0.2	-	0.2	-	-	-	10	13	7	-	Reject
Number of results below detect. limit	92	82	92	68	92	92	92	0	0	0	92	0
Total number of results	92	92	92	92	92	92	92	92	92	92	92	92

Note : (i) Results below the detection limit of the analysis method have not been used in calculations of averages.

(ii) [< DL] signifies that concentrations in all samples were below the detection limit of the analysis method.

(iii) pH data has been deemed invalid because of poor correlations of sub-sample results.

Table D1/1(a)
Summary Groundwater Quality Data from Tsang Tsui Borehole-A

ERL (Asia) Ltd.

11th Floor, Hecny Tower
9 Chatham Road,
Tsimshatsui,
Kowloon, HONG KONG

ERL

Borehole-B; before delivery of ash to the lagoons (September 1986 to February 1987)

Statistic	Metals ($\mu g.l^{-1}$)						Metals ($mg.l^{-1}$)		Anions ($mg.l^{-1}$)		SS ($mg.l^{-1}$)	pH
	As	Cd	Cr	Pb	Mo	Se	B	Na	Cl^-	SO_4^{2-}		
AVERAGE	-	0.5	-	11	-	-	-	4	9	2	-	Reject
HIGHEST	<DL	0.6	<DL	25	<DL	<DL	<DL	5	19	3	< DL	Reject
LOWEST	-	0.2	-	1	-	-	-	3	6	1	-	Reject

Statistic	As	Cd	Cr	Pb	Mo	Se	B	Na	Cl^-	SO_4^{2-}	SS	pH
Number of results below detect. limit	18	5	18	1	18	18	18	0	0	0	10	0
Total number of results	18	18	18	18	18	18	18	8	18	18	10	16

Borehole-B; after delivery of ash to the lagoons (March, 1987 - August 1989)

Statistic	Metals ($\mu g.l^{-1}$)						Metals ($mg.l^{-1}$)		Anions ($mg.l^{-1}$)		SS ($mg.l^{-1}$)	pH
	As	Cd	Cr	Pb	Mo	Se	B	Na	Cl^-	SO_4^{2-}		
AVERAGE	-	0.5	-	9	-	-	-	9	13	5	-	Reject
HIGHEST	<DL	1.4	<DL	36	<DL	<DL	<DL	32	39	24	< DL	Reject
LOWEST	-	0.2	-	0.4	-	-	-	5	6	1	-	Reject

Statistic	As	Cd	Cr	Pb	Mo	Se	B	Na	Cl^-	SO_4^{2-}	SS	pH
Number of results below detect. limit	92	64	92	38	92	92	92	0	0	0	92	0
Total number of results	92	92	92	92	92	92	92	92	92	92	92	92

Note : (i) Results below the detection limit of the analysis method have not been used in calculations of averages.

(ii) [< DL] signifies that concentrations in all samples were below the detection limit of the analysis method.

(iii) pH data has been deemed invalid because of poor correlations of sub-sample results.

Table D1/1(b)
Summary Groundwater Quality Data from Tsang Tsui Borehole-B

Date collected	Sample Site	Sub-sample	Dissolved metals (*)								Anions ($mg.\ l^{-1}$)		Total Suspended Solids	pH
			$ug.\ l^{-1}$						$mg.\ l^{-1}$					
			As	Cd	Cr	Pb	Mo	Se	B	Na	Cl^-	SO_4^{-2}		
4/4/90	A	A1								16	23	14		5.8
		A2								16	24	14		5.7
		A3								16	24	14		5.8
		A4								15	23	14		5.8
	B	B1								6	10	4		5.5
		B2								5	11	4		5.5
		B3								5	11	4		5.5
		B4								5	11	4		5.4
9/5/90	A	A1								14	21	14		6.4
		A2								13	21	14		6.4
		A3								14	20	14		6.2
		A4								14	20	15		6.3
	B	B1		21						5	16	5		5.7
		B2		25						5	16	5		5.7
		B3		15						5	16	5		5.6
		B4		19						5	16	4		5.7
15/6/90	A	A1								13	20	10		6.3
		A2								13	20	10		6.2
		A3								13	19	10		6.2
		A4								13	20	10		6.2
	B	B1								5	15	3		5.8
		B2								5	15	3		5.8
		B3								5	15	3		5.8
		B4								5	15	3		5.8
17/7/90	A	A1								11	19	10		6.0
		A2								11	19	10		5.8
		A3								12	19	10		5.8
		A4								12	19	10		5.8
	B	B1		0.3						6	14	10		5.6
		B2		0.5						7	14	10		5.6
		B3		0.3						7	14	11		5.6
		B4		0.3						7	14	11		5.7

Blank space = Concentration found to be less than detection limit of the analysis method.
(*) = To the US-EPA definition.

Table D1/1(c)
Groundwater Quality Data from Tsang Tsui Boreholes A and B: April to July 1990

ERL (Asia) Ltd.

11th Floor, Hecny Tower
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Tsimshatsui,
Kowloon, HONG KONG

ERL

- **Selenium**

  Levels of selenium are below the 2.3 $\mu g/l^{-1}$ detection limit of the analysis method and therefore well within the WHO Drinking Water Guidelines Limit of 10 $\mu g.1^{-1}$.

- **Boron**

  All samples had concentrations of boron which were below the estimated 0.5 $mg.1^{-1}$ detection limit of the analysis method.

- **Sulphate (SO_4^{2-})**

  A comparison of sulphate concentrations before and after operation of the lagoons indicates possible increases at both boreholes due to deliveries of ash. The comparisons must be tempered with some caution, however, because natural seawater itself would typically contain 2,000–3,000 ppm of sulphate. Concentrations of sulphate in all samples were, nevertheless, found to be well within the WHO Guidelines Limit of 400 $mg.1^{-1}$, a figure which is based on aesthetic, rather than health considerations.

- **Suspended Solids**

  After rejection of a number of early results from Borehole–B because, in retrospect, they appeared to be abnormally high, possibly due to debris remaining from construction of the borehole, all samples have shown suspended solids levels below the detection limit of 10 $mg.1^{-1}$. (The WHO Guidelines provide no control limit for suspended solids).

- **pH**

  The validation of the results was considered inadequate by CLP and on–site measurements by alternative methods were proposed.

Conclusions

Other than the May 1990 level of Cadmium at Borehole B which was in exceedance of the WHO limit levels. Results, both before and after lagoon operation, complied with WHO standards.

ANNEX V1/E

NOISE ENVIRONMENT DATA

E1 DATA COLLECTION AND PROCESSING TECHNIQUES

E1.1 Introduction

A comprehensive baseline survey of the pre-existing noise climate i.e. the noise climate prior to any construction site and operational site activities, has been conducted in the vicinity of Black Point as the initial stage of the noise impact assessment of the construction and operational phases of the proposed development.

The baseline noise survey is intended to establish the daytime, evening and night-time noise levels in the vicinity of sensitive receptors such as dwellings, schools and churches. The data will be used in conjunction with the Hong Kong Planning Standard & Guidelines (HKPSG) on noise to suggest appropriate site specific, noise quality objectives which are related to sensitive time periods. This will assist the development of noise criteria with respect to the types of noisy activities to be regulated i.e. construction and operational noise, the phasing of the activities, the number and type of sensitive receptors and the anticipated changes in the character of the area and therefore noise climate due to other planned developments.

E1.2 Noise Monitoring Equipment

Measurement guidelines laid down in the Technical Memorandum for the Assessment of Noise from Places other than Domestic Premises, Public Places or Construction Sites were followed in the noise monitoring exercises. All the equipment used throughout the surveys complied with IEC Publications 651:1979 (Type 1) and 804:1985 (Type 1). Each item of noise monitoring equipment was calibrated immediately prior to and following each series of measurements in order to ensure validity. The following instrumentation was used:

1) B&K Sound Level Meter Type 2230 (S/N: 1033311)
   Half inch Condenser Microphone Type 4155 (S/N: 790642)

2) B&K Sound Level Meter Type 2231 (S/N: 1350240)
   Half inch Condenser Microphone Type 4155 (S/N: 1369969)

3) B&K Noise Level Analyser Type 4426 (S/N: 789529)
   Preamplifer Type 2639 (S/N: 1180780)
   Half inch Condenser Microphone Type 4149 (S/N: 1163325)

4) B&K Real-time Frequency Analyser Type 2143 (S/N: 1517035)
   Preamplifer Type 2639 (S/N: 1180779)
   Half inch Condenser Microphone Type 4149 (S/N: 1163320)

E1.3 Weather Conditions

All the measurements were taken under clement conditions and none were affected by rain or fog or excessive wind speeds. During the monitoring periods in question at the end of October and early November 1990, all the measurements were carried out in fine, mild and calm conditions with daytime and night-time temperatures around 26°C and 20°C respectively.

E1.4 Measurement Methodology & Parameters

Measurements were carried out by using the above sound measuring systems with half inch condenser microphones attached to sound level meters held on tripods at a height of 1.2 metres above ground level and away from all reflecting structures. In acquiring the most accurate data, the instruments were adjusted in such a way that the following settings were always adhered to:

1) Input Preamplifier: most sensitive range
2) Time Weighting: Fast Response
3) Frequency Weighting: 'A' weighting network
4) Detector: Root-Mean-Square
5) Sampling Time: at 30-minute intervals
6) Measurement Parameters: SPL, L_{99}, L_{90}, L_{50}, L_{10}, L_1, and L_{eq}
7) Sound Incidence: Frontal

The measurement apparatus was checked on each occasion and then calibrated by using a sound source of known signal and sound pressure level. This was then followed by real measurements conducted over continuous, 36 hour periods from 7:00 pm to 7:00 am at each of the sites at 30 minute intervals. Brief notes were recorded simultaneously to provide a subjective description of the recorded source comprising the measured noise energy values.

Exact noise surveys and measurements were carried out at:

i)	Site A	on Wednesday, 21st November 1990 (7:30 pm) to Friday, 23rd November 1990 (8:30 am)
ii)	Site B	on Monday, 29th October 1990 (7:00 pm) to Wednesday, 31st October 1990 (8:30 am)
iii)	Site C	on Monday, 29th October 1990 (8:00 pm) to Wednesday, 31st October 1990 (6:30 am)
iv)	Site D	on Tuesday, 6th November 1990 (8:00 pm) to Thursday, 8th November 1990 (9:00 am)
v)	Site E	on Wednesday, 28th November 1990 (8:00 pm) to Friday, 30th November 1990 (9:00 am)

In addition to the above dB(A) noise parameters, third octave, real time frequency analyses were also carried out during daytime and night-time periods to identify the typical background noise components at different sampling areas.

A similar noise monitoring exercise may be carried out during 1991 in order to determine whether seasonal changes e.g. summer periods, have any effect on the background noise levels.

E1.5 Recording of Data

The various noise data derived from the sound level instruments were recorded at 30 minutes intervals on to prepared record sheets alongside a subjective description of the noise. In addition, other 1/3 octave data from the real time frequency analyser were recorded at the time of each measurement.

The range of noise parameters recorded during each monitoring exercise was subsequently transferred to a computer database on a diskette.

ANNEX V1/F

TERRESTRIAL ECOLOGY DATA

V1/F TERRESTRIAL ECOLOGICAL SURVEY AT BLACK POINT: WINTER SEASON

Introduction

Prior to the intense human impact of the past few thousand years, Hong Kong would have been covered by dense rain forest with an extremely rich flora and fauna. As a consequence of this history, a high proportion of Hong Kong's native biota is adapted to and dependent upon forest. By contrast, the open, non-forest vegetation created by centuries of cutting and burning has a relatively species-poor biota, except where there is a perennial water supply. In the extreme case, the fire-maintained grasslands which cover much of the Territory support only a few, highly-tolerant, species of plants, birds, mammals and invertebrates. If protected from fire and cutting, forest will regenerate, through a shrubland stage, on all but the most eroded slopes. This secondary forest, however, does not approach the diversity and structural complexity of the primeval vegetation.

The major aim of biological conservation is to preserve or enhance biotic diversity in the landscape. From this viewpoint, remnant patches of primary forest should have the highest conservation priority. Much of Hong Kong's flora and fauna is confined to such areas. Other terrestrial habitats can be ranked in terms of the height, density and area of tree and shrub cover since, in the majority of Hong Kong landscapes, biological diversity is limited by the restricted extent of dense shrubland and secondary woodland. Perennial water supply is also a major limiting factor for biological diversity in most Hong Kong landscapes. Streams with year-round flow provide islands of diversity even in the most barren of hillside grasslands and marshy areas in abandoned paddy fields play a similar role.

The north-west New Territories may have had a longer history of major human impact than the rest of Hong Kong. There is evidence for deforestation starting two thousand years ago at Futian, just north of the Chinese border and there was a military post near Castle Peak from the 18th century onwards. Today, despite the low population density, much of the area is an extreme example of the ecological devastation which results from deforestation and repeated burning on granitic slopes. As a result, there are no remnants of primary forest and only very small patches of secondary forest. In general, the flat areas are cultivated or abandoned cultivation and the hill slopes are covered in fire-maintained grasslands with a variable shrub component.

Methods

The study area was divided into three for the purpose of this survey:

1. The coastal flat land around the settlements at Yung Long and northwest of Lung Kwu Sheung Tan. This consists largely of cultivated areas and abandoned cultivation, with small patches of semi-natural coastal scrub behind the beaches.

2. The hill-slope vegetation within the area that will be directly impacted by the proposed development. This consists of the Black Point headland and smaller, disturbed areas to the east and north of Yung Long. This area is all below 150m.

3. The hill-slope area to the east, outside the direct footprint of the development. This consists of grassland and shrubland vegetation, and extends continuously eastwards to Castle Peak. Most of this is between 100m and 200m above sea-level.

After an initial general survey it was obvious that the coastal flat land (1) contained nothing of conservation interest. Attention was therefore focussed on the hill-slope areas (2 & 3). The area within the development footprint was surveyed intensively. All plant species encountered were identified and a thorough search made for signs of mammal activity (scats, food remains, burrows etc). The area outside the footprint was investigated more superficially, largely from the major paths, with particular attention paid to the damp valleys where species diversity was expected to be the greatest.

Existing Environment

1. Coastal Flat Lands

The vegetation of the coastal flat lands is of no conservation significance. There is no native woodland or shrubland and the few trees are all planted and mostly exotic. Land that is not currently cultivated is covered in a varying mixture of native and exotic weedy species. The exotics - a curious mixture of species of American (e.g. Agave vivipara, Lantana camara, Mikania micrantha, Opuntia stricta) and African (e.g. Crassocephalum crepidioides, Rhynchelytrum repens) origin - are signs of continued disturbance. At the rear of the beach there is an admixture of native coastal species, such as Hibiscus tiliaceus and Scaevola sericea.

2. Hill-slopes within the Development Footprint

The most well developed vegetation is on the Black Point headland. The other areas are more disturbed and contain no additional communities or species. The vegetation of Black Point consists of a mosaic of grassland, fernland and shrubland communities, with all possible intermediates. The vegetation is better developed here than most places in the northwest New Territories, presumably because the presence of sea on three sides has reduced the fire frequency. The flora is typical of granitic hill-slopes in Hong Kong: virtually identical to that of Chek Lap Kok, for instance. Similar vegetation is well-represented in Hong Kong's Country Park system. The vegetation mosaic is at too fine a scale for mapping but, in general, the north face of the headland has denser and taller shrub cover than the south face, which is largely grassland.

Table V1/F1, lists all plant species recorded from Black Point headland. The grassland is dominated by Ischaemum spp., Arundinella setosa, Eulalia speciosa, and Cymbopogon tortilis, with a varying admixture of Rhodomyrtus tomentosa, Eurya japonica, Rhaphiolepis indica and other shrub species. The fernland consists of almost pure stands of Dicranopteris linearis. The shrubland patches are very varied. The commonest species, in addition to Rhodomyrtus, Eurya and Rhaphiolepis, are Baeckia frutescens, Embelia laeta, Litsea rotundifolia, and Melastoma sanguineum, with the climbers Alyxia sincensis and Gnetum montanum. In one small area, Aporusa chinensis, Bridelia tomentosa, Cratoxylum cochinchinense, Schefflera octophylla and Sterculia lanceolata form a low woodland.

This type of vegetation is an unpromising habitat for mammals, other than the common hillside rats. However, the distinctive scats of civets were surprisingly abundant on rocks throughout the area and a preliminary analysis of hairs in these scats suggests the presence of two civet species, Paguma larvata and Viverricula indica (Nick Goodyer, pers. comm.). Presumably, the piles of boulders provide alternative hiding places for these animals. Fresh pangolin (Manis pentadactylia) droppings were also found. Given the presence of these mammals, the occurrence of other, less easily-detected species, such as porcupines, barking deer and ferret badgers, cannot be entirely ruled out.

A thorough bird survey would take at least a year but the habitat available is unlikely to support any of the rarer species, which require wetlands or woodland. However, the rocks on the north face of the headland had obviously (from the white droppings smelling strongly of fish) been used in the recent past as a roost by a large flock of sea-birds, probably cormorants.

3. Hill-slopes outside the Development Footprint

The hill-slopes to the east of the proposed development exhibit an exceptional degree of erosion. The vegetation is mostly sparse grassland and is very poor in species, except in a few damp valleys and along streams. At these permanently wet sites, the pitcher plant, Nepenthes mirabilis, is locally abundant. There are also scattered individuals of tree species not found on Black Point: Elaeocarpus sylvestris, Lasianthus chinensis, Litsea chinensis, Machilus velutina and Sideroxylon wightianum. The flora is otherwise very similar to that of the Black Point headland and other granitic areas in the Territory. Evidence for the presence of civets was found in the boulder-strewn valley above Pak Long but not elsewhere.

Rare and Protected Species

No species of plant or animal identified from the area to be developed is rare or endangered in Hong Kong. However, several species are protected under current legislation. Gardenia jasminoides is protected under the Forestry Regulations (Cap. 96, section 3) while Phoenix hanceana is covered by the Animals and Plants (Protection of Endangered Species) Ordinance (Cap. 187). Neither species is rare in Hong Kong and the reasons for their current protection are unclear. Several orchid species, all of which are protected, are to be expected, but are not detectable in a winter survey. In any case, rare and endangered orchid species are largely confined to wooded upland valleys in Hong Kong.

Among the species found only outside the area directly affected by development, Litsea cubeba is covered by the Forestry Regulations and Nepenthes mirabilis by the Animals and Plants Ordinance. Litsea cubeba is common in many parts of the Territory and well-represented in Country Parks. Nepenthes is often considered rare but is locally abundant in web valleys on granite in the northwest New Territories and cannot be considered an endangered species in Hong Kong. However, few of its known localities are within Country Parks.

All birds and all mammals, except rats, mice and shrews, are protected in Hong Kong under the Wild Animals Protection Ordinance (Cap. 170). The pangolin and the two civet species are widespread in the Territory at low densities. All three species will presumably move away from the area once development starts and their eventual fate will depend on whether suitable habitats inland are already saturated.

Direct Impacts

The direct impact of construction will involve the loss of all habitat within the development footprint and of all the biota, except birds and mammals able to leave the area.

Indirect Impacts

Off-site impacts during and after construction need to be considered in the context of other current and proposed developments in the area, since the effects will be cumulative.

Indirect impacts from dust and gaseous pollutants cannot be accurately assessed without further information on the likely extent and intensity of pollution. Unfortunately, no information is available on the susceptibility of local species to pollution. Local soils and streams tend to be fairly well buffered so significant acidification problems are unlikely.

Mitigation Measures

No significant mitigation of terrestrial ecological impacts within the area directly affected by construction is possible. However, improvement of the vegetation on the hillsides around the construction area by the planting of mixed, native tree species would, in part, compensate for the inevitable loss of habitat. Planting material of native species is not widely available in Hong Kong so it would be necessary to establish a special nursery. The advice of local conservation management experts, such as the World Wide Fund for Nature (WWF) Hong Kong, should be sought on appropriate species to use.

Conclusions

The loss of any stretch of undeveloped coastline is a serious matter, particularly in view of the expected massive losses in connection with the PADS project on Lantau. However, accepting that a coastal location is essential for the proposed power plant, construction at Black Point will probably have a less serious terrestrial ecological impact than at any other non-urban coastal site in Hong Kong. The organisms and ecological communities present in the area are not unique or unusually diverse and, with the exception noted above, are well-represented in Hong Kong's Country Park system. Moreover, the surrounding area is all either developed already or in the process of development in connection with the Western New Territories (WENT) landfill and the NWNT sewerage scheme.

ANNEX V1/G

MARINE AND LITTORAL ECOLOGY DATA

CLP's LTPS BASELINE MARINE ECOLOGICAL SURVEY

INTERIM REPORT

1. INTRODUCTION

China Light and Power Company proposes to build a Large Thermal Power Station at Black Point. The construction work will involve a significant amount of dredging and reclamation at the Black Point headland, and these activities may adversely affect the marine ecology near the site. The thermal discharge from the proposed power plant may also affect the marine fauna and flora in the the near and far fields. A marine ecological survey was, therefore, initiated in January 1991, to study the shore communities, the pelagic and demersal fish communities and the benthic community near Black Point, with a view to provide scientific data for environmental impact assessment.

2. MATERIALS AND METHODS

Sea shore survey

Sandy shore

Two transects were set up at the sandy beach at Yung Long and another two at Lung Kwu Sheung Tan, from the supra–littoral fringe to the low tidal level (Figure V1/G1(a)). The shore profiles were surveyed. Quantitative distribution and abundance of macro–fauna and flora in the top 0.5 m sediment of a 1m belt along the four transects were studied in January 1991.

Rocky shore

Two transect lines were set up from the supra–littoral fringe to the low tidal levels at rocky shores at the headland of Black Point (Figure V1/G1(a)), and the shore profiles were surveyed. Quantitative distribution and abundance of fauna and flora in a 1 m belt along the two transects were studied in January 1991.

General survey

A general qualitative survey on the sandy shore and rocky shore habitats at the above locations was carried out in February 1991, in order to provide supplementary information on rare species and on species not covered by the transects.

Fish survey

Demersal species

A demersal survey was carried out in February 1991. Five transects were set up to study the demersal fish community (Figure V1/G1(b)): two near the outfall, one parallel to the shore of Yung Long , one parallel to the shore of Lung Kwu Sheung Tan and one near the existing power plant at Tap Shek Kok. Earlier studies showed that seven replicates are required to cover the variance of beam trawling and sample 90% of total demersal species (Wu, 1982). Seven replicate trawls were therefore taken from each of the 5 transects, using a conventional beam trawl of 2.4 m width and 1.5 cm mesh size at the cod end. Trawling time was five minutes per replicate and the distance covered was about 500 m, sampling an area of approximately 1,200 m^2. Macro–invertbrates caught in the trawl samples were also recorded and analysed.

Pelegic species

A survey for pelagic species was carried out in February 1991. Three stations were set up to sample pelagic fish (Figure V1/G1(b)): one at the outfall, one at Yung Long and the other at Lung Kwu Sheung Tan. Six replicates of gill net (mesh size : 3.8 cm) were set up at each of the three stations. Fish and macro-invertebrates caught within a one hour period were recorded and identified.

2.3 Benthic survey

A benthic survey was carried out in January 1991. A sampling grid consists of 20 sampling points was established in the vicinity of the outfall, covering areas where both near and far field impact might be expected (Figure V1/G1(c)). Earlier studies showed that 5 replicates are required to cover the variance of marine benthic communities in Deep Bay and to sample 90% of total benthic species. Five replicates of benthos were therefore sampled by a 0.05 m^2 van Veen grab at each sampling point.

Benthos were sieved through a 0.5 mm sieve and those retained on the sieve were sorted, preserved and identified as far as possible.

3. RESULTS AND DISCUSSION

Sea shore survey

Sandy shore

The sandy shore at Lung Kwu Sheung Tan is relatively sheltered with a gentle slope. The beach substrate shows a clear zonation : the lower shore resembles a typical boulder beach, while the middle and upper shores are essentially built of coarse sand grains. The upper shore, however, can be easily distinguished from the middle shore by the presence of a thin layer of fine sand on the surface.

A total of 21 animal species was found in the January survey. Animal species found on the shore and their general abundance are shown in Table V1/G1(a). The rock oyster Saccostrea cucullata and the anemone Haliplanella luciae typically associated with boulders on the shore in large numbers. Other dominant epifauna included the gastropod Bursa granularis, Nerita albicilla, Nerita chamaelon and Thais clavigera and the shore crab Parasesarma pictum. Compared with the epifauna, typical infauna were less diversified and well represented : only three species of polychaetes (Terebella ehrenbergii, Nereis sp., Marphysa sp.) , one species of sipunclid worm (Sipunculus nudus) and one species of snapping shrimp (Alpheus bisincisus) were recorded in low numbers in the January study.

All the epifauna and infauna found at Lung Kwu Sheung Tan are common inter-tidal species that might be expected for a moderately sheltered boulder / sandy shore in Hong Kong.

The sandy shore at Yung Long is very exposed and steep. The substrate is highly mobile, clean, and mainly consists of very coarse sand with a fairly uniform grain size of about 4 to 8 mm.

The sandy shore at Yung Long is virtually a biological desert and only one species of polychaete (Ceratonereis sp.) was found in the January survey (Table 2). The low species number and low biological diversity are typically features of exposed sandy shores with an unstable substrate (Morton and Morton, 1983).

Rocky shore

The rocky shore at the headland of Black Point is exposed and typical of Hong Kong's igneous coast. The slope is steep and a distinct but narrow tripartite zonation can be observed.

A total of 13 animal and 2 plant species was found in the January survey, and these species and their general abundance are given in Table V1/G1(c). Dominant species typically included the rock oyster (Saccostrea cucullata) and the green algae Enteromorpha compressa in the lower tidal; the barnacles Balanus sp. and Pollicepes mitella in the mid tidal and three species of littorines (Nodilittorina exigua, N. millegrana and N. pyramidalis) in the upper tidal. The limpet Siphonaria japonica and the gastropod Nerita albicilla were also abundant.

All animals and plants found at the headland of Black Point are typical exposed rocky shore species found in Hong Kong (Morton, 1979; Morton & Morton, 1983).

General shore survey

During the general survey at Lung Kwu Sheung Tan, the bivalve Tapes philippinarum was found in small numbers outside the transect and holes which are characteristics of Ocypode crabs were also generally noted on the shore.

No new species was found outside the transects at Yung Long.

At the headland of Black Point, the green algae Ulva sp., the barnacles Balanus tintinnabulum volcano, Balanus amphitrite amphitrite, the gastropod Lunella coronata were recorded outside the transects during the general shore survey.

To sum up, only very few species was found in addition during the general shore survey. Most of the species had already been covered during the transect surveys. Again, all the species found in addition during the general survey are common inter-tidal species in Hong Kong.

Fish survey

Demersal species

Fish and macro-invertebrates species recorded and their general abundance are shown in Table V1/G1(d). The demersal fish community in the areas of Yung Long, the outfall and Lung Kwu Sheung Tan was characterised by a high species diversity but low numbers. A total of 44 species was identified (21 fish species, 5 crab species, 12 shrimp species, and another 6 species of crustaceans, cephalopod, gastropods and urchin). The urchin Temnopleurus reevsii, the shrimp Trachpenaeus curvirostris and hermit crabs were found in large numbers and appeared to be the dominant species in the area. Food fish species such as the soles (Cynoglossus puncticeps and Solea orata) , the flounder (Psuedorhombus sp.), the crocker (Johnius belengerii), the flat head (Platycephalus indicus), the scad (Trachurus japonicus) and the rabbit fish (Signaus oramin) were present, but in very low numbers. Other macro-invertebrates of commercial value such as the crab Portunus pelagicus, the whelk Hemifusus ternatana and the various species of shrimps were also found in low numbers.

The urchin Temnopleurus reevsii and the croaker Johnius belengerii dominated the community at Tap Shek Kok, and the species composition was basically similar to that of the study area, although hermit crabs (abundant at the study site) were absent and generally less species was found.

Pelagic species

Fish and macro-invertebrate species found in the gill net survey, together with their general abundance, are shown in Table V1/G1(e). A total of 12 species (8 species of fish and another 4 species of crabs, mantis shrimps and urchin) was recorded. Except for the number of the croaker Johnius belengerii, numbers of all other species were very low. Pelagic catch was extremely poor at Lung Kwu Sheung Tan : only 1 Leiognathus brevirostris and one hermit crab were found in six replicates.

Other than some juvenile flat heads (Platycephalus indicus) and croakers (Johnius belengerii) found in the trawl/gill net samples, no significant number of fish fingerlings was found in the area.

All demersal and pelagic species recorded are species commonly found in the coastal waters of Hong Kong (Annon, 1972; Chan & Chilvers, 1972; Morton, 1979; Richards & Wu, 1985; Hodgkiss, 1988).

Benthos

Except for F2 and F5 where a higher percentage of sand was found, the bottom sediment of the entire study area is fairly uniform and mainly comprises of silt-clay. Preliminary examination on the January benthic samples revealed that both species diversity and species number of benthos were low in the study area. Species noted so far included the holothurian Protankyra bidentata, and Paracaudina sp., the urchin Temnopleurus reevsii , the brittle star Ophiura kinbergii, the gastropod Turritella terebra, the decapod Eucrate sp. and a number of polychaete species. The benthic species noted so far are typical of benthic communities in the western area of Hong Kong as reported in the other studies (Shin, 1977; Lam, 1988; Shin & Thompson, 1982; Wu and Richards, 1981). Detailed identification, however, is necessary before any firm conclusion can be drawn.

4. CONCLUSION

Based on the data collected in January and February 1991, all species recorded so far were those commonly found in marine habitats elsewhere in Hong Kong. Rare species , species unique to the study area and species of particular ecological / scientific interest were not identifiable in the study area (pending on the results of detailed identification of benthic samples, which is now underway).

A diversity of food fish and macro-invertebrate species was found in the study area. In view of the fact that: (a) only low numbers were found, and (b) almost all of the species are not high priced species, the fisheries resource in the study area is unlikely to be important. However, since there is considerable seasonal variations in fish communities, further data covering seasonal variations of demersal and pelagic species are required before any firm conclusion can be established. To this end, the consultants have also written to the Agriculture & Fisheries Department, requesting data on fish landing from the area. This supplementary information will enable the consultants to make a more accurate evaluation on fisheries resource in the study area.

In conclusion, the existing data tend to suggest that the removal of littoral, benthic and fish species from the study area will only exert a localised impact on the marine environment, and is unlikely to cause any significant disturbance to the marine ecosystem, scientific research values and fisheries resources of Hong Kong.

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Table V1/G1(a)
Species list and general abundance of sandy shore fauna found on the transects at Lung Kwu Sheung Tan

Species		General Abundance*
Anthozoan		
	Haliplanella luciae	+++
Bivalves		
	Polychiera rufescens	+
	Saccostrea cucullata	++++
Gastropods		
	Bursa granularis	++++
	Mitrella sp.	+
	Monodonta neritoides	++
	Morula musica	++
	Nassarius sp.	+
	Nerita albicilla	++
	Nerita chamaeleon	++++
	Thais clavigera	+++
Crustaceans		
	Alpheus bisincisus	+
	Epixanthus frontalis	+
	Hemigrapsus sanguineus	+
	Metagrapsus sp.	+
	Nanosesarma minutum	+
	Parasesarma pictum	+++
Polychaetes		
	Marphysa sp.	+
	Nereis sp.	+
	Terebella ehrenbergii	+
Sipunculid		
	Sipunculus nudus	+

*

Very High	++++
High	+++
Moderate	++
Low	+

Table V1/G1(b)
Species list and general abundance of sandy shore fauna found on the transects at Yung Long

Species	General Abundance*
Polychaete	
Ceratonereis sp.	+

*

Very High	++++
High	+++
Moderate	++
Low	+

Table V1/G1(c)
Species list and general abundance of rocky shore fauna and flora found on the transects at Black Point

Species		General Abundance*
Anthozoan		
	Haliplanella luciae	+
Chlorophyte		
	Enteromorpha compressa	++++
Rhodophyte		
	Gelidium amonsii	+
Bivalve		
	Saccostrea cucullata	++++
Gastropods		
	Cellana grata	+
	Nerita albicilla	++++
	Nodilittorina exigua	++++
	Nodilittorina millegrana	++++
	Nodilittorina pyramidalis	++
	Patelloida pygmaea	+
	Siphonaria japonica	+++
	Thais clavigera	++
Cirripedes		
	Balanus sp.	+++
	Tetraclita squamosa	+
	Pollicepes mitella	+++

*

Very High	++++
High	+++
Moderate	++
Low	+

Table V1/G1(d)

Species list and general abundance of fish and macro-invertebrates found in the study areas during the demersal fish survey in February 1991

Species	General Abundance* Yung Long to Lung Kwu Sheung Tan	Tap Shek Kok
Fish		
Accentrogobius caninus	+	
Cynoglossus puncticeps	+	
Dasyatis zujei	+	
Gerreomorpha japonica	+	
Glossogobius giurus	+	
Inimicus japonicus	+	+
Johnius belengerii	+	++++
Leiognathus brevirostris	+	
Monacanthus sp.	+	
Mustelus sp.	+	
Paraplagusia blochi	+	
Platycephalus indicus	+	+
Polynemus sextarius	+	
Pseudorhombus sp.	+	
Siganus oramin	+	
Silago sihama	+	
Solea ovata	+	+
Thrissa kammalensis	+	
Trachurus japonicus	+	
Triacanthus brevirostris	+	
Unidentifed gobbies	+	+
Crabs		
Charybdis truncata	+	+
Charybdis variegata	++	+
Dorippe facchio	+	
Portunus pelagicus	+	+
Hermit crabs	++++	
Shrimps		
Lysmata vittata	+	+
Parapenaeopsis tenella	+	
Metapenaeopsis barbata	+	+
Metapenaeopsis palmensis	+	
Metapenaeus affinis	+	

(cont'........)

Table V1/G1(d) (cont')

Species	General Abundance* Yung Long to Lung Kwu Sheung Tan	Tap Shek Kok
Shrimps		
Parapenaeopsis hungerfordi	+	
Parapenaeopsis cornuta	+	
Parapenaeopsis hardwickii	+	
Penaeus indicus	+	
Penaeus penicillatus	+	
Tozeunia lanceolatum	+	
Trachypenaeus curvirostris	++++	
Other Crustaceans		
Alpheus distinquendus	+	
Oratosquilla oratoria	+	+
Cephalopods		
Octopus aegina	++	+
Gastropods		
Hemifusus ternatana	+	
Turritella terebra	+	
Urchins		
Temnopleurus reevsii	++++	++++

*

Very High	++++
High	+++
Moderate	++
Low	+

Table V1/G1(e)
Species list and general abundance of fish and macro-invertebrates found in the study areas during the pelagic fish survey in February 1991.

Species	General Abundance*
Fish	
Clupanodon punctatus	+
Ilisha indicus	+
Johnius belengerii	++++
Leiognathus brevirostris	+
Paraplagusia blochi	+
Platycephalus indicus	+
Sciaena russelli	+
Solea ovata	+
Crabs	
Charybdis truncata	+
Hermit crab	+
Other Crustacean	
Oratosquilla oratoria	+
Urchins	
Temnopleurus reevsii	++

*

Very High	++++
High	+++
Moderate	++
Low	+

Table V1/G1(f)
Major animals in the benthic samples collected from the study area in February 1991, as based on a preliminary examination of the samples

Gastropod

Turritella terebra

Crustaceans

Eucrate sp.
Some other crab species

Polychaetes

A number of polychaete species

Holothurian

Paracaudina sp.
Protankyra bidentata

Echinoids

Temnopleurus reevsii

Ophiuroids

Ophiura kinbergii

Pisces

Unidentifed species

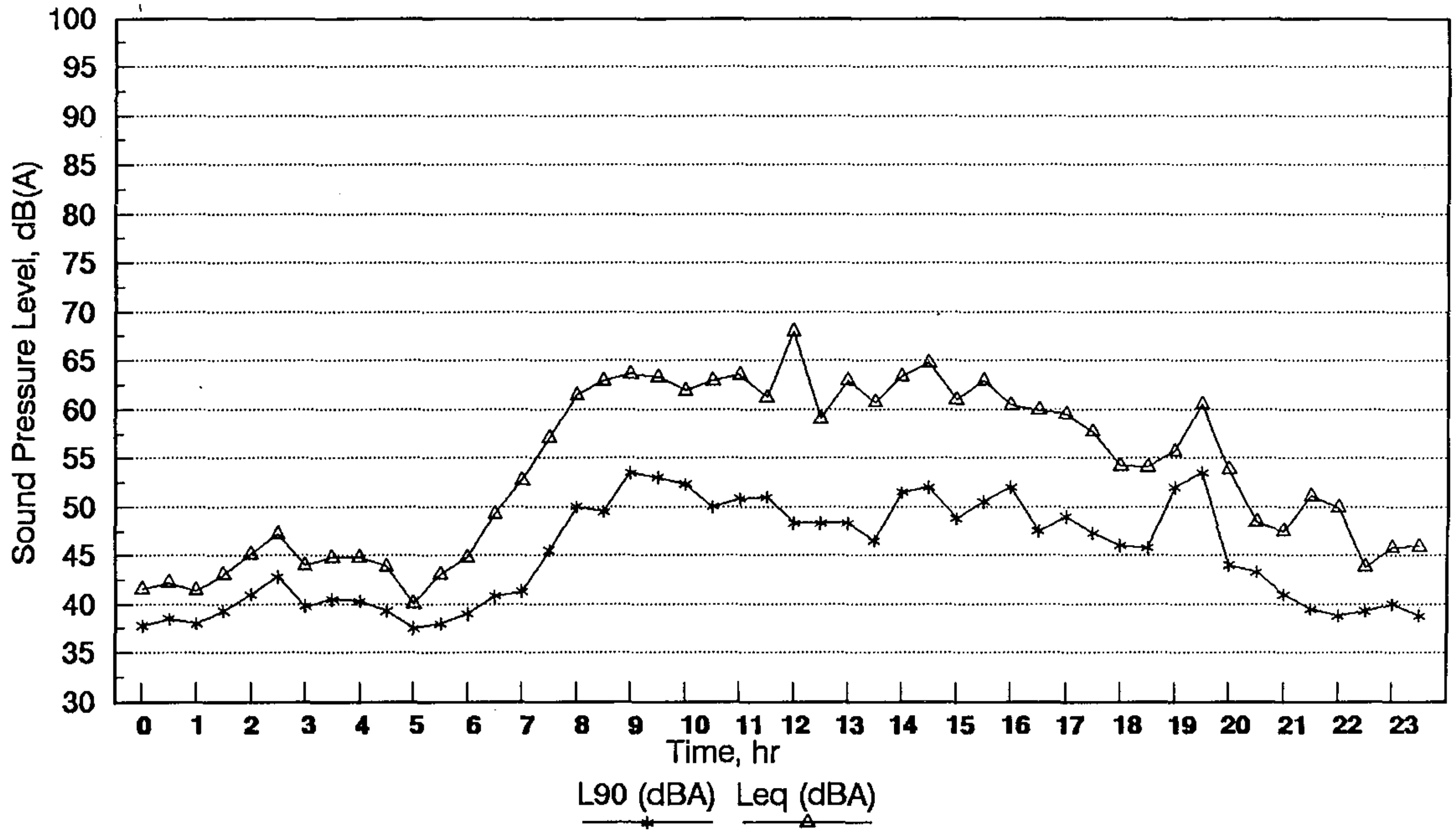

Figure V1/E2 (a) **Existing Noise Level at Lung Kwu Tan Village**

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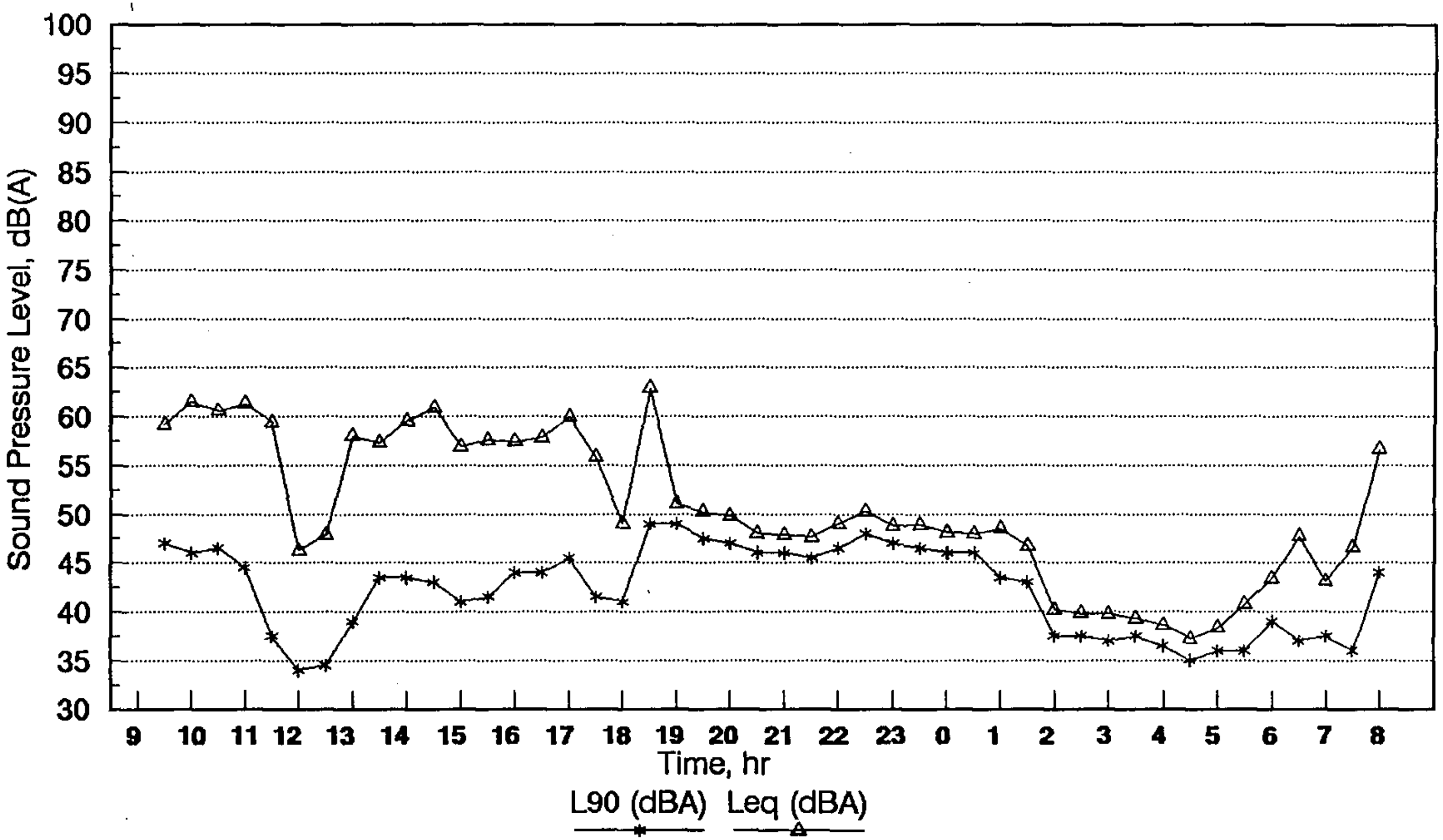

Figure V1/E2 (b) **Existing Noise Level at Lung Kwu Sheung Tan Village**

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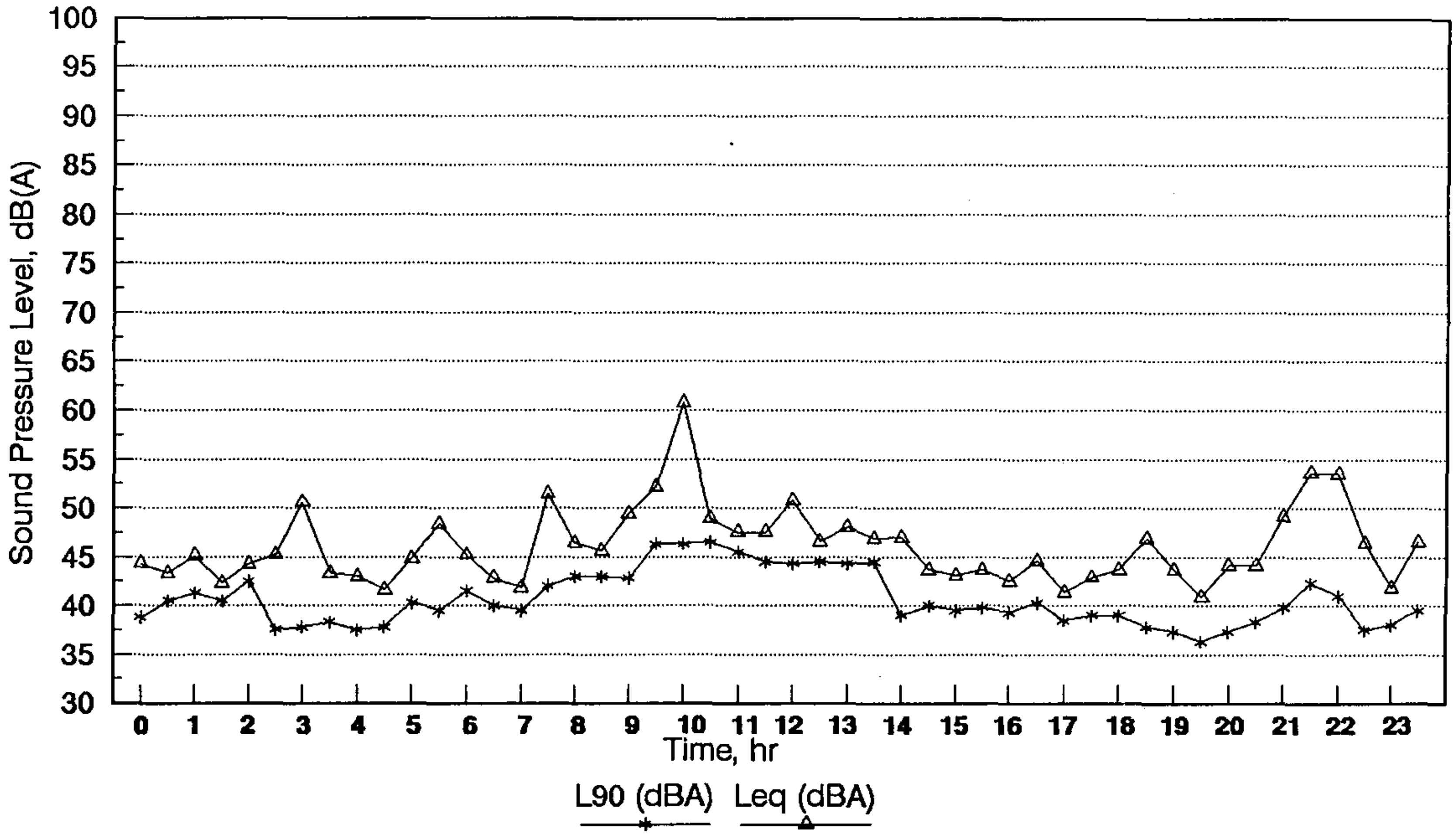

Figure V1/E2 (d) **Existing Noise Level at Tsang Tsui Lagoon Berth Area**

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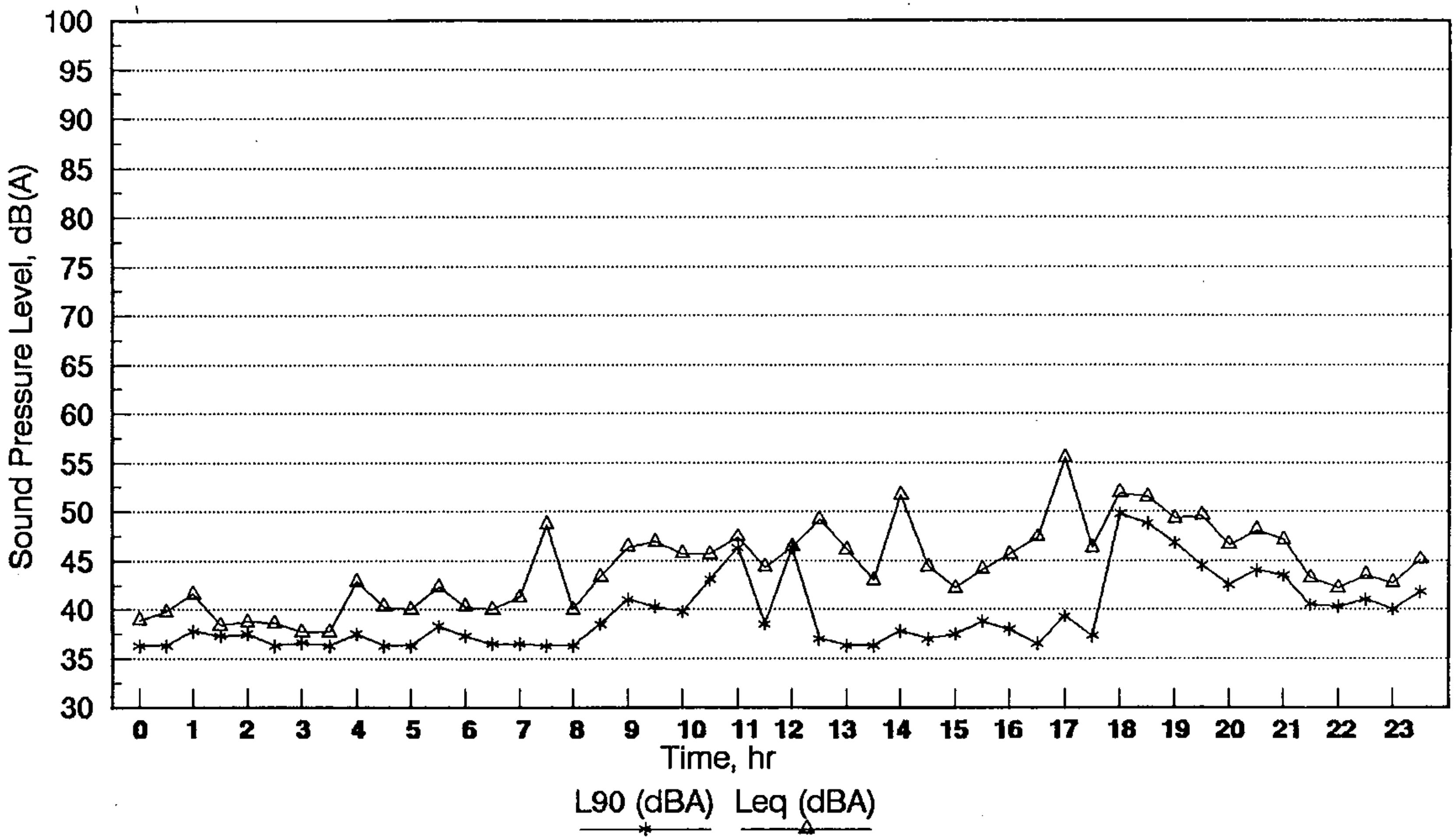

Figure V1/E2 (c) Existing Noise Level at Yung Long Village

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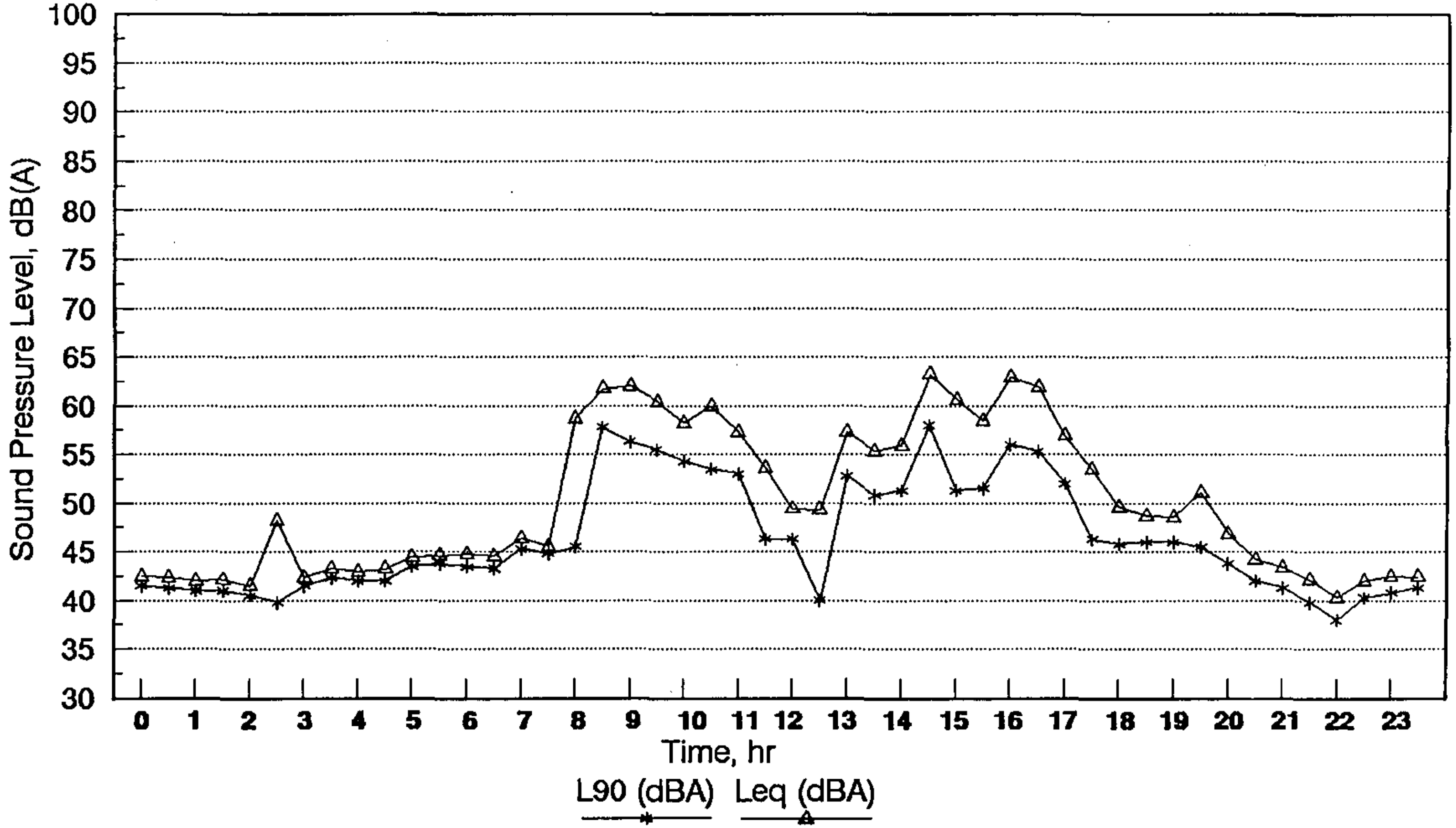

Figure V1/E2 (e) **Existing Noise Level at Nim Wan**

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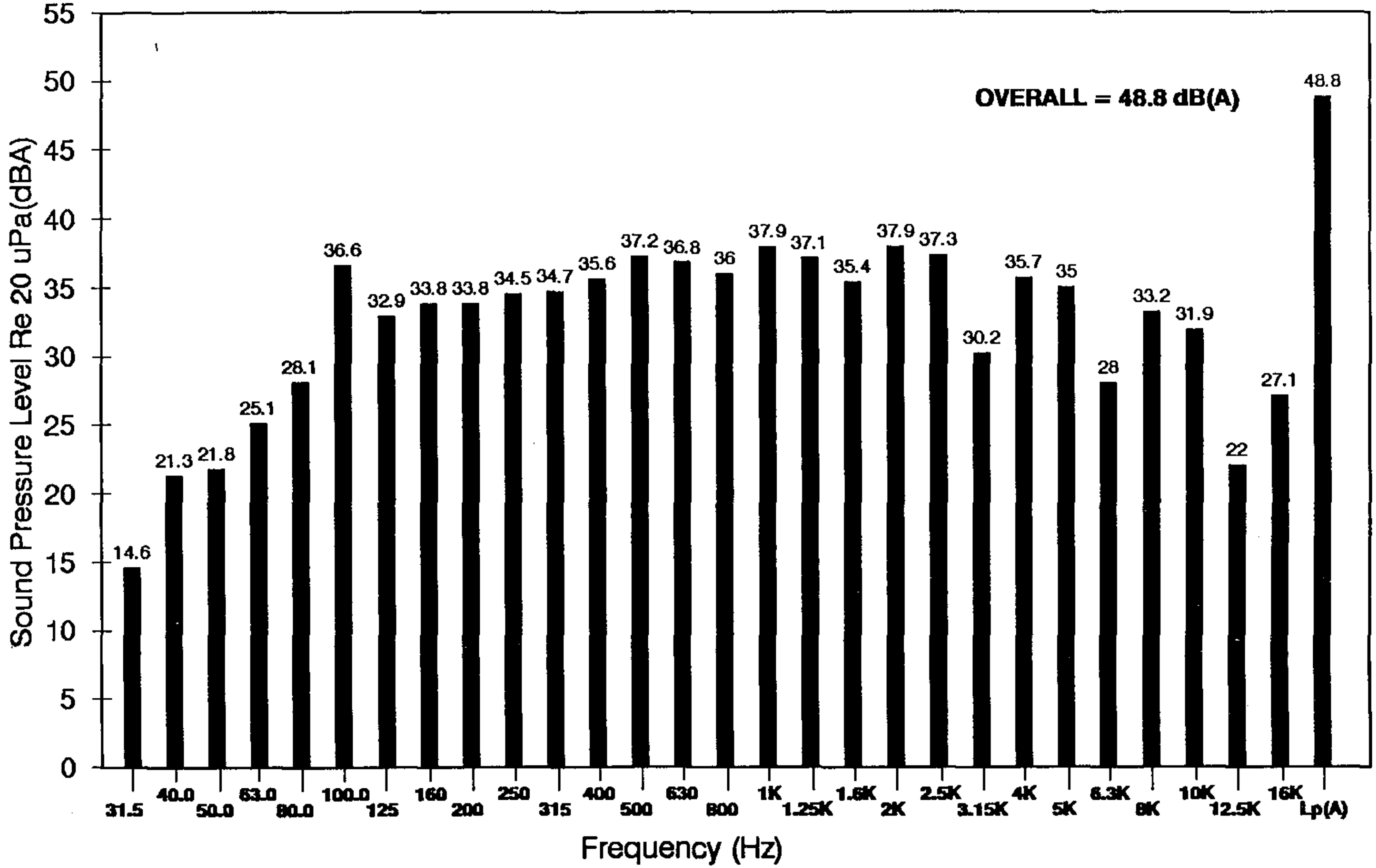

Figure V1/E2 (f) **1/3 Octave Background Noise Spectrum at Site A**

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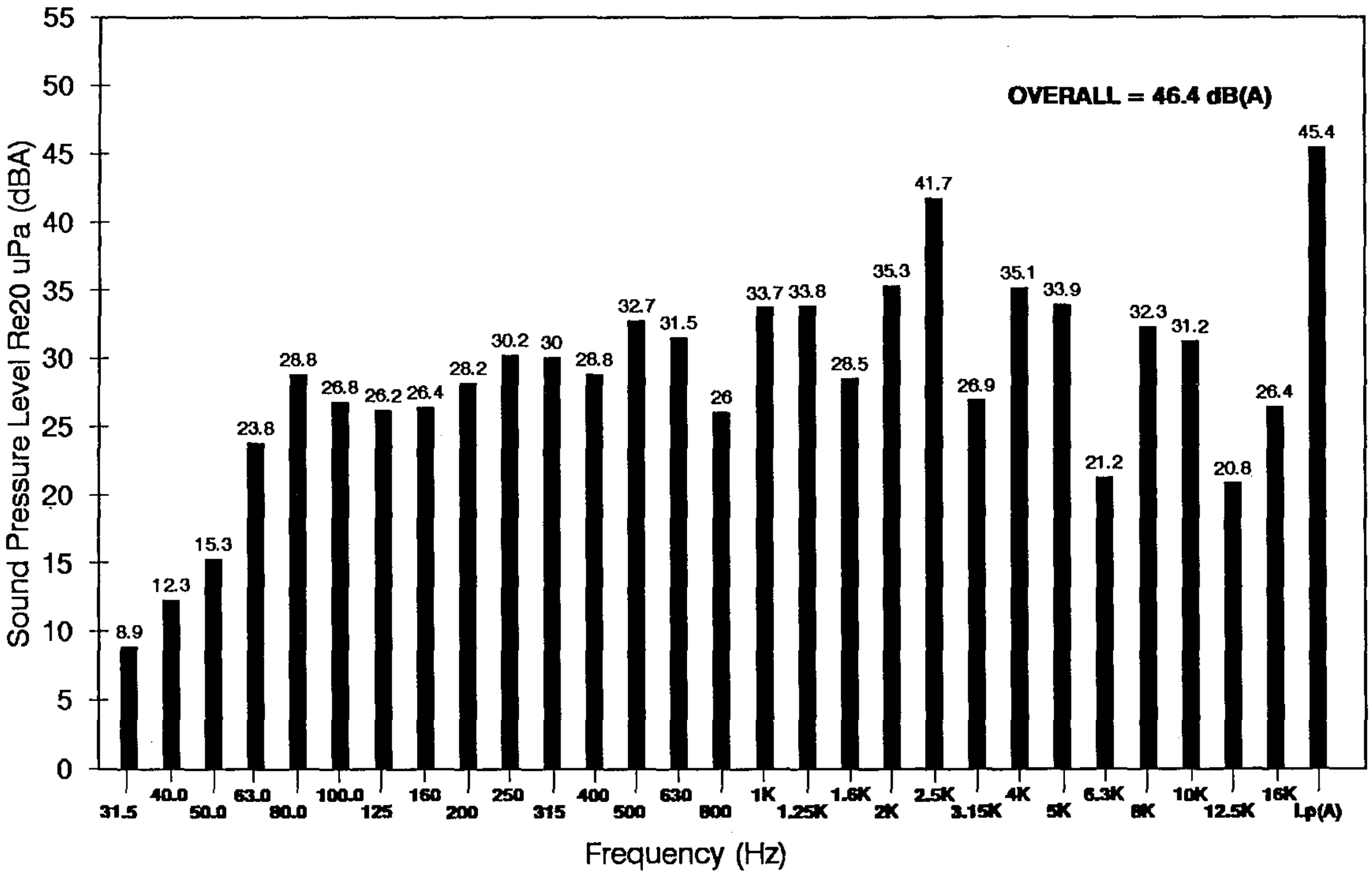

Figure V1/E2 (g) **1/3 Octave Background Noise Spectrum at Site B**

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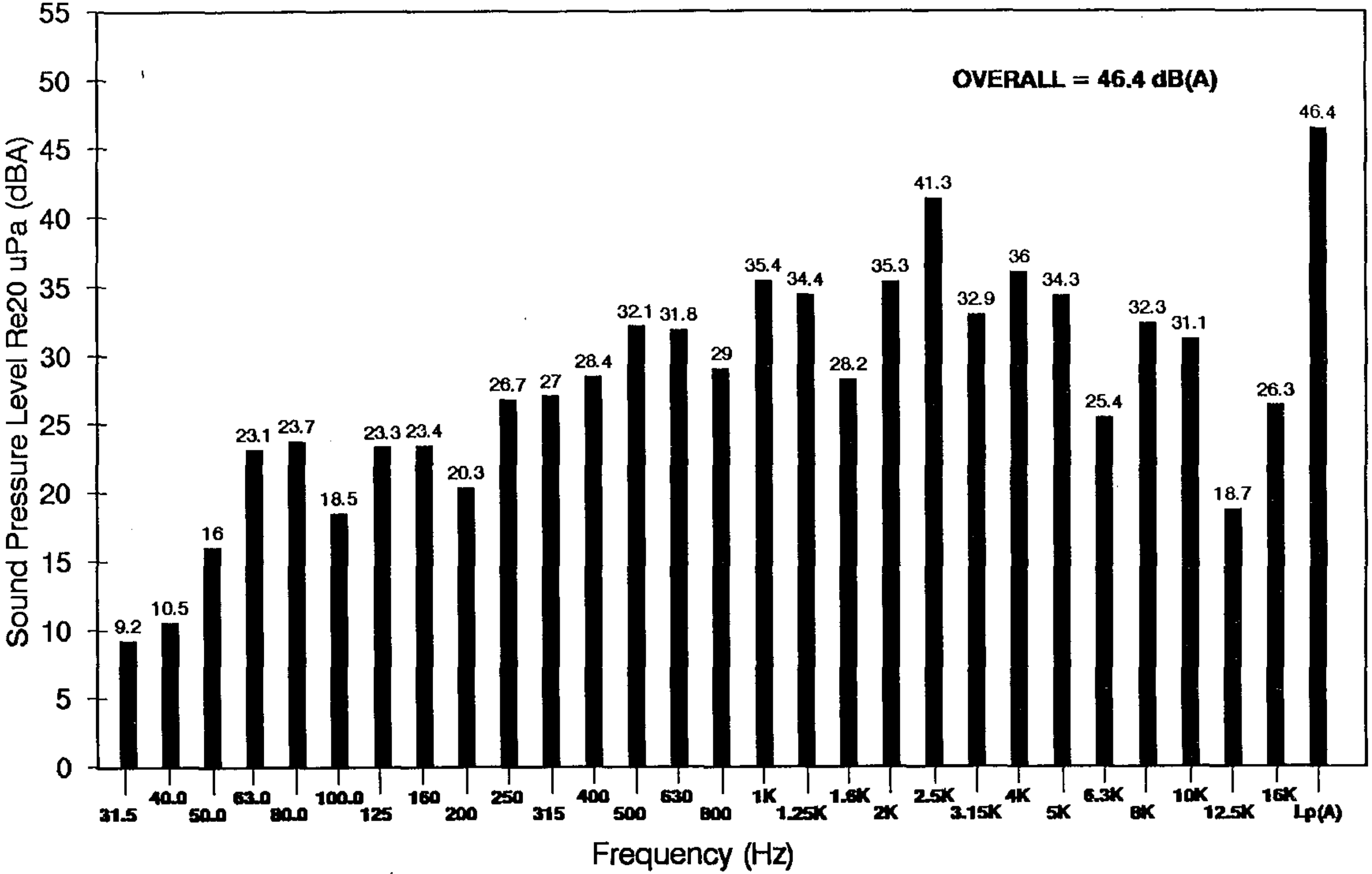

Figure V1/E2 (h) **1/3 Octave Background Noise Spectrum at Site C**

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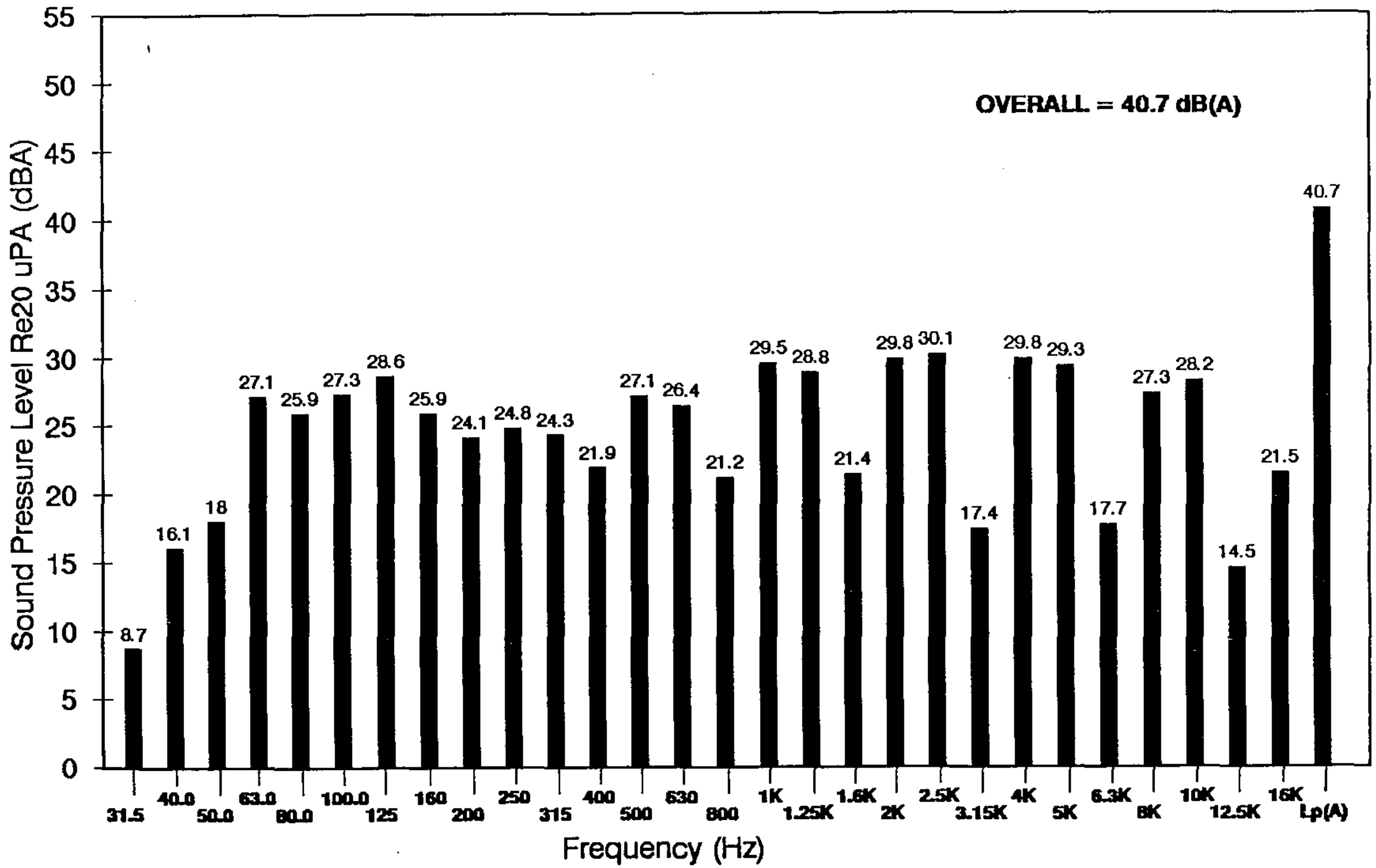

Figure V1/E2 (i) **1/3 Octave Background Noise Spectrum at Site D**

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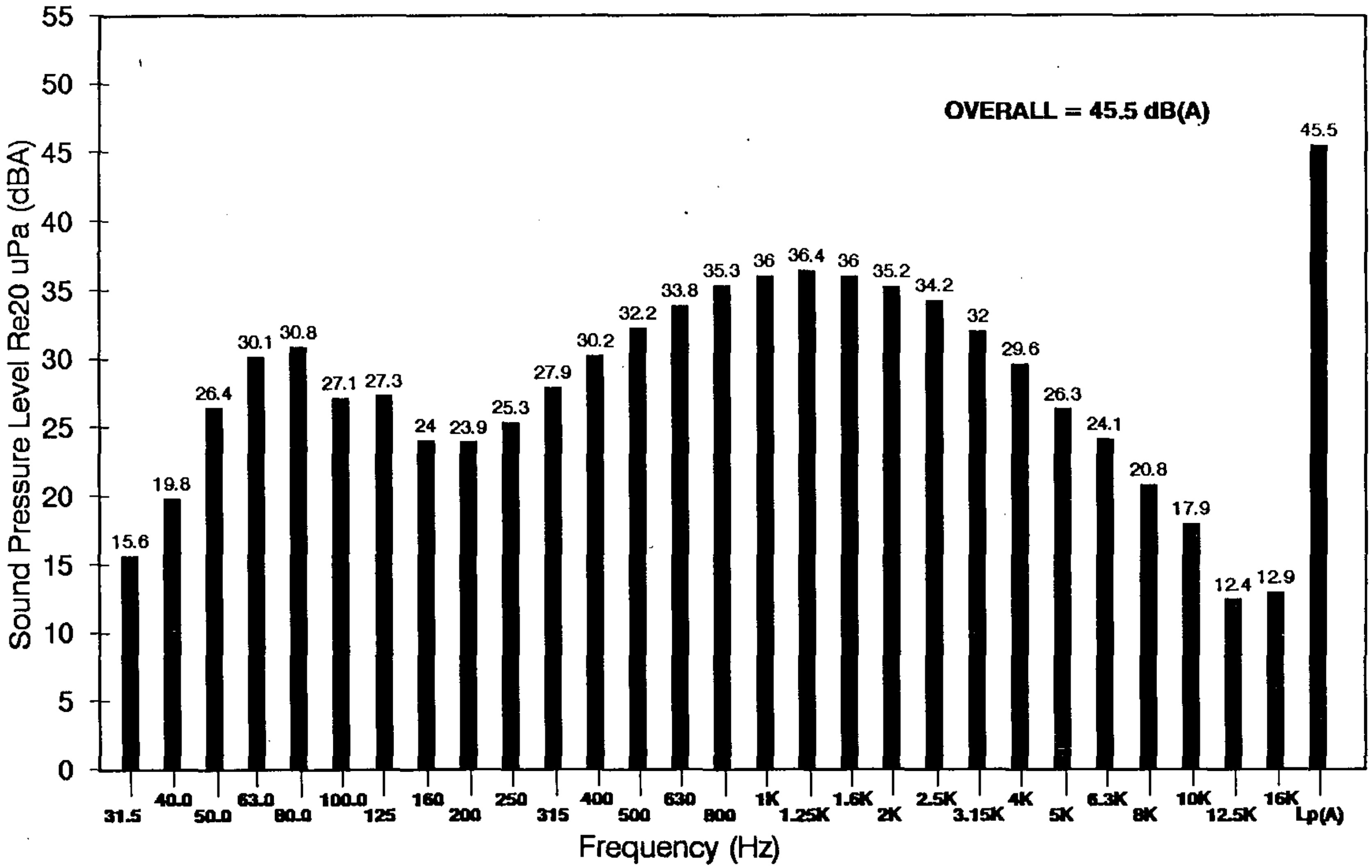
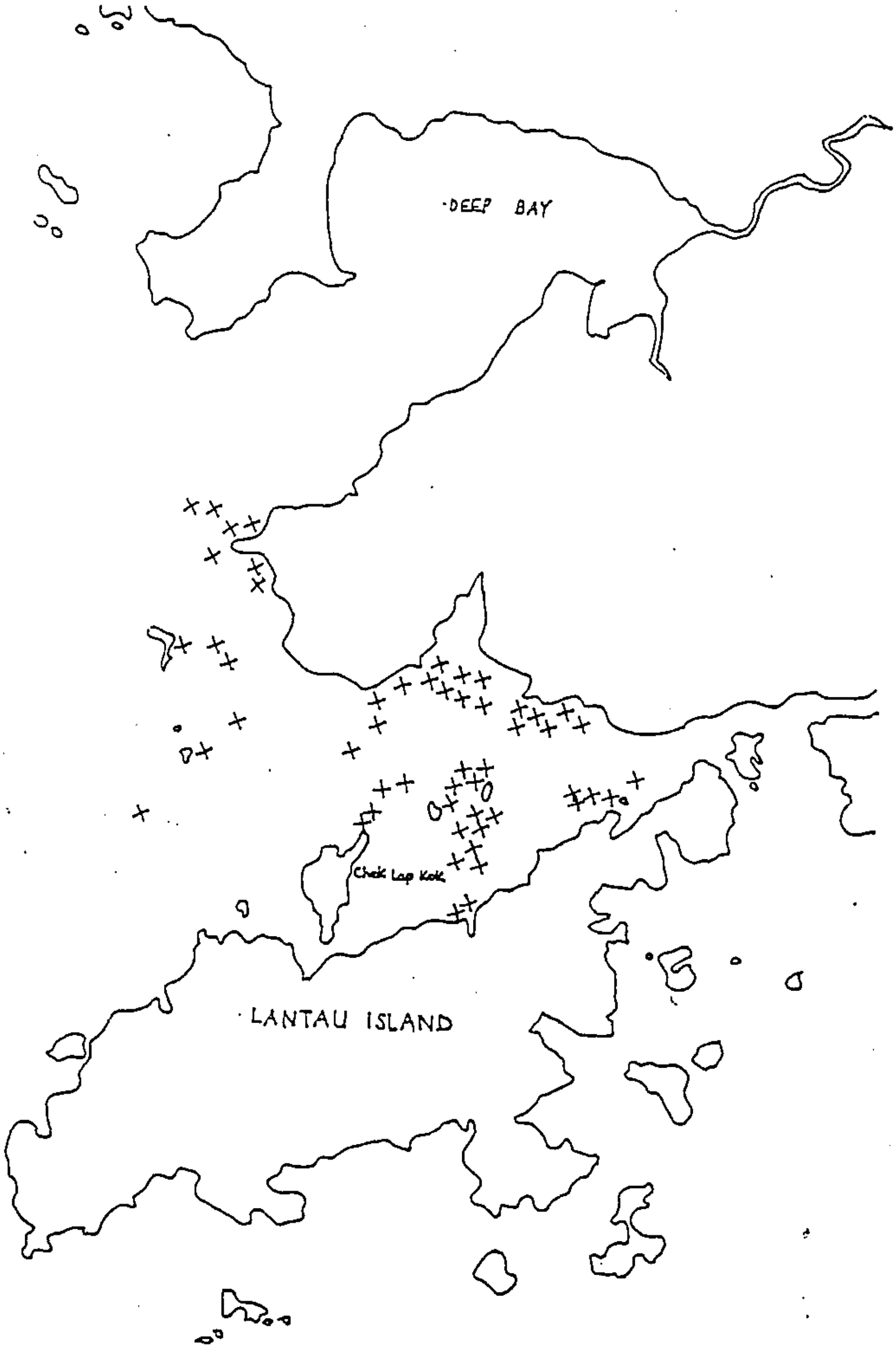


Figure V1/E2 (j) **1/3 Octave Background Noise Spectrum at Site E**

ERL



X - One Dolphin Sighting

Figure V1/G2(a)

Dolphin Sightings: November 1990 - February 1991

Sources: World Wide Fund for Nature and AFD

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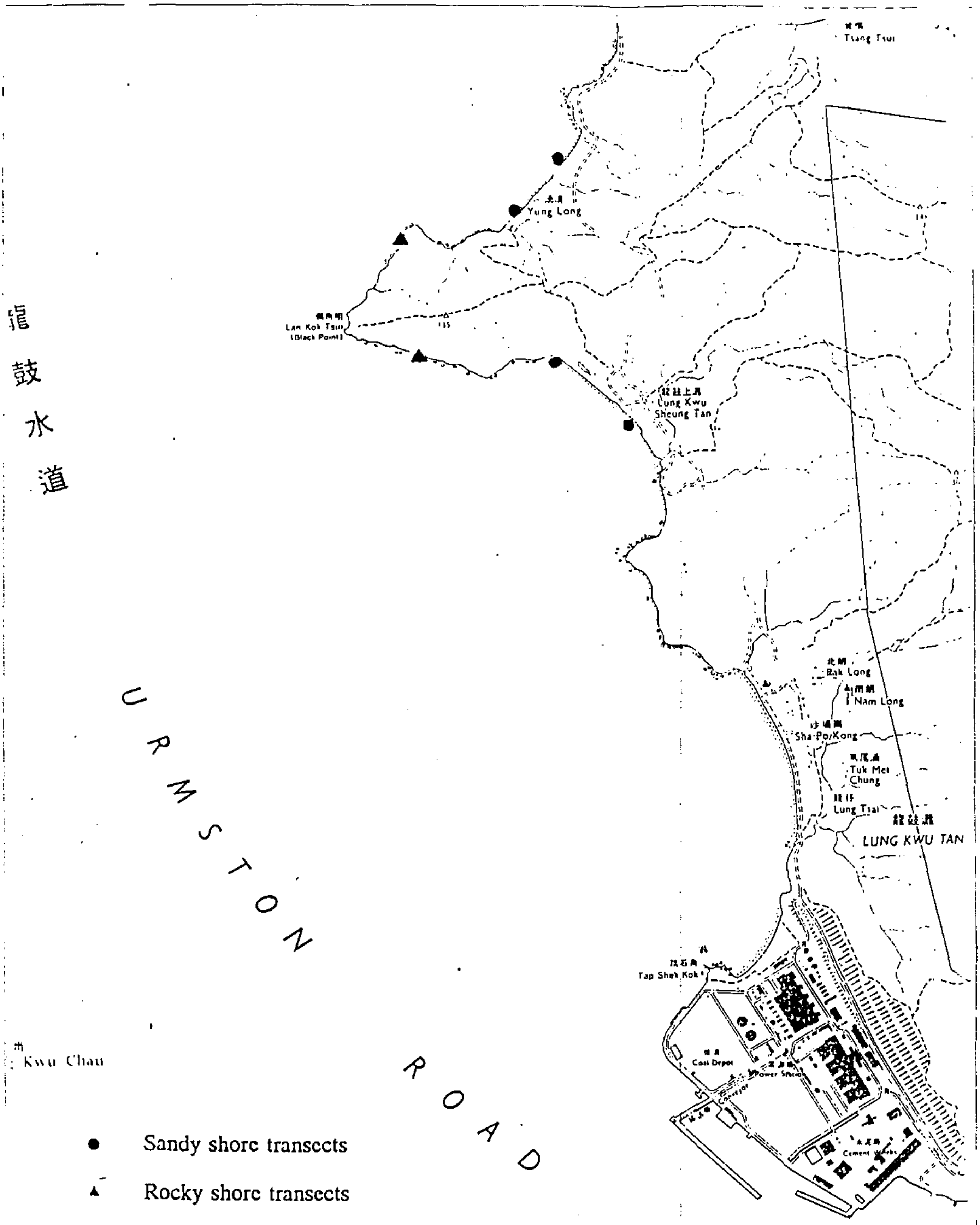

Figure V1/G1(a)

Shore survey: location of sandy shore and rocky shore transects

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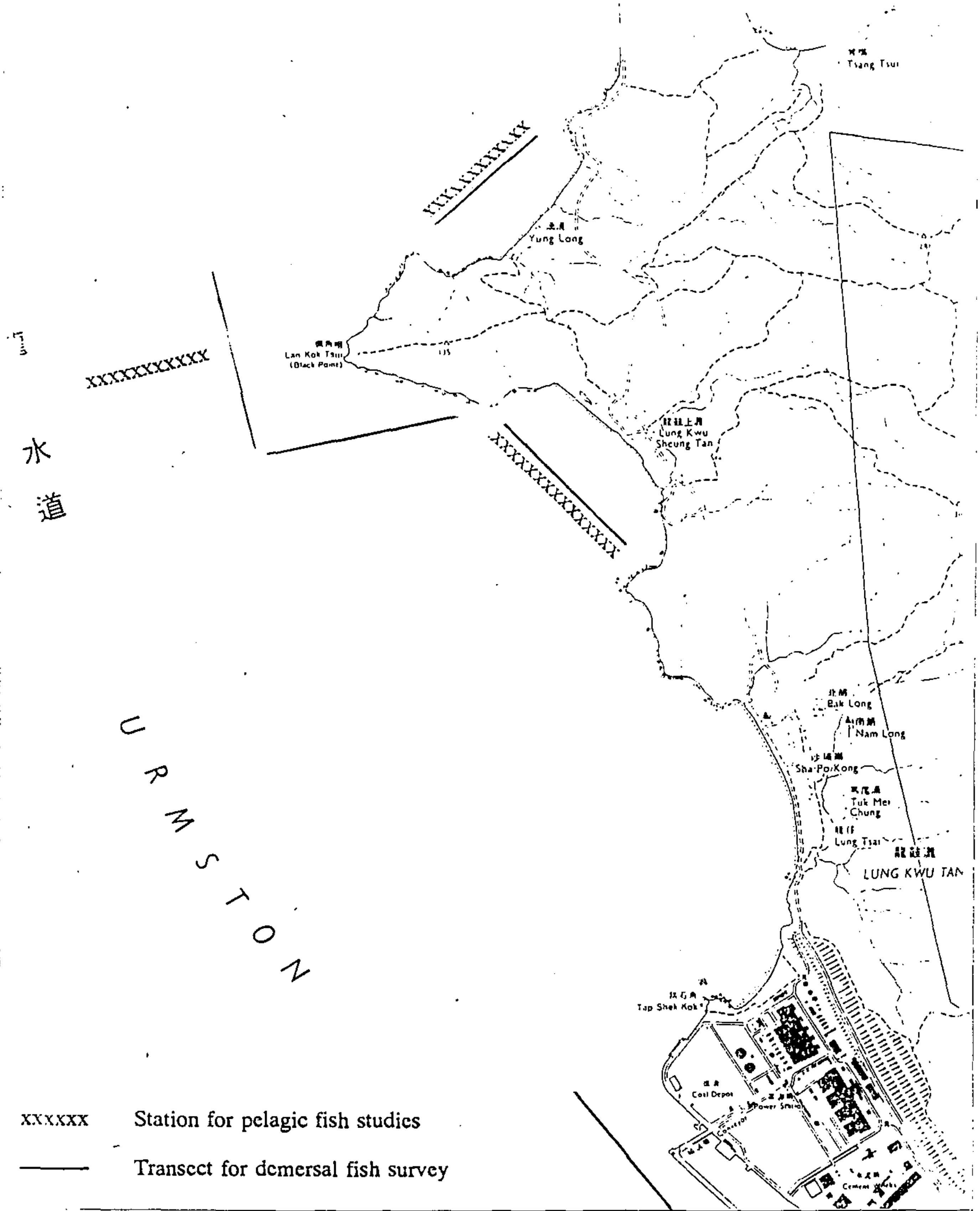

xxxxxx Station for pelagic fish studies

——— Transect for demersal fish survey

Figure V1/G1(b)

Fish survey: location of stations for pelagic fish studies and demersal fish survey

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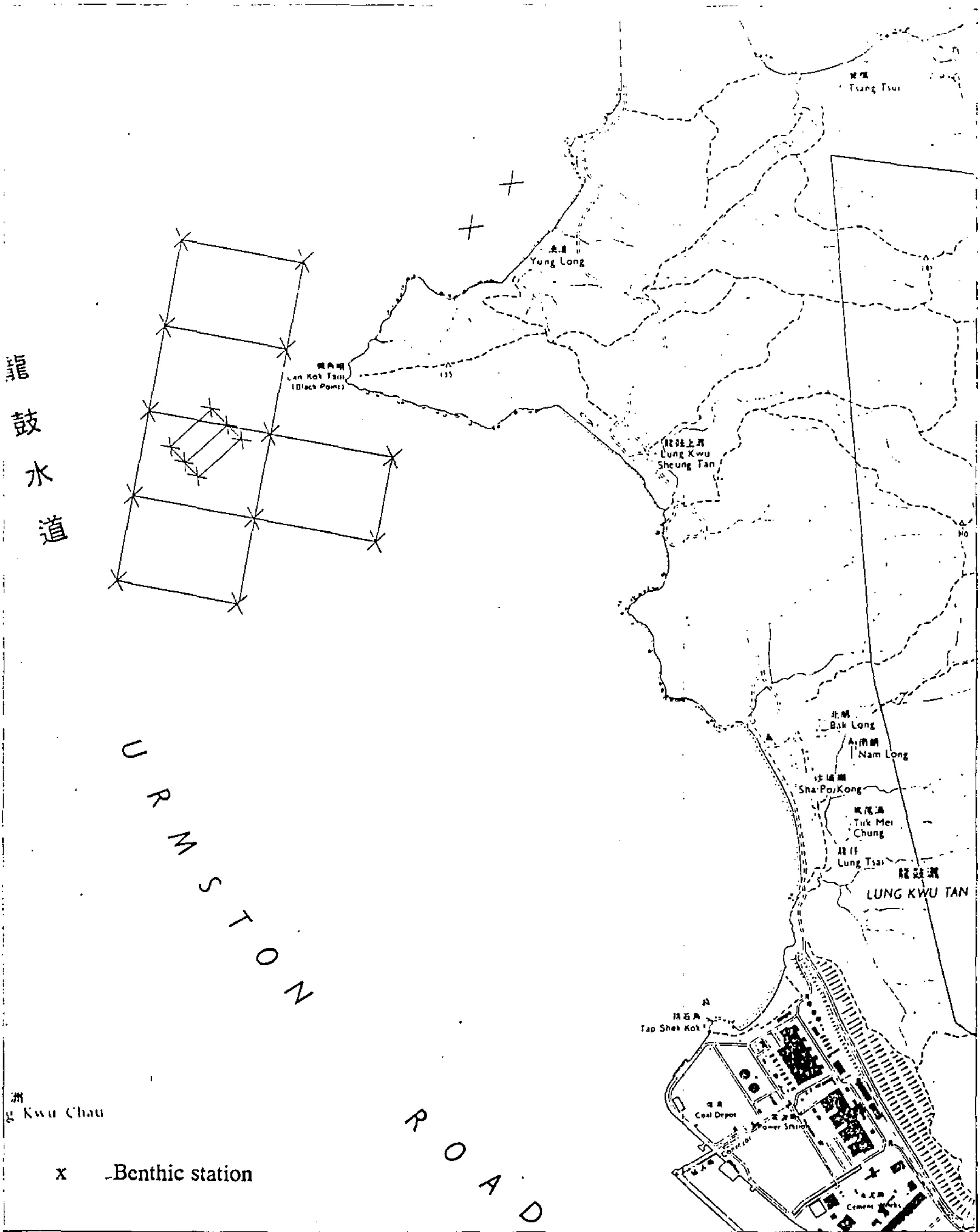

Figure V1/G1(c)

Benthic survey: location of benthic stations

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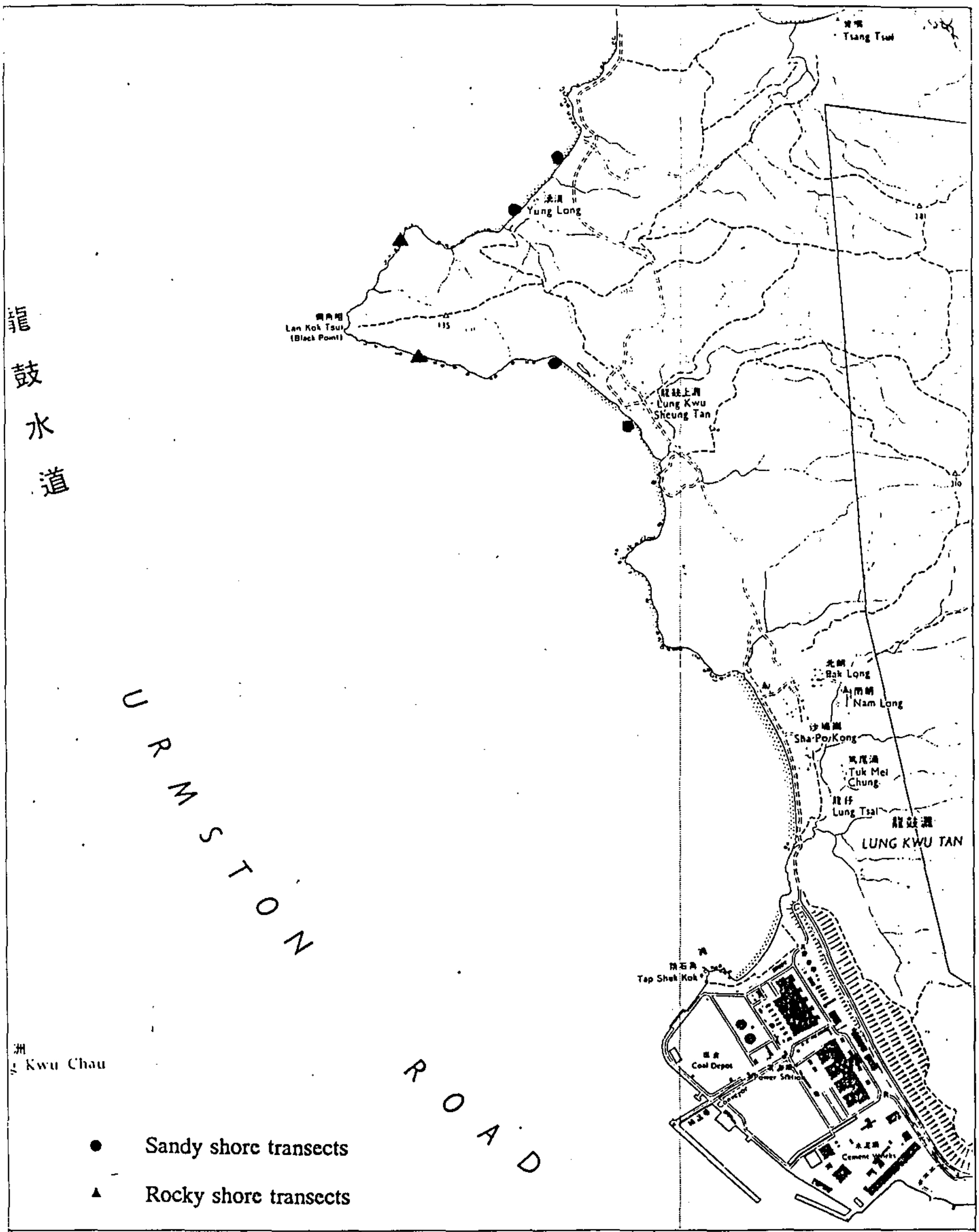

Figure V1/G1(a)

Shore survey: location of sandy shore and rocky shore transects

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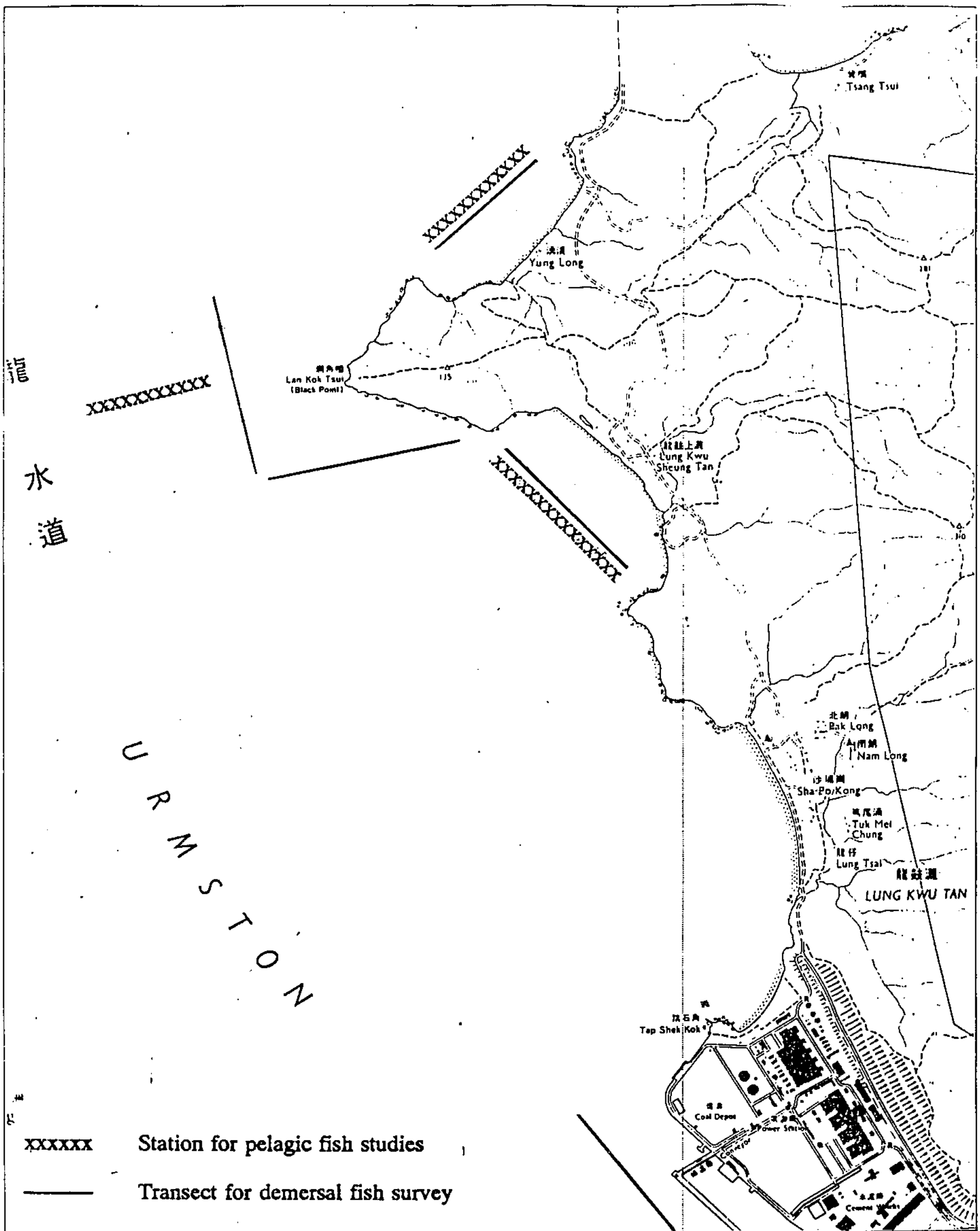

Figure V1/G1(b)

Fish survey: location of stations for pelagic fish studies and demersal fish survey

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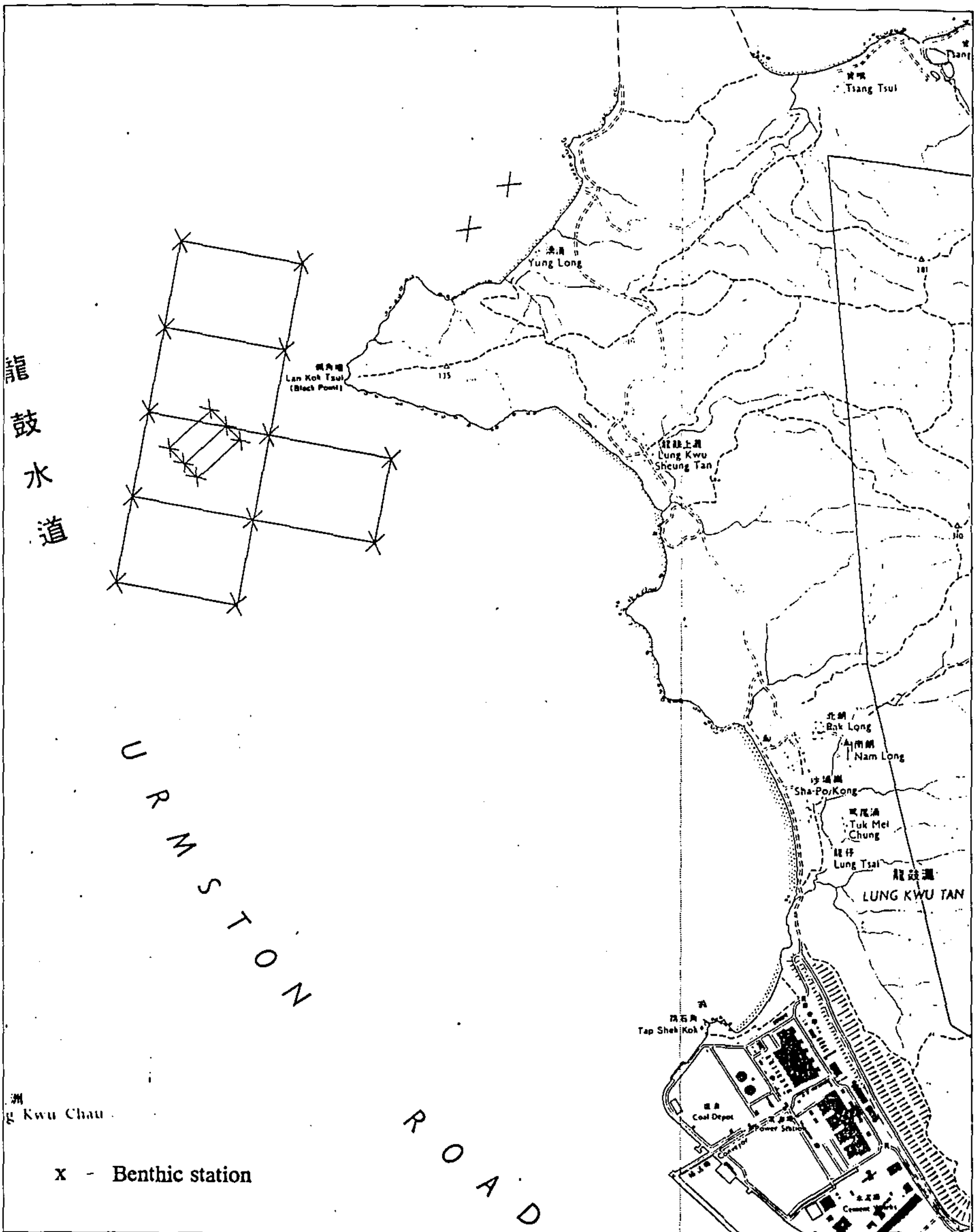

Figure V1/G1(c)

Benthic survey: location of benthic stations

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