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SOUTH-EAST TSING YI PORT DEVELOPMENT PLANNING & ENGINEERING FEASIBILITY STUDY FOR CONTAINER TERMINAL NO.9

FINAL REPORT

APPENDICES

AUGUST 1991

MAUNSELL-SCOTT WILSON

in association with

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APPENDIX A

STUDY BRIEF

South-East Tsing Yi Port Development
Planning & Engineering Feasibility Study
for Container Terminal No. 9

Brief

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AGREEMENT NO. CE 3/90

South-East Tsing Yi Port Development Planning and Engineering Feasibility Study for Container Terminal No. 9

Brief

1. General

1.1 Scope of the Study

1.1.1 The Project, for which the Consulting Engineers are to undertake and perform the duties described in the Memorandum of Agreement, is a planning and engineering study (hereinafter referred to as 'the Study') for the development of South East Tsing Yi. This will include the proposed Container Terminal No. 9 (CT9), together with the necessary backup areas and infrastructure requirements, including the preparation of a technical schedule for the construction of CT9. Preliminary studies which have been completed are referred to paragraph 4.1.

1.1.2 The broad extent of the Study Area is shown on the plan attached at Annex A.

1.1.3 The study shall be completed within a period of twelve months from commencement.

1.2 Background to the Study

1.2.1 On 7 March 1988 Government commissioned the Port and Airport Development Strategy Study (PADS). The purpose of the study was to review the long term requirements and provision of new port and airport facilities, with a view to establishing a development strategy.

1.2.2 Due to the rapid growth rate of container freight passing through Hong Kong the PADS study team was required to make recommendations on suitable sites for Container Terminals 8 and 9 before the end of 1989.

1.2.3 PADS recommended that detailed consideration should be given to two sites, one on the south east side of Tsing Yi Island and the other off the west coast of Stonecutters Island, which appeared to be suitable for CT8.

1.2.4 A planning and engineering study has been undertaken to further investigate the development of CT8 at Tsing Yi and Stonecutters Island including the backup areas and associated infrastructure. The study recommended that CT8 be developed at Stonecutters Island.

1.2.5 The recommendation to develop CT8 upon new reclamation to the north and west of Stonecutters Island was accepted by Government in August 1989. At the same time the development of CT9 was agreed for South East Tsing Yi subject to further detailed studies.

1.2.6 At its 89th meeting on 16 November 1989, the Development Progress Committee approved the PADS Development Statement No. 1 - Container Terminal 9 and Back Up Facilities S.E. Tsing Yi. The purpose of this document was to initiate and guide the detailed planning, environmental and engineering studies for the development of CT9 and back up areas at S.E. Tsing Yi. The study for CT9 will be undertaken having particular regard to the contents of the Development Statement which is attached at Annex B.

2. Objectives

2.1 *General*

Taking into account the results of studies on the marine capacity of the Rambler Channel area and the seawall alignment developed for CT9 in the Site Investigation & Engineering Study for the Development of CT8, to determine the best configuration and development option for CT9. The recommended development option shall include the backup areas and associated infrastructure and shall allow maximum throughput of container traffic, minimum environmental impact on adjacent land users and water quality and minimum effect on harbour operations. It shall also be able to meet the requirement to have the first container berth in operation by November 1994. The first berth and each subsequent berth are each required to have a minimum capacity of 0.4 million TEU's per annum. Where practicable the design of the reclamation should take into account the desirability of alleviating existing environmental problems and the existing general shortage of back-up areas.

2.2 *Specific*

2.2.1 To prepare detailed land use layout plans for the Study Area. This will be done in accordance with good planning practice and with a view to providing compatible developments which minimise the need to reprovision existing facilities or services affected by the works.

2.2.2 To carry out a detailed investigation of suitable marine and land borrow areas to identify and recommend the sources of soft fill and rock for the reclamation, as well as locating and confirming a suitable site and method for the disposal of the dredged spoil, in consultation with EPD.

2.2.3 To identify all marine facilities and installations that may be affected by the development of CT9 and make recommendations for their reprovisioning as necessary.

2.2.4 To assess the traffic impact of the proposed development upon the existing and planned road networks and make recommendations on the provision of external transport links and internal roads including the layout design of new roads and the improvement of existing road networks. Account should be taken of all existing and proposed development/redevelopment on Tsing Yi, in particular the possible development of a multi-purpose terminal on West Tsing Yi, and the use of underground caverns for container terminal related uses or hazardous goods storage.

2.2.5 To investigate and make detailed proposals for the provision of services such as sewerage, water supply, etc. to the study area.

2.2.6 To investigate and make detailed proposals for the reduction of risks associated with Potentially Hazardous Installations (PHIs) such that development of CT9 and associated back-up areas can proceed. Particular reference shall be made to the Interim Risk Guidelines adopted by the Government. Detailed recommendations shall be made as to how the risks are to be reduced and the programme of activities and responsibilities necessary to achieve that reduction shall be specified.

2.2.7 In addition to the risk amelioration outlined above, to carry out a detailed assessment of the environmental impact of the proposed development and recommend appropriate ameliorative measures. Particular regard should be paid to the interface issues arising from the port development activities and the existing residential uses in the area.

2.2.8 To prepare detailed cost estimates and a works programme and to recommend the most cost effective, practical and timely way of carrying out the works to achieve the commissioning of the first container berth not later than November 1994, with each subsequent berth coming into operation at 6 month intervals.

3. Requirements of the Study

3.1 General

3.1.1 In addition to the provisions of Clause 14 of the General Conditions of Employment of Consulting Engineers for the Investigation of Civil Engineering Projects, the Consulting Engineers shall perform the duties and services as detailed in this Brief.

3.1.2 With respect to the development of S.E. Tsing Yi for CT9 and port related uses particular reference shall be made to the PADS Development Statement No. 1 - South East Tsing Yi, in particular Part B - New Land Use Requirements and Part F - Implementation.

3.2 Planning Study

3.2.1 The Consulting Engineers shall prepare Conceptual Land Use plans for a range of development options and shall evaluate those options against agreed objectives and evaluation criteria. The development options produced shall allow for maximum flexibility with regard to final shape, area and disposition of container berths and on-site/adjacent back-up facilities. They shall also show the reprovided marine access arrangements for existing land users and proposed land uses for the Mobil and Hong Kong Oil sites. The boundaries and scale for the land use plans shall be agreed with the Director's Representative.

3.2.2 The recommended development option shall be detailed in Layout Plan(s) which together with a supporting Explanatory Statement shall show:

(a) the layout of internal roads and connections to external road network;

(b) the layout of external road network necessary to serve all existing and proposed developments/redevelopments including crossings of Rambler Channel and connections to Kwai Chung and Tsuen Wan road network;

(c) the recommended location, type of use, dimension and height of buildings, quays, berthing area, container freight station and storage areas and all other planned uses;

(d) the details as to the timing of the stages/phases of the proposed development;

(e) an outline of the drainage and sewerage networks as well as utilities including water supplies;

(f) the parking, loading and unloading areas for various types of vehicles, details of access, gate control and queuing facilities within the site;

(g) interface with the proposed Route 3 alignment and the trunk road and rail link to Chek Lap Kok Airport;

(h) Landscaping and environmental mitigation proposals.

3.2.3 The Consulting Engineers shall prepare plans and supporting documentation to detail the changes necessary to the draft Tsing Yi Outline Zoning Plan (Plan No. S/TY/5) and the draft Tsing Yi Outline Development Plan (Plan No. D/TY/1A) to give effect to the recommended development option.

3.3 *Engineering Study*

3.3.1 The Consulting Engineers shall carry out engineering studies for all the development options, which shall comprise the following aspects:-

3.3.1.1 Fill and Reclamation

(i) Assemble, assess and interpret any existing information and recommend, where required, additional site investigations for the identification of marine sources of filling materials for the reclamation and land-based sources for rockfill. Consideration should be given to the findings of the search for marine sources of fill being conducted by the Geotechnical Control Office. In conjunction with the Fill Management Committee undertake an evaluation of the appropriateness of the possible sources of fill identified, taking into account traffic and environmental impacts. A recommendation on the most appropriate sources of fill shall be made.

(ii) Identify and obtain the agreement of the Fill Management Committee to a suitable proposal for the disposal of dredged material not suitable for a beneficial use. Chemical analysis shall be conducted to assess the quality of the materials to be removed.

(ii) Identify the potential problems pertaining to deep water reclamation having regard to the water movement in the area and recommend methods to overcome such problems.

(iv) Investigate the problems of having to reclaim over existing services taking into consideration future maintenance of the services and recommend methods of protection and/or diversion of the services. In all cases the agreement of the relevant departments/agencies to the recommendations shall be sought.

(v) Recommend, the type and design of seawalls to retain the reclamation. Allowance shall be made for the requirements for the construction of the Route 3 immersed tube tunnel.

(vi) Recommend a suitable method, phasing and programme for the reclamation, taking account of the need to achieve an operation date of November 1994 for the first berth of CT9 and subsequent commissioning of each additional berth at 6-month intervals. Each berth shall have a minimum capacity of 0.4 million TEUs per annum. The method and phasing shall take into account the effects of the programme for the construction of the Route 3 immersed tube tunnel across the Rambler Channel.

3.3.1.2 Land Servicing and Trunk Mains

(i) Propose a main stormwater drainage and foul water network, and a water supply arrangement, after investigation of alternative options in consultation with the Environmental Protection Department, the Drainage Services Department and the Water Supplies Department.

3.3.1.3 Highway Infrastructure

(i) Propose a road network on the study area together with links to the existing network taking into account the possible need to provide a further crossing over the Rambler Channel for container port traffic.

3.4 Environmental Study

3.4.1 The Consulting Engineers shall be required to carry out an Environmental Assessment (EA) of the construction and operation phases of the proposed development options. The EA shall comprise an Assessment Working Paper to identify and address the key environmental issues and, if necessary, recommend suitable and cost effective ameliorative measures. Following the selection of the recommended development option, the Consulting Engineers will be required to refine the EA for that particular option and provide further details for incorporation in the Design Memorandum.

3.4.2 In completing the assessment the Consulting Engineers shall address the following, and any other potential environmental issues:-

(i) Air Pollution:

Examine the air pollution aspects due to borrowing and transportation of fill, reclamation and construction activities and terminal operations and recommend suitable control measures.

(ii) Visual Impact and Glare Nuisance:

Examine and recommend methods of providing lighting that satisfies the need for 24 hour operation of the terminal whilst at the same time minimising the nuisance of glare to adjacent residential development.

(iii) Noise Pollution:

(a) Carry out a predictive noise impact assessment of traffic and cargo handling movements to and from the reclamation and on the reclamation on the basis of the recommended development option, and construction activities (including borrowing, transportation of fill and reclamation activities) on agreed noise sensitive receivers in the light of present and anticipated legislative requirements and the Hong Kong Planning Standards and Guidelines.

(b) Recommend cost effective measures to mitigate adverse noise impacts on all existing, committed and planned noise sensitive land uses likely to be affected.

(iv) Water Pollution:

(a) Collect, assess and interpret existing relevant information and carry out where required detailed site and laboratory investigations for the identification of potentially contaminated marine mud deposits at the reclamation and marine sand borrow areas; and evaluate and recommend the most appropriate method for the expected dredging, reclamation and marine spoil disposal taking into account the potential adverse net and cumulative water quality impacts.

(b) Collect, assess and interpret existing relevant information and carry out where required detailed hydrological studies to ensure optimum bulk water exchange characteristics of the location of quays, berths, crossings of Rambler Channel, back-up areas and the optimum assimilation (dilution and dispersion) of discharges from existing and planned stormwater drainage and foul water networks.

3.4.3 Environmental Monitoring and Audit:

The Consulting Engineers shall specify environmental monitoring and audit requirements comprising baseline, impact and compliance monitoring and compliance and post-project audit. The Consulting Engineers shall also propose an appropriate Action Plan based on the monitoring proposals. This is necessary to identify compliance with regulatory requirements, policies and standards and any remedial works required to redress consequential or unanticipated environmental impacts. This information will be necessary for inclusion in the Design Memorandum.

3.4.4 Hazard Assessment and Mitigation:

The Consulting Engineers shall undertake a risk assessment of the recommended development option and propose a detailed series of measures for the reduction of the risks to acceptable levels. The measures so proposed shall be in the form of a programme and recommended actions by various agencies and departments, which shall be agreed with Electrical and Mechanical Services Department (Gas Standards Office) and Environmental Protection Department.

3.5 Traffic and Transport Study

3.5.1 The Consulting Engineers, utilising the SATURN traffic model developed in the CT8 study, shall assess the traffic impact of the proposed development under each option on the external road network. Problem areas and locations with capacity deficiencies will be identified. The study area which shall be agreed with the Director's Representative, should cover the entire Tsing Yi Island and part of Kwai Chung and Tsuen Wan adjacent to the road approaches to North and South Tsing Yi.

3.5.2 Detailed traffic studies shall be undertaken once the recommended development option is agreed. Problem areas shall also be indicated. A particular set of junctions to be agreed with the Directors' Representative will be examined for capacity deficiencies and appropriate mitigation measures shall be recommended where necessary. These shall include the production of scheme layouts for the junctions concerned. Traffic assessments shall be undertaken for the years 1996 and 2001.

3.6 Technical Schedule

The Consulting Engineers shall prepare, for the recommended development option, a technical schedule for the construction of the container terminal, backup areas and associated infrastructure to enable the formulation of Lease Conditions for inclusion in a tender for the CT9 development, and subsequent detailed design and construction of the works. The Consulting Engineers shall liaise with the District Lands Office, Kwai Tsing regarding the requirements for formulation of the lease conditions. 30 copies of a draft technical schedule shall be submitted to the Director's Representative one month prior to the completion of the Study.

3.7 Development Programme and Costs

The Consulting Engineers shall prepare a detailed estimate of costs and a works programme for the recommended development option, which reflects the most cost effective, practical and timely way of carrying out the works. As far as practically possible, the works programme shall aim to achieve a commissioning of the first container berth not later than November 1994 and thereafter each additional berth at 6-month intervals. The Consulting Engineers, in liaison with the Buildings and Lands Department, shall also take into account the cost estimates (including land resumption costs, compensations under the relevant Ordinances and depreciation in value of the Government's land bank) and programme for land availability.

4. Inputs to Study

4.1 CT8 Study and South East Tsing Yi Development Statement

4.1.1 The Site Investigation and Engineering Study for the Development of Container Terminal 8 Interim Report plus Annexures and Final Report plus Annexures together with the PADS Development Statement No. 1 - South East Tsing Yi, shall form the principal inputs and background to the study.

4.2 Previous and Current Studies

4.2.1 In addition reference shall be made to the following previous and current studies.

4.2.2 Previous Studies

(i) Port & Airport Development Strategy Stage Report No. 2 'Siting of Container Terminals No. 8 and 9'.

(ii) 'Harbour Reclamation and urban Growth Study' (SHRUG) which first proposed the West Kowloon Reclamation.

(iii) The Preliminary Feasibility Study of Route X (now known as Route 3). The final Report of which was completed in April 1988.

(iv) Preliminary study on 'Improvements to Kwai Chung Road South and Container Port Road' which provided information on the traffic conditions in the area and a recommendation on the alignment of the possible link with the West Kowloon Expressway.

(v) Tsing Yi Development Review initiated by Project Manager (Tsuen Wan) to review the development potential of the island.

(vi) GCO Advisory Report No. ADR 30/88 'Marine Sources of Fill - Final Report'.

(vii) Port and Aiport Development Strategy Technical Paper No. 24 'Fill Sources and Costs'.

(viii) Tsuen Wan Transport Study, Phases II and III (1982/83), carried out by consultants for PM/TW.

(ix) Tsuen Wan 1991 Principal Roads Improvement Strategy (1984).

(x) Texaco Road Improvement Feasibility Study (1985) carried out by consultants for Project Manager (Tsuen Wan).

(xi) "Container Port 2000, Development of Container Terminals, Kwai Chung" by HIT, January 1989.

(xii) "Future Expansion of Container Facilities - Tsing Yi Container Port" by MTL, December 1988.

(xiii) Tsing Yi Island Risk Reassessment Study carried out by Consultants for the Director of Electrical and Mechanical Services.

4.2.3 Current Studies

(i) "Water Quality and Hydraulic Model Studies" (WAHMO) commissioned to study the effects of all the proposed urban reclamations on harbour waters, in respect of currents, sourcing, navigation and general water quality.

(ii) "Second Comprehensive Transport Study" (CTS-2), and subsequent updatings the findings of which will define the boundary conditions for the Transport and Traffic Study mentioned in para 3.5.

(iii) "Port and Airport Development Strategy Study" (PADS) being undertaken by the Strategic Planning Unit of Planning Environment and Lands Branch.

(iv) West Kowloon Reclamation Transport Study undertaken by consultants for Project Manager (Urban Area).

(v) West Kowloon Reclamation Planning and Engineering Feasibility Study carried out by the Urban Area Development Office of TDD.

(vi) "Study on Sewage Strategy for Hong Kong" being undertaken by the Environmental Protection Department.

(vii) "Metropolitan Sub-regional Planning Study (Metroplan)" being undertaken by the Strategic Planning Unit of Planning Environment and Lands Branch.

(viii) Review of the environmental implications of the development of CT7 and CT8 at Kwai Chung carried out by the Environmental Protection Department.

(ix) Preliminary planning and feasibility study of container port development and related uses at Stonecutters Island undertaken by Project Manager (Urban Area).

(x) Preliminary studies to formulate an inventory of land required for container back-up facilities and planning thereof in areas east of CT6 and CT7 carried out by Project Manager (Tsuen Wan) and Project Manager (Urban Areas).

(xi) Feasibility Study for improvements to Kwai Chung Road South between Lai Chi Kok Bridge and Tsuen Wan Bypass and realignment/extension of Container Port Road undertaken by Consultants for Project Manager (Tsuen Wan).

(xii) Route 3 - Road Link between North West New Territories and West Kowloon - Feasibility Study. Final Report October - 1989 undertaken by Consultants for Director of Highways.

(xiii) Study of Potential Users of Underground Space (SPUN) being undertaken by consultants on behalf of the Strategic Planning Unit of Planning Environment and Lands Branch.

(xiv) SEAMAT Study - Investigation of marine sources of sand and gravel for use in reclamation and building works, being undertaken by the Geotechnical Control Office.

(xv) Northwest Kowloon Transport Study carried out by consultants for Transport Department.

(xvi) Lantau Fixed Crossing additional studies by consultants for Highways Department.

(xvii) Airport Railway Feasibility Study.

5. Work Programme, Study Management and Reporting Requirements

5.1 Report and Outline Work Programme

5.1.1 The Study shall be completed within a period of 12 months from commencement.

5.1.2 Within 3 weeks of the Study commencing, 30 copies of a brief Inception Report shall be submitted to the Director's Representative for his approval. The inception report shall consist of, inter alia, the following:-

(i) The methodology for the various work streams of the Study.

(ii) A work programme, with major tasks identified and briefly described. The critical activities in the programme shall be clearly defined.

(iii) A schedule of submission of reports, technical papers and plans necessary to fulfill the requirements of the Study. The schedule shall also propose dates for Steering and Working Group meetings.

5.1.3 80 copies of a draft Final Report shall be submitted to the Director's Representative within 10 months of commencement of the Study, subject to the necessary instructions of the Director's Representative. The draft Final Report shall contain all materials specified in this Brief and Clause 14(2) of the General Conditions for Employment of Consulting Engineers for the Investigation of Civil Engineering Projects and other data as may be required by the Director's Representative. A period of 1 month will then be allowed for the circulation of the draft Final Report.

5.1.4 80 copies of a Final Report, together with an Executive Summary, shall be submitted to the Director's Representative within one month of the receipt of comments on the draft Final Report. The Final Report shall contain a summary of the comments on the draft Final Report and the Consulting Engineers' responses.

5.2 *Control of Study*

5.2.1 The Director's Representative for this Study as defined in the General Conditions for Employment of Consulting Engineers will be the Project Manager/Tsuen Wan Development Office of the Territory Development Department.

5.2.2 During the course of the Study the Consulting Engineers shall report directly to the Director's Representative and all work shall be submitted to him. Where required information is not available by a specific date, the Consulting Engineers will be directed by the Director's Representative as to the appropriate assumptions to be made in the light of information available at that time. In addition to their duties specified in the General Conditions for Employment of Consulting Engineers, the Consulting Engineers shall attend meetings as required by the Director's Representative to discuss matters related to the Study.

5.3 *Liaison*

5.3.1 The Consulting Engineers shall maintain necessary liaison and consultation with the relevant Government departments and other relevant parties throughout the course of the Study. The Director's Representative shall be involved in such discussions where possible. Correspondence recording decisions reached in discussions with Government departments and other parties shall be copied to the Director's Representative and to other departments who are likely to be affected.

5.4 *Steering Group/Working Group*

5.4.1 A Steering Group will be formed within Government to provide guidance to the Consulting Engineers on all policy matters and consider all the major recommendations from the Consulting Engineers and to monitor progress.

5.4.2 In addition, Working Groups will be formed within Government to provide general and technical guidance to the Consulting Engineers in their tasks required by this Brief, to facilitate the exchange of information and monitor progress. The Consulting Engineers will be required to provide secretarial services for Working Group meetings.

5.4.3 The Project Director or Study Manager, as appropriate, of the Consulting Engineers, together with one or more of his professional staff of the study team will be required to attend meetings of the Steering and Working Groups. Consulting Engineers may be required to attend briefing sessions for District Boards and other relevant committees when required.

5.4.4 All submissions to Steering and Working Groups shall be in the form of a written paper together with supporting plans and diagrams as required. All papers for Steering and Working Group consideration shall be available not less than 10 working days prior to the agreed meeting date.

5.5 *Study Outputs and Reporting Requirements*

5.5.1 Unless otherwise specified, the Consulting Engineers shall supply the Director's Representative with up to 30 copies of all reports, technical papers, plans and other supporting documents as may be required during the Study.

5.5.2 The Consulting Engineers shall also supply the Director's Representative with 2 copies each of the film transparency (positive) of the Conceptual Layout Plan and other engineering drawings produced for the Study.

5.5.3 The Consulting Engineers shall submit to the Director's Representative at the end of the Study two sets of data input files to the models used in the study. These files will be in the form of disks and hardcopy printouts.

5.5.4 With respect to the Works Programme referred to in paras 2.2.7 and 3.7 the output shall be in the form of comprehensive activity networks in accordance with the computer based PERT methods used by PADS/PCO. These being TIMELINE software by Symantec Inc, on MS.DOC o/s, 80286 computers. A network diagram shall be required showing in detail the duration of all activities, resources required, the critical path, all key dates and any other dates or important events taking into account the activities of Agencies, other authorities, contractors or organisation impacting on the proposed activities. Activity duration shall be measured on a weekly scale. Any activity exceeding 12 weeks in duration shall be divided into sub-activities the duration of which shall not exceed 12 weeks. The number of activities on the network diagram shall not normally be more than 500, but shall contain sufficient detail to permit control of the proposed activities.

6. General

6.1 *Design Standards*

For the purpose of this Study, design and planning standards which are in current use by Government departments, shall be adopted. Should instances arise where appropriate standards do not exist or where modification to existing standards appears desirable, the Consulting Engineers shall submit proposals to the Director's Representative for approval.

6.2 *Design Memorandum*

The Consulting Engineers shall submit 10 copies of a Design Memorandum at the same time when submitting the draft final Report stating the design criteria that shall be used in the future detailed design of the recommended proposals.

6.3 *Consulting Engineers' Office*

The Consulting Engineers shall maintain an office in Hong Kong under the control of a Resident Partner who shall be responsible for the Study. He shall have adequate authority and sufficient professional, technical and administrative support staff in all relevant disciplines to ensure progress to the satisfaction of the Director's Representative.

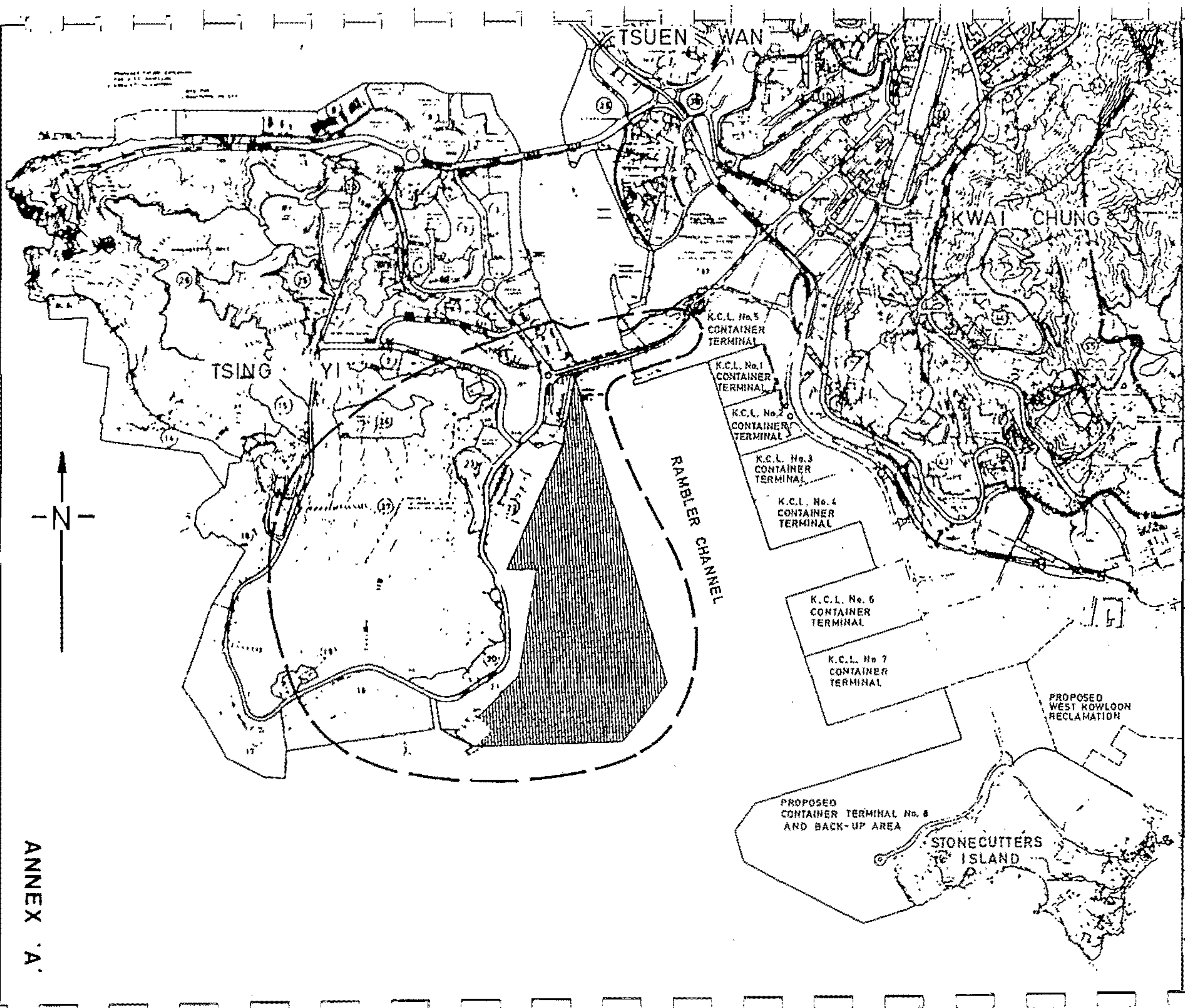
6.4 *Documents*

A copy of any relevant Government documents and manuals (except the Civil Engineering Manual and the Transport Planning & Design Manual) not already available from the Government Publications Office, drawings and plans, together with one clear polyester film transparency of any drawings and plans published by the Buildings and Lands Department and relevant to the Study will be supplied free of charge to the Consulting Engineers when requested. A charge may be made for additional copies, if these are required.

6.5 *Units of Measurement*

The system of units to be used is the SI (System International d' Unites).

ANNEX 'A'



No	DATE	DESCRIPTION	INITIAL
REVISION			

	NAME	DATE
DRAWN	B.Y. TSUI	21-5-90
CHECKED		

APPROVED

CHIEF ENGINEER

DATE

FILE No	TW 2/350 CL / 41
PROJECT No	350 CL

DRAWING TITLE

SE TSING YI PORT
DEVELOPMENT–
PLANNING AND
ENGINEERING
FEASIBILITY STUDY
FOR CONTAINER
TERMINAL NO. 9

DRAWING No	SCALE
TWCE/1287	1 : 30 000

TSUEN WAN
DEVELOPMENT OFFICE
TERRITORY DEVELOPMENT

PADS

Development Statement No.1

South East Tsing Yi

Strategic Planning Unit
Planning, Environment & Lands Branch
April 1991

ANNEX `B´

PADS Development Statement No. 1 : South East Tsing Yi

Introduction

1. ExCo on 10th October 1989 approved the selection of the PADS Recommended Strategy B (Chek Lap Kok airport) as a basis for the future planning of port and airport facilities in Hong Kong. In that context, the Governor also announced that Container Terminal 9 and associated back up facilities should be sited on South East Tsing Yi.

2. In order to implement the Strategy, it will be the general practice for the Planning Department to initiate procedures through the preparation of Development Statements. Such Statements will provide a link between the broad brush strategic studies and local action area planning and project implementation by specifying land use requirements and guidelines for the development of major PADS projects.

3. Using Development Statements as a context, detailed planning, transport and engineering feasibility studies and environmental assessments, will need to be co-ordinated by TDD to draw up land use/transport development plans and development programmes to achieve the objectives described in this Development Statement.

4. This Development Statement sets out the land use guidelines for the development of port facilities on SE Tsing Yi and provides guidelines on how these may be satisfied. It sets out objectives for port development; indicates the requirements for various facilities and how their development will affect existing and proposed land uses; identifies land use planning constraints which need to be taken into account in planning the area; and illustrates general development concepts.

Port Development on South East Tsing Yi

5. Port Development on Tsing Yi will comprise:

- CT9 and its associated backup facilities;
- back up facilities to help alleviate shortages elsewhere in the Kwai Chung port area;
- marine facilities necessary to serve existing deep waterfront industries; and
- supporting facilities and infrastructure.

Study Area

6. The study area comprises the proposed reclamation area at SETY together with adjacent lots, and a notional area for a SPUN cavern under Tsing Yi. The area to be covered in traffic studies is wider, including the whole of Tsing Yi and part of Kwai Chung.

Development Objectives

7. Port development on Tsing Yi will be implemented within the overall constraints imposed by the safe operation of the port, and in such a way as to aim to:

(a) maximise the capacity and efficiency of the port in terms of throughput;

(b) maximise the efficiency of the port in terms of the landward movement of goods;

(c) provide for expansion or relocation of existing facilities;

(d) provide for the timely provision of Route 3;

(e) maximise opportunities for the replanning of and improvement to existing urban development on Tsing Yi;

(f) minimise, and where possible provide the opportunity to reduce, the impact of noise, air pollution and glare on sensitive uses;

(g) ensure that the risk posed by existing and proposed PHIs meets the Interim Guidelines;

(h) ensure that development does not degrade water quality, and will not lead to environmental problems;

(i) minimise the disturbance to existing communities during and subsequent to construction;

(j) ensure that the Metroplan Landscape Strategy for the Urban Fringe is upheld;

(k) ensure that the land uses are flexible both in terms of distribution and timing without prejudicing the overall development strategy;

(l) ensure that development can be implemented according to a logical sequence; and

(m) maximise revenue to Government

8. The Study Steering Group will need to agree on the relative importance of the objectives, and derive appropriate evaluative criteria.

South East Tsing Yi in the Future:
New Land-Use Requirements - Characteristics and Timing

9. The port land uses to be taken into account in the formulation of the Development Plan and Programme for SETY include a 3 berth (possibly 4 berth) container terminal, a range of back-up facilities, cargo working areas and infrastructure. Various existing industries and a navigational aid for aircraft will be affected by the reclamation and will need to be modified or reprovisioned. Depending on the land use budget there may be scope for other land uses.

Container Terminal

10. The container terminal will comprise 3 berths with a minimum combined capacity of 1.2M TEUs pa. On the basis of the current trigger point forecasts, which will be considered by the Port Committee early next year, the berths will need to become operational as follows:

Berth 1	12/94
Berth 2	5/95
Berth 3	10/95

11. It is possible, however, that CT8 on Stonecutters Island will comprise 4 berths. A decision on this will be taken during the course of the SETY studies. A 4th CT8 berth could delay the trigger point for the 1st berth of CT9 by 10 months. Consideration will also need to be given a 4th berth at SETY (available 3/96 or later depending on the number of berths on CT8) should the CT8 Study Stage 2 indicate that the associated additional marine traffic could be accommodated in Rambler Channel. Such consideration will include an analysis of traffic and other environmental impacts, and the effects on the provision of back-up facilities proposed on SETY.

Cargo Working Areas

12. PADS has indicated that 800m useable quay face for cargo working is required on SETY by 6/94.

Backup Facilities

13. Land for the provision of port backup facilities is also important, but the opportunities for meeting such needs are spread over a wider geographical area than that encompassed by SETY. However, in view of the constraints on land available elsewhere in Kwai Tsing, SETY must be regarded as the principal opportunity area to alleviate the current and projected short-term shortfalls.

14. The level of demand to be met within Kwai Tsing is set out in PADS TR5 and TP21. These are summarised in Table 1.

Table 1

Back Up Facilities - Land required to meet current Shortfall and Demand to 1996 in the Kwai Chung Area

CFS (40,000m.sq)	4 ha
Empty box storage/repair	24 ha net
Tractor/trailer parking/repair	45 - 70 ha net

15. In respect of CFS requirements, the CT8 Study indicated that trade has increased at a greater rate than that assumed in PADS, and concluded that it would be prudent to allocate some land for an off-terminal CFS in association with container terminal development. The CT8 Study noted that should the current rate of increase in trade continue, PADS' TEU throughput estimates could be about 2 million too low by 1996. This would generate an additional demand for off-terminal CFS facilities for 200,000 TEU pa, requiring about 40,000 m.sq. of undercover floorspace. This is equivalent to 2 floors of an ATL - type CFS for which a ground area of 4 ha is needed.

16. The estimate for tractor/trailer parking is a range based on a 50:50 split of multistorey and open ground parking for the lower (45ha) estimate rising to 70ha if all demand is accommodated on open ground.

17. The above requirements for back-up facilities within Kwai Tsing are based on the premise that part of the total demand will be met on Short Term Tenancies within Kwai Tsing. That is, the demands are net of an allowance for the continuation of existing STTs. The demands are also additional to land now permanently alienated for backup landuses. Table 2 and Appendix B set out the demand in Kwai Tsing in 1996 assumed to be met by existing STTs.

Table 2

Back-up Facilities on Existing STTs in Kwai Tsing Assumed Continue to 1996

Empty box storage/repair	6.0 ha net
Tractor/trailer parking/repair	7.5 ha net

Deep Waterfront Industry

18. In accordance with PADS recommendations, land will generally not be made available in SETY for Deep Waterfront Industry other than for the reprovisioning or expansion of existing SETY industries affected by port development.

Infrastructure - Route 3

19. Provision will need to be made for Route 3 (CRA4) and associated junctions. CRA4 is currently shown to traverse the reclamation from a tunnel portal near Tsing Yi Road in Area 21 to a tunnel under the Rambler Channel at the southern end of the reclamation. (See Figure 2). Consideration is also being given to routing CRA4 over a bridge to Stonecutters. This could affect the alignment, land take and waterfront uses on SETY. A decision on whether a bridge or a tunnel is to be provided is expected to be available in November 1989.

Other uses

20. Depending on the land use budget, other land uses which may be accommodated in the study area include:

- godowns
- offices
- allowance for uncommitted G/IC reservations
- other compatible uses

Summary of Requirements

21. The land-use requirements in respect of port development on SETY are set out in Table 3.

Table 3

Summary of Land-Use Requirements and Timing

Facility	Area/Quay face	Timing
Container Terminal	45 ha	-
Berth 1	-	12/94
Berth 2	-	5/95
Berth 3	-	10/95
Berth 4	15ha (provisional)	3/96
Cargo Working	800m	6/94
Back Up Facilities		
CFS	4 ha	5/95
Box Storage/Repair	upto 24ha	phased
T&T Parking/Repair	45 - 70ha	phased
Deep Waterfront Industry (reprov. only)	as required	phased
CWTC Extension	as required	1992
Infrastructure/Utilities		
TY South Dupl. Bridge	as required	12/94
Route 3	as required	2001
TY Sewage TW	as required	1993

South East Tsing Yi at the moment: Existing Land Uses, Current proposals

22. SETY has a very wide range of existing land uses ranging from residential through warehousing to PHIs and heavy industry. Full details of the existing land uses and interface problems are documented in the 'Tsing Yi Development Review' (May 1988) and a number of other studies.

23. This section highlights the more salient issues in respect of existing and proposed uses which will need to be taken into account in the preparation of the Development Plan and Programme.

Physical Features and Landscape Resources

24. Tsing Yi Island, separated from the mainland by the Rambler Channel, is characterised by steep rugged slopes of strategic importance rising to over 300m, and a littoral which has been considerably extended through reclamation and borrowing to provide for urban development. On the whole, urban development is well integrated with the backdrop afforded by the rugged slopes which culminate in a prominent ridge running NW-SE. A spur leading down to the Cheung Ching Estate separates and defines the south eastern quadrant, and it also forms the northern limit of the Study Area.

25. The Metroplan Landscape Strategy for the Urban Fringe (endorsed by LDPC in March 1989) designates the steep slopes and the ridgeline of Tsing Yi as Landscape Protection Areas with a general presumption against development. Port development on SETY must seek to maintain and reinforce this integration, and preserve the essential landscape features.

Existing Uses, current proposals

26. The existing uses and those proposed in the current ODP are shown on Figure 2.

Residential Development

27. Residential development is confined to the Cheung Ching Estate and to Mayfair Garden, and the Cheung Wan Temporary Housing Area. The population and households in each of these areas are shown in Table 3.

Table 3

Population, Households and Employment on SE Tsing Yi

Population			
	Cheung Ching Estate		23100
	Mayfair Gardens		4600
	Cheung Wan THA		1500
	Others		60
Flats			
	Cheung Ching Estate		4906
	Mayfair Gardens		1724
	Cheung Wah THA		850
	Other		-
Employment			
	PEPCO	TYTL 46	490
	ESSO	TYTL 46	100
	Swire Chem.	TYTL 96	50
	TCVT Chem.	TYTL 75 & Ext	162
	Dow Chem.	TYTL 59	79
	Outbd. Mne.	TYTL 54 & 67	600
	Tai Tung	TYTL 68	720
	CRC south	TYTL 57	39
	HK Oil	TYTL 45 SA	103
	Mobil Oil	TYTL 45 SB RP	150

28. The tenure of the Cheung Wan THA is scheduled for expiry in March 1990, although the Housing Authority has requested an extension of one year. The current ODP marks the THA site for container port back-up facilities. The site is currently scheduled for disposal through the Land Sales Programme in 1991/92. This will have to be reviewed.

Sewage Treatment Works

29. As recommended in the Sewage Strategy Study, the Sewage Treatment Works next to the THA and fronting Rambler Channel will be modified to provide only preliminary treatment (ie fine screening) and will be connected to a primary STW at Stonecutters Island through a deep tunnel. The Sewage Strategy Study provides for the connection and associated works to be completed in 1993. Under this scheme the TY STW site requirements (formerly based on primary treatment) will be reduced considerably:

(a) there will be no requirement for marine access for sludge disposal which would have arisen from primary treatment;

(b) the existing outfall will no longer be required; and

(c) fine screenings arising from preliminary treatment will be removed by road to landfill sites.

(d) The boundaries of the consolidated site need to be settled.

DEP has indicated that the current PWP item for the primary treatment facility will be withdrawn at the next review.

Mobil Oil

30. The Mobil Oil facility will be relocated to SW TY. The Mobil Oil site proper (TYTL 45 SB RP) has been returned to Government and is currently leased back to Mobil until 31 August 1993. The northern site formerly owned by Mobil (TYTL 45 RP) is now tenanted under STT. The two small sites near Tsing Yi Road, TYTL 45 SB SS2 and SC, will be developed for a petrol filling station. The future use of these sites will need to be related to buffering the adjacent residential uses from port development.

Area 23

31. The future use of the newly formed platforms in TY Area 23 across Tsing Yi Road is under review. It will need to be sensitive to the adjacent residential area.

HK Oil

32. The HK Oil depot is not likely to be a viable operation without marine access, and it should be assumed that the 6.7 ha site will be redeveloped for an appropriate land use.

Former CT6/CT7 Works Site

33. The partial reclamation of TY Area 21 annotated I(B) on the current ODP is under STT, and will be affected by Route 3 alignment CRA4. It would not be appropriate to permanently alienate this site.

Industrial Development

34. The band of established industrial uses along the SE shoreline, including Tai Tung Industrial Equipment and Outboard Marine Asia Ltd, will lose their marine access. The early resolution of this issue is critical to the development of port facilities on SETY.

35. Dow Chemicals, polystyrene manufacturers, currently occupy a 3ha site on the landward side of Tsing Yi Road, and have proposals for expansion onto a neighbouring site of similar area. They have no direct marine access, and rely on pipe lines from berths at the Esso and Mobil Oil depots. Dow Chemicals will require marine facilities, but these need not necessarily be dedicated.

Chemical Waste Treatment Centre

36. Work on the construction of the Chemical Waste Treatment Centre is likely to commence in early 1990 dislodging the current STTs for container vehicle parking and container stacking. The CWTC is expected to become operational in early 1992, from which date marine access to the CWTC will need to be maintained. In view of the fact that reclamation for development on SETY could commence soon after the CWTC becomes operational, it may be advantageous for the marine facilities to be initially provided temporarily off-site.

Temporary Container-related Uses

37. The existing waterfront sites mentioned above are intensively used for the berthing of lighters carrying containers, and parking tractor/trailer units. In recognition of the role of these facilities, PADS recommended that their reprovision be included in the development of port facilities on SETY.

CRC

38. China Resources Co. (CRC) is expected to be permitted to extend its site to consolidate its operations. The extent of the reclamation and details such as marine access will need to be addressed.

Development Constraints

39. The constraints on the development of port facilities in SETY are set out below, and illustrated in Figure 3. A number of these constraints, and in particular the need to reduce individual risk levels associated with LPG storage, must be overcome before reclamation can commence.

Risks Associated with Potentially Hazardous Installations

40. Development on reclamations on SETY is constrained by the risks associated with PHIs at the four oil/LPG storage installations. The low hazard installations at Dow Chemicals, TCVT, and the future CWTC do not impose significant constraints on nearby development.

41. Recent studies indicate that, on the basis of Interim Risk Guidelines, LPG storage at Mobil and HK Oil needs to be removed before the reclamation within the 10^{-5} risk area can be undertaken. Figure 3 indicates the extent of the individual risk associated with the current facilities.

42. LPG storage on the CRC and Esso sites prohibits reclamation within the 10^{-5} risk area (See Figure 3). Modifications proposed - burying the LPG in 500 Tonne bullets - will reduce the risks sufficient for the reclamation to proceed (See Figure 3). However, the timing of the LPG storage modifications will significantly affect the programming of development. Early modification of the LPG storage facilities is critical.

43. DBL has concluded negotiations with Mobil for relocation of its Tsing Yi operations to a new site in SWTY. The current tenancy expires on 31.8.93. Negotiations with HK Oil for a similar relocation are on-going. For the purposes of planning future development on SETY, however, it must be assumed that although the use of the HK Oil site for the storage of oil products will cease once the Mobil facility has been relocated, the site will be redeveloped. At the moment, HK Oil could redevelop for the zoned industrial use since it holds an 'unrestricted' lease.

44. In respect of the CRC south site, the transfer of oil storage facilities from TY North to an extension of the CRC site (located to the east and possibly to the south of the existing site) will have a negligible effect on off site risk levels.

45. Figure 3 also illustrates the areas of unacceptable individual risk associated with the CRC and ESSO sites based on the recommendations of the CT8 Interim Report: storage modification; better management control and communications systems; and arrangement of land uses to minimise population numbers in the vicinity of the oil depots.

Route 3

46. Route 3 alignment CRA4 passes through the Study Area, and will need to be taken into account in the planning of development. An outline of the preliminary alignment is shown in Figure 3. More detailed drawings are available from D of Hy.

47 The Development Plan and Programme will need to identify ways and means to

(a) protect the route prior to development;
(b) minimise disruption to the operation of CT9 and the backup facilities caused by construction of Route 3; and
(c) incorporate advanced work on the reclamation and at the seawall.

48. Noise and air pollution arising from Route 3 will need to be taken into account in the planning of the area.

Limited Capacity of the Existing Links to the Mainland

49. Tsing Yi is linked to the mainland by two bridges, but because the southern bridge is the preferred route to the Kwai Chung/Urban Area heavy congestion is evident at peak hours. Three new links will be required:

(a) Route 3 CRA1
(b) Route 3 CRA4
(c) Duplication of the Tsing Yi South Bridge

The timing of the Route 3 links has not been finalised. The Tsing Yi South Duplicate Bridge and junction improvements should be complete before the first container berth on SETY becomes operational.

Navigation

50. The results of the CT8 Study relating to the capacity of the Rambler Channel, and the reclamation limit should be taken into account.

Proximity of Residential Developments

51. Sensitive planning of future land uses in SETY, and the use of buffer land uses in particular, will be needed to minimise the intrusion of noise, (including traffic noise), glare and dust into the residential areas at Mayfair Garden and Cheung Ching Estate such that the guidelines set out in the HKPSG Ch 9 applicable to Mayfair Garden and Cheung Ching Estate are not exceeded.

Hydraulics and Water Quality

52. The results of the CT8 Study relating to the effects of the proposed reclamation on hydraulics and water quality should be taken into account, but not necessarily preclude additional work.

Submarine Outfalls

53. The Development Programme will need to allow for the submarine outfalls arising from storm water outlets to be reprovisioned.

54. The TY STW outfall will be replaced, according to the Sewage Strategy Study, by a deep tunnel link to the STW at Stonecutters. The Sewage Strategy Study envisaged that the modifications to the TY STW would be completed by end 1993.

Noise

55. Most of SETY is within the NEF 25 contour calculated for the CLK airport maximum case for the year 2030. New uses within the Study Area will need to be noise tolerant.

56. The abatement of traffic noise impinging on noise sensitive uses will need to be taken into account in both land use planning and traffic management.

Airport Height Restrictions

57. The height restrictions from Kai Tak and CLK will have no material affects on port development at SE Tsing Yi.

Airport Navigation Aids

58. A civil aviation navigation aid to the seaward of CRC imposes a constraint on building height to the west and to a lesser degree to the east. The affected areas are set out in Figure 3. Requiring 24 hour access, the IGS outer distance marker effectively sterilises the rocky outcrop to the south of the CRC site on which it is located. Although the nav. aid will become redundant when Kai Tak closes, CAD has indicated that it may be possible to relocate the nav. aid before then to facilitate a more efficient land use distribution. Relocation would also offer the opportunity for CRC to extend its site in a rational manner, and may be useful in Government's negotiations to persuade CRC to modify the LPG storage.

Existing and Proposed Uses with Marine Rights or Waterfront Access

59. Existing uses which may be affected by reclamation on SETY include

(a) Mobil Oil
(b) HK Oil
(c) Tai Tung Industrial Equipment Ltd
(d) Outboard Marine Asia Ltd
(e) China Resources Company Oil Depot

and the proposed uses are

(f) CWA seaward of the Cheung Wan THA
(g) sludge berth at the TY STW
(h) CWTC

In addition, Dow Chemicals uses the pier facilities at Mobil Oil, and will continue to need facilities for the delivery of feedstocks.

60. In-so-far as Mobil Oil and HK Oil will cease operations, and the sludge berth is no longer required, maintenance of waterfront access is required for items, c, d, e, f and h above.

Landscape Constraints

61. There are no major landscape features likely to be affected by port development on SETY.

Opportunity Spaces

62. (a) existing formed land uncommitted to permanent development -
including the THA site, platforms in TY Area 23, and TY Area 21, the site for the proposed PCWA, the 'G' site immediately to the north of the TY South Bridge in TY Area 6, and the site between the CWTC and CRC.

(b) existing land expected to be made available to the public sector through the relocation/redevelopment/modification of existing land use -
including the Mobil Oil Depot, and part of the TY STW;

(c) changes of existing land use expected to arise from redevelopment by the private sector
including redevelopment of the HK Oil site;

(d) land expected to be formed through reclamation.
The exact area of land to be made available through reclamation is dependant on the limit of reclamation to be provided by the CT8 Study, plus an allowance for extension of the CRC (South) site;

(e) space expected to be made available underground.
As indicated in the SPUN Study two uses are feasible and economic in SETY: container tractor and trailer parking and CFS/Warehousing.

Concept Plan

63. The general land use/transport structure for the area is described in Figure 5. This Concept Plan should be taken as a starting point to be developed further as the results of feasibility studies become available.

64. The paragraphs below indicate the broad land use potential for each of the sites.

Site 1
Container Terminal

65. This is the site of a 3 berth container terminal, the development of which will need to be in accordance with the general objectives set out above.

Site 1A
Container Terminal Extension:

66. This site is indicated on the basis that the CT8 Studies demonstrate that there is sufficient capacity in the Rambler Channel to support a 4th container berth, and the landside effects are also acceptable.

67. In the event that the 4th berth is not acceptable, this area may be developed for container back-up facilities, and the quay face used for lighter berthing (box transfer).

Sites 2A, 2B, 2C
Port Back-up Facilities

68. Port back-up facilities provided on these sites include container port backup facilities

- tractor & trailer parking
- empty box storage
- box repairs
- tractor/trailer repairs
- government land uses

Sites 3A & 3B
Cargo Working Areas

69. These two cargo working sites could provide for the PADS requirement for SETY of 800m of cargo working quay face.

Site 4
Buffer Uses/Port Back-up Facilities

70. This landlocked site close the Cheung Ching Estate on one side and cargo working/marine access on the other, and transversed by an elevated road accessing TY South Bridge is particularly difficult to plan. Although the site is separated from Cheung Ching Estate by a considerable vertical elevation, noise and glare could detrimentally affect the residential area. Every opportunity must be taken to ensure that land uses in this area buffer the residential areas from the back-up uses and the cargo working areas.

Site 5
Buffer Uses

71. Site 5, lying between the residential areas and the port, offers opportunities to develop effective buffers compatible with the adjacent uses. It is envisaged that development will take the form of noise/glare tolerant uses fronting Tsing Yi Road, with certain back-up related uses below podium accessed from the port side. This site also includes a proposed petrol filling station.

Site 6
Buffer Uses

72. This environmentally significant site will need to be developed for uses compatible with Mayfair Gardens, to create a buffer between the residential area and port development.

Site 7
HK Oil

73. It should be assumed that the HK Oil site will be redeveloped for another use, but bearing in mind the unrestricted nature of the lease conditions, it is not possible at this stage to be more specific. For traffic modelling purposes it would be prudent to adopt the same assumptions as in the CT8 Study Stage 1.

Site 8
Chemical Waste Treatment Centre & Extension

74. Site 8 comprises the CWTC and an extension over the reclamation to provide marine access and spare for future expansion. It may be desirable to adjust the site boundaries to provide a southern access to the reclamation.

Site 9
CRC

75. CRC's current site could be extended along the lines illustrated, to encompass part of the CRA3 reserve, the CAD nav. aid and reclamation, to provide scope to relocate the CRC Northern Depot. The risk analysis referred to above takes account of the latter relocation.

Site 10
Ancillary Craft/Cargo Working

76. This is a quay face for lighters, Government vessels, tugs and other craft ancillary to the operation of the port.

Site 11
Sewage Treatment Works

77. The current STW may be reduced (see para 29 above), and traversed by the ramp up to the Tsing Yi South Bridge.

Site 12
Underground CFS/Warehousing/Tractor-Trailer Parking

78. The SPUN studies have shown that the use of underground space for tractor trailer parking coupled with CFS/Warehousing may be feasible and economically viable. Given the shortfall of back-up land in the port area the potential use of underground space will need to be considered further in the preparation of the Development Plan.

Implementation

79. Under agreement with the container port operators, CT development to date has been carried out by the private sector based on the trigger point mechanism to decide when the next facilities should be initiated. CT development has proceeded through the tendering of seabed, leaving all works in the hands of the successful tenderer. This arrangement will apply to CT8. For CT9, however, only the trigger point mechanism will be applied, leaving open the implementation of works by either the private sector (by tender) or by Government. The latter would afford greater flexibility in matching supply with demand, but only if demand drops off. The programming of works for CT9 should allow for either approach, including in both cases the parallel provision of land for back-up facilities.

80. A number of aspects appear to be critical to the timely provision of port facilities. The principal ones are

- removal of LPG storage at HK Oil
- modification of the LPG storage at CRC and ESSO
- duplication of the South Tsing Yi Bridge

81. Attention is drawn to LWB Technical Circular 9/88 which sets out guidelines for an environmental review of major projects. A checklist, which is a precursor to TC9/88, highlighting the significant environmental characteristics and effects of the proposed land uses is included in Appendix A.

Output

82. The work to be undertaken by PM/TW will include the preparation of briefs for and the undertaking of detailed planning, engineering, environmental assessment, traffic and other feasibility studies to:

(a) formulate a land use/transport plan;
(b) formulate development programmes and implementation requirements; and
(c) produce detailed design/work drawings,

and to proceed with the development of the area, including gazetting, preparation of contracts etc.

Principal Working Assumptions and Data Inputs

83. Standards and policies to be adopted in formulating land use plans and carrying out feasibility and design studies will be based on current Government policies, procedures and practices.

84. Transport and environmental modelling will take account of the results and recommendations arising out of the CT8 Study and PADS.

85. In respect of sources of fill and disposal of marine mud, further studies will be guided by the Fill Management Committee and DEP. In this context, the disposal of highly contaminated mud will need particularly careful attention.

Relationship with CT8 Study

86. The CT8 Study Stage II, which is due for completion in early 1990 (DFR in January 1990), will establish the following in respect of port development on SETY:

(a) The limits of reclamation.

As part of the CT8 Consultants' review of the seawall alignment on SETY, ship movement simulation and marine impact studies will be undertaken to establish -

- the maximum marine capacity of the Rambler Channel and approaches;
- the effect of the new reclamation configuration on water movement and water quality; and
- the reclamation limit for SETY.

(b) The effect of CT9 and associated development on road intersections near CT8.

A traffic study will be undertaken for the design year 1996 with a view to preparing conceptual layout of those roads/junctions in close proximity to Stonecutters island which are identified as requiring improvement due to the siting of CT8 on Stonecutters island and CT9 on SETY.

The CT8 Consultants are required to complete the studies for ship movements and reclamation limits by December 1989.

87. Assumptions on local area road networks, traffic generators and models adopted in the traffic studies which may be carried out under this Development Statement should where possible be compatible with the work undertaken as part of the CT8 Study.

88. Interface with Other Studies

The findings recommendations arising from the following studies will need to be taken into account:

CT8 Study
CTS2 update
Marine/Land Fill
Metroplan
PADS
Rail Link to Airport
Route 3
Sewage Strategy Study
SPUN
Tsing Yi Development Review
Tsing Yi Island Risk Reassessment Report
TDS
West Kowloon Reclamation Studies
Contaminated Mud Management Study
Other on-going studies to be advised by PM/TW & PGTP/SP

The Process

89. On approval of the Development Statement by DPC, DTD will seek approval to:
(a) inject an item into Cat A of the PWP to fund the study; and
(b) include appropriate items in Cat B of the PWP for project implementation.

90. Subsequent to approval by DPC, PM/TW will initiate the preparation of a brief for undertaking detailed planning, traffic, engineering, environmental assessments and other feasibility and design studies to:

(a) formulate a land-use/transport development plan;
(b) produce development programmes for the production of land, infrastructure, and facilities.

91. Following the approval of the land-use/transport plan and the development programmes by DPC, PM/TW will

(a) undertake and co-ordinate the development of the area; and
(b) monitor and review the development of the area.

Timing of Detailed Studies

92. The aim should be to

(a) commence detailed studies in March 1990;
(b) complete a draft final report by March 1991.

Steering Group

93. A Steering Group will be established to guide the development of the area.

Membership:
Chairman PM/TW
DLO K&T
DO K&T
DEP
D of DS
D of P
D of M
D of Hy
C for T
DCES
DEMS
GE/PADS/PCO

In attendance when required:

S for T
SES
D of I
DFS
D of FS
C for P
Consultants

Secretary STP/TW

Terms of Reference

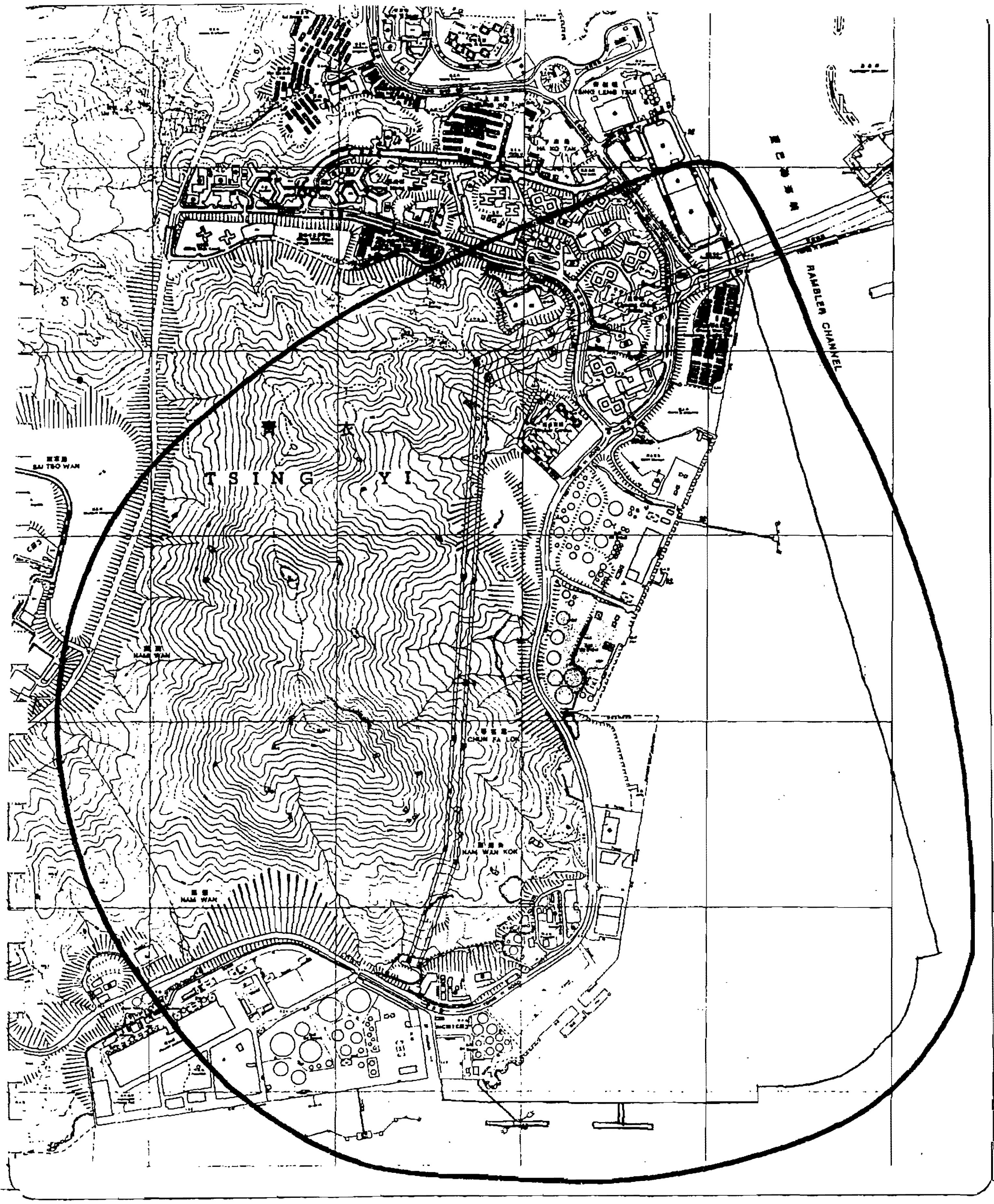
(a) To monitor progress of the preparation and implementation of the Development Plan and Programme, and to report to PADS Progress Committee.

(b) To facilitate liaison.

(c) To set up Working Groups as required, and provide guidance on matters referred by Working Groups.

(d) To consider reports on major issues.

(e) To ensure that the target dates for the various facilities are met.



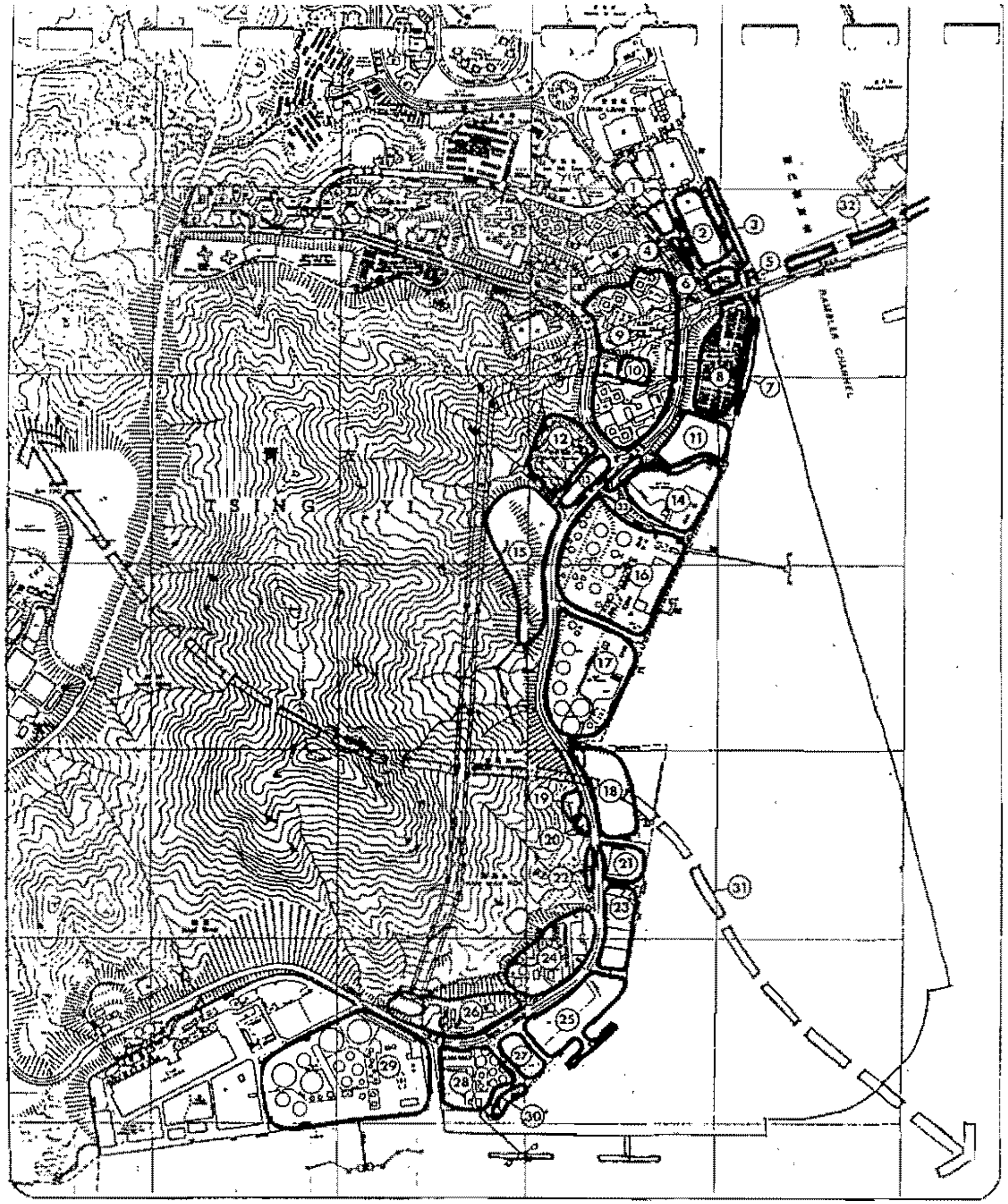
PADS/DS1

Study Area

0 100 200 300 400 500

1

Figure



PADS/OS1

Existing Uses & Current Proposals

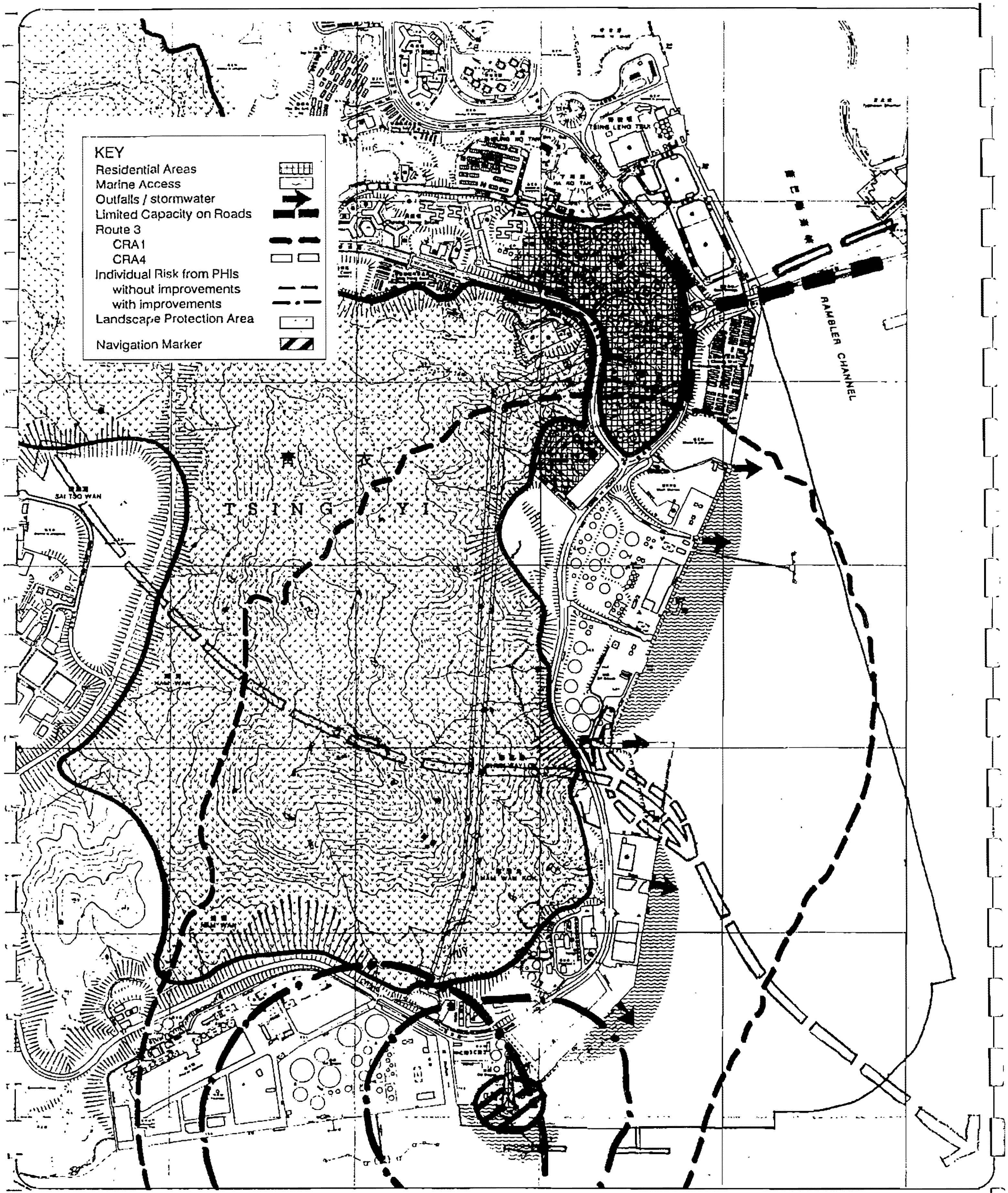
2

Figure

South East Tsing Yi Existing Use & Current Proposals

Key to Figure 2

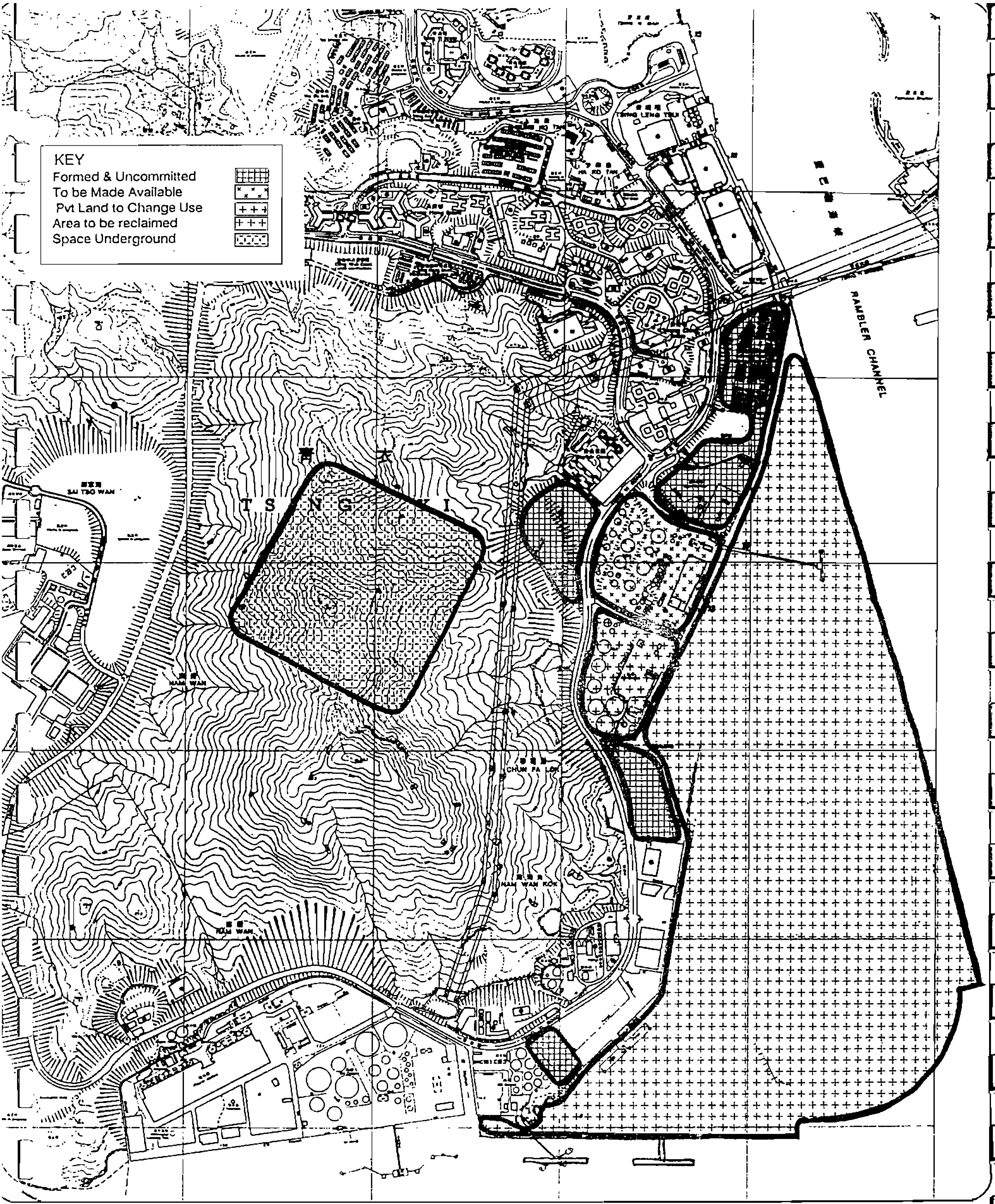
Site Reference (1) Factory building
(2) Flatted factory buildings in multiple ownership
(3) Promenade
(4) Government land
(5) -Tsing Yi Salt Water Pumping Station and Staff Quarters
(6) Container storage on S.T.T. Government site
(7) Public cargo handling area
(8) Existing Cheung Wan THA. Proposed container back-up area
(9) Cheung Ching Estate (Part)
(10) Primary school
(11) Sewage treatment plant
(12) Mayfair Garden - Private high-rise residential development
(13) Local Open Space
(14) Container storage on S.T.T. Government site. Use undetermined.
(15) Formed vacant site
(16) Mobil Site. (10.2ha.) for oil depot with access for tankers to jetty. Future use of site undetermined
(17) H.K. Oil Co. oil Depot. Recommended for removal in PHI Study. Future use of site undetermined.
(18) Reclamation. Temp. open storage use with I(B) Zoning.
(19) I(C) site reserved for bulk dangerous goods godown only
(20) Government site. Proposed L.O. and Cooked-food-centre
(21) Tai Tung Industrial Equipment Ltd. Container Storage under STW & STT
(22) I(C) Site. Temp. open storage use
(23) Outboard Marine Asia Ltd. - Industrial use. Also with container storage on S.T.W. and S.T.T.
(24) Dow Chemical (HK) Ltd. Chemical plant
(25) Proposed site for Government Chemical Waste Treatment Centre. Temp. use on S.T.T. for container vehicle parking and container stacking
(26) Tin Chiu Ve-Tsin-Industrial Use
(26) See (24)
(27) See 25
(28) China Resources Co. Oil Depot
(29) Esso Oil Depot
(30) Navigation Aid for Kai Tak
(31) Route 3 CRA4 alignment
(32) Route 3 CRA1 alignment
(33) Mobil Site - proposed Petrol Filling Station



PADS/DS1

Development Constraints

Figure 3

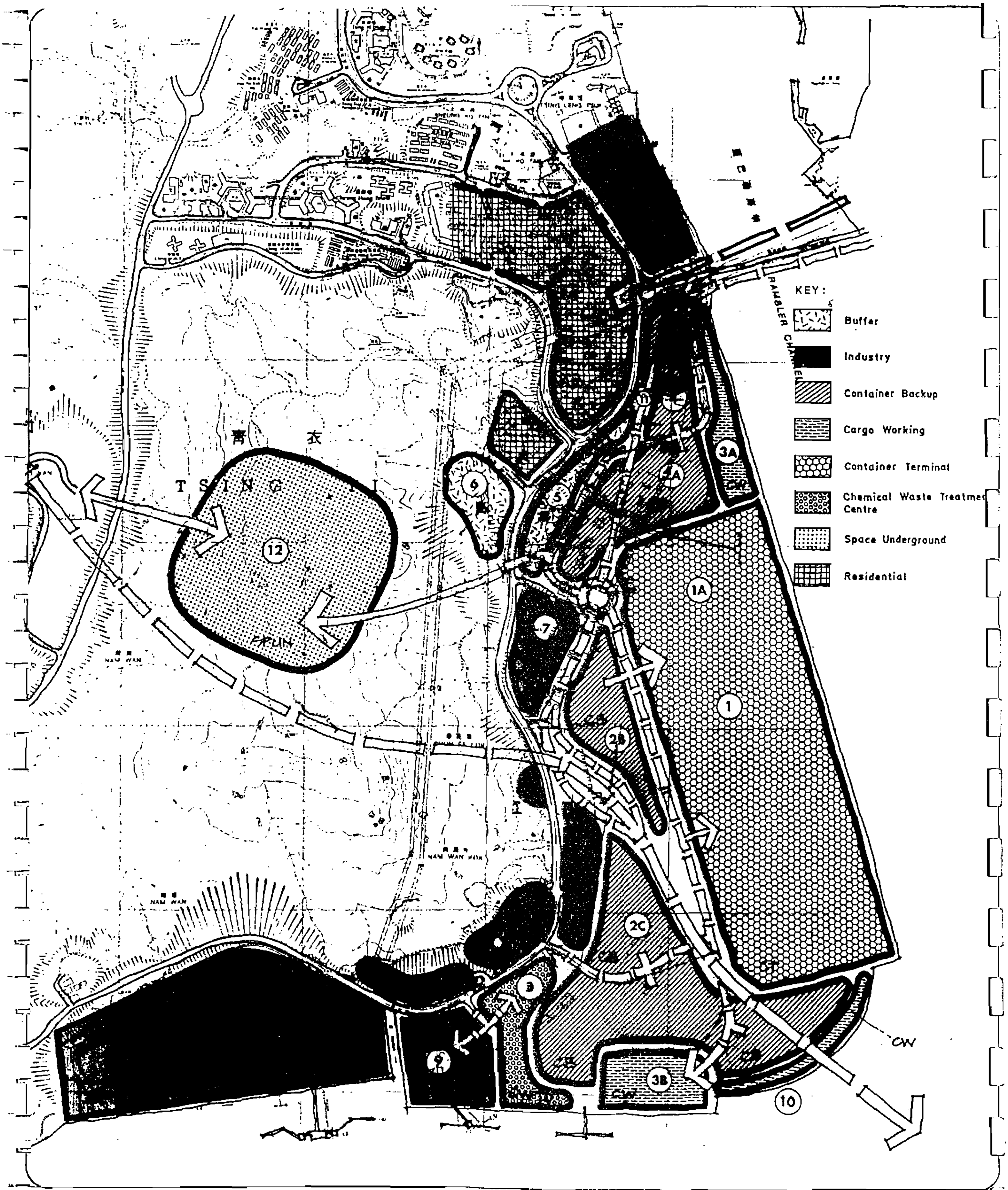


PADS/DS1

Opportunity Spaces

4

Figure



PADS/DS1

Concept Plan

0 100 200 300 400 500

5

Figure

Environmental Checklist

The following checklist highlights the significant environmental characteristics and effects of the proposed land uses. The first section deals with the effects of development, and the second deals with the effect on existing and planned land areas. This checklist is a precursor to the procedures outlined in LWTC 9/88, (which requires that a more detailed checklist be compiled for each project), to alert DEP to the environmental aspects of development envisaged in the Development Statement.

I. Environmental Effect of Development

A. Land-uses/activities likely to produce:

(a)	gaseous emission	traffic from development and Route 3
(b)	heat plumes	nil
(c)	liquid effluent/cooling water discharge	nil
(d)	dust or other particulates	reclamation, construction, traffic
(e)	odour	nil
(f)	noise	traffic, container terminal & back-up facilities (buf)

B. Land-uses/activities involving:

(a)	storage/disposal/transport of hazardous goods LPG and other oil products at CRC & ESSO, goods associated with TCVT, Dow Chemicals & CWTC, handling of haz. goods at CT, CFS and buf	
(b)	high levels of traffic generation from CT, CFS & buf	
(c)	night time operation	CT & buf
(d)	high visual impact	CT
(e)	high risk of pollution	nil

C. Construction/land formation requiring

(a)	reclamation	CT, buf etc
(b)	mud disposal	possibly very toxic
(c)	platform formation	nil
(d)	removal/despoilation of significant landscape features eg ridgelines, wooded areas	nil

II. Existing and Currently Planned Land-Uses/Features Affected

(a)	Residential and other sensitive urban land uses	residential & other sensitive uses to north of site
(b)	Country parks	nil
(c)	Beaches	nil
(d)	Agricultural priority areas	nil
(e)	Areas of conservation value	nil
(f)	Sites of Specific Scientific Interest (SSSI)	nil
(g)	Water courses	as marked on Figure 3
(h)	Water gathering grounds	nil
(i)	Ground-water resources	nil
(j)	Fisheries/mariculture areas	nil
(k)	Airsheds with limited dispersal	not known

Current STTS Assumed to be in existence in 1996 in Kwai Tsing

STTs for Empty Container Storage Depots (1996)

Area	Location	STT Ref. No.	Operator	Period	Area (sq.m.)
Kwai Fong	10K	455	Correp HKG Ltd	Qtly	12,000
		456	Container Care Ltd	Qtly	25,000
		KCTL315	Mack & Co	Qtly	9,000
		484	Fat Kee	Qtly	2,000
		454	Wing Wang Godown	Qtly	1,950
		465	Reynold Van Lines	Qtly	1,950
		466	Mee Lee Co	Qtly	1,960
	10E	308	Mack & Co	Qtly	1,650
Tsing Yi		398	Container Systems Ltd	Qtly	4,600
TOTAL					60,110

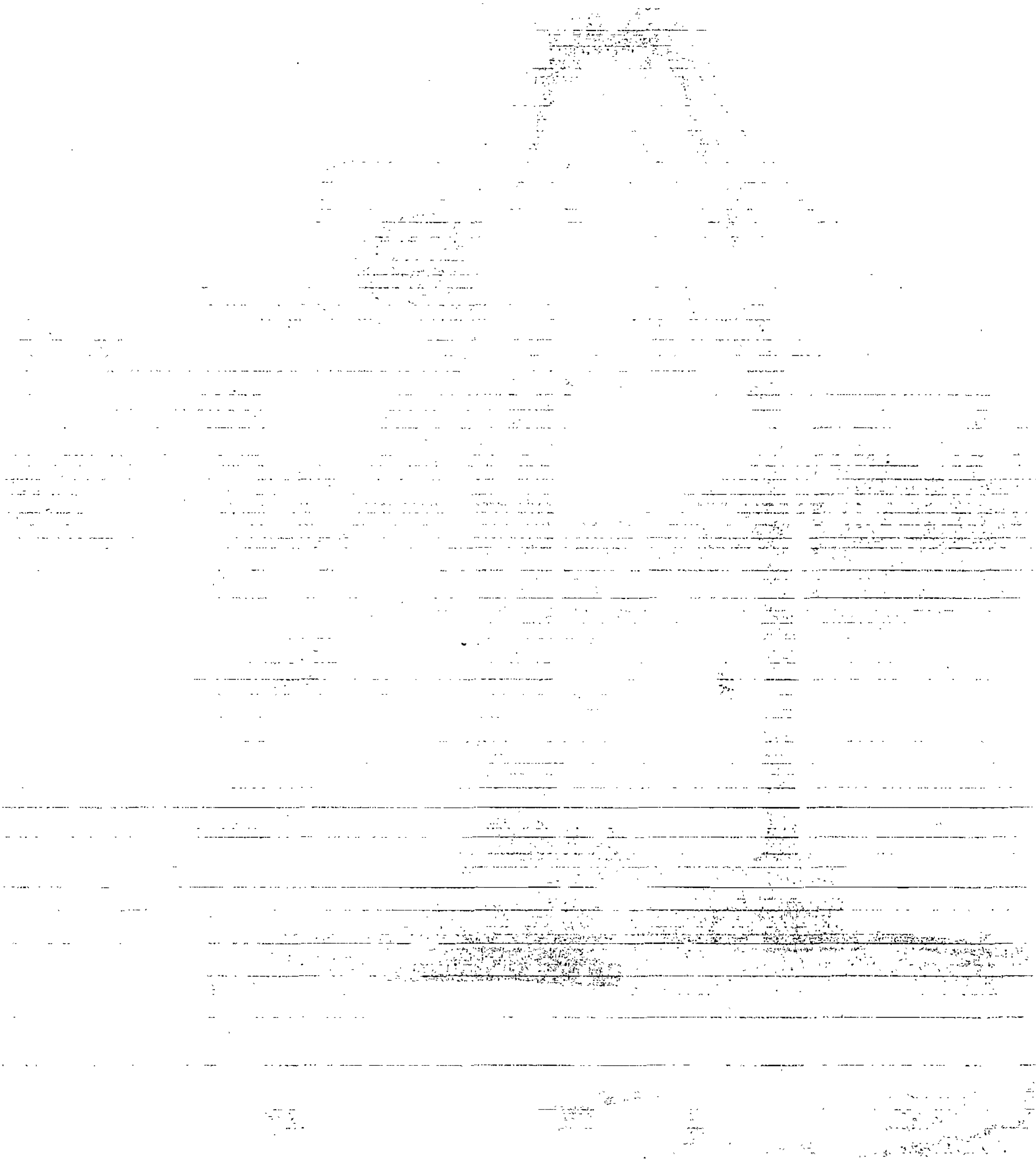
STTS for Container Vehicle Parking (1996)

Area	Location	STT Ref. No.	Operator	Period	Area (Sq.m)
Kwai Chung	10E	308		Qtly	1,650
	Adj. KCL4	3012	HKG CNTR.Tractor	Qtly	26,500
	10G	475	Kai Hing	Qtly	13,725
Tsuen Wan	35	663	UDS	Mthly	3,700
Tsing Yi	TY6	566	Zielona Transport	Mthly	2,600
	+TY6	3022	Tompkins Int'l (CCL)	2 yrs then Qtly	14,040
	+TY6				
		3024	West Coast Int'l	2 yrs then Qtly	12,900
Total					75,120

Notes:
\+ Use assumed to be changed to empty box storage
Source: PADS TP21-Need for Container Back-up Around Kwai Chung 2

APPENDIX B

MARINE IMPACT STUDIES



APPENDIX B1

MARINE IMPACT STUDY

MULTI-PURPOSE TERMINAL OPTION AT TSING YI

CONTENTS

FIGURES

MULTI-PURPOSE TERMINAL OPTION AT TSING YI

1. INTRODUCTION

The final phase of the CT8 study considered a 20 berth scheme with three container berths on the Stonecutters Island reclamation and five on the Tsing Yi reclamation (Fig. 1). The present study is required to consider the option of a 1,000 m multi-purpose terminal on the Tsing Yi site together with 800 m public cargo working area, replacing the container berths (Fig. 2). In addition, an extra container berth would be provided on Stonecutters Island (making 16 in all), together with some smaller facilities on the south face of the Tsing Yi reclamation, (Fig. 2A). It is assumed that lighters may work alongside the vessels at the MPT, up to two deep.

This report presents data on simulated traffic flows, vessel delays and typhoon evacuation for comparison with the all-container vessel layout, and compares the requirements for manoeuvring room in the two cases.

2. SHIP MANOEUVRING

2.1 Initial Considerations

Vessels using the Multi-Purpose Terminal will enter and leave the Rambler Channel via the entrance between the north west corner of Stonecutters Island and the south east corner of Tsing Yi. The vessels using the berths will be smaller and generally more manoeuvrable than the container ships using the Kwai Chung Container Terminal berths on the eastern side of the Rambler Channel.

The reclamation area proposed for the multi-purpose berths produces a situation with close similarities, from a manoeuvring point of view, to that studied at BMT Fluid Mechanics Ltd. for container ship manoeuvring in relation to the Route 3 project (ref. 1) and the proposed Container Terminal 8 (refs. 2 and 3). For this reason, and because the general cargo vessels using the multi-purpose berths are likely to be more manoeuvrable than the container ships studied in the two investigations already carried out, it is not considered necessary to carry out further manoeuvring simulations as part of this study. The assessments below are therefore based on the knowledge and information gained from the earlier studies.

2.2 Arrivals

Arrivals from the port entry point should be straight forward. There is adequate room between Stonecutters Island and Tsing Yi for general cargo vessels to pass any out-bound container ships, should this be necessary.

It is not considered that tug assistance would be required until the final breasting and berthing phase, the ship being slowed and stopped under its own power near the berth. Tugs would attend the ship in the Rambler Channel as it approached the berth, handling the ship when stopping, breasting and berthing. We suggest that tug recommendations made by the HKPA for the Ocean Terminal would be appropriate for the MPT so that ships over 180 metres in length would require 3 tugs for berthing (one as a stand-by in case one of the other two fails), ships less than this length requiring 2 tugs.

2.3 Departures

It is assumed that ships would be berthed "head-in" at the Multi-Purpose Terminal, thereby requiring a simple swing off the berth when departing. This would require 2 tugs which could be dispensed with once the swing was completed. The ship would then proceed down the Rambler Channel under her own power, making a turn to starboard at the entrance to the Channel and passing the port entry point outbound.

2.4 Possible Interference with Container Ship Operations

Ships at the Multi-Purpose Terminal are assumed to have lighters up to 2 deep alongside. It is further assumed that these lighters are 40 to 45 metres in length with a beam of up to 16 metres. Assuming the beam of the berthed vessel to be of the order of 20 metres, and that all multi-purpose berths were occupied by ships having lighters two abreast on their seaward side, an effective "obstruction" about 50 to 60 metres wide by 1,000 metres long would intrude into the Rambler Channel. Passing small craft traffic would find this obstruction left adequate room for their passage along the Rambler Channel in the event that no container ship handling operations were in progress in the Channel.

If a container ship were to be departing from berth E (Fig. 10) opposite the Multi-Purpose Terminal by swinging off its berth, simulation runs described in reference 1 show that it would require about 350 metres width for the manoeuvre. Allowing another 80 metres for tug operation, this would leave a clear space of at least 310 metres between the extremity of the swinging manoeuvre and the outermost lighter at the multi-purpose berths. Such a distance is adequate as a safety clearance between the container ship and the vessels berthed at the multi-purpose terminal; it would also provide sufficient room for small craft to pass while moving along the Rambler Channel. Container ships departing from the basin between Container Terminals 4 and 6 must swing in the Rambler Channel and will have room to do so even when the multi-purpose berths are fully occupied with ships and lighters. A complete swing of a 290 metre container ship (including room for the attendant tugs) should require no more than 580 metres of the Rambler Channel and, assuming this were done clear of container ships on berths D, E and I (Fig. 10) and vessels on the multi-purpose berths, a minimum of 130 metres clearance would still remain. This would occur for a short time at the "peak" of the swing and should be adequate for small traffic moving along the Rambler Channel provided there are no lighters moving clear of ships berthed at the MPT near the swinging ship. Simultaneous swinging manoeuvres by container vessels at Kwai Chung and lighters at the MPT is clearly the "worst-case" scenario and, although sufficient room for lighter movements is available, a short delay to through traffic may be incurred as the container ship passes the "peak" of its swing.

To swing a vessel off a multi-purpose berth at the same time as a container vessel was swinging off one of the Kwai Chung berths opposite, would be unwise as insufficient room is likely to be available for safety.

Container vessels arriving at any of the berths at Kwai Chung will not be affected by vessels and lighters berthed at the multi-purpose berths R to U (Fig. 10). Some conflict may arise at berth Q if lighters are operating when a container ship is inbound or outbound. The preferred track for such ships will be close to the chamfer on the SETY reclamation, which could bring them close to any lighters manoeuvring near to a ship on berth Q. The risk of collision between a container ship and a lighter at this critical point is of sufficient concern to warrant consideration of moving berth Q to the north, thus avoiding the possibility of lighter activities conflicting with in-bound or out-bound container ships.

The operation of container ships at the berths on North Stonecutters will not be affected by ships using the Multi-Purpose Terminal.

3. TRAFFIC FLOW SIMULATION

3.1 Traffic Levels

The traffic levels have been assumed as for stage II as shown in Fig. 1, but with the multi-purpose terminal and PCWA replacing the container berths on Tsing Yi (Fig. 2). In addition an extra berth for container vessels is provided on Stonecutters' Island, and some smaller facilities are included on Tsing Yi. Traffic movements are then as follows:

Container terminals	16 berths	3.3 movements/berth/day
MPT	5 berths	1.67 " " "
CRC		20 - 30 movements/month
Dow		12 - 16 " "
CWTF		60 " "
Tai Tung		20 " "
Dangerous goods ferry		32 movements/day
Lighters alongside ships		120 " "
Lighters at PCWA		96 " "

Movements of small vessels and of ferries remain unchanged. In line with the previous study, peak conditions have been considered by increasing the movements of vessels both at the MPT and the Container Terminals by factors of 1.5 and 2.0

3.2 Traffic Patterns

The routes followed are the same as those for the CT8 study, with only necessary amendments:

(i) The vessels using the MPT take the routes previously assigned to container vessels using the site.

(ii) Lighters attending the MPT or the PCWA use the routes to North and South, in the proportions 20% : 80% (Fig. 3).

(iii) Vessels using the basin on south Tsing Yi (Figs. 2 and 2A) approach from the south, by the Northern Fairway.

3.3 Traffic Simulation Model

The purpose of the traffic simulation model is to compare the possible terminal schemes in terms of congestion and safety. The model generates representative ship tracks and calculates the numbers of "encounters" - the occasions on which ships would approach within a specified distance of one another in the absence of avoidance actions. Details of the construction of the simulation model were given in the earlier CT8 studies (ref. 2).

3.4 Traffic Simulation Results

The generated ship tracks are shown in Figs. 4 - 5 for average traffic flows and peak MPT and container flows times 1.5 and times 2. As before, it is assumed that vessels will attempt to take the shortest practicable routes, constrained by the port layout. The actual spread of the traffic lanes must be uncertain, but for purposes of comparison, the same assumptions are adopted as for the previous work. The corresponding encounter positions are plotted in figures 7 - 9. The numbers of encounters for a 24 hour period have been calculated, broken down into head-on, crossing and overtaking encounters. For each traffic level we consider three groups; all encounters, those including container or MPT traffic and those involving only container or MPT traffic. In each case, the corresponding figure for the all-container case is given in brackets.

Traffic Level	Vessel Involvement	Encounter Numbers							
		Head-on		Crossing		Overtaking		TOTAL	
Average	All	2,265	(1,976)	2,989	(2,222)	91	(58)	5,345	(4,256)
	Including MP and containers	65	(76)	370	(368)	3	(3)	438	(447)
	MP and containers only	11	(15)	5	(5)	0	(1)	16	(20)
Average x 1.5	All	2,382	(1,979)	3,185	(2,324)	96	(71)	5,663	(4,374)
	Including MP and containers	102	(137)	518	(526)	5	(2)	625	(665)
	MP and containers only	18	(29)	14	(10)	1	(1)	33	(40)
Average x 2	All	2,454	(1,995)	3,365	(2,704)	97	(72)	5,916	(4,771)
	Including MP and containers	124	(165)	752	(807)	5	(13)	881	(985)
	MP and containers only	38	(44)	29	(45)	1	(2)	68	(91)

The trends of these figures are fairly consistent, and can be summarised as follows:

1) Encounters including vessels using the MPT and Container Terminals are slightly fewer than for the all-container option, corresponding to the overall reduction in movements at the terminals.

2) Encounters involving the above vessels only are further reduced to about 80% of the all-container level, suggesting that congestion effects between the larger vessels will be reduced.

3) The total number of encounters is increased by some 25%. However, it follows from 1) that these do not include the vessels using the terminals, but are largely attributable to lighter traffic mixing with the small vessels already using the Rambler Channel.

4. VESSEL DELAYS

4.1 Introduction

The delay calculations follow the procedures used in reference 2. The purpose of this analysis is to estimate the incidence of delays to ships using the proposed MPT and the container terminals. The MPT option, comprising a nominal 5 berths in addition to 16 container berths (Fig. 10) is compared with a 20-berth all-container option. As an indicator of the capacity of the complex, both options are considered with up to twice the expected movement rates.

4.2 Estimation of Ship Delays

Estimations of delays to ships using the terminals have taken account of three major sources of foreseeable disruptions to a vessel proceeding directly to or from its berth. Two sources arise when a berthing or passing vessel is delayed or blocked by the manoeuvre of another vessel. The third is the likely delay that could result from a random pattern of vessels arriving at the harbour, where a number of vessels could arrive at around the same time.

Estimates of delays have been made for the MPT proposal and compared with the all-container option. Both average delays for all ships and average delays per ship delayed have been calculated, and indicated as such where appropriate. Average delays are calculated over the whole port configuration.

Average delay per ship (all vessels) is calculated from the total delay time for all vessels divided by the total number of ships handled. Since only a proportion of the vessels will actually be obstructed, it is also useful to calculate the average delay experienced by ships when they are obstructed by other ship manoeuvres. This quantity has been called "average delay per ship delayed", and is calculated from the total delay time divided by the average number of vessels delayed.

To set these results in perspective, and to provide a sensitivity analysis, estimates have been calculated to show the effect of increases in traffic level from the base forecast level to twice the movement rate. The estimates at these traffic levels indicate the delays which could be experienced while such handling of traffic lasted. The extension of the results to higher traffic levels is also provided as a means for assessing the effective capacity of the channel and terminal system. Thus capacity may be determined by the maximum delay to ships which is judged to be acceptable. The estimates of delay over the wide range enables the identification of the traffic level at which any given maximum delay would occur. Provided this traffic level is higher than the capacity of the terminals to turn round the ships, the capacity of the channel will not be the limiting factor.

Finally consideration has been given to the varying times taken for vessels to "enter" and "exit" the port. These times are independent of any interaction with other container vessels.

4.3 Berth Delays

For the purpose of estimating delays caused by the manoeuvres of another vessel, a number of assumptions have been made. These are:

(i) Sufficient numbers of pilots and tugs will always be available at the time required.

(ii) All vessels will berth head-in on arrival, thus only swinging for departure movements.

(iii) Vessels underway can pass each other in the Rambler Channel and its approaches.

(iv) A vessel underway can pass another vessel engaged in either a berthing or unberthing manoeuvre, with the following exceptions:

  - an incoming vessel cannot berth while a departing vessel is manoeuvring at an opposite or adjacent berth.

  - an outgoing vessel cannot depart while another vessel is departing from an adjacent berth.

  - a vessel cannot conduct its departure swinging manoeuvre while another is departing from an opposite berth in the Rambler Channel.

(v) The durations of departure swinging manoeuvres have been assessed for each berth and are shown in Table 4.1. These times are consistent with the earlier work.

The delay estimates have been made by mathematical probability methods, details of the calculations being given in Appendix 2 of reference 2.

The results of these estimations are given in Table 4.2. This shows the percentage of berth arrivals and departures likely to be delayed by unberthing manoeuvres from adjacent berths and the average length of a delay. In each case the level of traffic is 3.3 movements per berth per day for the container berths and 1.67 movements per berth per day for the MPT berths. The effects of "peaking" up to twice these levels are considered in 4.6. The MPT option is compared with the 20-berth container option.

The Table shows the average number of berth movements delayed to be slightly greater for the MPT option. However, the average delay is slightly less and the total delay time is some 90% of the all-container option.

4.4 Passing Delays

For the second source of delay, i.e. that for ships using non-adjacent berths but passing an unberthing vessel, two levels of delay have been estimated on the basis of the following assumptions:

Level 1 -	assumes that ships may pass in one direction at a time, but if two ships moving in opposite directions wish to pass an unberthing vessel the second ship must wait until the first has passed. The time to pass an unberthing vessel has been taken as 5 minutes.
Level 2 -	this is a more severe criterion than Level 1 and assumes that no ship may pass while another is unberthing.

Clearly, the number of ships requiring to pass depends on the location of the unberthing vessel in the overall Rambler Channel area. No ships pass Terminals 1 and 5, whereas the majority of vessels will pass Terminal 7. This variation has been taken into account in the detailed calculations together with the effect of the different berth arrangements for the MPT option and the 20-berth container vessel configuration.

The calculation method for estimating passing delays was set out in Appendix 2 of reference 2.

The results of these delay calculations are given in Table 4.3. This table follows the detailed calculations used in the previous report. The line "Probability of Numbers of Movements" shows the probability of different numbers of passing movements occurring during the period of a single unberthing manoeuvre. The average delay per ship delayed is the same for both options for 1-way passing, and slightly less for the MPT option for the no passing case. In the latter case, the average delay over all vessels is 1.3 minutes per ship for the MPT option compared with 1.7 minutes per ship for the 20 berth container option.

Turning to the proportion of movements delayed, it will be seen that for the no passing case (Level 2) the proportion of ships delayed is around 11% for the MPT configuration compared with over 14% in the 20-berth container configuration. When this proportion of ships delayed is combined with the number of ships and the average delay per ship, the resulting total delay time is 80 minutes per day with the MPT option compared with 112 minutes per day with the 20 berth container option.

4.5 Effect of Lighter Traffic

The presence of lighter traffic in the MPT option is considered not to cause significant delays to the vessels using the MPT or the container terminals, for the following reasons:

1) The general assumption has been made, throughout the studies, that small vessels using the Rambler Channel will give way to the vessels using the terminals as necessary.

2) The lighters can be expected to keep clear of manoeuvring container vessels.

While this approach is consistent with the previous study, it is recognised that lighter traffic has increased significantly with the MPT and larger PCWA to the north and that instead of being through traffic, many lighters are now manoeuvring to berth/unberth along the SETY waterfront. These factors could cause an increase in vessel encounters and an increase in delays to larger vessels if lighters are allowed to move regardless of conflicts.

4.6 Effect of Increased Traffic

To test the effect of further increases in traffic on the level of delays, estimates of the percentage of ship movements delayed have been made for the average number of MPT and container berth movements per berth per day up to twice this value. The results of these estimations are given in Table 4.4. The purpose of these calculations is to provide a sensitivity analysis, and to illustrate the impact on average delays when ships arrive in clusters.

The results in this Table indicate that the percentage of delayed movements increases directly with the increase in the volume of ship movements per berth, within the range of increase which has been examined. The proportion delayed increases from 21% at the traffic level of 61 movements per day to 37% at a level of 120 movements per day.

4.7 Delays due to Random Arrivals

In all the previous calculations it has been assumed that ship movements occur randomly in time, as this is likely to present the worst situation from the point of conflicting movement requirements and hence delays. Traffic regulatory measures could be expected to improve this situation.

The situation will doubtless arise where periods of no arrivals of vessels will be followed by periods when several vessels arrive either simultaneously or at least too close together for a transit through Hong Kong harbour.

In the latter instance it will be necessary for a staged movement to allow for a safe following distance between the vessels, even if the vessels are bound for vacant berths. While determination of an appropriate distance between following vessels will lie with the Marine Department, for the purposes of calculating the likely delays we have assumed a minimum spacing of 10 minutes. The application of this rule would mean that when for example, two ships arrive at the entrance to the Rambler Channel area with less than 10 minutes between them, even if both ships are bound for vacant berths, the second ship would be held back to create the required 10-minute interval. This regulatory measure would create some level of delay to ship movements which is independent of the types of delay which have been discussed in the earlier sections.

Estimates of the proportion of movements likely to be delayed and the average delay time have been made for a range of traffic levels. The effect of an increase in the volume of movements is shown in Table 4.5, showing the effect on the MPT configuration of increasing the traffic level from 61 to 120 movements per day. The proportion of movements delayed increases from 21% to 42%. The average delay per ship delayed rises from 6.4 minutes to 8.6 minutes. The combination of these two effects with the increase in the number of ship movements results in a very sharp increase in the total delay time from 82 minutes per day to 429 minutes per day at the doubled traffic level.

4.8 Time Taken for Port Transit

Table 4.6 sets out the times taken to enter and exit the port for the MPT option. The times are estimated from the ship simulation work previously performed and are independent of vessel traffic interaction. The point of port entry or exit is taken as the start of the port approaches to the south east of Tsing Yi (Fig. 10).

The average times to transit the port are slightly less for the MPT option compared with the 20-berth container layout as a result of the positioning of the multi-purpose terminal.

4.9 Summary of Predicted Delay

Table 4.7 summarises the predicted delays explained in the previous sections and indicates figures for "total delays" converted to minutes per day based on the analysis described. At the forecast level of traffic (61 movements per day) the total delays are 230 minutes per day compared with 285 minutes per day for the 20 berth container option. At twice the level of traffic with the MPT configuration, these total delays are 945 minutes per day, compared with 1,185 minutes per day for the all-container option.

The MPT option is thus expected to have delays some 80% of those for the corresponding all-container option.

Table 4.1

Durations of Departure Swinging Manoeuvres

Berth	Duration	Berth	Duration	Berth	Duration
A	15	H	45	O	25
B	15	I	15	P	15
C	15	J	15	Q	10
D	15	K	30	R	10
E	15	L	45	S	10
F	30	M	45	T	10
G	45	N	35	U	10

Table 4.2

Berth Delays due to Unberthing at Adjacent and Opposite Berths

Parameters:	Containers	MPT
Numbers of berths	16	5
Berth movements/day	3.30	1.67

Unberthing Delays	MPT	(20 containers)
Average number of berth movements delayed	4.45	(4.19)
Proportion of movements delayed (%)	9.59	(9.49)
Average delay per ship delayed (mins)	11.55	(12.0)
Average delay, all ships (mins)	1.11	(1.14)
Number of ships delayed	5.86	(6.26)
Delay time (mins/day)	67.70	(75.0)

Table 4.3

Passing Delays Due to Unberthing Manoeuvres (per day)

Parameters:	Containers	MPT
Berths	16	5
Berth movements/day	3.30	1.67
Passing time (mins)	5.00	5.00

		MPT	(20 containers)
Average berths generating passing movements		5.57	(6.0)
Average passing movements per unberthing		0.26	(0.33)
Probability of numbers of movements (%)	0	77.49	(71.9)
	1	19.76	(23.7)
at least	2	2.75	(4.4)

Option - Level 1

	MPT	(20 containers)
Probability of opposite direction (%)	1.37	(2.2)
Probability of occurrence during unberthing (%)	0.30	(0.5)
Percentage of ships delayed	0.24	(0.3)
Number of ships delayed	0.15	(0.23)
Average delay to passing movement (mins)	2.50	(2.5)
Total delay time (mins/day)	0.36	(0.57)

Option - Level 2

	MPT	(20 containers)
Average number of passing movements	0.26	(0.33)
Percentage of ships delayed	11.31	(14.2)
Number of ships delayed	6.92	(9.3)
Average delay to delayed ships (mins)	11.55	(12.0)
Average delay per ship	1.31	(1.7)
Total delay time (mins/day)	79.87	(112)

Table 4.4

Effect of Increased Traffic on Percentage of Movements Delayed by Unberthing Manoeuvres

Parameters:	**Containers**	**MPT**
Number of berths	16	5
Passing time (mins)	5.00	5.00

Number of berth movements	61.15	66.00	70.00	80.00	90.00	100.00	110.00	120.00	130.00
PERCENTAGE DELAYS	(Containers only)								(Containers only)
Berth delays	9.59	(9.5)	10.82	12.18	13.50	14.78	16.02	17.22	(17.10)
Passing delays, level 1	0.24	(0.3)	0.29	0.36	0.43	0.51	0.58	0.65	(0.90)
Total, level 1	9.82	(9.8)	11.12	12.54	13.93	15.28	16.60	17.88	(18.00)
Passing delays, level 2	11.31	(14.2)	12.74	14.30	15.80	17.26	18.66	20.02	(24.50)
Total, level 2	20.90	(23.7)	23.56	26.48	29.30	32.03	34.68	37.24	(41.60)

Table 4.5

Delays caused by random arrival with imposition of minimum 10-minute interval

Parameters:	Containers	MPT
Number of berths Interval (mins)	16 10.00	5 10.00

Number of berth movements	61.15	66.00	70.00	80.00	90.00	100.00	110.00	120.00	130.00
DELAY STATISTICS	(Containers only)								(Containers only)
Average interval one-way (mins)	47.10	44.00	41.14	36.00	32.00	28.80	26.18	24.00	(22.00)
Proportion (%) of movements delayed	21.23	22.90	24.31	27.78	31.25	34.72	38.19	41.67	(45.10)
Number of ships delayed	12.98	15.12	17.01	22.22	28.13	34.72	42.01	50.00	(58.68)
Average delay over all ships (mins)	1.35	1.49	1.61	1.92	2.27	2.66	3.09	3.57	(4.11)
Average delay per ship delayed (mins)	6.35	6.49	6.61	6.92	7.27	7.66	8.09	8.57	(9.11)
Total delay time (mins/day)	82.42	98.10	112.39	153.85	204.55	265.96	339.89	428.57	(534.80)

Table 4.6

Port Transit Times

Berth	Arrival Time (mins)	Departure Time (mins)
A	40	49
B	33	43
C	29	39
D	27	37
E	25	35
F	27	35
G	29	37
H	29	35
I	26	28
J	25	27
K	25	29
L	28	35
M	29	37
N	26	31
O	23	26
P	20	22
Q	22	28
R	24	30
S	26	32
T	28	34
U	30	36
Average	**27.2**	**33.6**
(20 container berths)	(27.9)	(34.6)

Table 4.7

Overall Ship Movement Delays (minutes per day)

Parameters:	**Containers**	**MPT**
Numbers of berths Passing time (mins) Interval (mins)	16 5.00 10.00	5 5.00 10.00

Number of berth movements	61.15	66.00	70.00	80.00	90.00	100.00	110.00	120.00	130.00
OVERALL DELAYS (MINS)		(containers only)							(containers only)
Berthing delays	67.70	(75)	87.49	112.54	140.29	170.64	203.47	238.67	(267)
Level 2 passing delays	79.87	(112)	102.98	132.10	164.25	199.28	237.04	277.39	(383)
Random arrival delays	82.42	(98)	112.39	153.85	204.55	265.96	339.89	428.57	(535)
Total delays mins/day	229.99	(285)	302.86	398.48	509.09	635.88	780.40	944.63	(1185)
Total delays hrs/year	1399.08	(1734)	1842.39	2424.11	3096.98	3868.28	4747.43	5746.53	(7209)
Delay per ship	3.76	(4.3)	4.33	4.98	5.66	6.36	7.09	7.87	(9.1)

5. TYPHOON EVACUATION

This section addresses the question of the evacuation of the Rambler Channel berths, including those at Stonecutters Island, in the event of a typhoon warning or other emergency. The purpose of this is to make comparisons with the minimum times determined in the earlier Container Terminal 8 assessments, based on orderly sequential evacuation.

An orderly departure will need to be imposed if ship conflicts are to be avoided and all ships are to be cleared from the Rambler Channel. This will of course mean that some, if not most ships will have to depart before they might otherwise wish to do so. When there is a conflict of interest between the safety of the port and the safety or commercial requirements of an individual or group of ships, then the overall safety considerations of the port must prevail.

For comparison with the earlier study, the basic assumption is made that all 21 berths are occupied at the raising of the Typhoon No. 3 Signal and that all ships are "head in". The departure sequence of the ships will be such that a continuous flow of departure movements can take place.

To avoid ship conflicts within the Rambler Channel, the ships will need to depart in a sequence from adjacent or opposite berths. For the purposes of this exercise a notional Rambler Channel entry/exit point has been taken to the south of Tsing Yi, as indicated at Figure 10. Shown also at Figure 10 are the 21 berths, indicated as A - U. The times for exit, from each of the berths, are taken as those given earlier at Table 4.1 for the port transit time calculations.

Two basic "rules of departure" are used, identical to those adopted in the earlier Container Terminal 8 Study, namely:

(i) There shall be an interval of 15 minutes, at least, between vessels departing from adjacent or opposite berths to allow the preceding vessels to complete the departure swing.

(ii) There shall be an interval of at least 10 minutes between vessels passing the notional exit point.

Against these "rules of departure", example times for a sequential departure programme for all 21 vessels are shown at Table 5.1. As can be seen, the first departures are from the southern berths in the Rambler Channel, so that times of passing the notional exit point can commence as soon as possible from the raising of the Typhoon No. 3 Signal. The further assumption is made that a sufficient number of tugs and pilots will be available at the times required.

From Table 5.1 it can be seen that the total time for evacuation amounts to 5 hours 10 minutes by applying the "evacuation rules" described above. In practical terms it is unlikely that the timings will be so closely adhered to as shown in Table 5.1, thus it would be prudent to make an allowance of perhaps 50%, extending the total evacuation time to 7 hours 45 minutes. To set against this however is the unlikelihood of all 21 berths being occupied simultaneously at the raising of Typhoon No. 3 signal.

The total evacuation time given, with the 50% allowance, is some 33 minutes in excess of the total evacuation time of 7 hours 12 minutes given for the earlier Container Terminal No. 8 Study, for the evacuation of the 20 berth scheme.

Table 5.1

Sequence and Timing of Typhoon Evacuation Plan

Berth	Commence Departure	Clears Exit Point
P	00.00	00.22
O	00.15	00.41
N	00.30	01.01
K	00.45	01.14
M	00.55	01.32
L	01.10	01.45
Q	01.27	01.55
J	01.38	02.05
I	01.53	02.21
R	02.08	02.38
H	02.13	02.48
S	02.28	03.00
F	02.43	03.18
T	02.58	03.32
G	03.05	03.42
U	03.16	03.52
E	03.31	04.06
D	03.46	04.23
C	04.01	04.40
B	04.16	04.59
A	04.31	05.10
Total Time for Evacuation = 5 hours 10 minutes		

6. SUMMARY AND CONCLUSIONS

This report compares the MPT option with the maximum extension to the container terminals previously considered. The comparison is thus between:

MPT Option:

MPT 1,000 m	(nominal 5 berths)
PCWA 800 m	
Container terminals	16 berths
South Tsing Yi ferries, etc.	

All Container Option:

Container terminals	20 berths

Comparisons have been made in terms of:

Ship manoeuvring
Traffic simulation - ship encounters
Delays to ships using terminals
Typhoon evacuation times

6.1 Ship Manoeuvring

Ship manoeuvring simulation was not required on this occasion because of the smaller sizes and greater manoeuvrability of vessels at the MPT compared with container vessels which would use the site.

On the basis of earlier work, there will be sufficient room for container vessels to manoeuvre at Kwai Chung with vessels berthed at the MPT and lighters alongside. While container vessels are swinging opposite the MPT, lighter operations can continue, but through traffic may be subject to a short delay. Due to the possibility of lighter operations at berth Q conflicting with in-bound or out-bound container ships close to the chamfer on the SETY reclamation, berth Q should be moved northwards. The operation of container vessels at the berths on North Stonecutters will not be affected.

6.2 Traffic Simulation

The encounter frequencies can be summarised as follows:

Berth Movements	Vessels Involved	Encounters per day	
		MPT Option	(20 Container Berths)
Average	All Including MPT + containers MPT + containers only	5,345 438 16	(4,256) (447) (20)

2 x Average	All Including MPT + containers MPT + containers only	5,916 881 68	(4,771) (985) (91)

The numbers of encounters involving vessels using the terminals are slightly reduced with the MPT option, pointing to less congestion and the possibility of reduced delays in this case. The numbers of encounters involving other types of vessels are increased, because the volume of small vessels is increased by the lighters using the MPT and the PCWA.

6.3 Delays to Ships Using Terminal

The delays can be summarised in minutes per day for the options as follows:

Berth Movements	Delay Type	MPT Option	(20 Container Berths)
Average	Berthing	67.7	(75)
	Level 2 passing	79.9	(112)
	Random Arrivals	82.4	(98)
	Total	230	(285)
2 x Average	Berthing	239	(267)
	Level 2 passing	277	(383)
	Random Arrivals	429	(535)
	Total	945	(1,185)

There is a consistent reduction in delays with the MPT option, largely attributable to the smaller numbers of movements compared with the container vessels.

6.4 Typhoon Evacuations

The evacuation times were calculated as follows:

MPT Option	20 Container Berths
7 hours 48 minutes	7 hours 15 minutes

This small increase in evacuation time is mainly attributable to the extra berth for the MPT option.

6.5 Overall Marine Impact

We consider that the overall marine impact of the MPT option compares slightly favourably with the 20 container berth option.

REFERENCES

1. Road Link Between North West New Territories and West Kowloon (Route 3) - Maritime Study. April, 1989.
2. Container Terminal No. 8 Study - Marine Impact Assessment. July, 1989.
3. Stonecutters Options for Container Terminal 8, Hong Kong. A Channel width and Traffic Study. October, 1989.

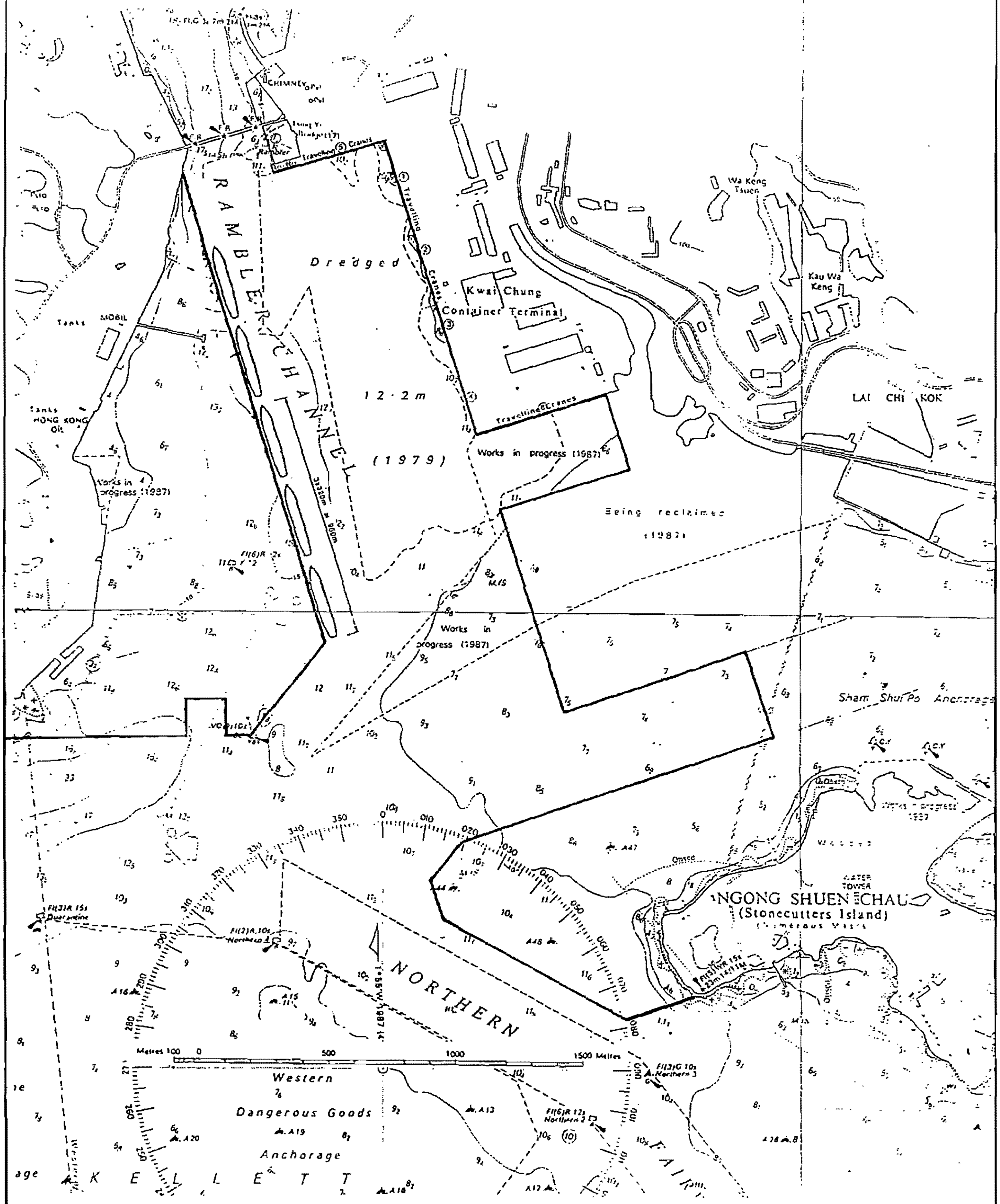


FIGURE 1

Layout - Showing 5-berth Scheme on Tsing Yi

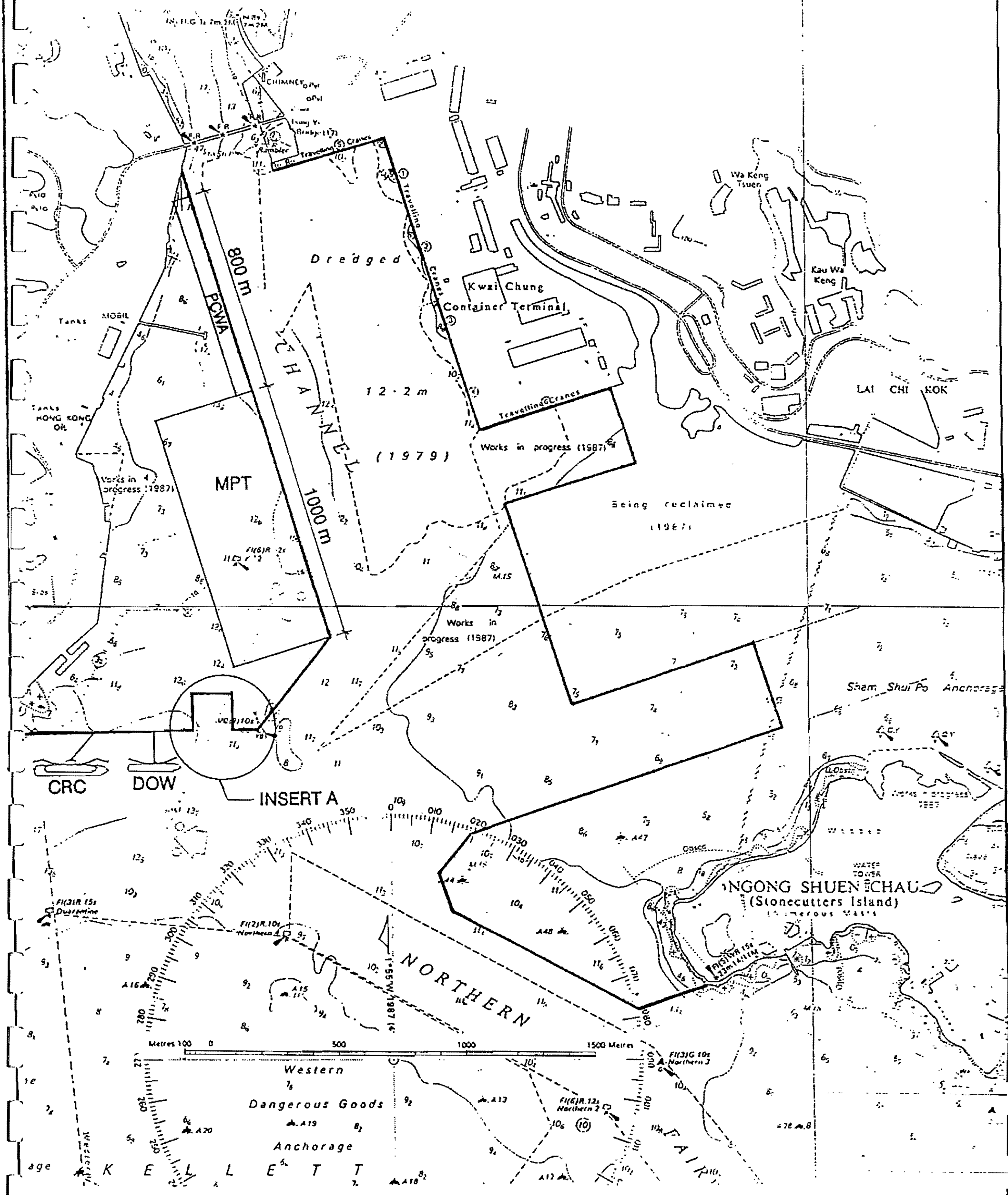


FIGURE 2

Outline Reclamation Plan for Marine Study for a MPT

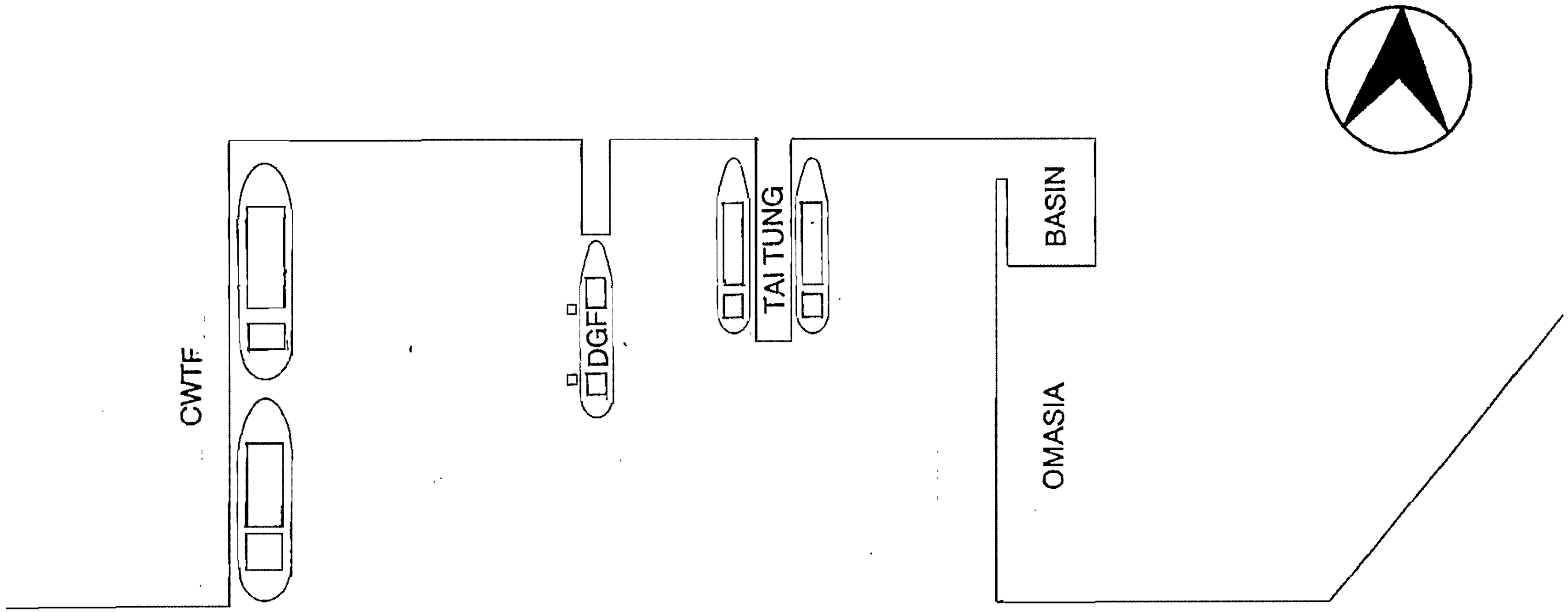


FIGURE 2A
INSERT A

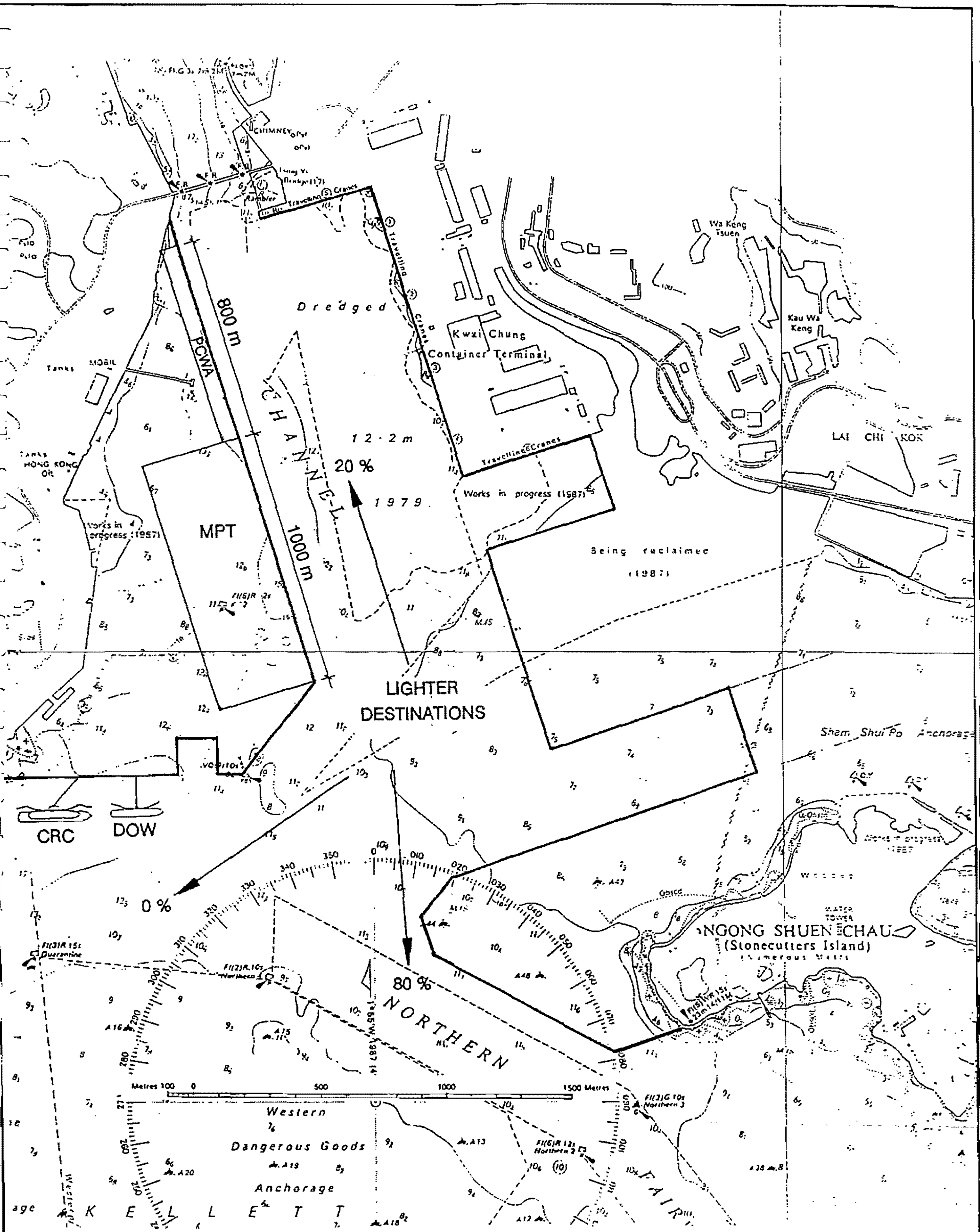


FIGURE 3
Outline Reclamation Plan for Marine Study for a MPT (Lighter Destinations)

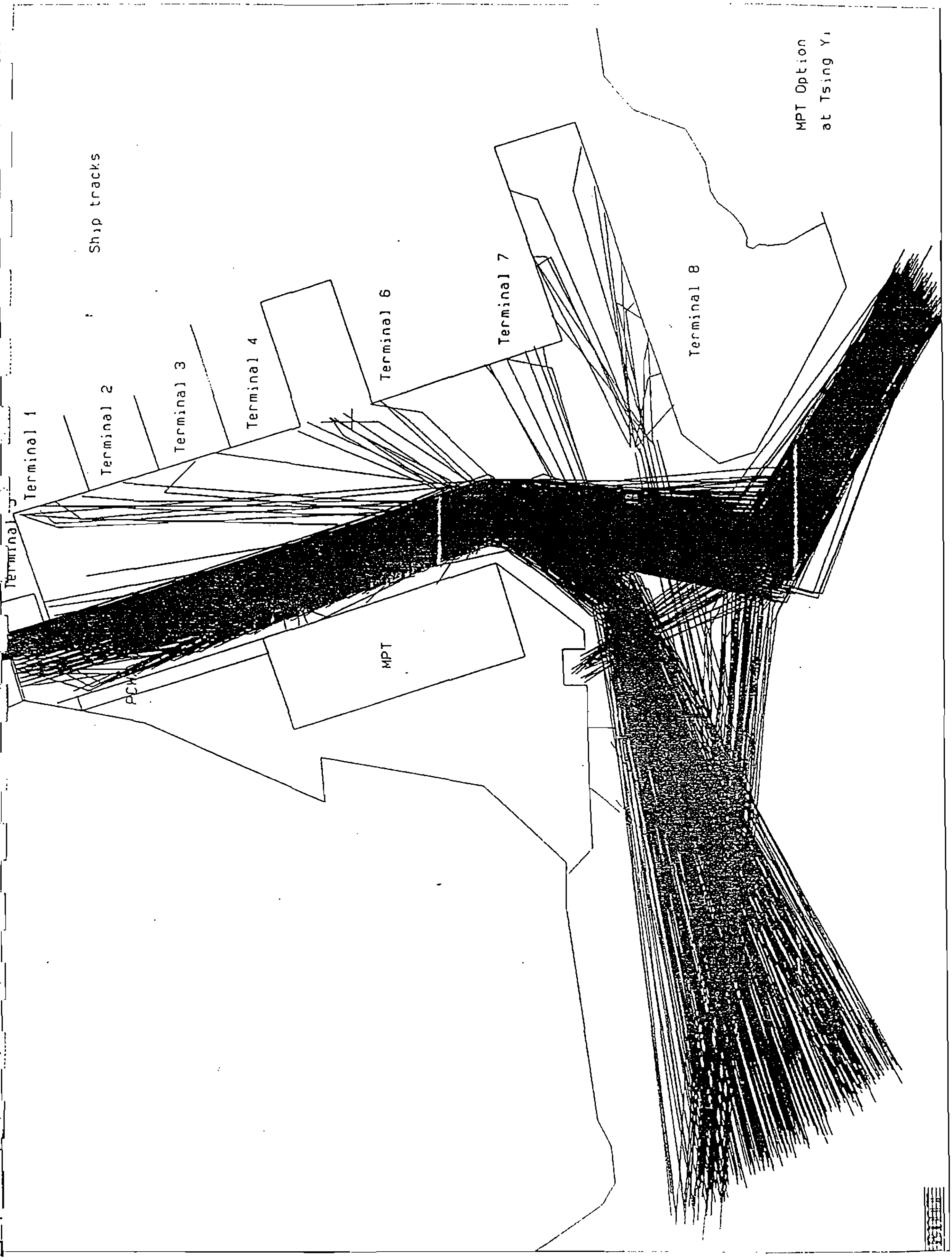
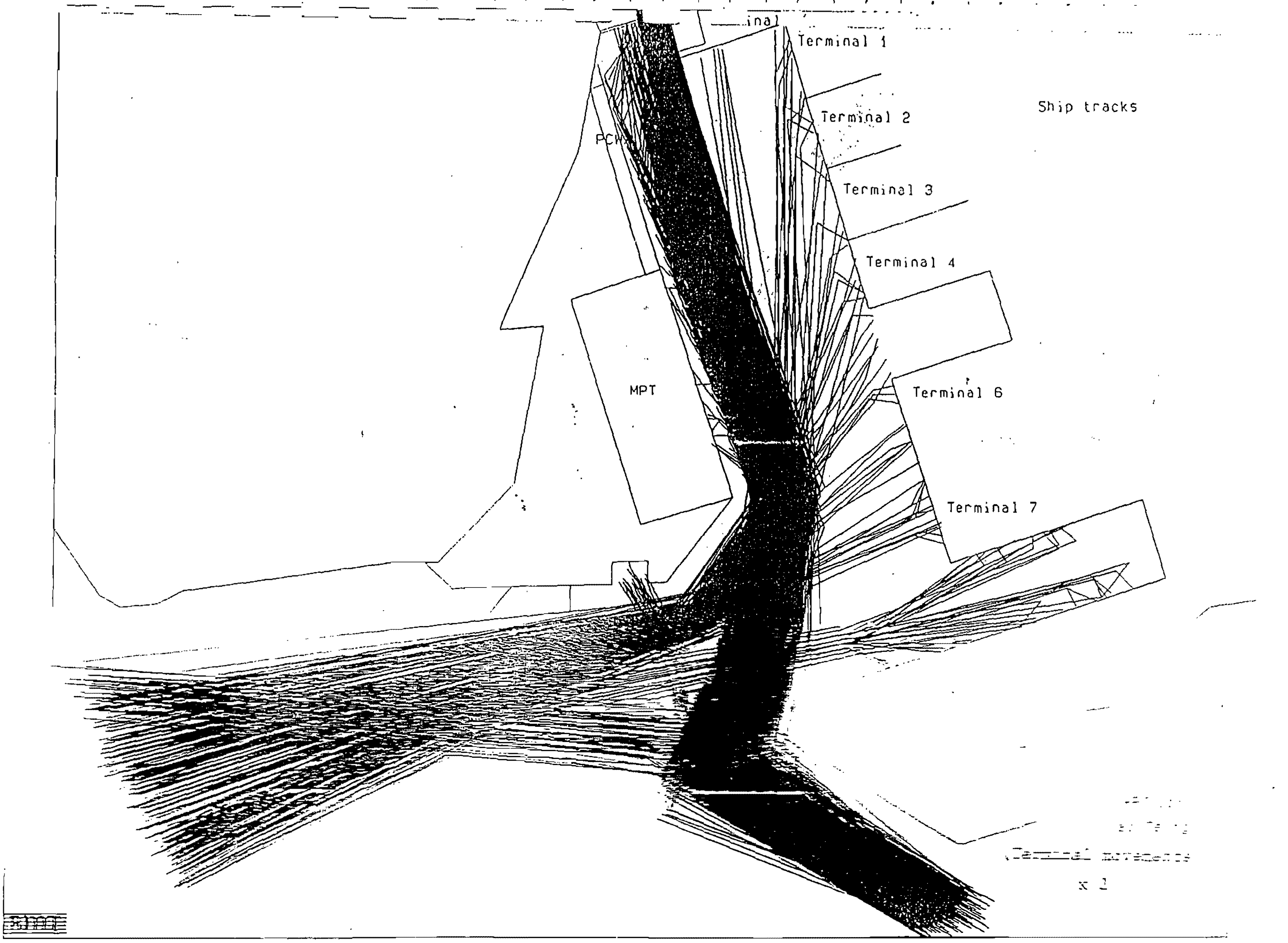

Ship tracks
MPT Option
at Tsing Y
Terminal 1
Terminal 2
Terminal 3
Terminal 4
Terminal
Terminal 6
Terminal 7
Terminal 8
MPT
PCW

FIGURE -

FIGURE 5


Terminal
Terminal 1
Ship tracks
Terminal 2
PCW
Terminal 3
Terminal 4
MPT
Terminal 6
Terminal 7
Terminal 8
MPT Option
at Tsing (
(Terminal movements)
x 1.5



Ship tracks
inal
Terminal 1
Terminal 2
Terminal 3
Terminal 4
Terminal 6
Terminal 7
PCH
MPT
Terminal movements
x 1

Figure 6

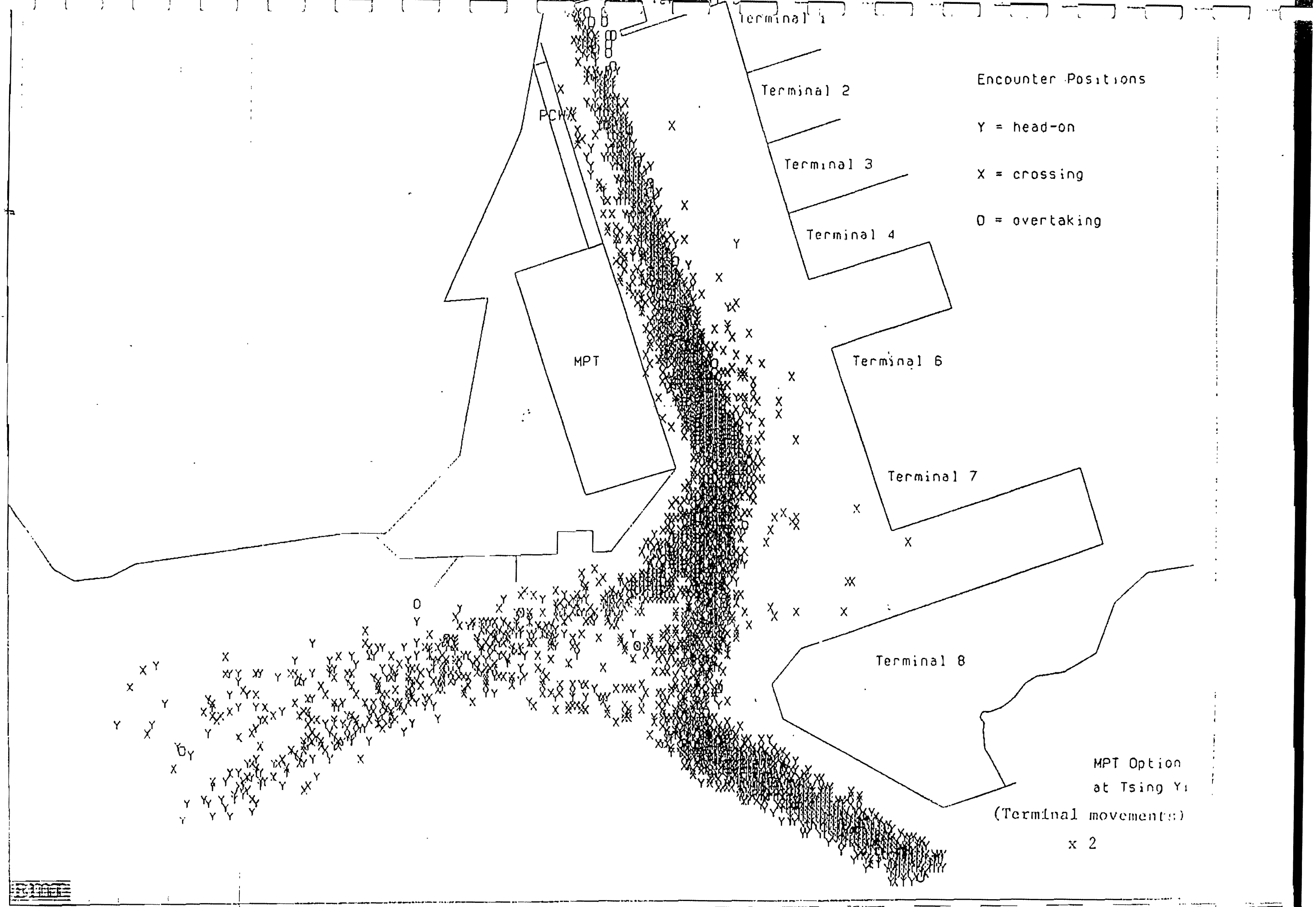

Terminal 1
Terminal 2
Terminal 3
Terminal 4
Terminal 6
Terminal 7
Terminal 8
PCWA
MPT
Encounter Positions
Y = head-on
X = crossing
O = overtaking
MPT Option
at Tsing Yi

FIGURE 7


Terminal 5
Terminal 1
Terminal 2
Terminal 3
Terminal 4
Terminal 6
Terminal 7
Terminal 8
PCW
MPT
Encounter Positions
Y = head-on
X = crossing
O = overtaking
MPT Option
at Tsing Yi
(Terminal movements)
x 1.5

FIGURE 5

FIGURE 9


Terminal 1
Terminal 2
Terminal 3
Terminal 4
Terminal 6
Terminal 7
Terminal 8
PCW
MPT
Encounter Positions
Y = head-on
X = crossing
O = overtaking
MPT Option
at Tsing Yi
(Terminal movements)
x 2

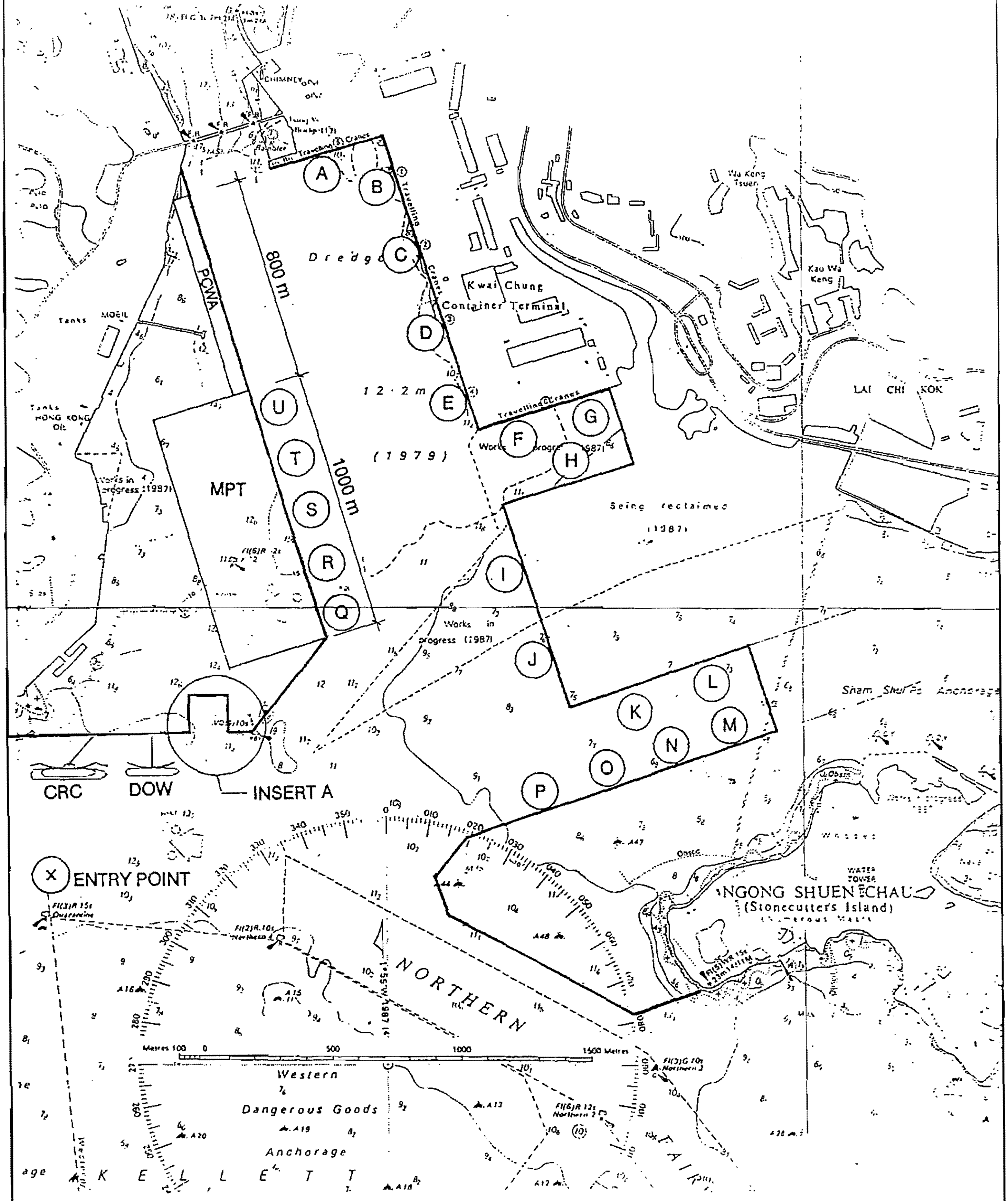


FIGURE 10

Outline Reclamation Plan for Marine Study for a MPT (Berth Positions)

APPENDIX B2

MARINE IMPACT STUDY

FAIRWAY REALIGNMENT

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PART 1

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PART 2

APPENDIX

List of Figures

Note : Figures 9, 10, 12, 13 and 15 not used.

PART 1

1. Introduction

The reclamation associated with Container Terminal No. 9 development, including new tanker and barge berth facilities proposed along the southern face, requires that the existing fairway south of Tsing Yi be realigned further south.

This fairway realignment will involve some modification to the existing anchorage areas at Kellett Bank. The additional facilities on the south face of the reclamation will also increase marine traffic in this area with a resulting effect on vessel encounters and delays.

A brief review of alternative fairway alignments was carried out prior to the commissioning of this marine impact study with a view to developing a new alignment which would, as far as possible, optimise the following conflicting requirements :

(1) minimise impacts on other port areas

(2) provide adequate clearance to the south Tsing Yi tanker piers

(3) simplify vessel approach manoeuvres and thus improve safety

(4) minimise losses in the Western Quarantine and Immigration and Western Dangerous Goods anchorage areas

(5) minimise overall dredging requirements at Kellett Bank

After some discussion with Marine Department, it was concluded that the layout shown in Figure 8 should be adopted as the preferred solution and should form the basis of any future detailed investigation.

Subsequently, this marine impact study was commissioned to evaluate the selected fairway realignment in detail and to assess the impacts of marine operations at the southern Tsing Yi marine facilities, including the marine basin, and the container vessel traffic to and from the Rambler Channel. A copy of the brief is included in the Appendix.

This Study has been carried out incorporating the following :

(1) Information Collection (Traffic Forecasts and Anchorage Area Usage)

(2) Traffic Simulation (Vessel Encounters and Delays)

(3) Operational Aspects (Fairway Options, Aids to Navigation)

(4) Allocation of Anchorages and Buoys (Western Dangerous Goods and Western Quarantine and Immigration Anchorages)

(5) Engineering Appraisal (Costing including buoy relocation and dredging)

Study results for Stages 1 and 5 are presented below. Stages 2, 3 and 4 are presented in Part 2 of this Report.

2. Information Collection

2.1 Traffic Forecasts

Traffic forecasts for 1997 corresponding to the programmed commissioning of the fourth container berth at Terminal 9 were required for this Study. The Study therefore considers the fully developed port scenario where effectively 20 container berths are in operation including 4 each at Terminals 8 and 9.

It was agreed with Marine Department that traffic forecasts adopted in the Terminal 8 Study would be used as a basis for this Study. In particular for the container berths it has been assumed that berth utilization would remain at 3.3 ship movements per day per berth. Traffic forecasts for ferries have allowed for a 5% increase per annum on the CT8 figures but were reduced by the amount of traffic forecast for the Dangerous Goods Ferry in the marine basin. River-craft traffic figures were escalated by 10% per annum to 1997 in line with the CT8 Study projection.

Traffic forecasts for the facilities located on the south of the SETY reclamation and Esso and CRC were based on information provided by individual operators as follows:

Esso

Traffic figures for 1990 were supplied by Esso and escalated by 5% per annum to 1997.

CRC

Marine Department supplied traffic forecasts for the CRC extended facility which were deemed to represent final development status in 1997. Traffic associated with the inner berths on the east of the main pier (cement ships and aggregate barges) were omitted as they conflicted with the provision of a tanker pier for Dow. Should the Dow pier not eventuate the Study findings would remain valid as the forecast CRC aggregate barge and cement ship traffic is not large and within the numbers of vessel movements allowed for the Dow pier.

Dow

Traffic forecasts for Dow are based on advice from Dow on 1990 traffic escalated by 5% per annum to 1997. Although typically vessels currently call once per week, at certain periods calls can be daily for up to 2 weeks. This higher frequency was conservatively used for the Study.

Chemical Waste Treatment Facility (CWTF)

The CWTF marine traffic level has been derived from a Marine Department estimate in December 1990 which indicated that allowance should be made for 1 call per day.

Dangerous Goods Vehicular Ferry (DGF)

The DGF marine traffic level assumes that a future dangerous good vehicular ferry service is provided between Tsing Yi and Central. It is also based on the following:

(i) Oil company responses indicating a ferry service from Tsing Yi to Tuen Mun or West Kowloon would not be used unless made compulsory by Government.

(ii) The assumption that Government continues to allow DG trucks to use bridges from Tsing Yi to Kowloon.

(iii) Current oil company and estimated CWTF DG truck trip numbers between Tsing Yi and Central.

(iv) A ferry capacity of 7 No. D.G. trucks.

(v) Ferries operate at an average of 75% capacity.

Tai Tung

Current traffic figures were supplied by the Managing Director of Tai Tung and escalated by 5% per annum to 1997.

Outboard Marine

Outboard Marine indicated that their facility was unlikely to generate any significant marine traffic other than infrequent pleasure craft calls.

2.2 Traffic Routes

Traffic routes for container vessels, river craft, ferries, commercial shipping and ocean going vessels were taken from the Container Terminal 8 Study for consistency. For Esso, CRC and the facilities to be located on the south of the SETY reclamation individual operators were consulted and traffic route estimates made.

A summary of traffic forecasts and routes are given in Tables 2.1 and 2.2.

Table 2.1 General Marine Traffic Forecasts - 1997

1.	Container Vessels	
	Assumes 20 berths in 1997 Rambler Channel to/from West (South Tsing Yi)	66 moves/day
2.	River Craft	
	a) Rambler Channel to/from Northern Fairway	660 moves/day
	b) Rambler Channel to/from West (South Tsing Yi)	340 moves/day
3.	Ferries	
	a) Through Rambler Channel to/from Northern Fairway	145 moves/day
	b) To/from West (South Tsing Yi) to/from Northern Fairway	45 moves/day
4.	Commercial Shipping	
	To/from West (South Tsing Yi) to/from Northern Fairway	28 moves/day
5.	Ocean Going Vessels	
	To/from West (South Tsing Yi) to/from Northern Fairway	10 moves/day

Table 2.2
Marine Traffic Forecasts for South Tsing Yi Facilities - 1997

	Vessel Details			Traffic Forecast		Traffic Route (percentage)		
Company	Vessel Type	Size DWT	Approx Length	Traffic 1990	Calls/Month 1997	West Access (South Tsing Yi)	Northern Fairway	Rambler Channel
Esso	Tanker	30,000-110,000	190-280	4	6	100	0	0
	Tanker	<30,000	160	4	5	80	20	0
	LPG Tanker	1,250-1,500	105	2	3	50	50	0
	Barges	600-1,600	40	190	270	20	80	0
	Barges	<500	25	14	20	50	50	0
CRC	Tanker	40,000-80,000	185-235	-	8	100	0	0
	Tanker	5,000	105	-	10	100	0	0
	Tanker	1,500	70	-	10	100	0	0
	LPG, Lube Oil and Chemical Carrier	<5,000	105	-	7	100	0	0
	Barges	<1,300	45	-	600	70	20	10
Dow	Tanker	<75,000	260	16	22	100	0	0
CWTF	Barge	1,200	60	30	42	50	50	0
DGF	Barge	450	57	340	480	0	100	0
Tai Tung	Barge	1,500	49	100	140	0	50	50
Outboard Marine	Small Craft	-	-	-	-	-	-	-

3. Anchorage Area Usage

3.1 General

An indication of the level of anchorage area usage was required in order to establish how sensitive harbour operations would be to potential anchorage area losses/gains.

3.2 Western Dangerous Goods Anchorage

Specific information on the level of usage in the WDGA was not available from the Vessel Traffic Centre however general information on buoy usage in Hong Kong was drawn from annual reports from Marine Department Statistics. (Refer to Section 8.2 in Part 2 of this Report).

3.3 Western Quarantine and Immigration Anchorage

Only very general information on the usage of the WQIA was available from the Immigration Department. Two spot surveys of anchored vessels were carried out by Marine Department in March 1991 to assist in predicting typical usage levels but it was decided that this information was too limited to be representative.

Without statistics it was not possible to realistically consider the likely future requirements of this anchorage area. However, it is acknowledged that there is little scope for boundary changes or alternative anchorage area sites in this instance.

4. Engineering Appraisal

4.1 General

In accordance with the Study Brief this section addresses the costs of the proposed fairway realignment. The costs provided are estimates only but are believed to be sufficiently accurate to assist in the planning of this work. Works costed have included initial dredging, the relocation of buoys for navigation markers and anchorage area moorings and maintenance dredging. Costs are based on mid-1991 prices.

4.2 Dredging

Initial Dredging

Realignment of the fairway south of the existing location requires dredging of the northern extent of Kellett Bank. Quantities have been based on the seabed contours given on Admiralty Navigation Chart 3280 and are based on a dredged level of -15.0mCD with seabed batters of 1 in 5 where necessary.

Dredging quantities exclude that required in the area immediately north of the realigned fairway, which amounts to 150,000 cu.m. This area of dredging to the north is not included as it is not required for the existing CRC facility nor for the vessels that are initially expected to call at the possible Dow pier. Rates for dredging are those used in the SETY Draft Final Report based on mud disposal at South Cheung Chau with a premium of 20% to allow for the smaller size of the works relative to that involved for SETY.

Table 4.1 summarises initial dredging costs excluding allowances for preliminaries and contingencies.

Table 4.1 Initial Dredging Costs

Dredging Volume Million cu.m.	Rate HK$/cu.m.	Total Amount HK$ Million
3.92	18.00	71

Maintenance Dredging

In order to estimate maintenance dredging costs, an estimate of the long term siltation rate in the Kellett Bank area needs to be established. WAHMO model analyses carried out by Port Works Division, CESD, which modelled the seabed before and after the fairway realignment, have been reviewed and compared. These runs have indicated that the time over which lower tidal velocities occurred in the approach fairway (less than 0.1m/s) increased by about 20% as a result of the fairway realignment. This suggests that future siltation rates could increase by approximately 20%, compared with the existing rates, following the fairway realignment.

Seabed soundings at the northern end of the Northern Fairway (1976 to 1987) indicated a maximum decrease in water depth of 0.85m over 11 years. This represents effectively 80mm/year siltation which is a useful guide to the order of siltation in the approach fairway. Thus allowing for a 20% increase in siltation for the approach fairway due to realignment a figure of 100mm/year has been allowed for future maintenance dredging cost estimates. Costs for maintenance dredging have been based on only that area requiring initial dredging.

The costing rate for maintenance dredging will depend very much on the volume of mud to be removed under individual maintenance contracts, with smaller sized maintenance works costing relatively more per cubic metre. Port Works Division, CESD have indicated that a grab dredge should be assumed for maintenance dredging as the availability of a suction dredge cannot be guaranteed in Hong Kong. They also indicated that for dredging volumes in excess of 5000 cu.m. between 5m and 15m below CD a rate of HK$20.00 per cu.m. should be assumed for dredging and disposal. Allowing for maintenance dredging between -14.5mCD and -15.0mCD approximately 490,000 cu.m. of material would require dredging. Accordingly a rate of 20 HK$/cu.m. has been used for costing.

Cost estimates for maintenance dredging are given in Table 4.2. These costs exclude allowances for preliminaries and contingencies.

Table 4.2 Maintenance Dredging Costs

Dredging Volume Million cu.m.	Rate HK$/cu.m.	Total Amount HK$ Million
490,000	20.00	10

Note: The above costs assume one off maintenance dredging between - 14.5m and - 15.0m CD. For a siltation rate of 100mm/year, these costs would be incurred every 5 years.

4.3 Navigation and Mooring Buoys

The need for navigation and anchorage area buoys is discussed in Part 2 of this Report (Refer to Sections 6 and 8). Buoy relocations have been valued at HK$100,000 per buoy in line with Marine Department advice and rates given in a recent Port Works contract. It should be noted that costings assume that the Kellett Buoy will be used to mark the northern edge of the realigned fairway assuming dredging immediately north is not carried out in the first instance. It has also been assumed that the cost of removing this buoy is insignificant. No new buoys are required.

Cost estimates for navigation and mooring buoy reprovisioning are given in Table 4.3 and exclude allowances for preliminaries and contingencies.

Table 4.3 Navigation and Mooring Buoy Relocation Costs

Navigation Buoys No.	Mooring Buoys No.	Total Buoys No.	Rate Thousand HK$/Buoy	Amount Thousand HK$
3	2	5	100	500

4.4 Summary of Costs

Costs estimates for initial dredging, navigation and mooring buoys and the anticipated maintenance dredging in the first 5 years are summarised in Table 4.4. Remuneration losses to Government from anchorage area losses have not been included. An allowance for 6% preliminaries and 10% contingencies has been made.

Table 4.4 Summary of Costs

Initial Dredging HK$ million	Maintenance Dredging HK$ million	Buoys HK$ million	Total Amount HK$ million
71	10	0.5	95

Note : The above dredging costs have been rounded up to the nearest HK$ million.

5. Recommendations

Recommendations include the following :

- the realigned fairway should be dredged to -15mCD with a navigation buoy on the northern edge to mark the undredged area to the north. It would, however, be desirable to dredge this area to -15mCD to remove the hazard to deep draught container vessels and oil tankers on the north of the fairway. After such dredging, the buoy on the northern edge of the fairway could be removed and reused elsewhere if desired.

- the width of the mouth of the basin be reduced. This not only will improve the shelter to the basin but will also maximise protection afforded by the physical presence of the breakwater to the eastern most dolphin of the possible tanker berth. An entrance width reduced to approximately 80 metres, which is five times the beam of the largest basin vessels, would cater for one way traffic. Allowance for one way traffic would be acceptable in this case because of the relatively low traffic volumes. A preliminary layout of the marine basin with a revised entrance is shown in Figure 18.

- Marine Department should consider investigating alternative QIAs to compensate for the loss in the WQIA area due to the proposed fairway realignment.

PART 2

1. Introduction

The formation of the South-East Tsing Yi (SETY) reclamation, with the development of an additional container terminal (CT9) in the Rambler Channel and reprovisioned berths on the south face of the reclamation, requires consideration to be given to the realignment of the approach fairway to the southern Rambler Channel.

This realignment will affect the marine impacts including delays to be expected between the container vessels and the vessels using the reprovisioned berths.

It will also affect the area available for mooring and anchoring in the region of the Kellett Bank. Measures to maintain the available area or number of moorings may be limited by the approach of vessels from the south to the Ma Wan Channel.

The realignment is to be reviewed having regard to vessel operational considerations and anchorage area needs.

In accordance with the Study Brief, and the subsequent discussions with Tsuen Wan Development Office and Marine Department, a proposal was developed which forms the basis of the present study. This report deals with stages 2 to 4 of that proposal, under the headings Traffic Simulation, Operational Aspects and Allocation of Anchorages and Buoys.

2. Method of Study

The investigation centres initially around the simulation model used in previous parts of the SETY Study. This is set up to represent the likely traffic flows for the SETY development with and without the fairway realignment specified in the Study Brief (Fairway Realignment Scheme and the Base Case respectively). The levels of potential ship conflicts are assessed as represented by encounters between container vessels and ships using the south face of the reclamation. Possible resultant delays are also assessed and compared with the overall expected delays obtained in earlier studies.

Having estimated the levels of potential ship conflicts and delays with the above limiting cases, the study goes on to consider the fairway requirements in detail, in relation to its dimensions and to the management of traffic flows. The effects on anchorage areas and buoy provision are investigated. The relationship of the SETY berths to the traffic using the fairway is checked.

Finally, the conclusions are summarised.

3. TRAFFIC SIMULATION

The traffic simulation follows the methodology used in the previous marine impact assessments for CT8 and SETY. As far as possible, assumptions remain the same as for the earlier work.

3.1 Traffic Levels

The traffic levels for this study have been based on the final phase of the CT8 Study, with 20 container berths in operation. The levels are calculated for the year 1997, and take account of the SETY facilities and data provided from existing private operators where relevant. Traffic movements are then predicted as follows:

Ship Type	Route	Movements/day
Container vessels	Terminals 1-7 ⇄ E. Lamma Channel	40
	Terminal 8 ⇄ E.Lamma Channel	13
	Terminal 9 ⇄ E.Lamma Channel	13
River craft	Rambler Channel ⇄ Northn. Fairway	660
	Rambler Channel ⇄ West	340
Ferries	Rambler Channel ⇄ Northn. Fairway	145
	Northern Fairway ⇄ West	45
Commercial Shipping	Northern Fairway ⇄ West	28
Ocean Going Shipping	Northern Fairway ⇄ E.Lamma Channel	10
Barges	SETY Basin ⇄ Rambler Channel	5
	SETY Basin ⇄ Northern Fairway	38
	SETY Basin ⇄ West	1
	Esso ⇄ Northern Fairway	15
	Esso ⇄ West	4
	CRC ⇄ Rambler Channel	4
	CRC ⇄ Northern Fairway	8
	CRC ⇄ West	28
Tankers	Esso ⇄ Northern Fairway	0.2
	Esso ⇄ E.Lamma Channel	0.7
	CRC ⇄ E.Lamma Channel	2.3
	Dow ⇄ E.Lamma Channel	1.5

3.2 Traffic Patterns

Each route is determined by the constraints of destinations, fairways and available water and defined as a series of straight segments between course altering lines, giving rise to the ship tracks shown for the simulated cases. The routes followed are those used in previous studies of the proposed container terminal developments and south-east Tsing Yi, adjusted to suit the positions of the developments now under consideration. The starting point is the final phase of the CT8 Study, consisting of a 20 berth scheme with three container berths on the Stonecutters Island reclamation and five on the Tsing Yi reclamation (Figure 1). For the present study four berths on Stonecutters Island and four on Tsing Yi have been assumed, giving the same total of 20 berths as in the CT8 Study. The major change, however, is the provisioning of the south face of the SETY reclamation with a basin and jetties for the use of CRC and Dow Chemical (Figure 2). The latter facilities project south of the face of the reclamation and cause some diversion of the vessels passing south of Tsing Yi, as well as generating extra traffic. For these reasons it has been necessary to simulate a new "Base Case" with which the realigned fairway can be compared.

As a qualitative check of the present traffic in this general region, a sample from the VTS radar records is presented in Figure 3. This consists of the tracks of all vessels which were "tagged" by the operators, generally the ocean-going vessels in the area. The figure represents three days in October 1989, and is derived from digital records of ship positions taken at three-minute intervals. The routes taken by the ocean-going vessels can clearly be seen, together with positions taken up by ships anchored or moored at buoys. It should be emphasised that these are selected ship tracks only and that they will be modified by proposed port developments.

3.3 Traffic Simulation Model

The traffic simulation model is the same as that used in previous CT8 studies [Reference 1]. Its purpose is to compare possible schemes in terms of congestion and safety. The model generates representative ship tracks based on the traffic levels and patterns as obtained above. It then calculates the numbers of "encounters" - the occasions on which ships would approach within a specified distance of one another in the absence of avoidance action. The numbers of such encounters are an index of traffic congestion and an indication of possible numbers of collisions.

In setting up the model to represent the traffic to the SETY developments it has been necessary to make some simplifications because of the large number of individual berth locations involved, particularly for vessels using the basin and the smaller vessels visiting the CRC and Esso terminals. These tracks have therefore been lumped together and terminated at the entrance to the basin or close to the CRC and Esso terminals as appropriate. This will not affect the encounters with the container vessels using the SETY fairway.

3.4 Traffic Simulation Results

The generated ship tracks are shown in Figures 4 and 5. Figure 4 represents the "Base Case" with the traffic constrained by the southern edge of the existing SETY fairway (assumed to be dredged to -15m CD) and the proposed SETY developments. As before, it is assumed that vessels will attempt to take the shortest practicable routes, within the constraints of the port layout, including the fairways where appropriate. The actual spread of the traffic lanes must have a degree of uncertainty, but for the purposes of comparison the same assumptions are adopted as for the previous studies.

Figure 5 shows the corresponding set of tracks with the fairway extended south as proposed in the Study Brief. Within the 600m width available it is assumed that the container vessels will follow a comparatively narrow band of tracks and, in particular, will keep to the south at the western end of the fairway to shorten the distance travelled and to allow a wider turn into the Rambler Channel. Other ocean-going vessels to and from the East Lamma Channel will merge with the container vessels at the western end of the fairway. The smaller vessels are expected to keep largely to present routes.

The encounter positions are shown in Figures 6 and 7. It can be seen that for the realigned fairway there is less concentration of encounters close to the SETY development.

The numbers of encounters for a 24 hour period have been calculated and are presented below, broken down into head-on, crossing and overtaking encounters. For each case three groups are considered:

- all encounters;
- encounters involving container vessels;
- encounters involving only container vessels.

As for previous studies, the "all encounters" category is a less important indicator of traffic congestion as it is dominated by encounters between the larger numbers of smaller vessels.

Encounter Rates (per day)				
Base Case				
Vessel Involvement	Encounter Numbers			
	Head-on	Crossing	Overtaking	All
All	2062	2491	75	4628 (+9%)
Inc. containers	65	390	4	459 (+3%)
Containers only	9	9	0	18 (-10%)

The figures in brackets are changes relative to the previous 20 berth case, with three berths on the Stonecutters Island development, five berths on Tsing Yi, and without traffic from the proposed facilities along the southern edge of SETY.

Encounter Rates (per day)				
Realigned Fairway				
Vessel Involvement	Encounter Numbers			
	Head-on	Crossing	Overtaking	All
All	2026	2437	75	4538 (-2%)
Inc. containers	48	359	3	410 (-11%)
Containers only	10	8	0	18 (0%)

The figures in brackets are changes relative to the "Base Case", and are attributable to the realigned fairway. It can be seen that the improvements are experienced most particularly by the container vessels, which are able to spread out from the relatively congested region immediately to the south of the SETY development.

In terms of encounters involving the container vessels, the realigned 600m wide fairway can, therefore, be considered to more than compensate for the effects of the provisioning of the SETY area.

4. TRAFFIC DELAYS

As in previous studies, the delays calculated are those expected by the container vessels using the port. These have previously been limited to delays due to interference between container vessels berthing, unberthing and passing berths and these remain unchanged in the present study. Hence a strict application of the previous criteria would show no additional delays since the additional encounters calculated in the previous section do not lead to delays, as defined above, to the container vessels.

However, taking a more cautious view, the additional possibility of delays caused by vessels using facilities along the southern edge of the SETY developments, and those of CRC and Esso, are here considered. It is recognised that in practice most, if not all, vessels using these developments could be expected to keep clear of the container vessels. Nevertheless, in dealing with the uncertainties of human behaviour there is some merit in considering a pessimistic scenario to give an upper bound to possible delays.

The scenario considered is that of container vessels leaving port and being accidentally delayed by barges leaving the southern edge of SETY for the Northern Fairway and hence passing directly across their route. Larger vessels travelling between the southern edge of SETY and other locations (principally the East Lamma Channel) are assumed to stay clear of the container vessel route by adjusting the position of any swinging manoeuvres appropriately.

This scenario is specifically limited to the outbound directions for both classes of vessels on the grounds that there is most scope for misjudgments in this case. (In the event that a container vessel is entering port its course and speed should be well established and obvious to other vessels. Alternatively, if a vessel is approaching the southern face of SETY from the Northern Fairway it should have plenty of room to manoeuvre.)

Two levels of delay have been estimated, modelled on the assumptions used in previous studies. These are:

Level 1 - Assumes that ships may pass in one direction at a time, but if two ships moving in opposite directions wish to pass an unberthing vessel the second ship must wait until the first ship has passed. A container vessel would therefore only be impeded if it met another container vessel opposite SETY as a vessel was leaving there.

Level 2 - This is a more severe criterion than level 1 and assumes that no ship may pass outbound while one is unberthing. As mentioned earlier, this would give an upper bound to the possibility of some vessels leaving the south face of SETY inadvertently impeding the outbound container vessels. (Note that inbound container vessels are assumed to be on well-established courses and given right of way by the vessels leaving the south face of SETY.)

Bearing in mind that these are both pessimistic criteria, upper limits to possible delays may be estimated by assigning level 1 to the most favourable case with the 600m fairway and level 2 to the least favourable case with no additional dredging. Level 1 is then taken to correspond to the situation with the realigned fairway, while level 2 is considered appropriate to the more restricted waters of the "Base Case".

In comparing these assumptions with the corresponding assumptions for the Rambler Channel with an 800m separation, it must be remembered that the latter is for container vessels being impeded by other container vessels only. For the situation off the south face of SETY, although container vessels are not generally expected to be impeded by small vessels, a pessimistic scenario has been assumed in order to establish an upper bound to delays caused by human errors.

The calculation method used for estimating passing delays was set out in Appendix 2 of Reference 1.

The results of these delay calculations are given below.

Passing Delays due to vessels leaving SETY (per day)

The mean time for a container vessel to pass SETY, or for barges leaving SETY to clear the area, has been taken as five minutes. These can only be order of magnitude figures and are not dictated by any particular SETY facility nor by swinging procedures. However, in view of the delays calculated, they are evidently not critical.

Container vessels leaving/day	33	
Mean passing time (mins)	5	
Crossing vessels from SETY south /day	31	
Mean crossing time (mins)	5	
Average passing movements during mean crossing time	0.23	
Probability of numbers of passing movements (%)	No.	Prob. %
	0	79.52
	1	18.23
at least	2	2.26

1-way passing (Realigned Fairway)

Probability of opposite direction (%)	1.13
Number of ships delayed per day	0.35
Proportion of ships delayed (%)	1.06
Average delay to ships delayed (mins)	2.5
Average delay per ship (mins)	0.03
Total delay time (mins/day)	0.87

No passing ("Base Case")

Average outbound movements (%)	11.5
Number of ships delayed per day	3.55
Proportion of ships delayed (%)	10.76
Average delay to ships delayed (mins)	2.5
Average delay per ship (mins)	0.27
Total delay time (mins/day)	8.88

The above total delay times are the increments attributable to the developments proposed along the south face of the SETY reclamation and are thus additional to the total delays of 285 minutes/day previously estimated for the 20 berth container port [Reference 2]. Whereas the delays previously estimated were for interference between container vessels only, the above delays make the more rigorous assumption that some of the smaller vessels may delay the container vessels under particular circumstances. Hence the percentage increases are estimated to be less than the following amounts:

Delay increment (%)

"Base Case"	+3.1
Realigned fairway	+0.3

Although the assumptions made are more severe than for previous studies, it can be seen that the maximum estimated delays are small, and negligible for the realigned fairway of the Study Brief. Delays to container vessels are therefore considered not to be a significant problem for the developments.

5 Fairway Requirements

5.1 Description of Fairway

The existing SETY Fairway serves as the link between the main north-south shipping route through the Western Harbour and the container terminals in the Rambler Channel. Although for use primarily by the container traffic, it is also used extensively by lighters, ferries and other traffic to and from the Northern Fairway passing south of Tsing Yi.

The present width of the SETY Fairway is 600m, with depths varying between -13.5m CD and over -20m CD, except for the southern edge of the fairway where, according to the latest Admiralty Chart No. 3280, recent dredging has brought the depth to -15.0m CD. The length of the fairway between the parallel fairway edges is currently 1600m from the Kellett Buoy to the bend south east of Tsing Yi.

The realigned fairway, as proposed in the Study Brief, is parallel to the existing fairway but displaced by about 470m to the south east. This will enable an easier line of access and exit to the Rambler Channel for the container ship traffic, allowing for the reclamation work at the southeast of Tsing Yi. The realigned fairway is shown in Figure 8. It is 600m in width, the same as the existing fairway, and would intrude significantly upon the Western Dangerous Goods Anchorage and the Western Quarantine and Immigration Anchorage. It would also necessitate the relocation of the A.16 mooring buoy.

As well as investigating reprovisioning of the existing 600m wide fairway, the opportunity has been taken to assess whether the width of 600m is a necessary requirement for the realigned fairway. This is discussed below in terms of depth and width requirements for the container ship traffic.

5.2 Depth Requirements

The determining depth in the fairway will be set by the draft requirements of the larger container vessels.

During the earlier study concerned with the immersed tunnel for the crossing of the Rambler Channel, consideration was given to the likely maximum drafts of existing and future container ship fleets. The conclusion of that investigation was that the present maximum draft of container vessels of 13.5m is unlikely to be exceeded in the future. The main rationale behind this conclusion was to the effect that 13.5m is the maximum effective draft for container vessels restrained by Panamax dimensions; post-Panamax vessels are expected to be greater in length and beam, but less in draft.

It is considered therefore that a maximum draft of 13.5m should be taken as the depth criterion of the new fairway. In accordance with general practice for determining underkeel clearances, a value of not less than 10% of the static draft of the vessel should be allowed. The water depth to be provided for the large container vessel traffic should therefore be taken as -15.0m CD. Shown also in Figure 8 is the extent of the area of dredging necessary to provide a water depth of -15.0m CD for the realigned fairway.

5.3 Width Requirements

The determination of the width dimension depends upon the ship sizes, the severity of any bends, the water depth available, the extent to which a fairway may be "canalised", prevailing winds and currents, and whether one-way or two-way shipping is envisaged.

For the new fairway it will be necessary to accommodate two-way traffic and the assumption is made that the channel should be wide enough to accept the passing of two large post-Panamax vessels, the dimensions of which are taken as follows for the purpose of this appraisal:

- length b.p. = 300m
- beam = 39.4m
- draft = 13.5m

The above dimensions do not reflect the dimensions of any known container ships. Rather, they have been selected as indicative of likely extreme individual dimensions of future vessels for the purposes of fairway width determination.

The beam width quoted above is taken from the largest post-Panamax container vessels on order, i.e. those of American President Lines, constructed for stacking containers 16 wide across the deck. Other post-Panamax container vessels on order, i.e. those for NEDLLOYD and CGM are 37.5m in beam, allowing for 15 containers to be stacked across the deck.

The maximum cross wind assumed is 30 knots, and the maximum cross current 2 knots, based on WAHMO modelling of spring tidal velocities and observations from a previous study by others. In particular WAHMO modelling has predicted that the strongest cross currents will occur across the western end of the realigned fairway. These are not expected to increase as a result of the CT8 and CT9 reclamations but an increase in cross current speeds of 25% has been predicted by WAHMO midway along the realigned fairway, as a result of the proposed fairway dredging.

A method of assessing the required width of fairway is recommended in Reference 3 (DTp, "Ship Behaviour in Ports and their Approaches", Part 7). A typical expected ship speed of 5 knots within the fairway has been used.

This method of calculation would arrive at a fairway width of 590 metres, approximating to the 600m proposed. However, this method is not considered reliable for values of cross current in excess of approximately 0.25 x ship speed, when severe problems of ship controllability can be expected, particularly as the cross current is understood to vary along the length of the fairway.

Marine Department have advised that they know of no operational problems with the existing fairway. However, the predicted 25% increase in cross currents, as a result of the dredging required for the realigned fairway, would be expected to increase navigation difficulty, particularly at the western end where cross currents are strongest. The proposed dogleg detail, however, is an improvement on the existing alignment and will tend to assist in alleviating any increased turning difficulty due to higher cross currents.

Should operational difficulties arise with the realigned fairway, the northern boundary could be shifted further north to provide more turning room, making use of the additional dredged area recommended in the next section. If required, it would be possible to investigate the extreme current cases by ship manoeuvring simulation.

6. Management of Traffic Flows

6.1 Aids to Navigation

The present SETY Fairway has no marks delineating the northern boundary, there being no particular restriction on width due to available water depth. This will not be the case however with the realigned fairway as there is an area to the north of the boundary with lesser depths than the -15.0m CD required for the container traffic.

If the area to the north of the boundary was to be dredged to -15.0m CD, then no marking of the northern boundary would be considered necessary. If this additional dredging is not undertaken, then re-location of the buoys is proposed as shown in Figure 8.

This involves moving the Quarantine Buoy to mark the south-west corner of the fairway, with the Kellett Buoy moved to the north to provide a "gate" for the fairway entrance; amended characteristics would be required to indicate the new purpose of the buoys. A re-location of the Northern 4 Buoy should also be made.

6.2 Effect on Traffic Flows during Fairway Construction

The assumption is made that the construction of CT8 will have been completed with associated dredging and removal of buoys A.44, A.47 and A.48 prior to commencing the construction of the new fairway. Based upon that assumption, dredging works to the east of the Northern Fairway may be disregarded for the purposes of this assessment.

Provided that the dredging for the new fairway is completed first, there is no reason to believe that this construction phase will interfere with the flow of traffic to and from the Rambler Channel. Some disruption will however be caused to traffic at the northern end of the Northern Fairway. If dredging to the east of the Northern Fairway is not completed prior to the fairway realignment works, then this will need to be staged to avoid disruption to the northern entrance of the Northern Fairway.

To minimise potential disruption, it is recommended that self-propelled trailer suction dredgers are used exclusively. If stationary plant is utilised, then temporary diversions around the dredgers will need to be implemented, involving the placing of additional buoys to mark the diversionary navigational routes, as the dredgers work across the Northern Fairway.

During the dredging operations it will be necessary, as is common practice, for a dredging craft to be equipped with VHF radio for the purposes of communicating the position and intention of the dredger movements to the Hong Kong VTS.

6.3 The Hong Kong VTS

It is not envisaged that any additional or changed VTS procedures are necessary. With the main radar station of the VTS situated at the Macau Ferry Terminal, the areas of visibility will not be affected by the SETY developments. There is a need for an on-site dredging craft to be able to report progress of dredging or incident to the VTS and this should be specified in the dredging contract. This information would be necessary for the VTS to advise traffic, through VHF broadcasts, of the dredging activities and the positions of any temporary buoyage, or to instigate its own emergency procedures as appropriate.

7. Effect of Fairway on Anchorage Areas

This section is devoted to a discussion of the effects on anchorage areas of the fairway. The provision of mooring buoys within these areas is addressed in Section 8.

7.1 Western Dangerous Goods Anchorage

With a fairway width of 600m, the loss of water area from the Western Dangerous Goods Anchorage would amount to approximately 18.0 ha, as illustrated in Figure 11.

7.2 Western Quarantine and Immigration Anchorage

With a fairway width of 600m, the loss of anchorage area would amount to approximately 58.1 ha, as illustrated in Figure 11.

7.3 Additional Areas for Anchorage

Clearly there is little space remaining for the allocation of additional areas for anchorage close to the numerous facilities in the western section of the harbour. The potential developments related to the Port and Airport Development Strategy may place further restrictions on additional areas for anchorage to the west of the limit of Hong Kong harbour at some time in the medium to long term future. As can be seen from the composite picture of radar tracks shown in Figure 3, this area is presently used for anchorage.

It would however be feasible to utilise the existing area of anchorage to the west of the Quarantine Anchorage, up to the line of the approach to the SETY Fairway. The southern and south-eastern boundaries of the area could be extended to within 220m of the A74 buoy and 260m of buoys A41 and A42 (used for overlength vessels up to 225m length). This would provide an additional 18.3 ha, as shown in Figure 11.

Additional space for the Western Quarantine and Immigration Anchorage would be generated by altering the approach fairway dogleg to the west or by displacing the north south fairway to Ma Wan to the west. This is discussed below.

At present, vessels arriving for the Rambler Channel via the East Lamma Channel will continue on a course of approximately 334°(T) until abeam of buoy A.49 before altering course to the north towards the Kellett Buoy, then making the 66°alteration of course to pass south of Tsing Yi. Vessels proceeding towards Ma Wan will continue on the course of 334°(T) until they alter course to 340°(T), heading for Gemini Point, to reach a position off Ma Wan to make the turn around the island.

It is believed, however, that it would be imprudent to displace these tracks to the west for two main reasons. The first is that the displaced routes would restrict the sea space available for additional shipping routes likely to be required for the Lantau Port Peninsula development. The second is that the eventual angle of turn necessary to round Ma Wan would be increased, creating additional ship manoeuvring difficulties for the large vessel transits.

A sharper dogleg is also not recommended in view of the relatively severe cross current conditions predicted in the area by WAHMO.

A summary of the losses and gains of anchorage areas is given below.

Summary of Anchorage Areas : Losses and Gains

Criteria	Quarantine & Immigration Anchorage			Dangerous Goods Anchorage
	Loss of Area	Potential Gain	Overall Loss/Gain	Loss of Area
Area (ha)	-58.1	+18.3	-39.8	-18.0
Percentage of Total Area of Anchorage	-46.6	+14.7	-31.9	-9.2

The above 32% loss of the existing WQIA area is substantial and investigation of other QIAs by Marine Department should be carried out to alleviate this loss.

8. Effect of Fairway Re-alignment on Buoy Moorings

8.1 Re-location of A.16 and Other Buoys

The Class A mooring buoys are presently available for use by vessels of up to 183m in length, with corresponding drafts. Class A buoys are generally situated some 440m apart throughout the Harbour, in depths ranging from 6.5m to 12m. The A.16 buoy is located as the most northerly buoy in the Western Dangerous Goods Anchorage, in 8m water depth.

In the event that the SETY Fairway is realigned in the manner proposed, it will be necessary to move the A.16 buoy from its present location. To retain the A.16 buoy within the Western Dangerous Goods Anchorage, at the required separation distance of 440m between Class A buoys, some re-arrangement of other buoys would also be necessary. This would entail, firstly, the relocation of the A.20 buoy to a position 90m to the south, thereby maintaining the same separation distance from the A.19 buoy and retaining a 400m separation from the B.27 buoy to the south. The A.16 buoy could then be relocated to a position 240m to the southeast, retaining a 440m separation distance from the A.15 buoy and the relocated A.20 buoy. The new position of the A.16 buoy would be in a water depth of -7.7m CD and 230m clear of the southern edge of the fairway, as shown in Figure 14. There would thus be no loss of buoys, but two would require relocation.

In view of the overall loss of water area within the Western Dangerous Goods Anchorage as a result of realigning the fairway, coupled with the overall shortage of mooring buoys in the Western Harbour, it is worth considering means of providing additional buoys within the available areas.

At present there are seven A Class buoys within the Western Dangerous Goods Anchorage. Shown in Figure 16 is a possible buoy arrangement to maximise the number that can be situated within this anchorage area. It can be seen that there is still potential to locate nine A Class buoys within the anchorage area, with a limited extension of the anchorage area to the southwest.

This buoy arrangement would require the relocation of buoys A.16, A.18, A.19 and A.20 to create the space for the two additional buoys. As shown in Figure 16, each buoy is at least 440m distant from the other A Class buoys.

The B Class mooring buoys are presently available for use by vessels of up to 137m in length, with corresponding drafts. These buoys are generally situated 360m apart in water depths ranging from 5.5m to 8 m.

The suggested re-arrangement to provide additional buoys within the Western Dangerous Goods Anchorage would impinge upon the present location of three B Class buoys to the southwest of the anchorage area. Shown in Figure 16 is a possible relocation of these buoys and of the A.73 buoy. As can be seen, each of the buoys maintains the required separation distances and is within water depths appropriate to Class, with the possible exception of a reduced depth within the area of the relocated A.20 buoy, where a small pocket of depth -5.3m CD is indicated.

8.2 Usage of Harbour Mooring Buoys

Data supplied from Hong Kong indicates that in 1989 there were 48 Class A buoys and 27 Class B buoys in use.

The Statistical Tables produced by the Marine Department indicate a very high level of utilisation of these buoys, as summarised below from available data.

Buoy Usage	1985	1986	1987
No. of "A" Buoys	44	44	44
No. of "B" Buoys	28	27	26
Days booked/occupied "A"	11,640	12,452	14,837
Days booked/occupied "B"	7,789	7,716	8,954
Percentage use of "A"	74.2%	86.4%	92.4%
Percentage use of "B"	79.0%	78.3%	94.4%

Further data on buoy utilisation for the later year 1989 indicates that on average each A Class buoy was used by 61.1 vessels and each B Class buoy by 69.0 vessels. Taking account of the number of buoys available in 1989, this suggests that each vessel had occupied or booked a Class A or Class B buoy for about 3.5 days. If this is correct it suggests a very high level of utilisation.

The statistics available do not differentiate as to whether the level of utilisation actually refers to days when ships were working cargo at the buoys, whether a ship was at the buoy but not working cargo or whether the buoys were booked but with no ship moored.

Clearly the optimum number of buoys required cannot be resolved without details of the nature of the buoy utilisation, forecasts of the likely numbers of ships wishing to use the buoys and the arrival and departure intervals between ships using the buoys. Further aspects would require data on ship waiting/delay costs, the costs of providing the buoys and indeed the booking and pricing policies for buoy usage.

It is apparent however that the present number of buoys available is likely to be inadequate for future requirements. The two additional buoy spaces possible within the Western Dangerous Goods Anchorage, as discussed above, will make little impact on any shortfall of required buoys but may be of help in the short term.

9. Effect of Fairway on SETY Berths

9.1 Approaches to CRC and Dow Berths

The proposed SETY reclamation and location of the CRC and Dow terminals will place the vessels moored at these berths in close proximity to two main traffic flows. The first of these is the main flow of container ship traffic through the SETY Fairway. The second is the flow of small craft across the south of Tsing Yi.

The approaches to these two berths would need to take account of the main flows of traffic to avoid unwanted conflicts. It is therefore recommended that the approach should be on a track continuing north of the Kellett Buoy and turning east to approach the berths outside the northern boundary of the SETY Fairway. This will remove the risk of encounter with the container ships within the restriction of the SETY Fairway, but will place the vessels within the traffic flows of the smaller craft. This approach would in any event be necessary to allow for the draft of the largest vessel acceptable at the CRC berth of 80,000 dwt. A corresponding draft for a vessel of that size would be 14m, requiring 15.4m water depth. This approach is shown in Figure 17, where although preference would be for a "head-in" berthing, this may not always be possible and allowance needs to be made for the greater swinging area required if the vessel arrives for a "head-out" berthing.

9.2 Manoeuvring Area Requirements

Typical overall dimensions of the sizes of vessels to be accepted at the CRC and Dow berths would be:

	CRC	Dow
dwt.	80,000	75,000
length o.a.	250 m.	240 m.
beam	40 m.	38 m.
draft	14 m.	13.8 m.

The swinging circle diameter requirement for large vessels is generally taken as approximately 1.8 x ship length with the aid of tugs, for other than extreme conditions of wind or current [References 4 & 5]. In the case of the vessel dimensions given above, these would amount to:

CRC Vessel = 450m
Dow Vessel = 432m

If these vessels were required to make a swing prior to berthing, they would clearly intrude into the fairway and lie across the main flow of container vessel traffic departing from the Rambler Channel. Container vessel traffic entering the Rambler Channel would be in the southern part of the fairway in observance of the "keep to the right" rule and clear of the swinging manoeuvre.

Even if these vessels swing on departure off the berth, while the diameter of the turning circle would be less as the vessel would commence from the fixed position alongside, there would still be intrusion into the main fairway. This swinging area, for both arrivals and departures, would also be at the location where small craft in the east/west routes off the south of Tsing Yi would be entering the SETY Fairway both for destinations in the Rambler Channel and to and from the Northern Fairway. Manoeuvring of the large vessels in this area is clearly likely to produce a high number of encounters with both large and small vessels at a location where these vessels will be making adjustments to their course headings.

To avoid encounters in the area immediately off the berth, it would be prudent to move the swinging area. A proposed area for swinging is also indicated in Figure 17, which would place the area clear of the container vessel traffic and also allow the small craft to clear the manoeuvreing area beyond the location where traffic is making course alterations for the Rambler Channel. The location of these swinging areas would however necessitate the vessels being towed to or from the berths. This would increase the duration of the manoeuvre and thus expose the vessels to more encounters. These encounters would however be with the small craft moving south of Tsing Yi, but outside the SETY fairway, which is preferable to encountering the large vessels within the fairway.

9.3 Likelihood of Striking the SETY Berths

Of the two proposed berth locations at SETY, that for Dow is closer to the flows of passing traffic and closer to the convergent traffic area at the corner of SETY. As such, the Dow berth must offer a higher likelihood of being struck by the passing traffic.

Although the likelihood of the event is believed to be low, it is by no means unknown at other locations for a moored vessel to be struck by passing traffic. In this case, not only will the passing traffic be close, it will be in an area of many course alterations, for navigation and collision avoidance. In addition to the passing traffic, there is also the potential for small craft entering and leaving the basin to strike the moored tanker, although an extension of the breakwater to the east as shown in Figure 18 would reduce the likelihood of such an event.

The consequence of a striking can be severe, particularly if the moored vessel is loaded with a potentially hazardous or pollutant cargo.

It is considered therefore that, on the grounds of safety of that port area, the proposed location of the Dow berth is not appropriate for the berthing of a 75,000 dwt tanker which may be carrying a potentially hazardous cargo. Further consideration needs to be given to a relocation of this berth, possibly to be set further west and/or set back to the face of the Tsing Yi reclamation, to locate the berthed ship further from the flows of passing traffic.

Additionally, consideration needs to be given to the interactive forces acting upon a moored ship by a passing vessel. The effect of this has been studied in terms of likely additional loads imposed upon a ship's moorings by a passing vessel which will depend greatly upon the passing distance and the size and speed of the passing vessel [Reference 6]. Port incident data indicates that these interactive forces can cause mooring damage and in extreme cases cause the moored vessel to break away from the berth. This possibility will need to be taken account of in the design of moorings at this berth.

The same reservation does not apply to the proposed location of the CRC terminal which, while clear of the corner of SETY and the small craft basin, is also a further 150m from the likely tracks of passing container vessels. The drawings provided for this study indicate an inside berth for a vessel of 1,500 to 5,000 dwt at CRC, barges along the sea wall and a berth for a 5,000 dwt LPG carrier against the sea wall between the CRC berth and that of Esso. These vessels will be well sheltered from the passing traffic, but it would be prudent for them to adopt the same lines of approach and departure for the berths as discussed above and shown in Figure 17.

10. Conclusions

The conclusions of the study can be summarised under the chapter headings as follows, with the subheading numbers shown in brackets:

Traffic Simulation
(3.4) In terms of encounters involving the container vessels, the realigned fairway gives an improvement which more than compensates for the effects of provisioning of the SETY area.

Traffic Delays
(4.) The estimated delays to container vessels are small or negligible compared with overall predicted levels and are considered not to be a significant problem for the SETY development.

Fairway Requirements
(5.3) A predicted 2 knot cross current suggests that vessels using the fairway will suffer problems of controllability during periods of peak tidal flow, alleviated by the improved entrance alignment. In the event of operational difficulties, the northern boundary could be shifted northwards. If required, possible difficulties could be investigated in advance by ship manoeuvring simulation.

Management of Traffic Flows
(6.1) Appropriate modifications to the provision of navigational buoys have been proposed for the realigned fairway. It is recommended that the area immediately north of the fairway should also be dredged to -15m CD.

(6.2) Providing that mobile dredging plant is used, no significant disruption to the traffic flow in the northern section of the Northern Fairway is envisaged during the fairway construction, subject to coordination with any CT8 dredging which might be incomplete.

(6.3) No additional or changed procedures are considered necessary for the Hong Kong VTS.

Effect of Fairway Width on Anchorage Areas
(7.1/2) The losses of area in the anchorages are calculated. In view of the substantial loss in the WQIA area, alternative QIAs should be investigated by Marine Department.

Effect of Fairway Realignment on Buoy Moorings
(8.1) Re-location positions are recommended for the A.16 buoy and a possible scheme of buoy re-arrangement is given to provide some additional buoys.

(8.2) From the limited amount of data available, the present number of buoys available appears inadequate and two additional locations have been suggested.

Effect of Fairway on SETY Berths
(9.1) Approach courses are recommended for the CRC and Dow berths.

(9.2) A swinging area for the ships is suggested clear of the container vessel traffic.

(9.3) The proposed location of the Dow berth is questioned on the grounds of the potentially hazardous consequences of a possible striking by passing traffic.

11. References

1. Container Terminal No. 8 Study - Marine Impact Assessment. July 1989.

2. Container Terminal 8, Stonecutters and Tsing Yi reclamations -Container vessel delays and port capacity studies. January 1990.

3. Department of Transport (UK). Ship Behavior in Ports and their Approaches, Part 7.

4. International Commission for the Reception of Large Ships. Report of Working Group IV. Permanent International Association of Navigation Congresses. 1980.

5. Thoresen, C.A. Port Design Guidelines and Recommendations. Tapir Publications. 1988.

6. Dand, I.W. Simulation of the Behavior of a Moored Ship when Passed by Other Ships. National Maritime Institute Technical Memorandum 51.

APPENDIX

Additional Marine Impact - Fairway Realignment

Brief

In addition to those already covered under Agreement No. CE3/90, the Consultants shall undertake the following duties. These duties shall be carried out as part of the Study and shall be completed within the original time for completion of the Study. Unless specified below, the requirements stated in the Study Brief of Agreement No. CE3/90 shall be followed.

PURPOSE OF THE SUPPLEMENTAL BRIEF

The purpose of this additional work is to investigate the effects of realigning the approach fairway to Kwai Chung container port area as a result of the proposed South-East Tsing Yi reclamation and marine related impacts on container traffic by trips generated along the reprovisioned piers on the south face of the proposed reclamation.

SPECIFIC DUTIES

The specific duties to be carried out shall include :-

(a) As a result of the necessary realignment of the approach fairway to Kwai Chung, the Consultants shall assess the likely conflicts with overall marine traffic in the vicinity, including through traffic using the Ma Wan channel bearing in mind the safety aspect of navigation;

(b) The Consultants shall estimate the volume of marine traffic forecast to use the port facilities along the south face of the proposed reclamation which comprise ocean-going and local tanker pier and barge/ferry traffic (including those inside the proposed reprovisioning basin) and assess its impacts and possible delay time on vessels proceeding to/from the Kwai Chung container berths (the assessment shall include traffic from the future CRC South site);

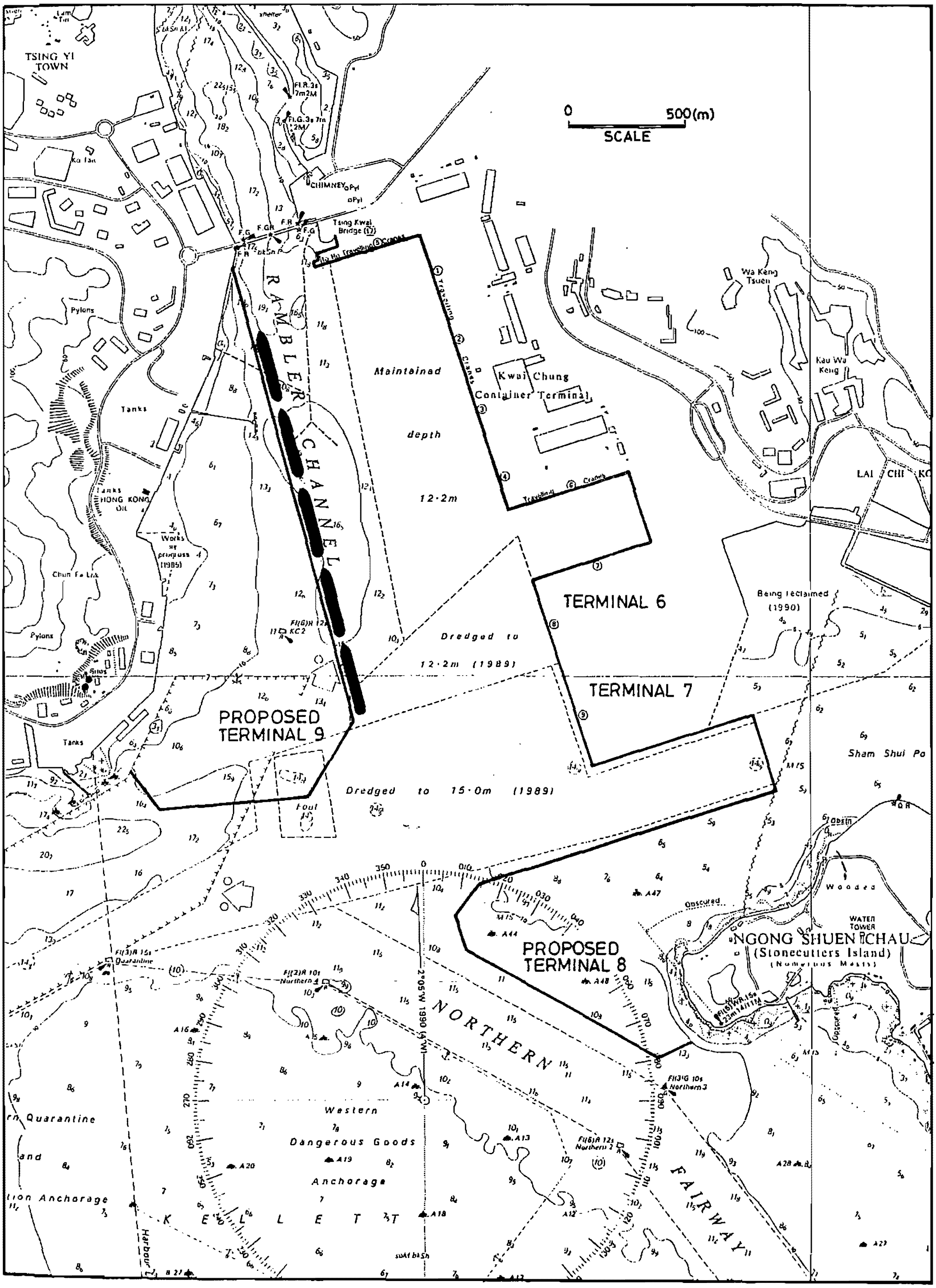
(c) The Consultants shall recommend a site for the relocation of displaced harbour mooring buoy A16 and alternative sites/boundaries for the Western Quarantine & Immigration and Western DG Anchorages whilst maintaining their services in the immediate vicinity;

(d) The Consultants shall recommend revisions/resiting of aids to navigation and prepare detailed plans of the amended fairways; and

(e) The Consultants shall assess the engineering costs, including possibly maintenance costs, associated with the fairway realignment which would necessitate the dredging of anchorage areas at the northern part of Kellett Bank to a depth compatible with existing and proposed depths for the Kwai Chung terminals.

Figure 1

CT8 Study -
Container Berth Layout



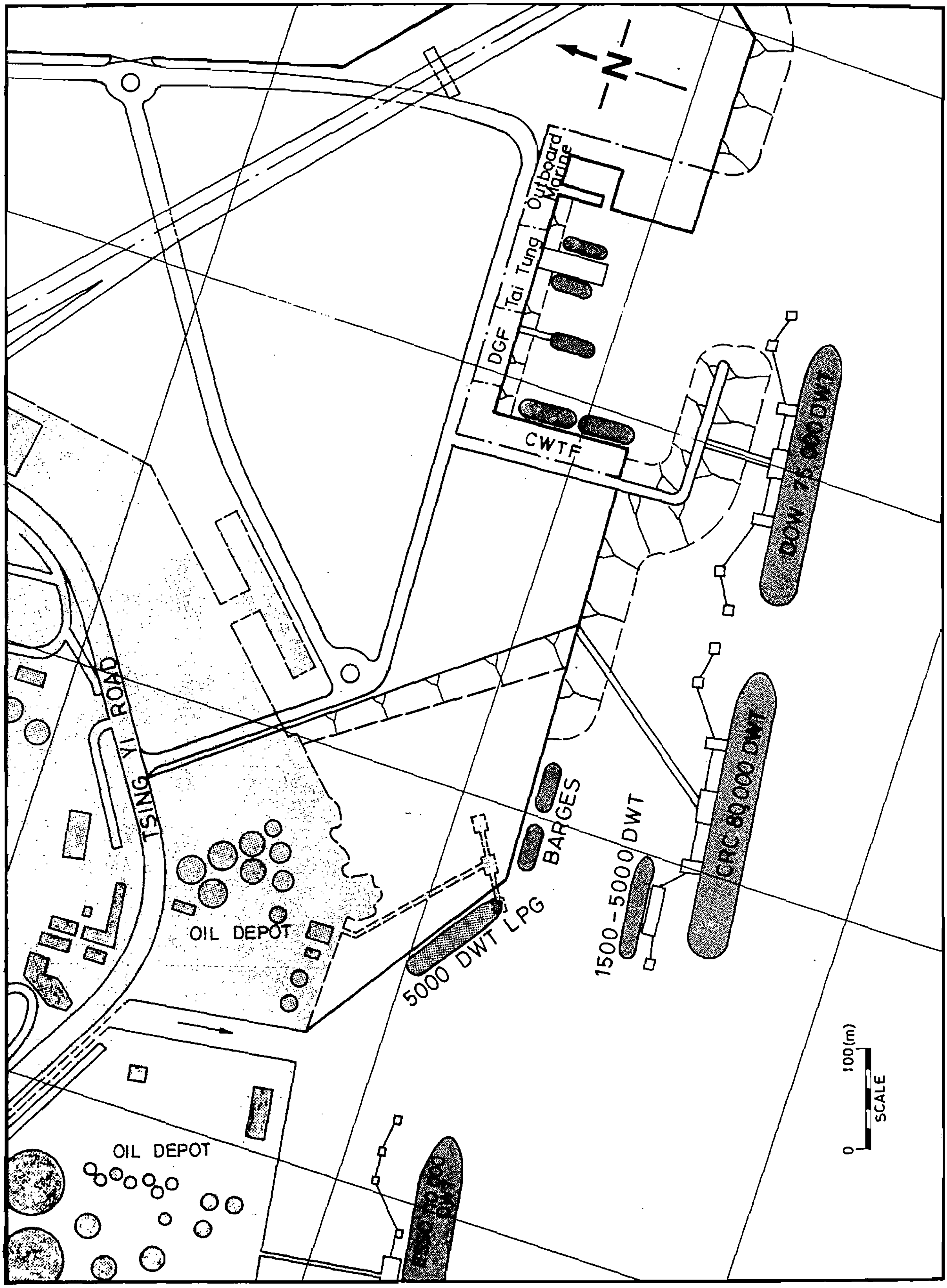

N
Outboard Marine
Tai Tung
DGF
CWTF
DOW 75,000 DWT
CRC 80,000 DWT
1500-5000 DWT
BARGES
5000 DWT LPG
OIL DEPOT
TSING YI ROAD
OIL DEPOT
ESSO 40,000 DWT
0
100(m)
SCALE

Figure 3

Radar Track Records
(South of Tsing Yi)

Figure 4

SETY CT9 "Base Case" Ship Tracks

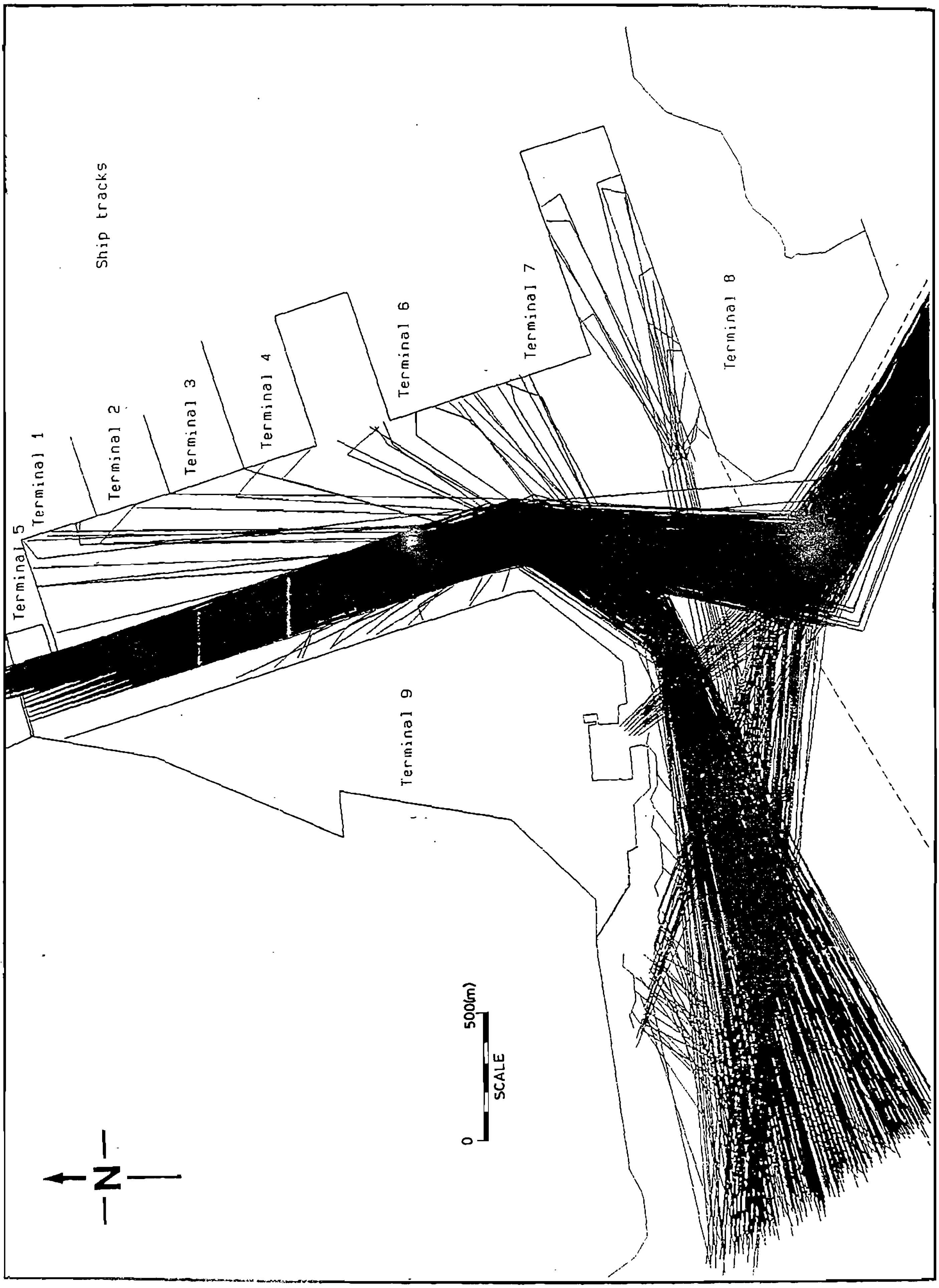


Figure 5

SETY CT9 Realigned Fairway Ship Tracks

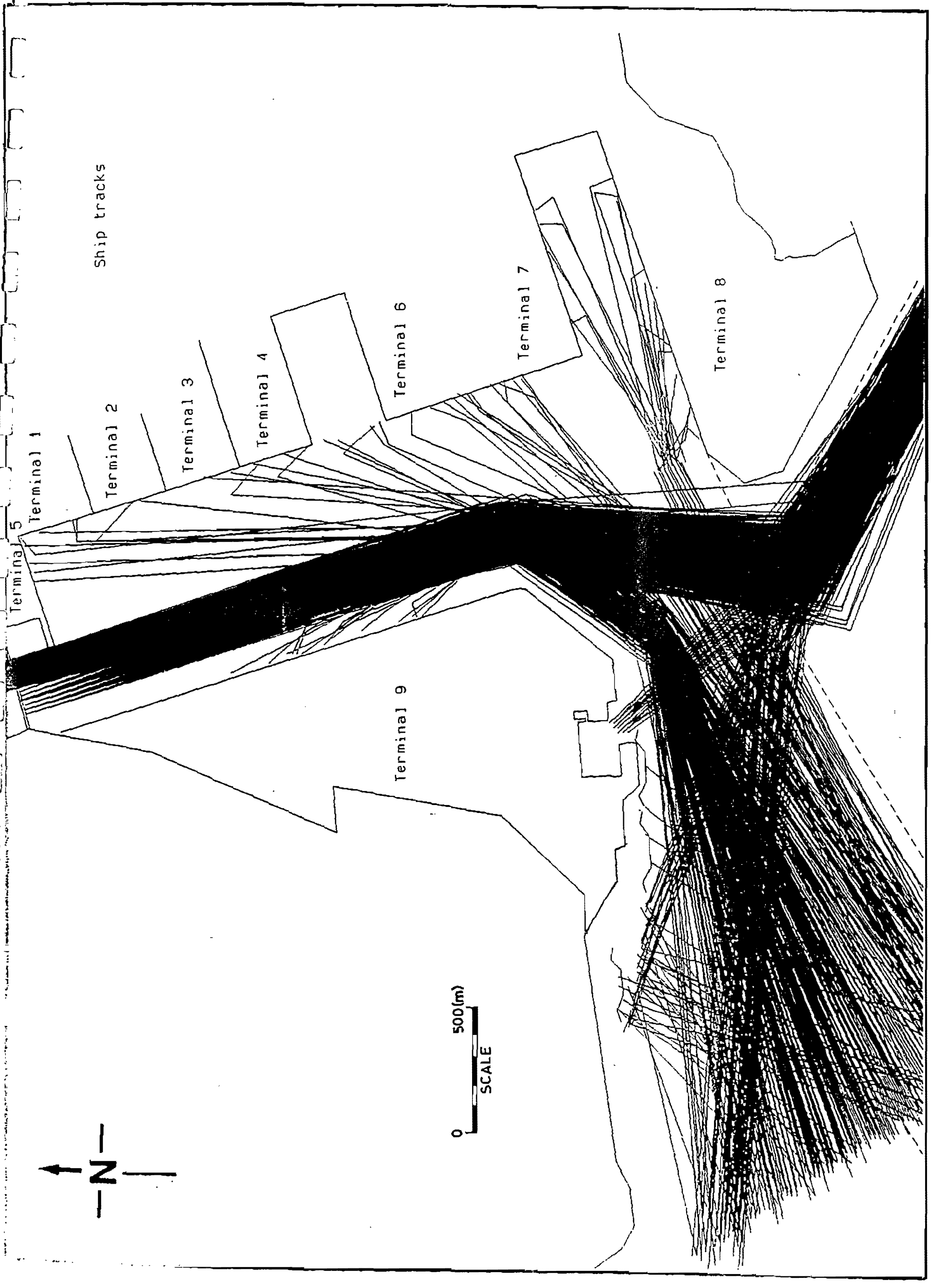


Figure 6

SETY CT9 "Base Case" Encounter Positions

Figure 7

SETY CT9 Realigned Fairway Encounter Positions

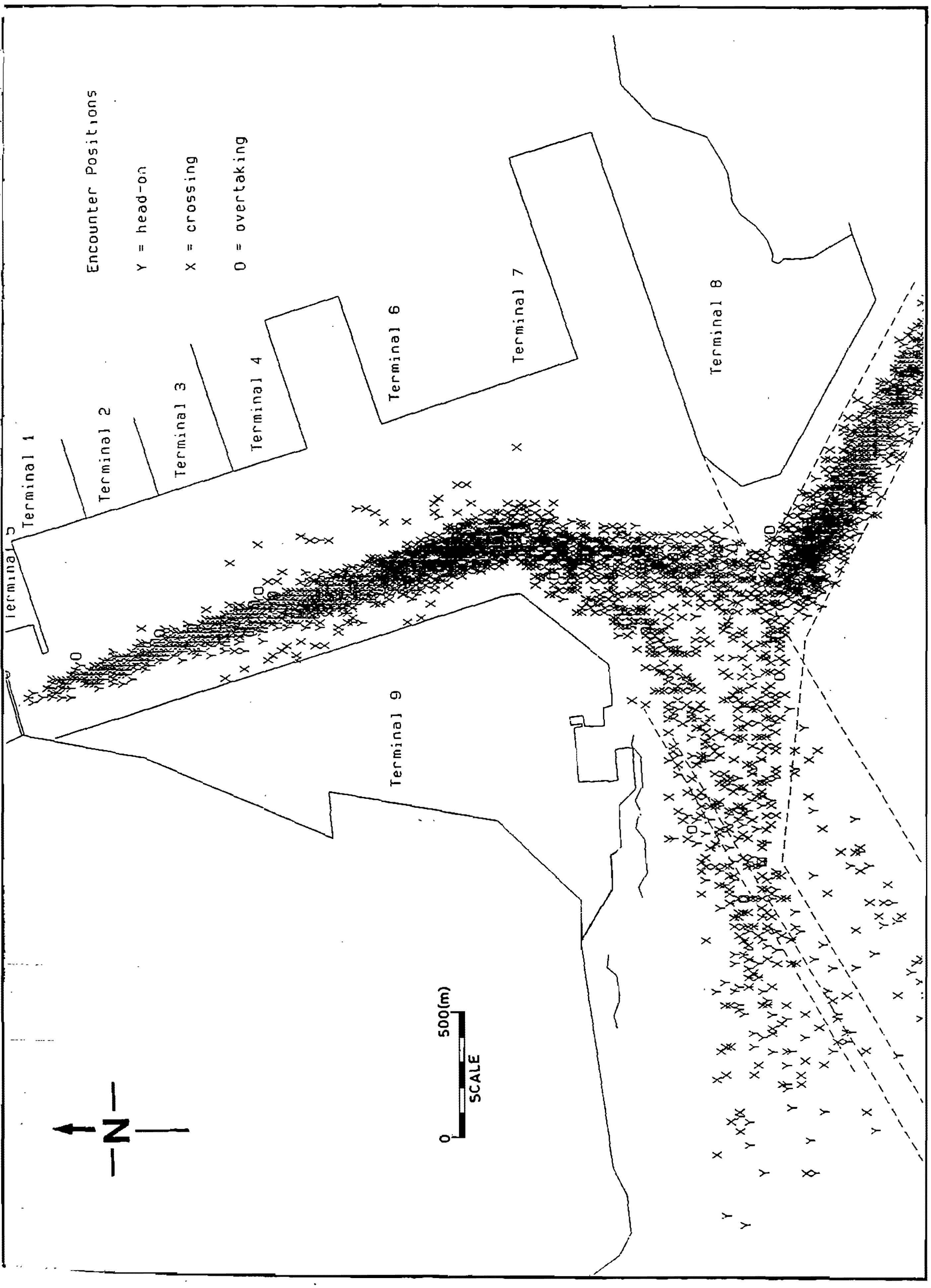


Figure 8

Layout of Realigned Fairway

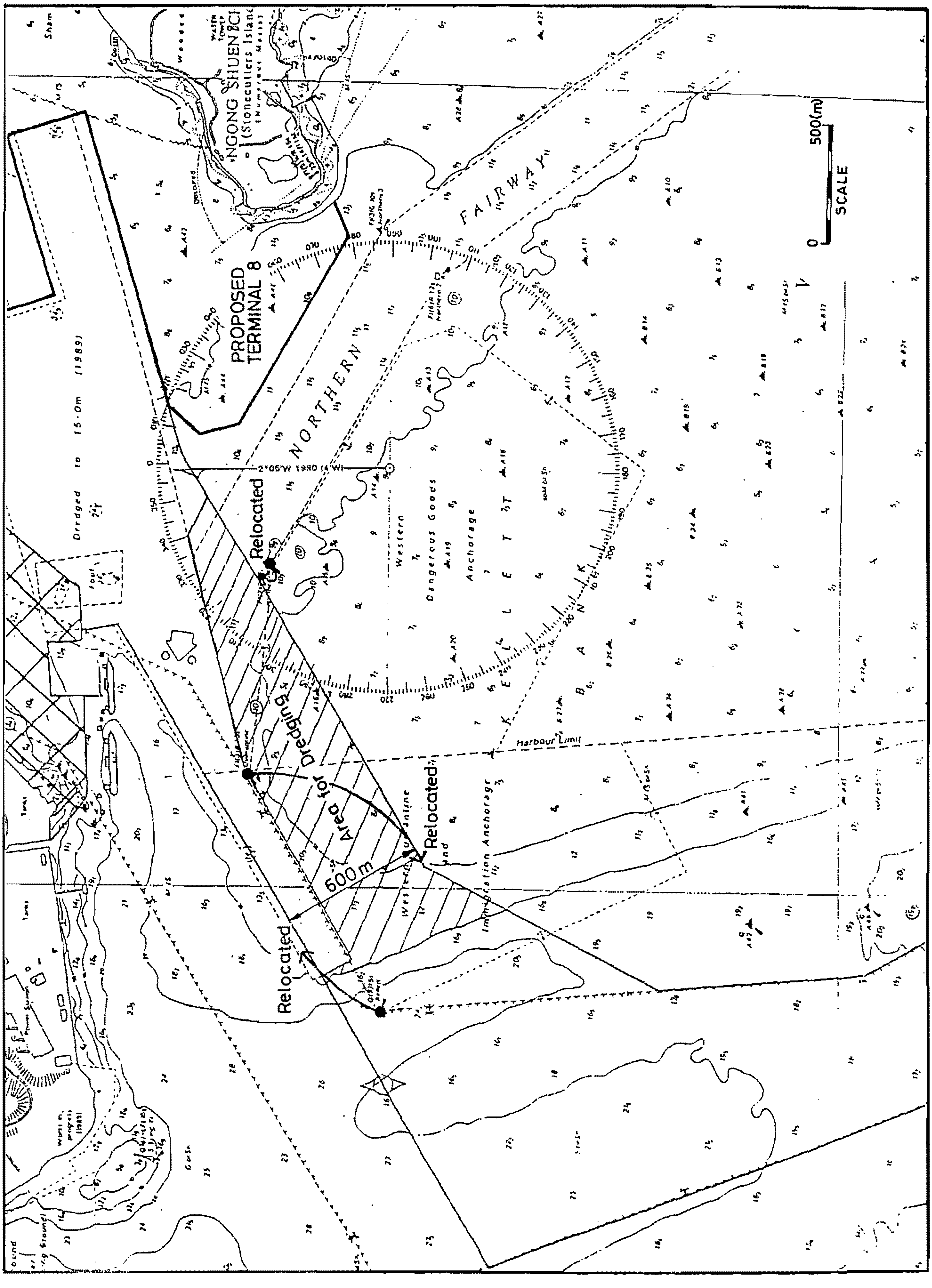
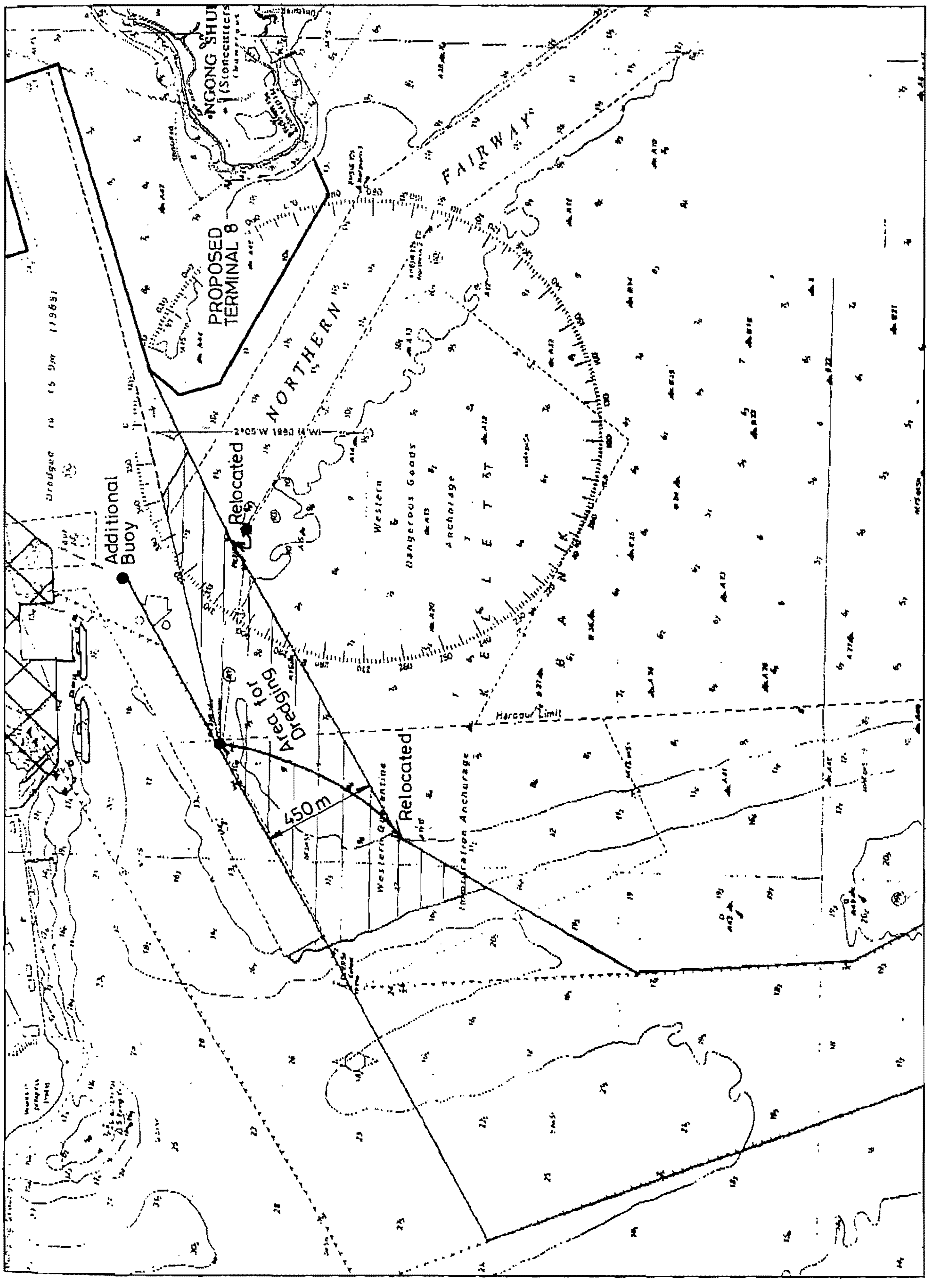


Figure 9

Scheme 1a Fairway @ 450m Width



Scheme 2 Fairway
@ 370m Width

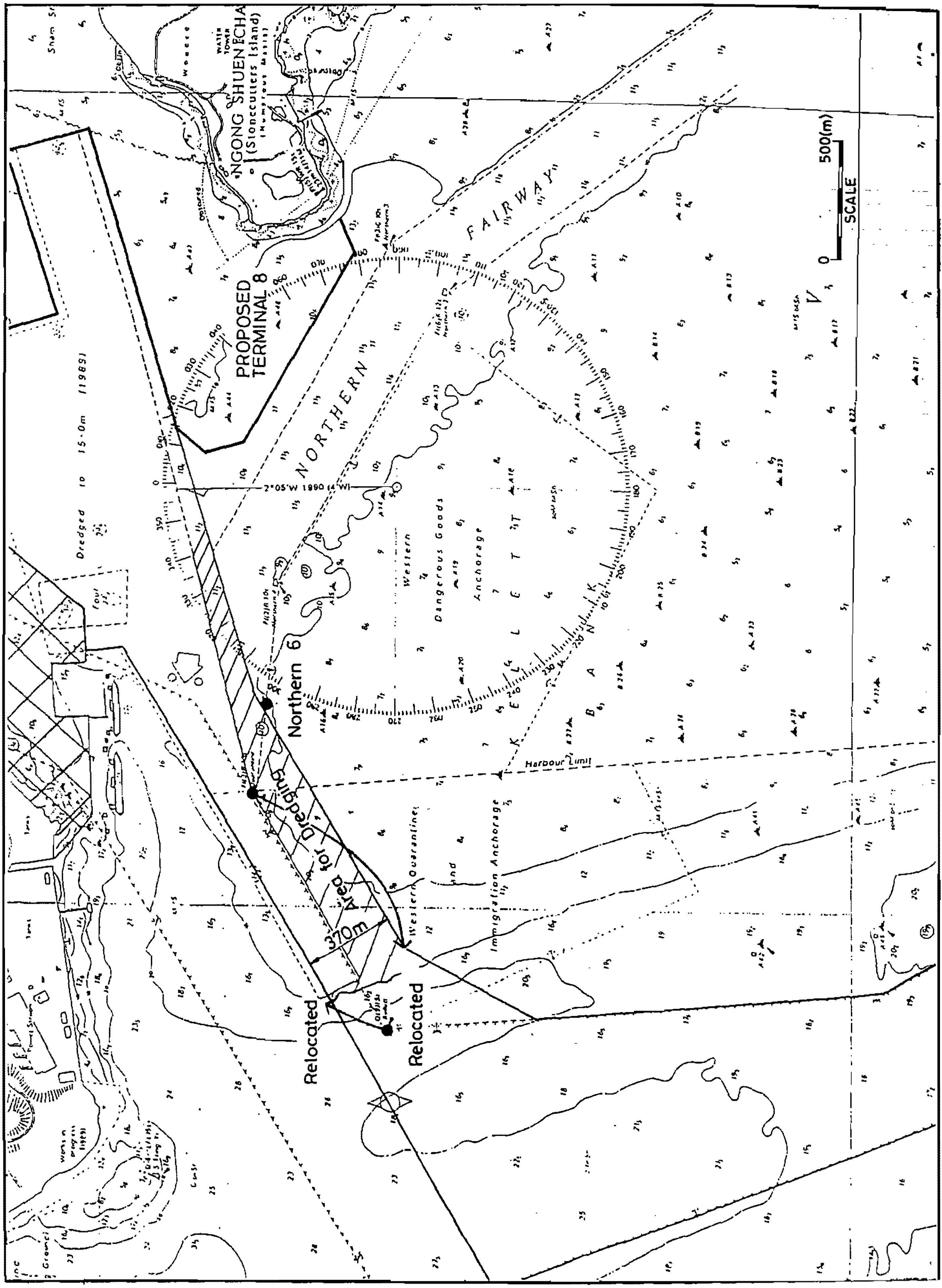


Figure 11

Effect on Anchorage Areas

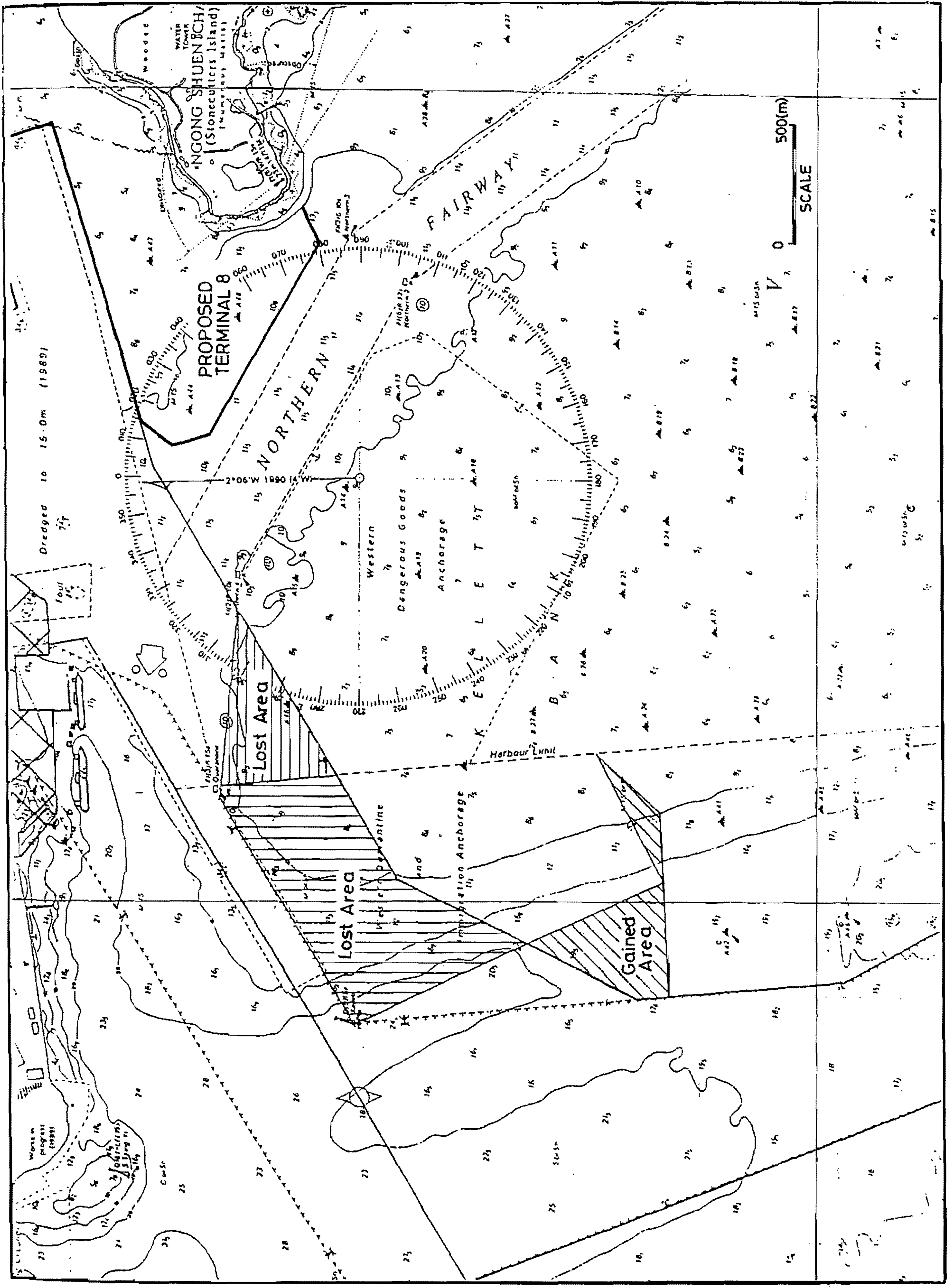


Figure 12

Effect on Anchorage Areas of Scheme 2

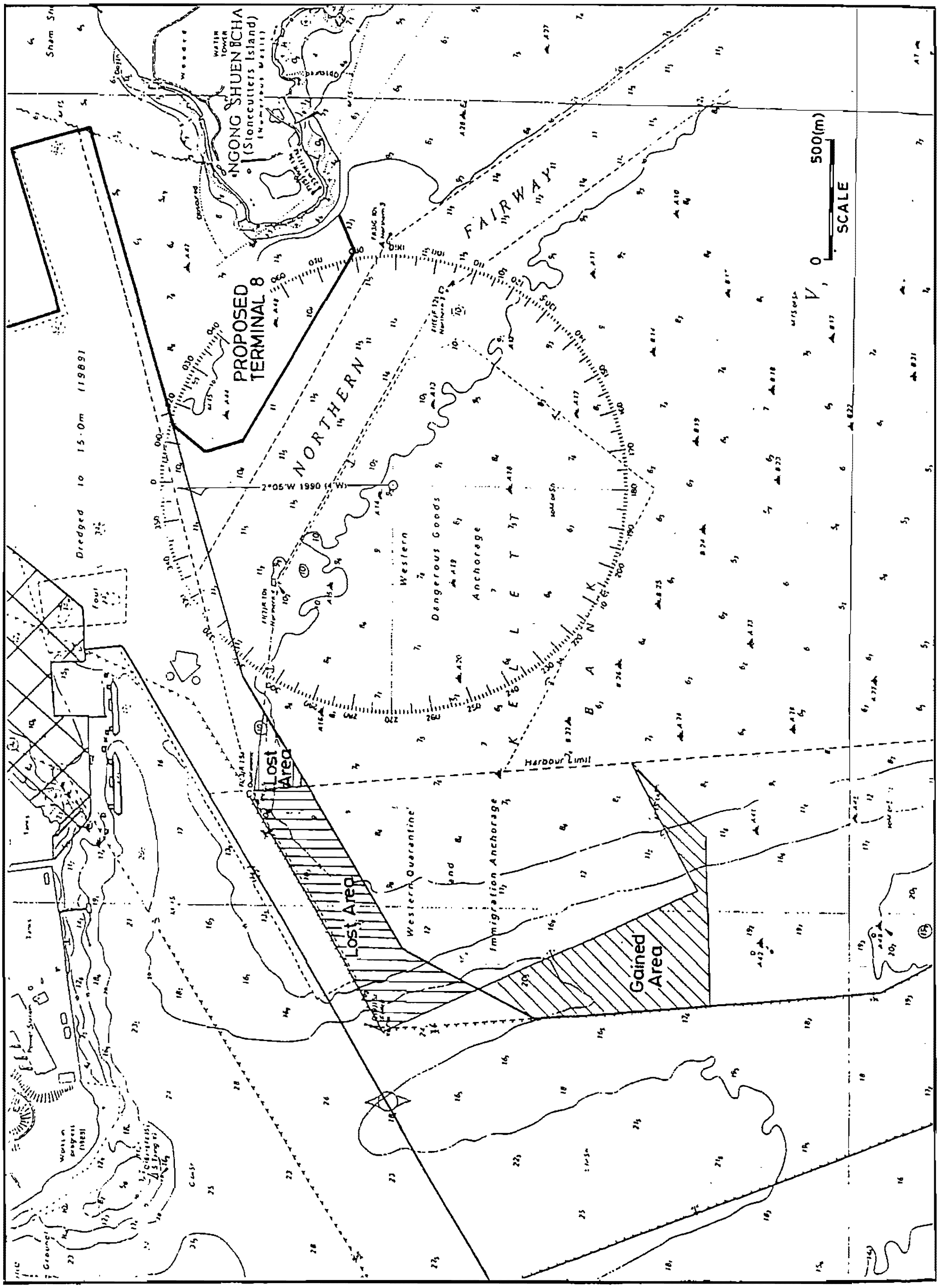


Figure 13

Scheme 3 Fairway @ 370m Width

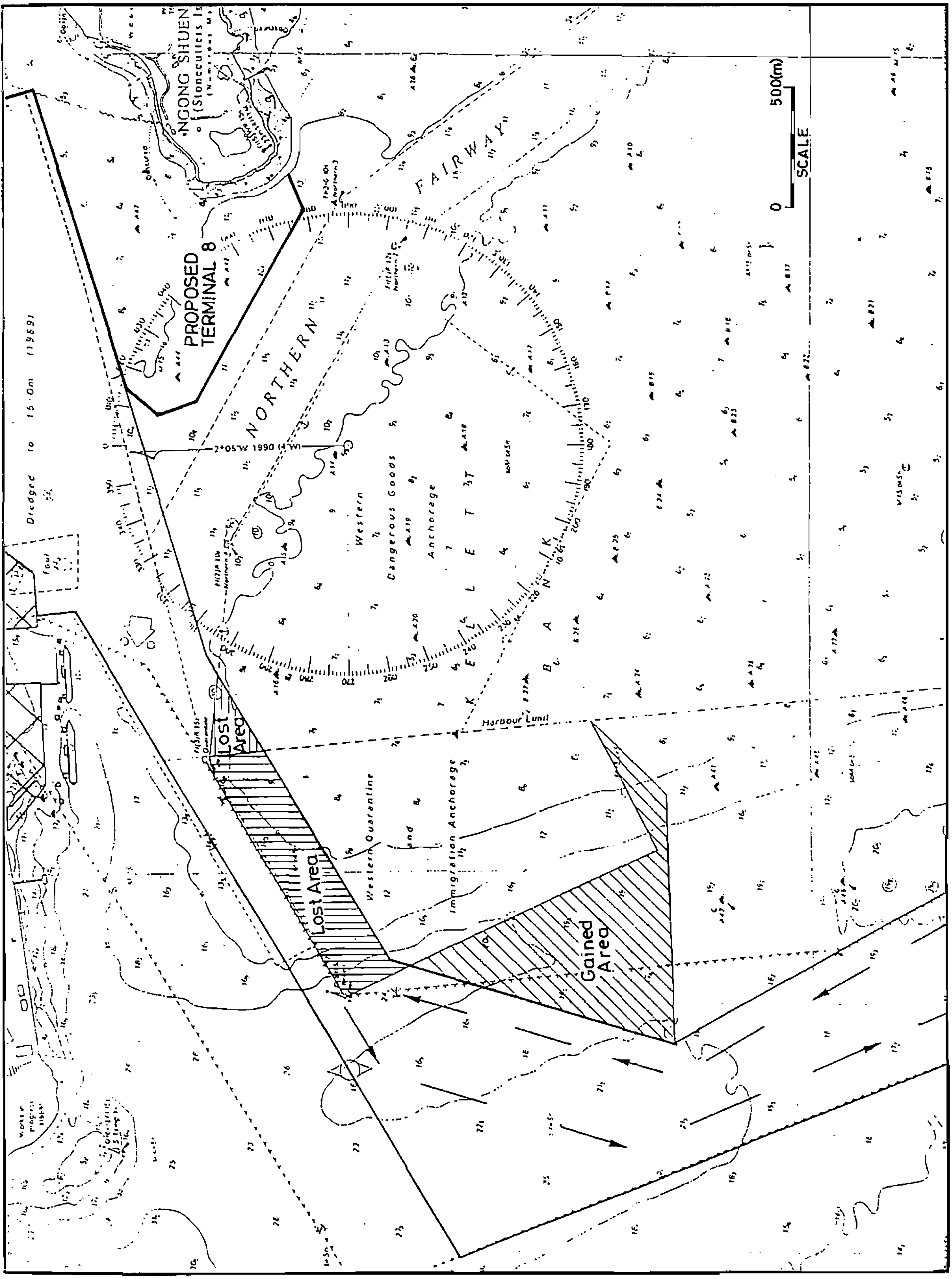
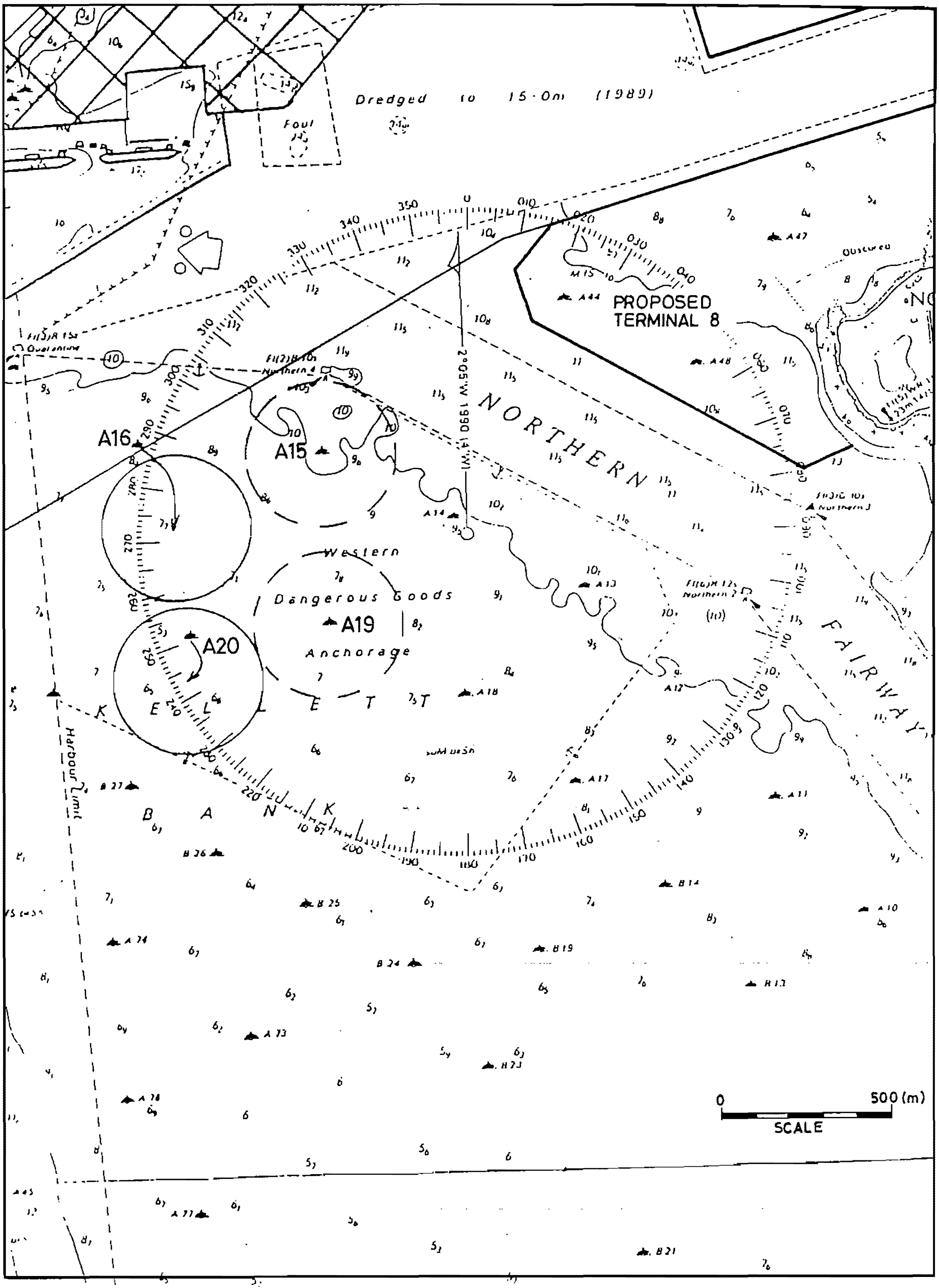


Figure 14

Relocation of A.16 Buoy



Relocation of A.16 Buoy Schemes 2 & 3

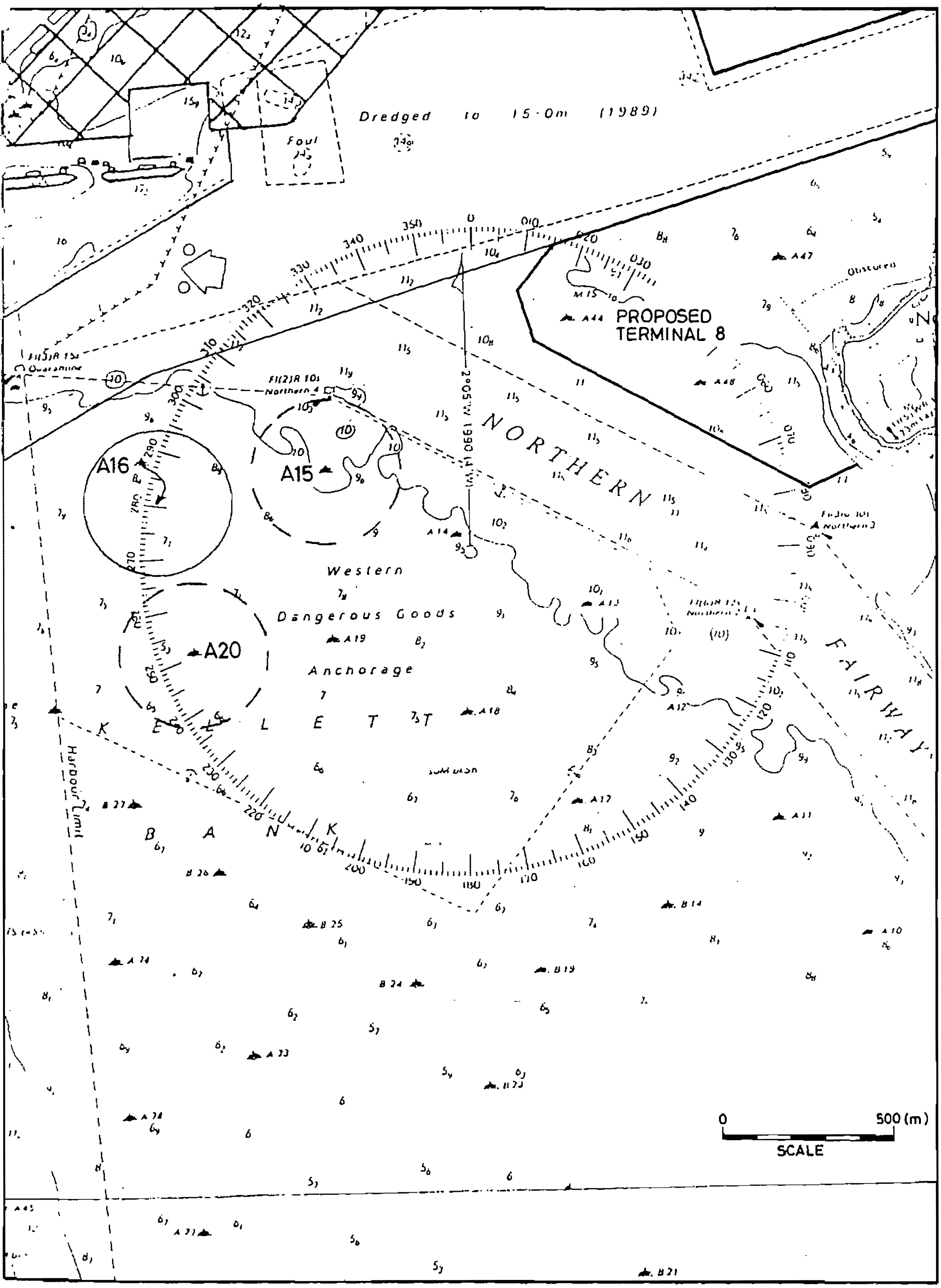
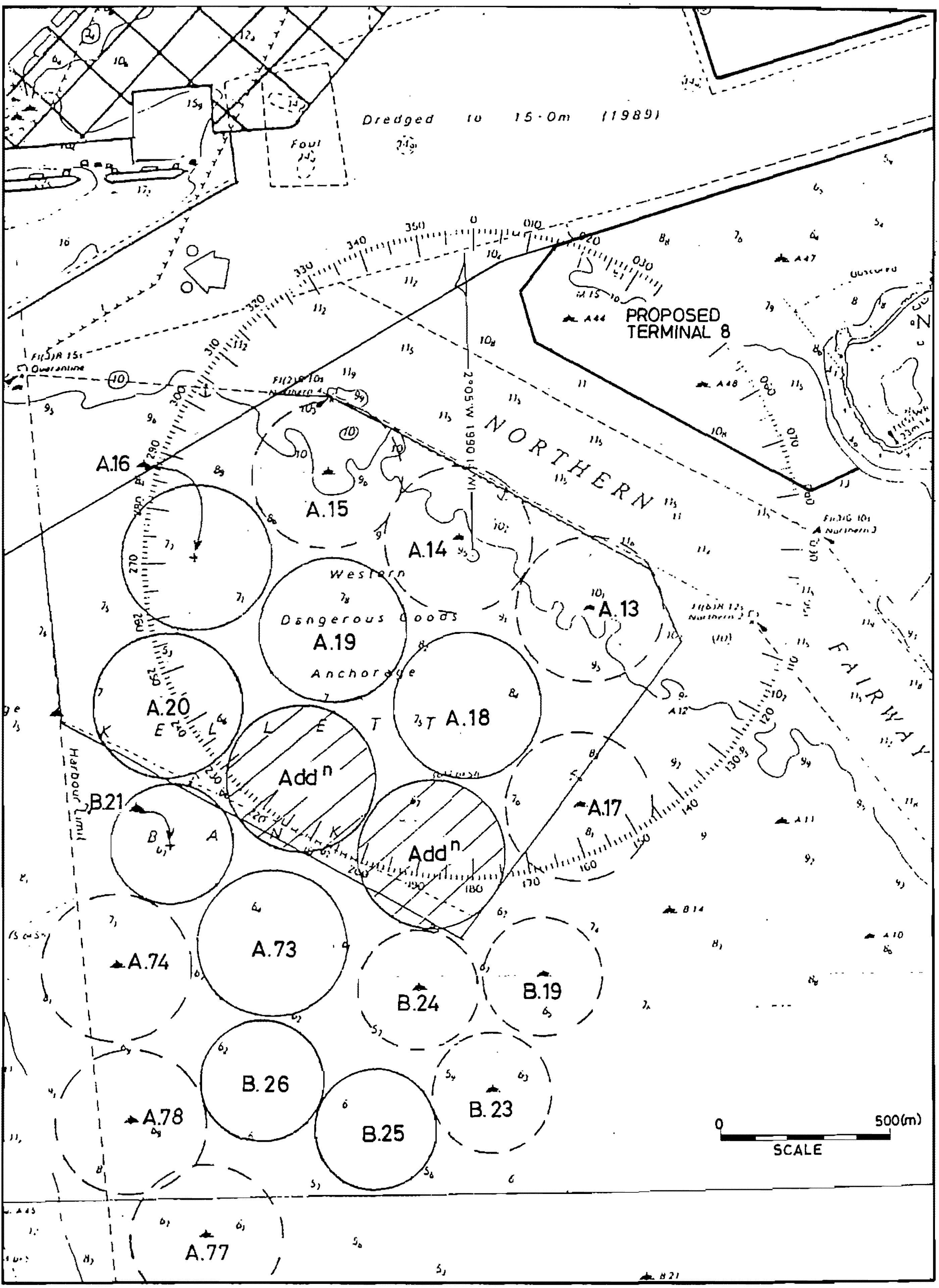
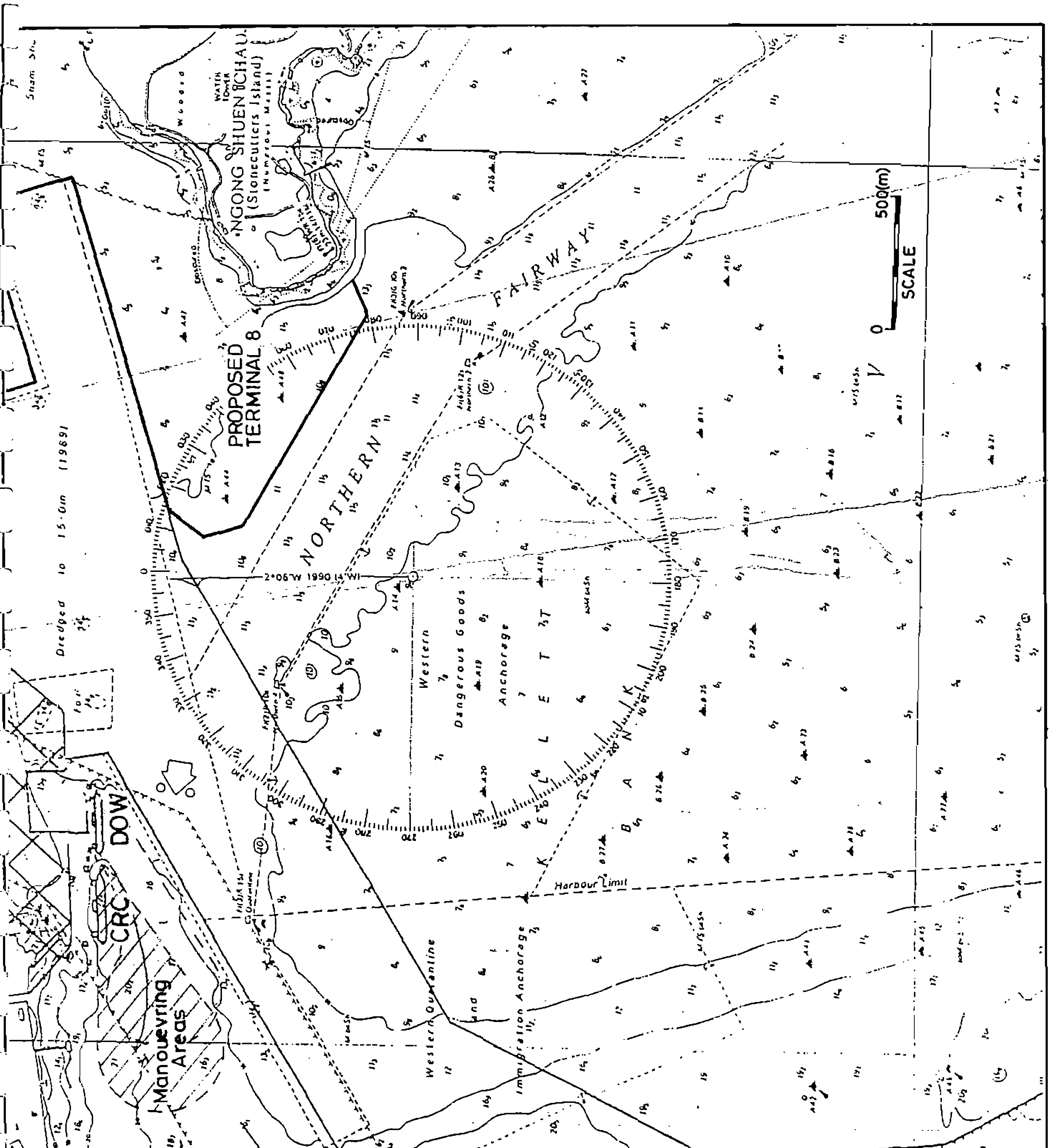


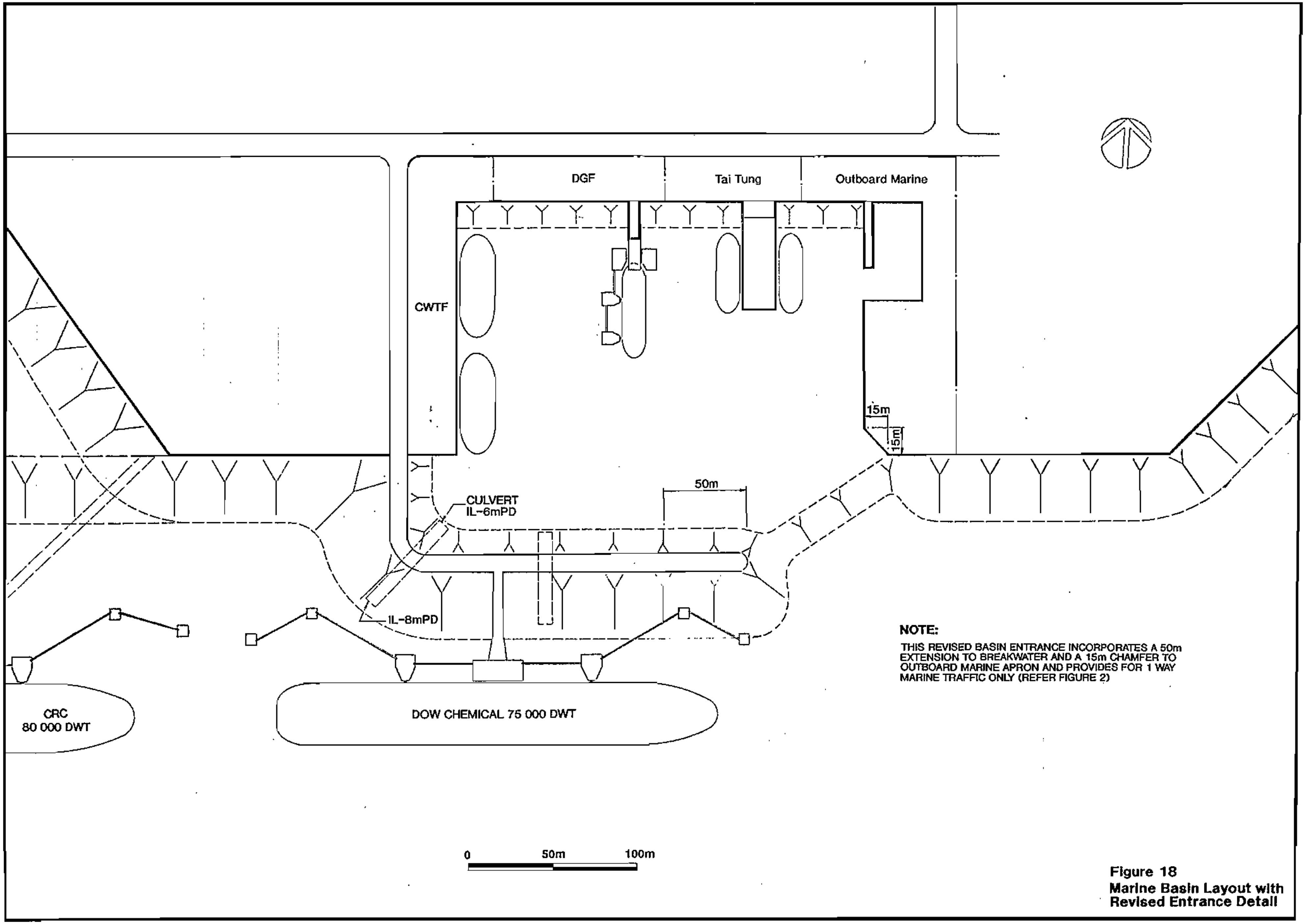
Figure 16

Provision of Additional Buoys



Approaches to CRC and DOW Berths





NOTE:

THIS REVISED BASIN ENTRANCE INCORPORATES A 50m EXTENSION TO BREAKWATER AND A 15m CHAMFER TO OUTBOARD MARINE APRON AND PROVIDES FOR 1 WAY MARINE TRAFFIC ONLY (REFER FIGURE 2)

Figure 18
Marine Basin Layout with Revised Entrance Detail

APPENDIX B3

MARINE IMPACT STUDY

AN ASSESSMENT OF TIDAL FLOW AND WAVE CLIMATE SIMULATIONS

ABSTRACT

Following several previous model studies designed to examine tidal flows and wave disturbance in the Southern Rambler Channel and approaches, the Port Works Division of the Civil Engineering Services Department of the Hong Kong Government applied the WAHMO two-dimensional depth averaged flow model and the WAHMO PORTRAY model on local fine grids. The results from the simulations were assessed in terms of changes to local hydraulic conditions and were compared with previous predictions of the local hydraulic conditions. On this occasion, the impact of a re-aligned fairway which required dredging of the northern limits of the Kellet Bank was examined in association with previously simulated reclamations. Any questions relating to this report should be directed to Dr J G Rodger, Hydraulics Research (Asia) Ltd.

CONTENTS

FIGURES

CONTENTS (Contd)

FIGURES (Contd)

APPENDICES

1 INTRODUCTION

In March 1991, Hydraulics Research (Asia) Ltd were provided with the results of simulations of tidal flows and wave disturbance following reclamations in the Southern Rambler Channel and Stonecutters Island. These simulations were carried out by the Port Works Division of the Civil Engineering Services Department of the Hong Kong Government using the WAHMO PORTRAY wave disturbance model and the two-dimensional depth averaged WAHMO model of tidal flows (Ref 1) on a 50m grid to simulate dry season spring tide conditions. These simulations followed earlier simulations carried out to examine the development of the proposed Container Terminals 8 & 9 (Refs 2,3,4). The results of the simulations were to be assessed in terms of changes to existing flow patterns and wave climate.

This report describes the reclamation layout examined and the results of the simulations based on the computer plots of the model results provided.

2 THE RECLAMATION LAYOUT

The reclamation layout was the same as that examined in Reference 3 and described as "Blocked Channel". Results from that simulation are included (Figs 7-10) and identified as "Blk". The latest SETY layout, however, had a re-aligned fairway as shown in the plot of the bathymetry used in the model (Fig 2). Any changes to tidal flow patterns compared to those simulated before would therefore be the result of the re-aligned fairway

Previous studies of the Blocked Channel layout concluded that, compared to existing conditions, only marginal changes in water speeds would result. In general, the Blk reclamations would not generate flow conditions which lie outside the range of conditions currently experienced in the Southern Rambler Channel and approaches.

The re-aligned fairway was expected to result in a redistribution of flows locally and, in examining this, a comparison was made between the SETY layout and the previously examined Blk layout.

3 SETY LAYOUT - TIDAL FLOW SIMULATIONS

The results of the tidal flow simulations provided by the Port Works Division are presented in the form of illustrative velocity vector plots, peak speed plots and, at the 18 stations shown in Fig 2, plots of the variation in water speed and direction over a diurnal spring tide (Figs 3-6). Comparable plots for the previously simulated 'Blk' layout are shown in Figures 7-10.

The fixed station plots of water speed for both schemes show that at all the stations in the Southern Rambler Channel (6-18), the realigned fairway has no significant impact on the predicted water velocities.

At Station 1, no change in flows is predicted following the re-aligned fairway. At Stations 3 and 4, however, while flood tide flows appear unchanged, peak ebb speeds on the ebb tide increase by the order of between 0.05m/s and 0.1m/s reaching a maximum of 0.35m/s at Station 4 compared to 0.3m/s for the Blk layout (Fig 6a & 10a).

Figures 3 & 7 show the impact of the re-aligned fairway on peak water speeds. It can be seen that re-aligning the fairway results in a general increase in speed over a large area over the Kellet Bank to the South of Tsing Yi and East of Stonecutters Islands. In order to examine this in more detail, additional time history plots were produced at the 3 sites shown in Figure 11 for the simulations with and without the re-aligned fairway for comparison.

It can be seen (Fig 12 & 13) that at stations B & C where the water depths remain unchanged, peak flood tide velocities remain unchanged following the re-alignment of the fairway. Peak ebb speeds, however, increase by approximately 50% reaching a maximum of 0.5m/s.

At Station A in the new fairway, peak flood tide velocities decrease by approximately 30% and peak ebb velocities increase but by only 30% approximately. This is consistent with the results from Stations B & C but where the increased depths in the new fairway result in the reduction in flood tide velocities and relatively smaller increase in ebb velocities. It would appear from the model results that the re-aligned fairway, while having little impact on flood tide velocities, encourages a larger discharge over the Kellett Bank on the ebb tide.

The re-aligned fairway does not have a significant affect on the local flow direction which, on the flood tide, is at approximately 90° to the re-aligned fairway.

3.1 MODEL ACCURACY

In the previous studies, the accuracy of the model was examined (Ref 2,3) and, where possible, the model compared with relevant field data. Changes were made to the model boundary conditions and model parameters in order to achieve the most accurate comparison. The model tended to under-predict peak water speeds including the area of relatively high speed flows which extends the length of the Southern Rambler Channel. In areas remote from this higher speed area where water velocities were observed to be of the order of 0.4m/s, the model under-predicted them by the order of 0.1m/s. As a result of this under-prediction of observed velocities at some sites, the results can most usefully be assessed in relative terms by comparing the simulations of existing and base conditions.

The most significant result from the simulation appears to be the increase in peak speeds over a large area of the Kellett Bank following the re-alignment of the fairway. Speeds were predicted to reach 0.5m/s which is an increase of approximately 50% compared to existing conditions. As a result, water speeds in future could exceed the range of values encountered in this area at present.

Allowing for the accuracy of the model and that the peak speeds may exceed the predicted value of approximately 0.5m/s, it is still thought that they will remain within the typical water speeds encountered elsewhere in Victoria Harbour and the Western Harbour.

4 SILTATION ASSESSMENT

As part of the original WAHMO study (Ref 5), two-layer models of wet and dry season tidal flows and sediment transport (Ref 6) were set up and calibrated. The sediment transport model predicted deposition rates as a result of the natural influx of sediment from the Pearl Estuary and the results were compared with available historic data (soundings) and previous assessments (Ref 6).

In particular, the model results were compared with soundings made over an 11 year period (1976-1987) in the Northern Fairway (Fig 14). The data indicated that over the 11 year period, accretion in the fairway amounted to 0.54m averaged over the 2.5km length of channel examined. This is equivalent to 49mm per year averaged over the 11 year period. The soundings also showed a maximum decrease in depth of 0.85m at the Northern end of the section shown in Figure 14 over the 11 year period.

The source of this sediment would include the natural sediment supplied in suspension from the Pearl Estuary, local bed sediments disturbed during dredging and reclamation works nearby and reported dumping of spoil South of Tsing Yi Island. Storm action can also erode bed sediments rapidly in relatively shallow areas and siltation rates in neighbouring dredged channels can increase rapidly over relatively short periods. The accretion rates given above will reflect the integrated contribution from all these sources over the 11 year period.

The siltation rates observed will depend on the local sediment supply in the water column and the local tidal flows in relation to the dredged channel. Decreasing local water speeds as a result of dredging could result in increased siltation rates. The flow direction relative to the channel is also important in determining siltation rates with maximum siltation being encouraged when the channel is at 90° to the local flow direction. The increased siltation observed at the Northern end of the section of channel previously studied (Fig 14) could be the result of a combination of the orientation of the channel with respect to the local flow directions which would often be across the channel and reclamation and dredging activities in the Rambler Channel.

Examination of Figures 1 and 4 suggest that for the flood tide, tidal velocities will be perpendicular to the channel and siltation will be encouraged by this alignment. Examination of Figures 12 & 13 at Station A indicates that flood tide water speeds decrease in the re-aligned fairway. Closer examination of these figures indicates that, from the point of view of siltation, the length of time lower speeds are encountered (less than 0.1m/s say) increases by about 20% at Station A. The model used is depth averaged and cannot simulate the details of the vertical structure of the flow over the water column and this analysis is simplified. However, it is possible that future siltation rates could increase by the order of 20% compared to those in the Northern fairway at present. This simplified analysis does not allow for the possible increased re-erosion of unconsolidated sediments deposited at slack water which might occur as a result of the predicted increase in ebb tidal water speeds (Fig 12 & 13) and therefore reduction in the predicted siltation rates.

Over the Kellet Bank, flood tide velocities remain virtually unchanged following the dredging of the re-aligned fairway but ebb speeds increase. The Kellett Bank is a naturally shallower area where it is assumed the bed level has become stable under the natural siltation processes and existing tidal regime. The change in water speeds would reduce the potential for deposition in this area but the changes are not thought to be sufficient to result in any erosion of the consolidated bed deposits in this area. Re-aligning the fairway should not affect the existing natural bed levels over the Kellett Bank.

In conclusion, it is thought that siltation rates over the Kellett Bank will remain unchanged and that the bed will remain stable as at present. In the re-aligned fairway, siltation rates should be assumed to be at least equal to those previously determined at the Northern end of the Northern Fairway which, averaged over several years, were in the region of 80mm per year. As a result of the the slight reductions in flood tide water speed, this previously determined siltation rate could increase by 20% say giving an annual siltation rate averaged over a number of years of approximately 100mm per year.

5 SETY LAYOUT - WAVE DISTURBANCE SIMULATIONS

The Port Works Division of CESD used the WAHMO PORTRAY model (Ref 7) to simulate wave disturbance over the area shown in Figure 15 which also illustrates the model grids used and the modelled bathymetry. The model was used to simulate to events with nominal return periods of 1/1yr and 50/1yr. These same wave conditions had been used in previous studies to examine the impact various developments in the Southern Rambler Channel and on Stonecutters Island would have on the local wave climate (Ref 2,4)

The results from four model simulations were available which allowed comparison of the effects of dredging the new channel along the Northern limits of the Kellett Bank. Using the identification numbering provided by the Port Works Division, the following simulations were carried out :

Run	Simulation	Return Period	Reflection Coefficients
Base	Base Layout	50/1yr	1.0
Base	Base Layout	1/1yr	1.0
91	CT9 Layout	50/1yr	1.0
89.1	New Channel	50/1yr	1.0
93	CT9 layout	50/1yr	0.4
89a.1	New Channel	50/1yr	0.4
94	CT9 layout	1/1yr	0.4
89a.2	New Channel	1/1yr	0.4

The "Base Layout" representing existing conditions and the CT9 Layout have been examined in previous studies (Ref 4). The "New Channel" layout was obtained from the CT9 Layout by adding the dredged channel and so the effect of the channel could be determined.

The results from the model were provided in the form of predicted ray diagrams and tabulated wave heights (Appendix 1). Wave heights were compared at the large number of points shown in Figure 16. In the absence of long term field data, it has not been possible to calibrate or validate the models in detail locally. As a result, it is not possible to examine the absolute wave heights predicted by the model but it is possible to examine relative changes in wave height between different simulations.

5.1 DISCUSSION OF 50/1yr WAVE CONDITIONS

Two simulations of the nominal 50/1yr event were carried out for both the CT9 and new Channel layouts. These simulations used reflection coefficients on the new sea walls of 1.0 (vertical walls) and 0.4 (rubble mound).

5.1.1 Reflection Coefficient 1.0

A general trend established by comparing Runs 91 and 89.1 was an increase in wave heights of approximately 30% along the Eastern Side of the Rambler Channel off the existing terminals (see Positions 20,24,26,29,32,34, Fig 16) with a similar decrease in wave height in the vicinity of CT8 and in the Southern approaches to CT8 (Positions 21,38,39,48 for example). The new channel appears to be directing energy away from Stonecutters Island towards the Eastern side of the Rambler Channel.

On the Southern side of the Tsing Yi Reclamations, there is a general increase in wave height following the new channel. For example, at Positions 57,58 and 68, wave heights increase by approximately 10% to 30% following dredging of the channel.

In the Rambler Channel (Position 20,24,26,29), wave heights remain lower than in the Base Layout (Appendix 1 & Ref 4)but are substantially higher in the Southern part (Positions 32,34).

There are also areas of increased wave activity in the approaches to CT 8 & 9 in the vicinity of and to the North of Green Island (Positions 2,5,41,49,14) These are consistent with the behaviour just described.

At most other locations, wave heights are substantially unchanged by the new channel alignment

5.1.2 Reflection Coefficient 0.4

With the lower reflection coefficients on the sea walls, the changes to the wave climate caused by the dredged channel were less clearly defined than when the vertical sea walls were modelled. The trend for reduced wave activity on the Eastern side of the approaches to CT8 (Positions 48,39,36,21) but for an increase on the Western side immediately North of Green Island (Positions 41,49,14) was still evident. In general terms, the new channel appears to direct energy towards the South East Face of Tsing Yi away from Stonecutters which would be beneficial to the Stonecutters developments.

There are also local improvements in some areas in the Rambler Channel with decreases in wave height following the introduction of the channel (Positions 20,29,32). These reductions in wave height are of the order of 10%-20%. On the South face of the Tsing Yi reclamations, wave heights at the Western end show an increase of approximately 10%-30% (Positions 57,68). Wave heights at the Eastern end decrease by approximately 10% with the channel in place. This behaviour is all consistent with the expected impact of the relocated channel.

The effect of reducing the reflection coefficients from 1.0 to 0.4 (Runs 89.1 and 89a.1) is to reduce wave heights immediately adjacent to the reclamations by between 10% and 40% (Positions 38,57,58,66,67,68,71).

5.2 DISCUSSION OF 1/1yr WAVE CONDITIONS

One simulation of each of the CT9 Layout and the New Channel layout were available for direct comparison; Runs 94 and 89a.2 where reflection coefficients of 0.4 had been simulated in both runs.

The trends in wave height variation were similar to those described above for the 50/1yr event but not so marked. In the area between CT8&9 there is a tendency for wave heights to increase on introduction of the channel (Positions 14,69,70,65,59). These effects are particularly large in the area of Positions 65 & 69 where wave heights are predicted to increase by approximately 50%. In the Rambler Channel, there is some variability in wave height with some areas increasing and others decreasing. Wave activity in this area will be affected both by waves penetrating from the channel and by the complex pattern of reflections from the boundaries in the container terminal area and so some variability in the response of the wave climate to the introduction of the channel is to be expected.

On the South face of the Tsing Yi reclamations, there is a tendency for wave heights to decrease at the Western end by approximately 10% (Position 57) but to increase slightly at the Eastern end the order of 5% (Position 58). The general trend in this area (Positions 57,58,68,67,66) is for wave heights to decrease following introduction of the channel.

6 SUMMARY AND CONCLUSIONS

The impact of a dredged channel running along the Northern extent of the Kellett Bank on dry season spring tidal flows, siltation rates and wave climate has been examined based on the results from WAHMO model simulations and available data.

6.1 TIDAL FLOWS

The tidal model used to simulate the reclamation layouts and dredged channel was depth averaged and could not resolve the vertical structure of the local flows in the vicinity of the channel. However, it was found that over a large area modelled, the dredged channel resulted in little change to flood tidal flows but ebb tidal water speeds were predicted to increase. The increase in water speed was not thought to be important as far as the stability of the existing sea bed is concerned. The increased water speeds (predicted to reach 0.5m/s from 0.3m/s) would still lie within the range of water velocities encountered in the Harbour waters and so should not be of concern to ship movements.

6.2 SILTATION RATES

Siltation rates in the proposed dredged channel were assessed using observed siltation rates in the existing Northern Fairway where the suspended sediment load would be similar to those in the area of the dredged channel and allowance was made for the predicted reduction in flood tidal velocities in the dredged channel. In the existing Northern Fairway, siltation rates averaged over an 11 year period were found to be approximately 80mm per year. Allowing for the enhanced deposition which could occur because of the reduction in flood tidal velocities but ignoring the possible enhanced re-erosion on the ebb tide of the fluffy mud deposits which might form during periods of slack water resulted in an estimated relatively long term average siltation rate of 100mm per year.

There is a natural deeper channel running along the Southern side of Tsing Yi Island and the proposed channel would increase water depths through the Kellett Bank along the Southern limit of this naturally deeper water. It is possible that, to some extent, the tidal flows could become aligned by the new channel and siltation rates could be less than those observed in a channel dredged through the middle of a naturally shallower area. It is thought that the estimated siltation rate of 100mm per year is a reasonable upper limit based on the information and studies carried out to date.

6.3 WAVE DISTURBANCE

In Reference 4, it was concluded that the reclamations with vertical walls would lead to significant increases in wave heights and that, compared to existing conditions, it was likely that unacceptable conditions would be generated at, and in the approaches to, the berths. Introduction of sea walls with low reflection characteristics (0.4) improved the situation substantially and resulted in predicted future conditions being similar to those at present.

Introduction of the dredged channel to the reclamation layout had a larger impact on the more frequent (50/1yr) events. The effect of the dredged channel was mixed with increases and decreases in wave height being predicted in different areas. The maximum increase in wave height caused by the channel appeared to be between CT8 & 9 where an increase of 50% was predicted. In other areas the changes were generally of the order of 30% or less.

As in the previous studies, it was found that the sea walls with the lower reflection coefficients (0.4) resulted in reductions in local wave heights of 10%-40% compared to those predicted for sea walls with a reflection coefficient of 1.0.

There was a general trend for the dredged channel to direct wave energy away from Stonecutters Island which would be beneficial for the Stonecutters developments.

7 REFERENCES

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2. CONTAINER TERMINAL NUMBER 8. A Review of WAHMO Modelling Carried Out by CESD. Hydraulics Research (Asia) Ltd, Report No. 003, July 1989.

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4 CONTAINER TERMINAL NUMBER 9. A Review of Mathematical Model Simulations of Tidal Flows and Wave Disturbance. Hydraulics Research (Asia) Ltd, Report No. 006, January 1990.

5. HYDRAULIC AND WATER QUALITY STUDIES VICTORIA HARBOUR. Two-layer Mathematical Model Simulation of Spring and Neap Tidal Flows in the Wet and Dry Seasons. Hydraulics Research Ltd Report No. EX 1685, March 1988.

6. HYDRAULIC AND WATER QUALITY STUDIES VICTORIA HARBOUR. Two-layer Mathematical Model Simulation of Mud and Particulate Effluent Transport. Calibration and Validation. Hydraulics Research Ltd Report No. EX 1688, May 1988.

7. HYDRAULIC AND WATER QUALITY STUDIES VICTORIA HARBOUR. Wave Modelling Studies : Calibration and Validation Report. Hydraulics Research Ltd Report No. EX 1688, May 1988.

FIGURES

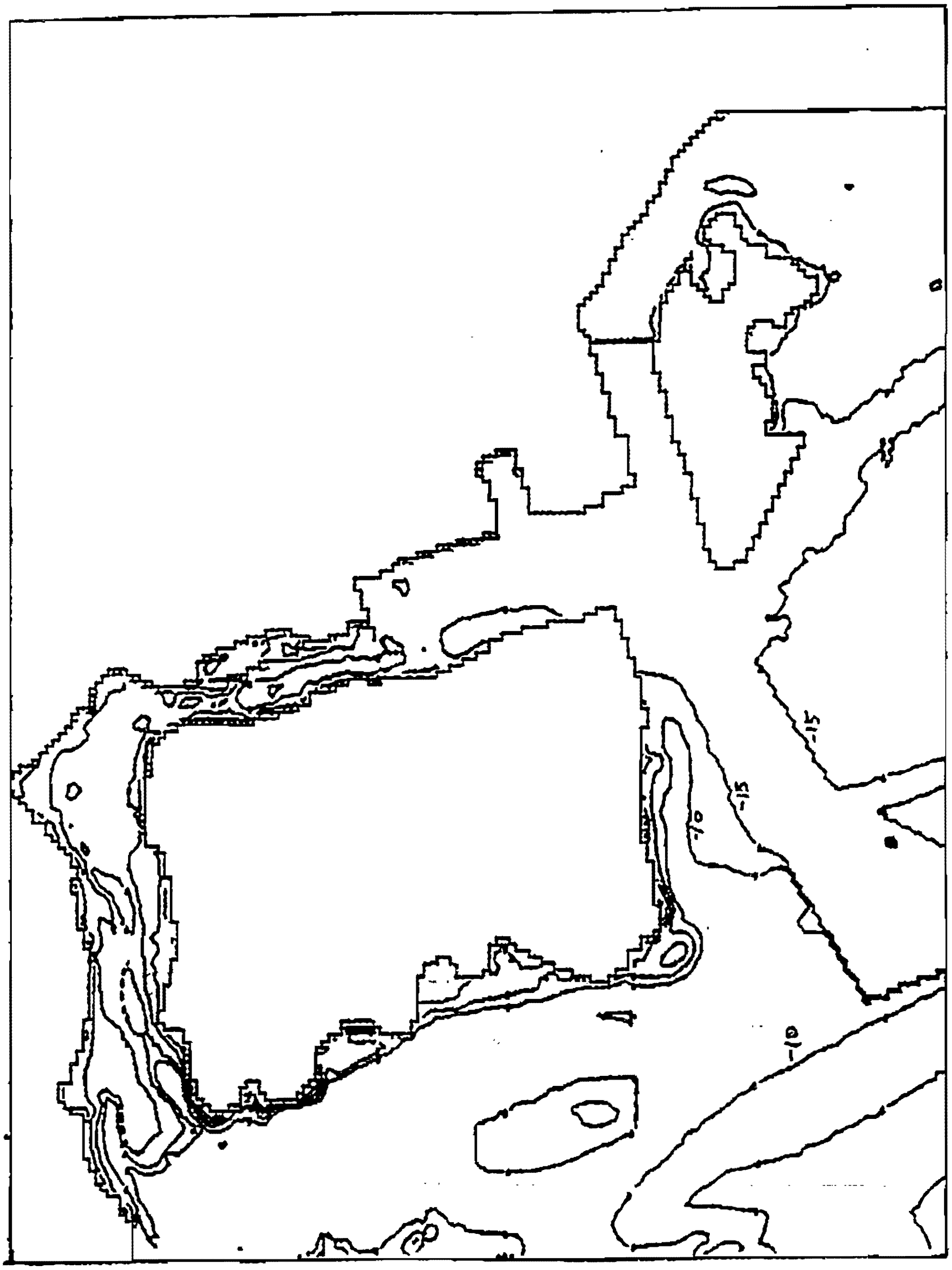


FIG 1 MODELLED BATHYMETRY SHOWING THE REALIGNED FAIRWAY

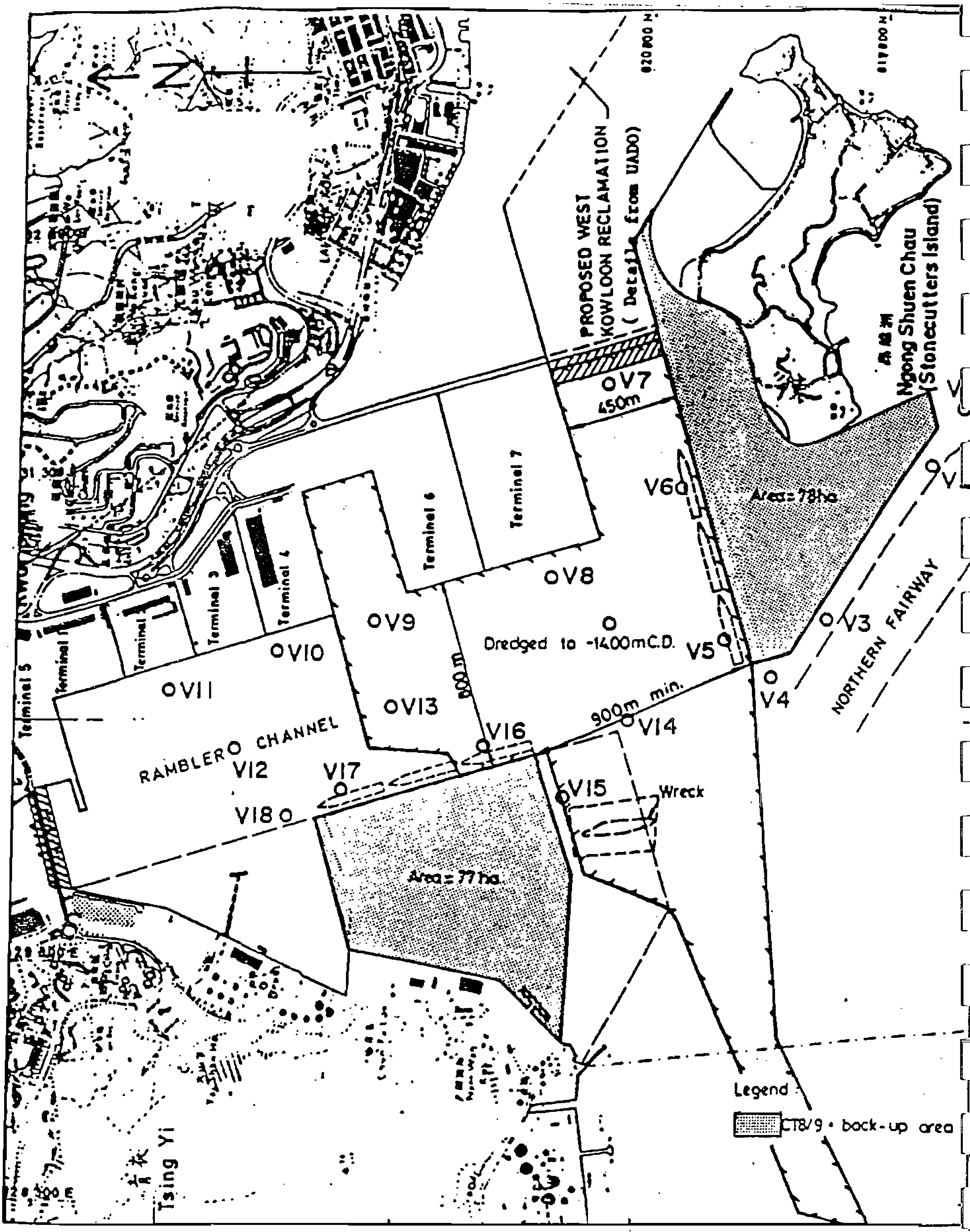


FIG 2 LOCATION PLAN SHOWING FIXED VELOCITY STATIONS

LEGEND :

▨ DISCHARGE SECTION

○ V3 VELOCITY POINT

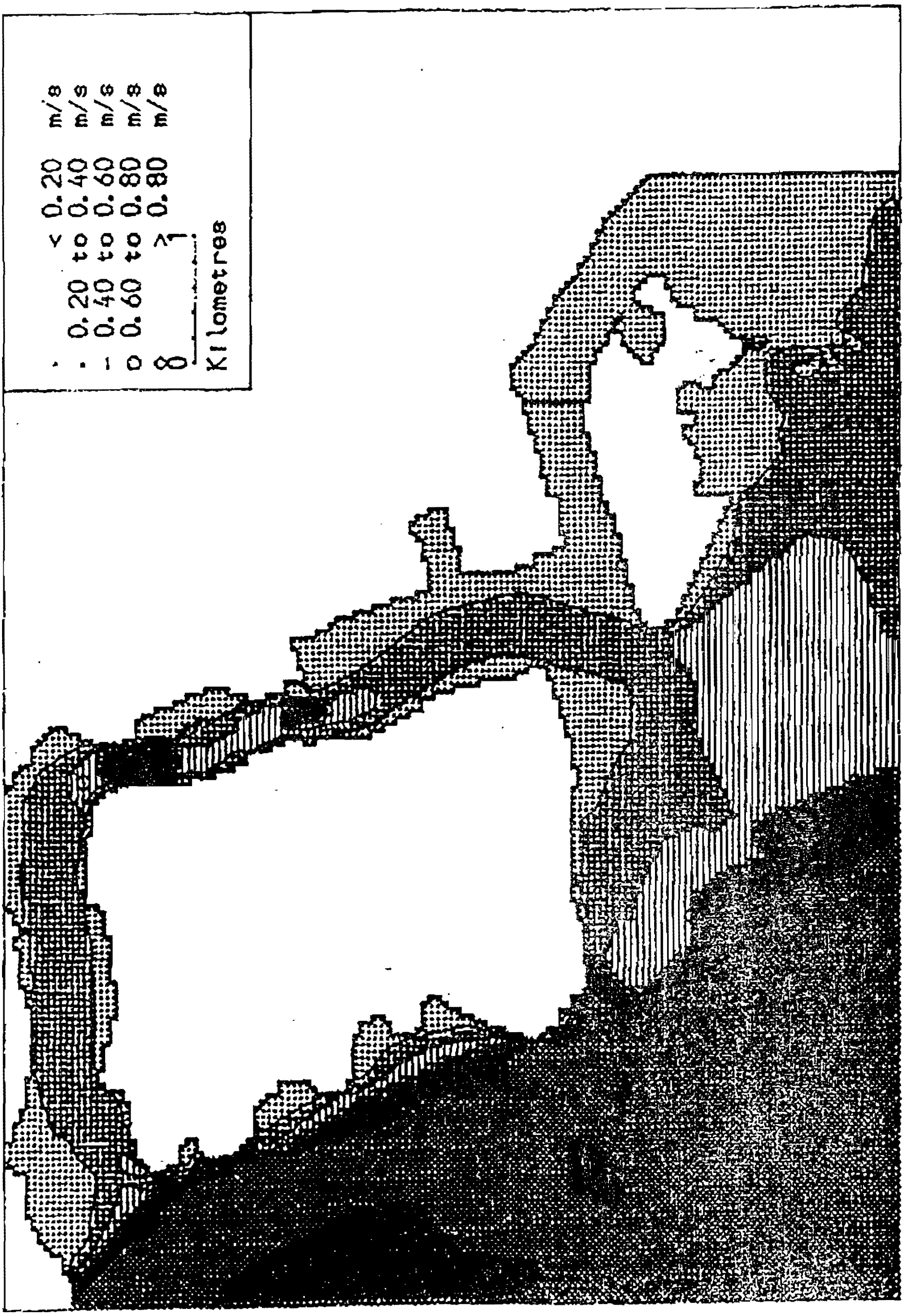


FIG 3 TERMINAL 8 SCHEME SETY - SPRING TIDE MAXIMUM SPEEDS

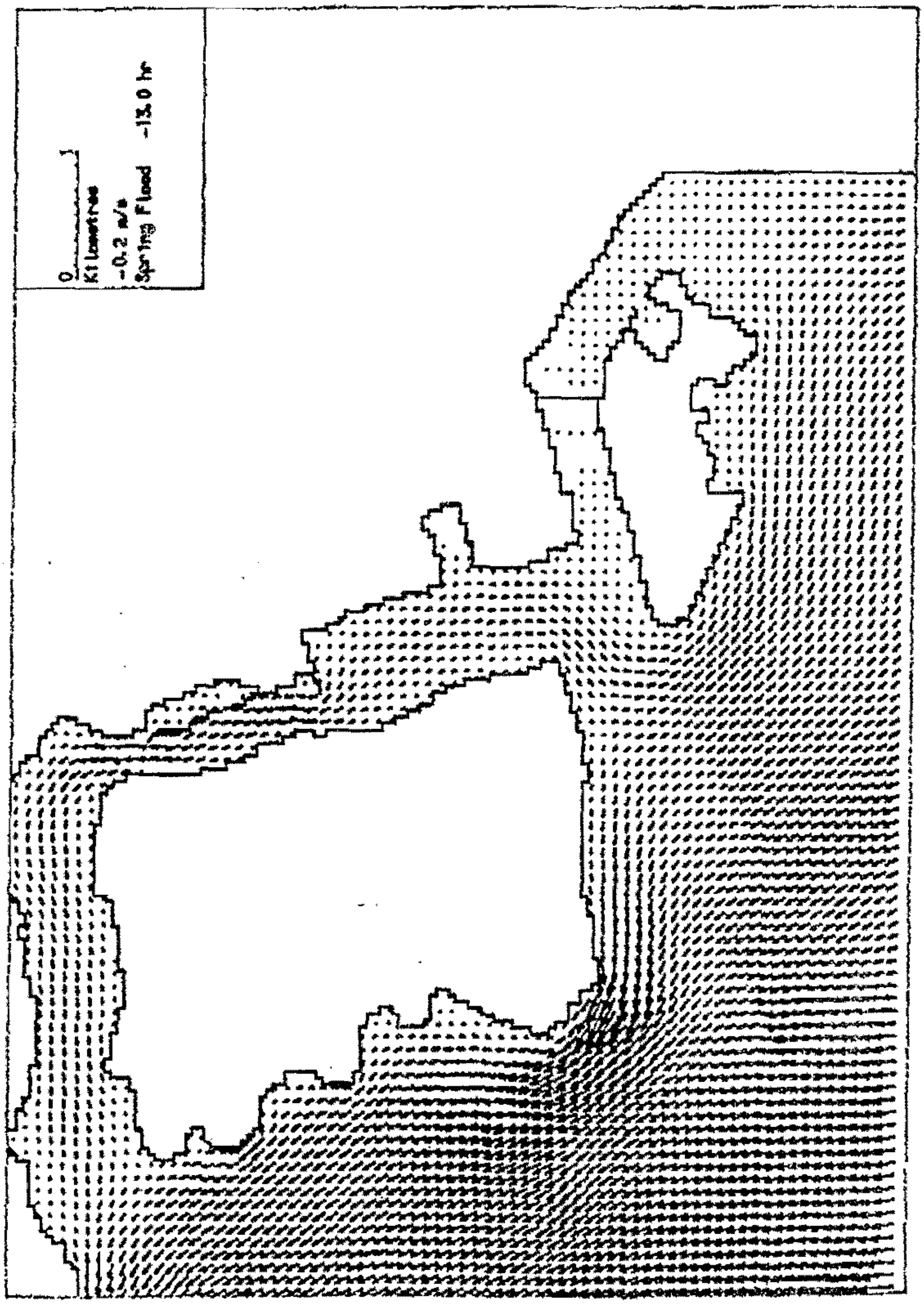


FIG 4 TERMINAL 8 SCHEME SETY - PEAK FLOOD TIDE VELOCITIES

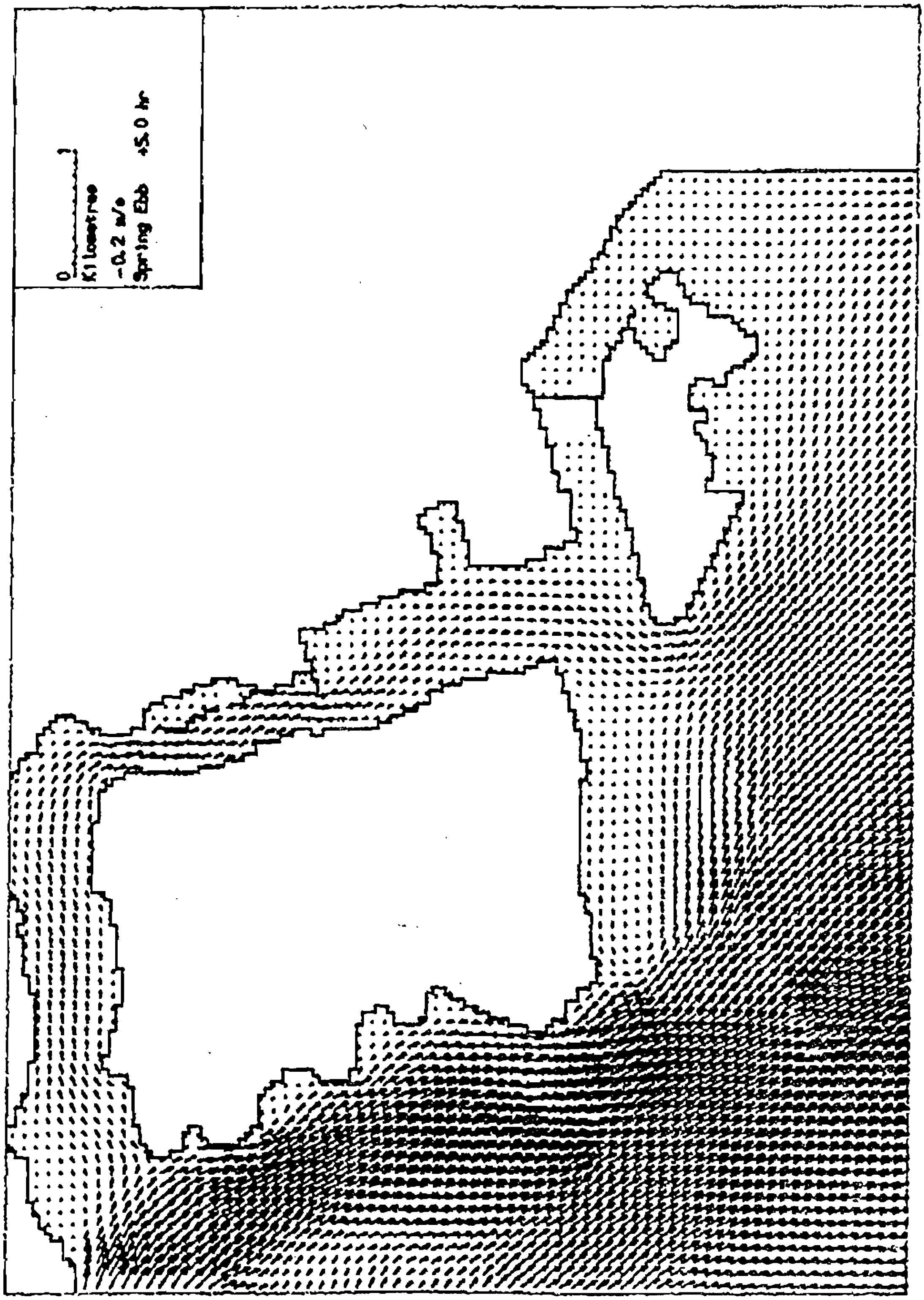


FIG 5 TERMINAL 8 SCHEME SETY - PEAK EBB TIDE VELOCITIES

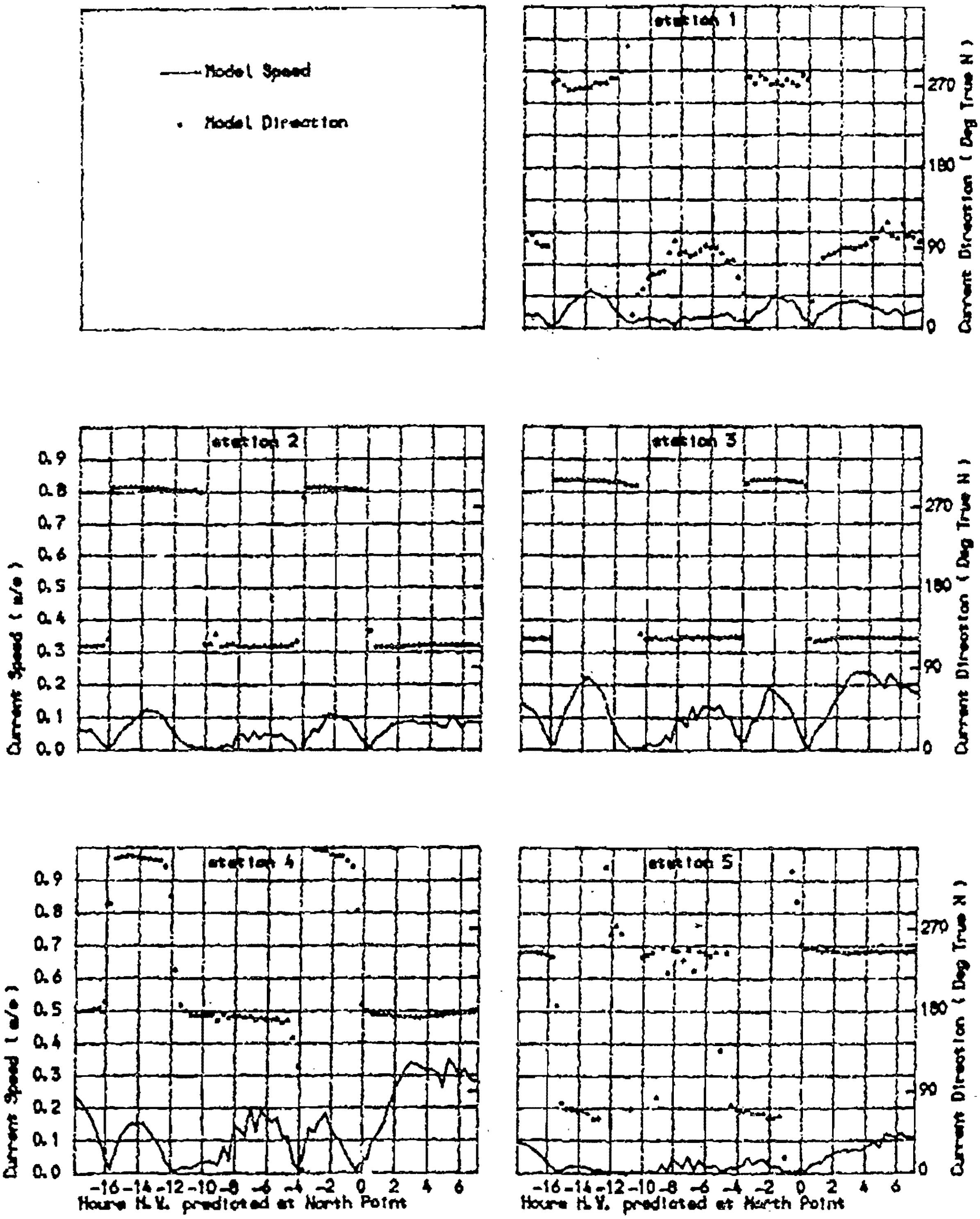


FIG 6a TERMINAL 8 SCHEME SETY - SIMULATED VELOCITIES, STATIONS 1-5

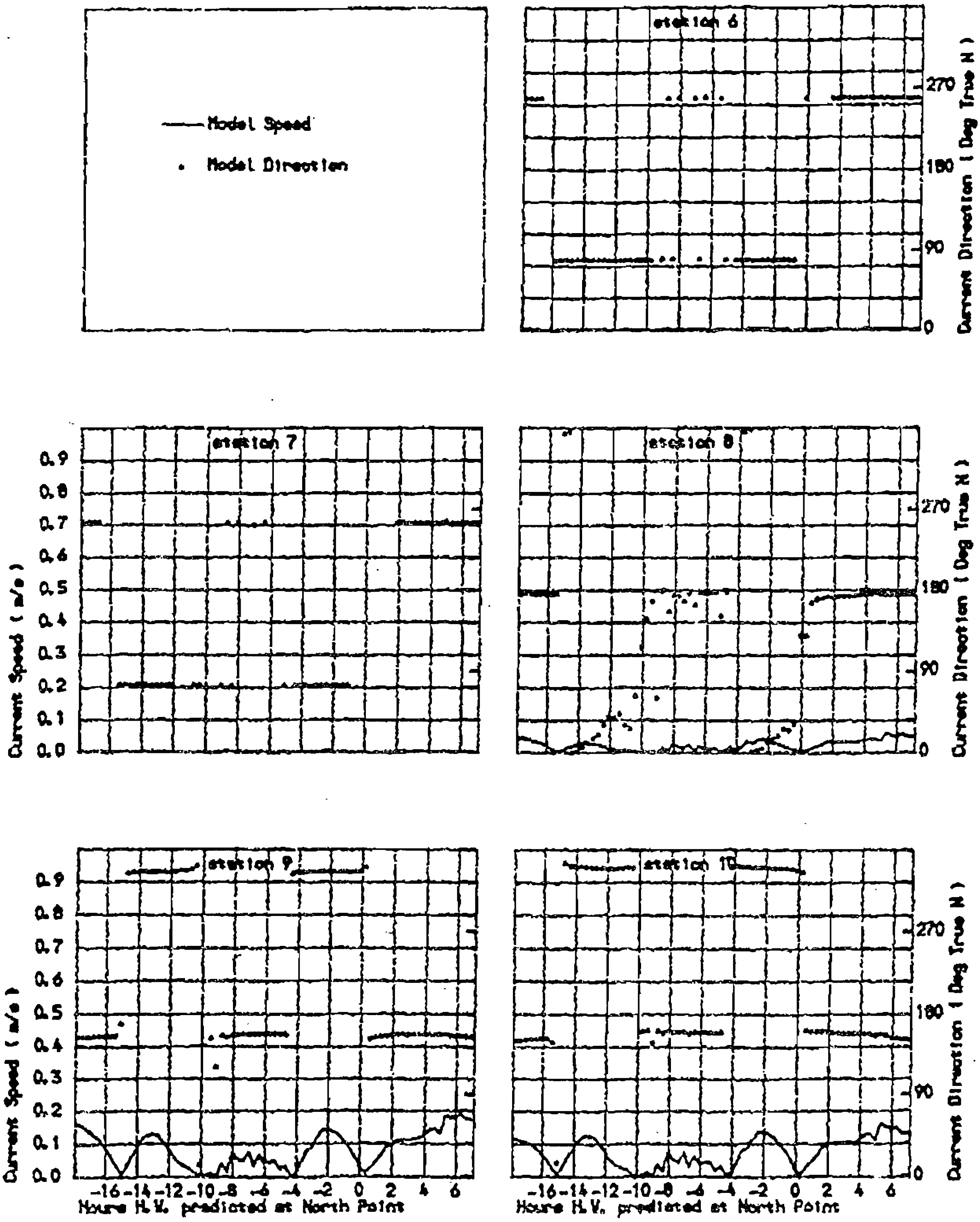


FIG 6b TERMINAL 8 SCHEME SETY - SIMULATED VELOCITIES, STATIONS 6-10

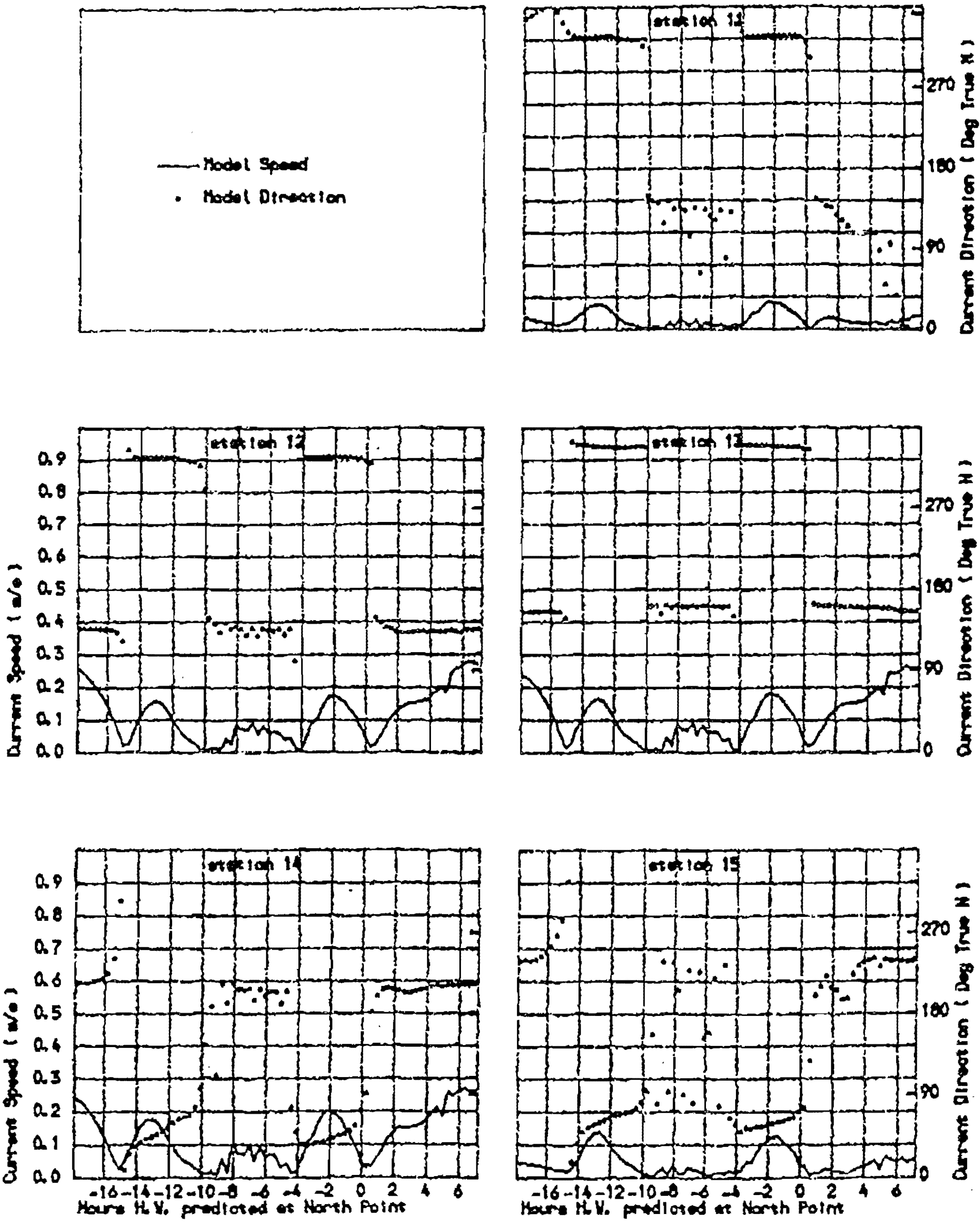


FIG 6c TERMINAL 8 SCHEME SETY - SIMULATED VELOCITIES, STATIONS 11-15

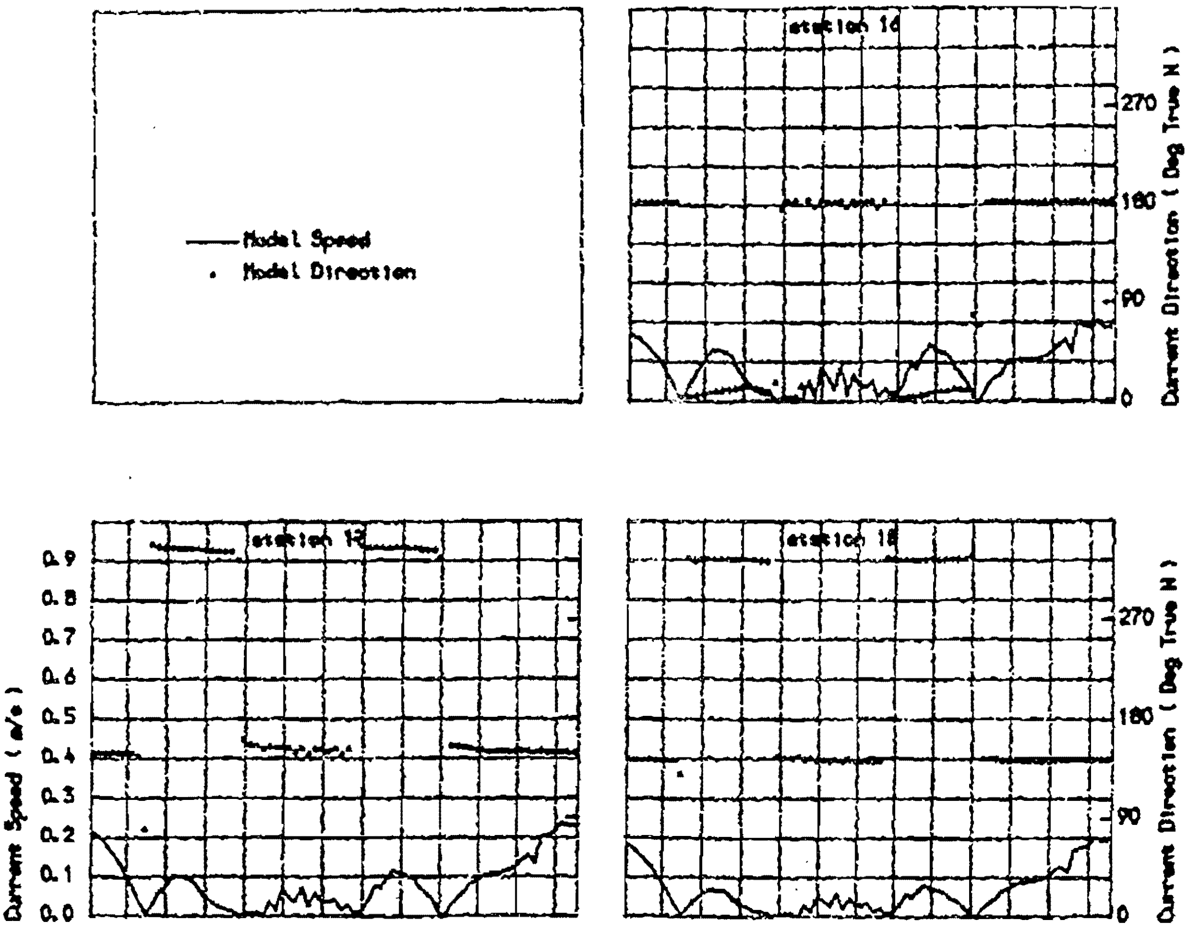


FIG 6d TERMINAL 8 SCHEME SETY - SIMULATED VELOCITIES, STATIONS 16-18

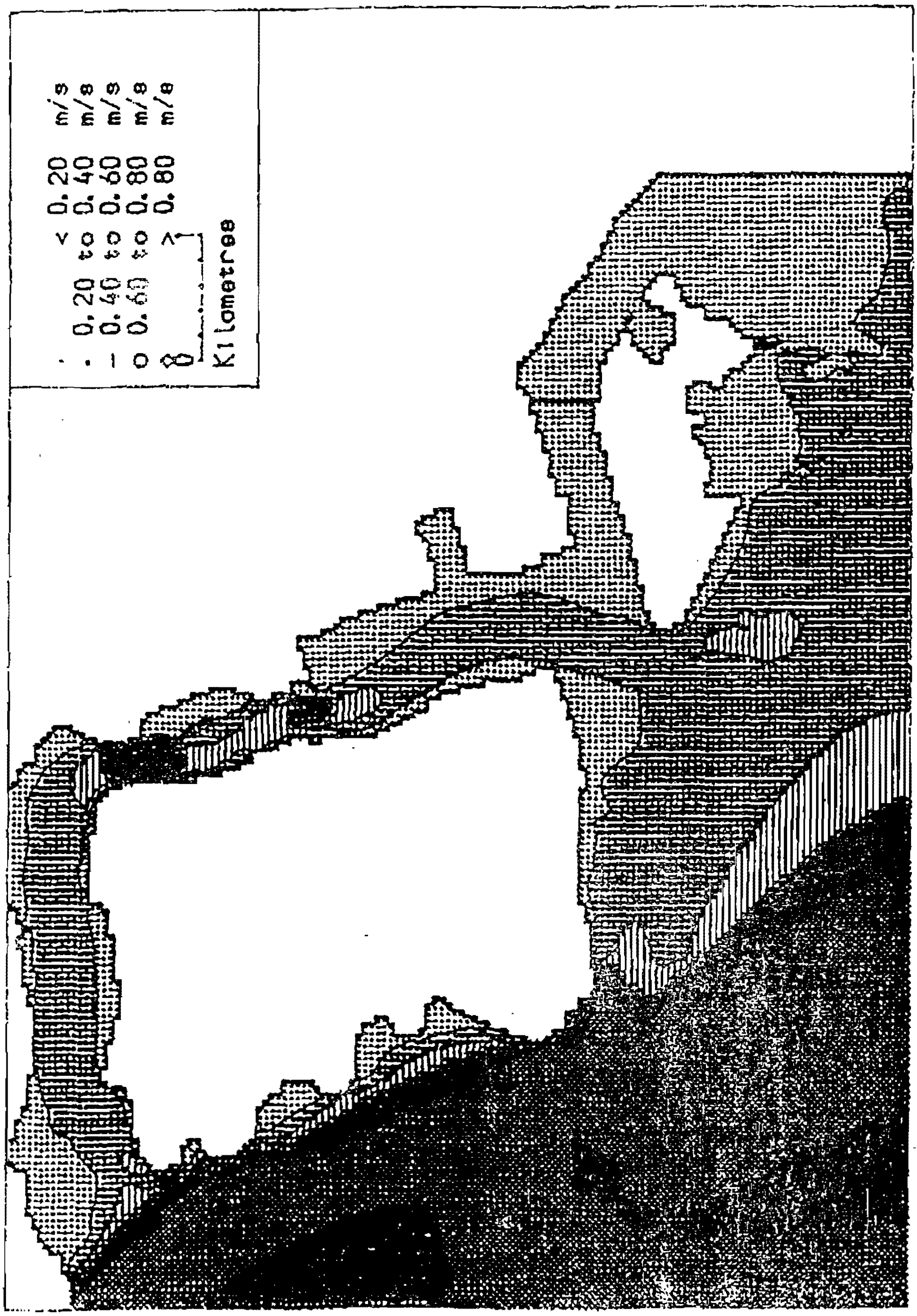


FIG 7 TERMINAL 8 SCHEME B1k - SPRING TIDE MAXIMUM SPEEDS

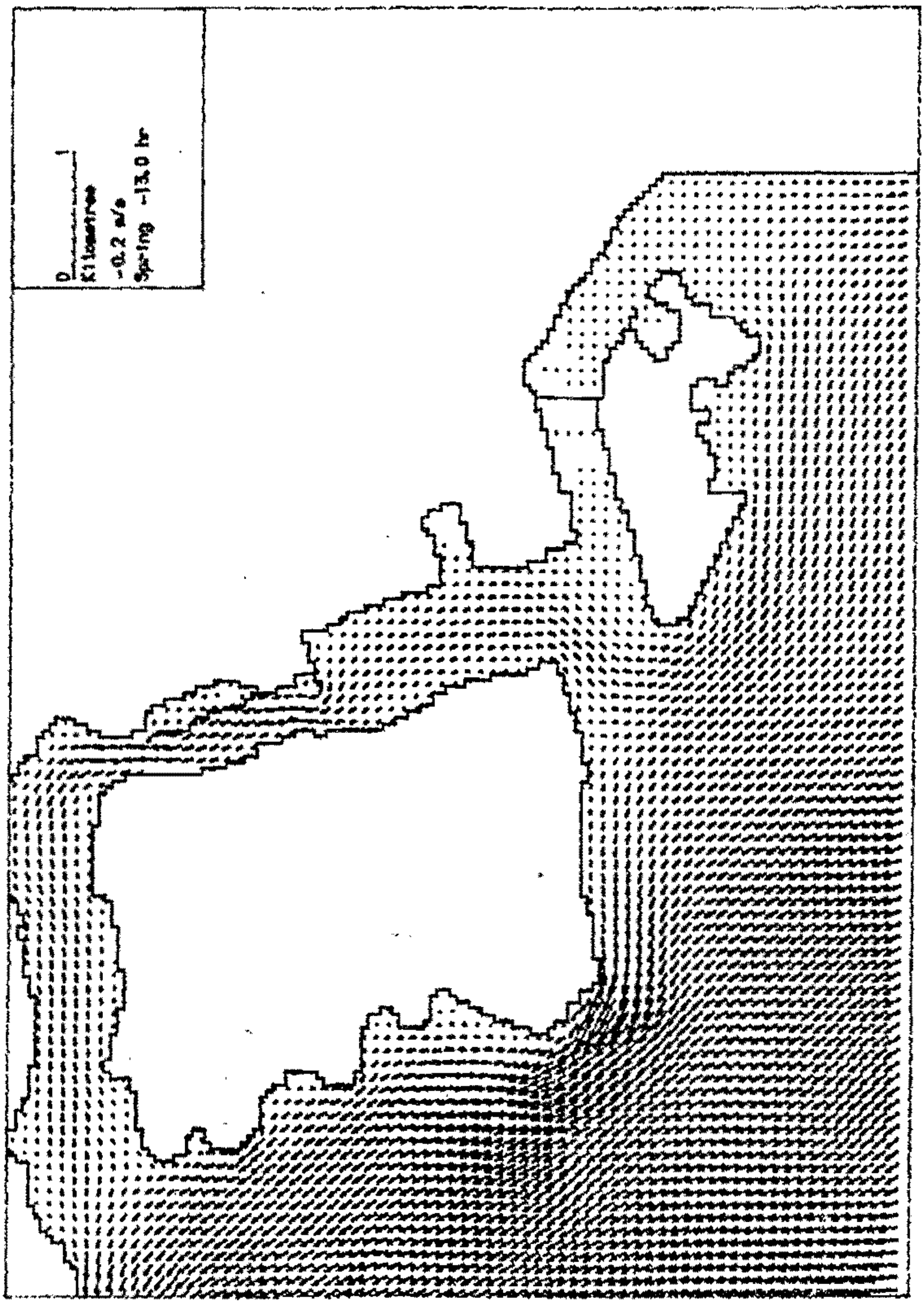


FIG 8 TERMINAL 8 SCHEME B1k - PEAK FLOOD TIDE VELOCITIES

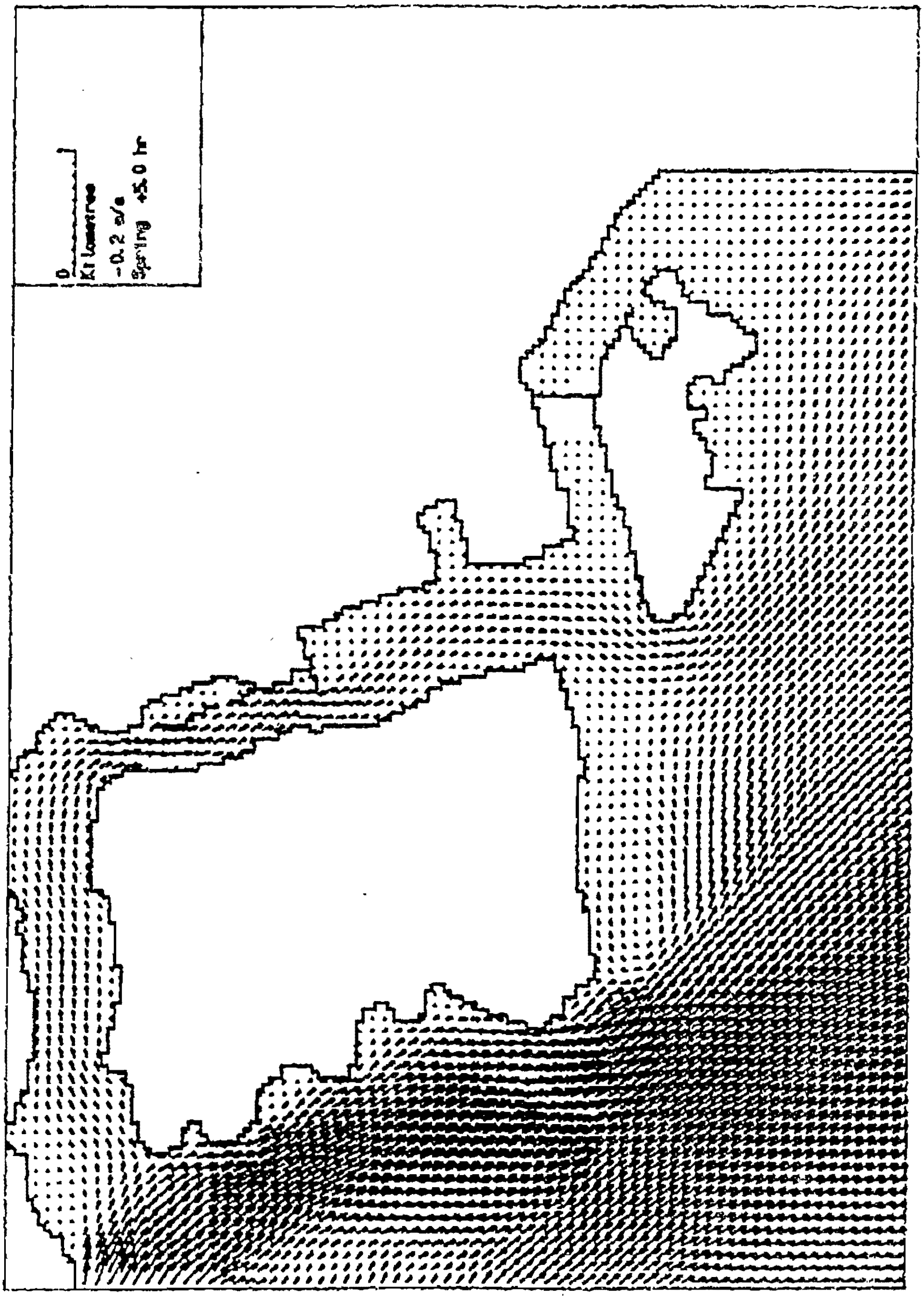


FIG 9 TERMINAL 8 SCHEME B1k - PEAK EBB TIDE VELOCITIES

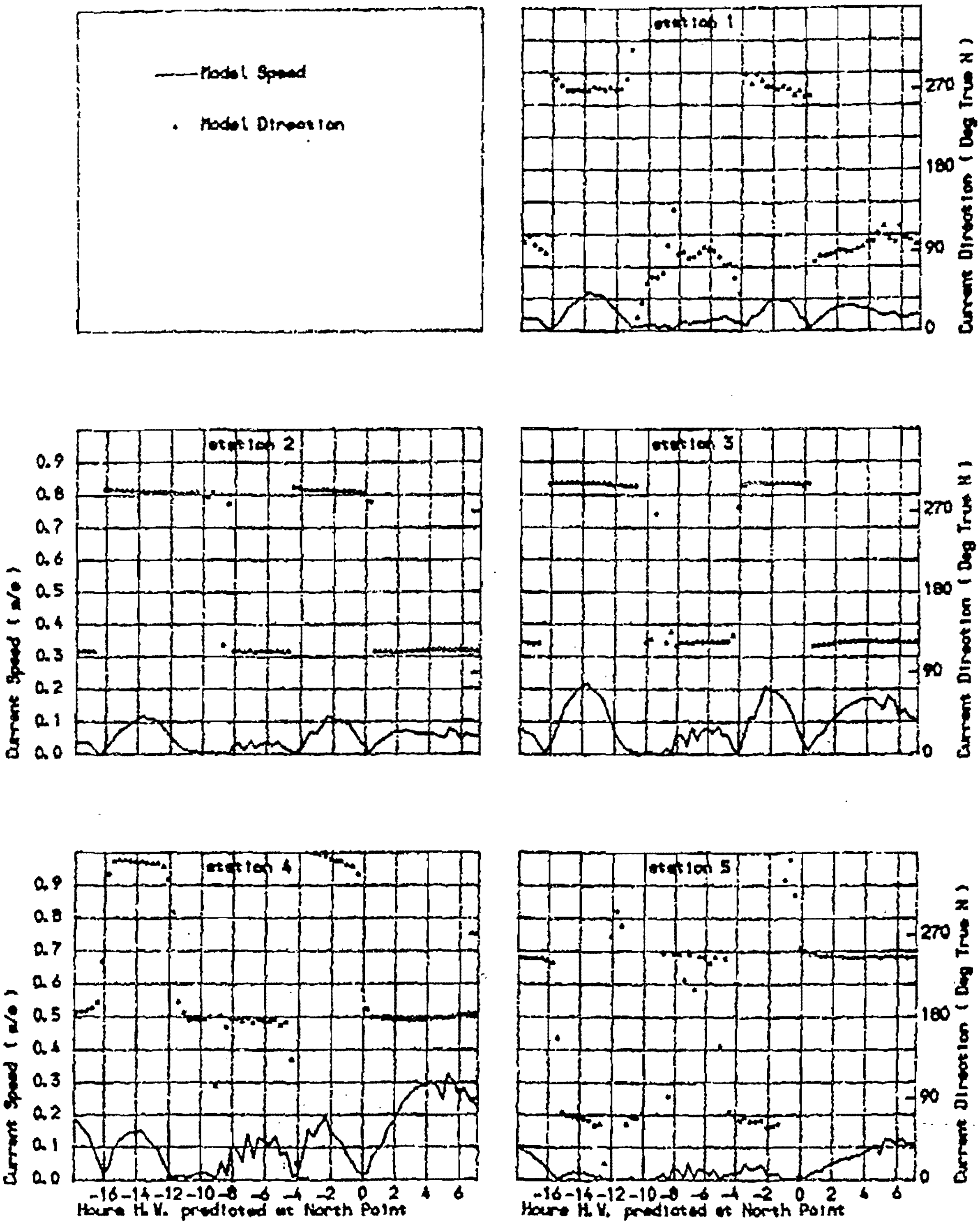


FIG 10a TERMINAL 8 SCHEME B1k - SIMULATED VELOCITIES, STATIONS 1-5

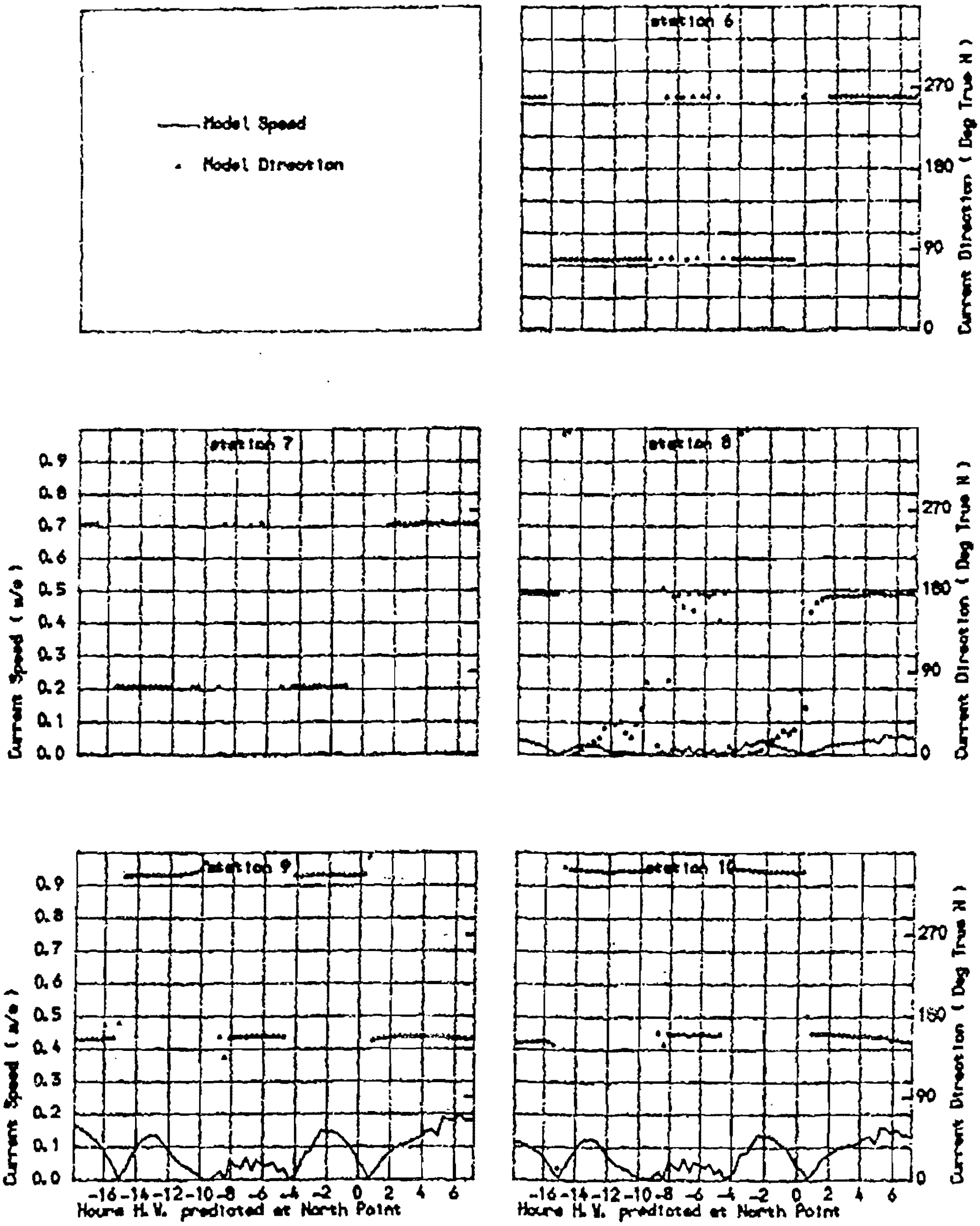


FIG 10b TERMINAL 8 SCHEME B1k - SIMULATED VELOCITIES, STATIONS 6-10

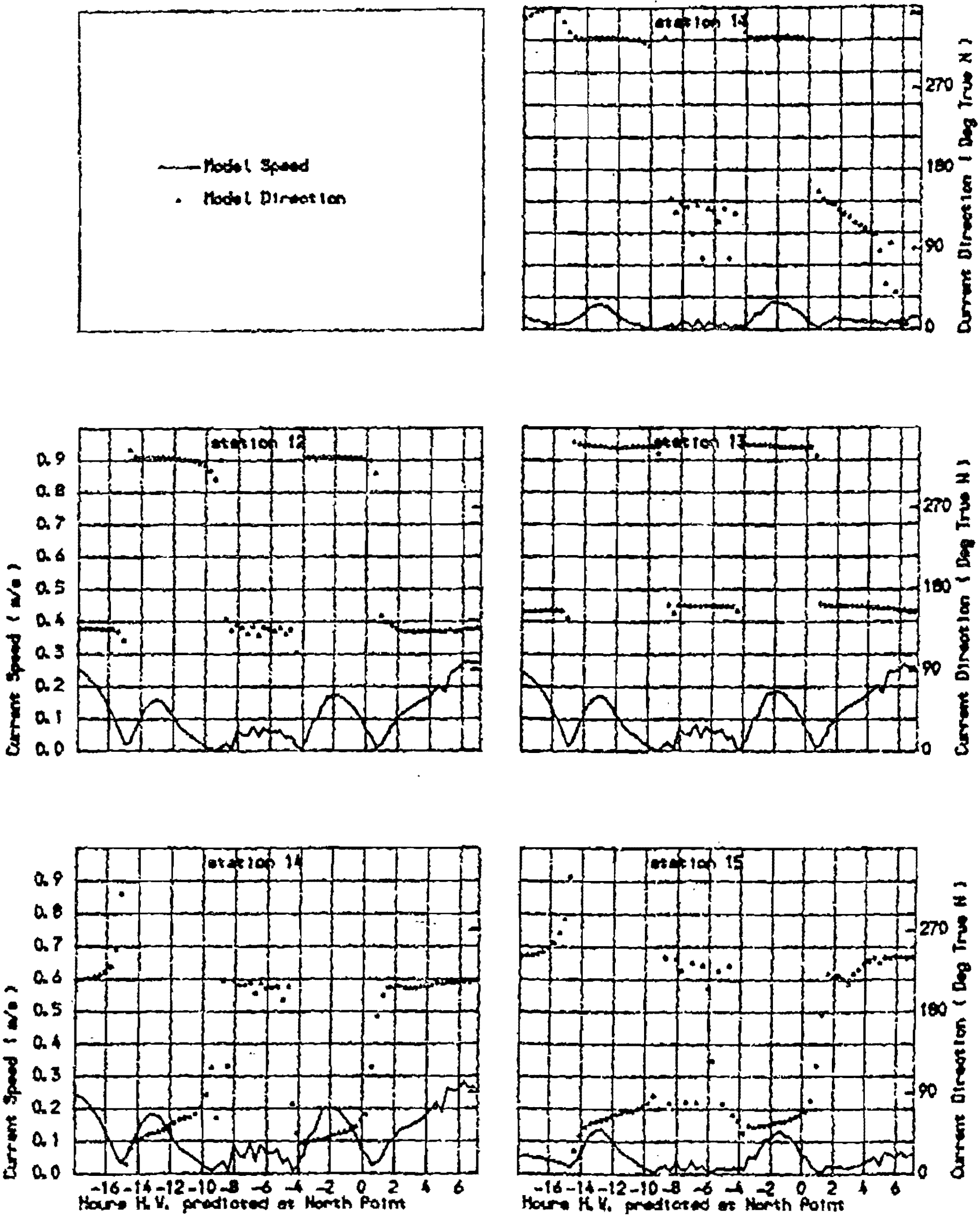


FIG 10c TERMINAL 8 SCHEME B1k - SIMULATED VELOCITIES, STATIONS 11-15

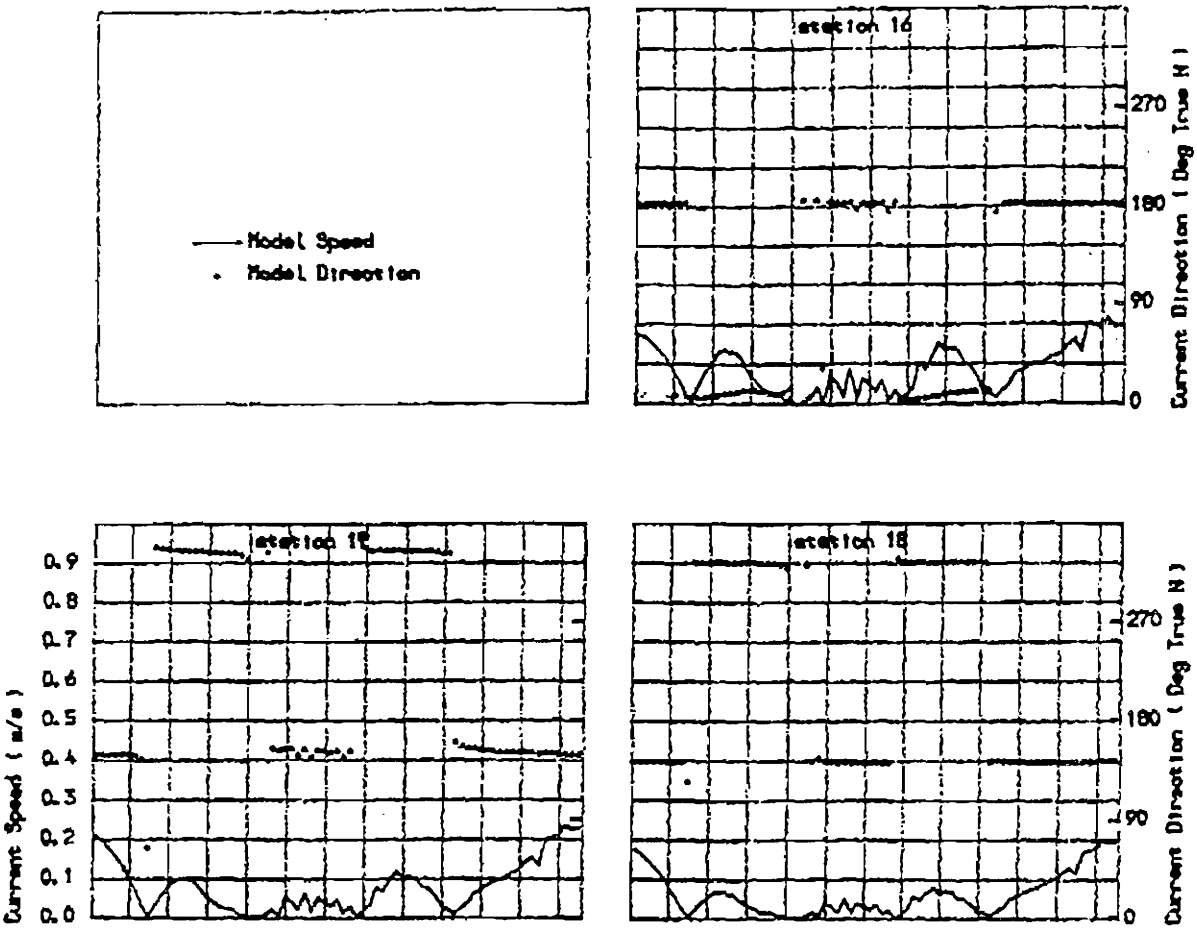


FIG 10d TERMINAL 8 SCHEME B1k - SIMULATED VELOCITIES, STATIONS 16-18

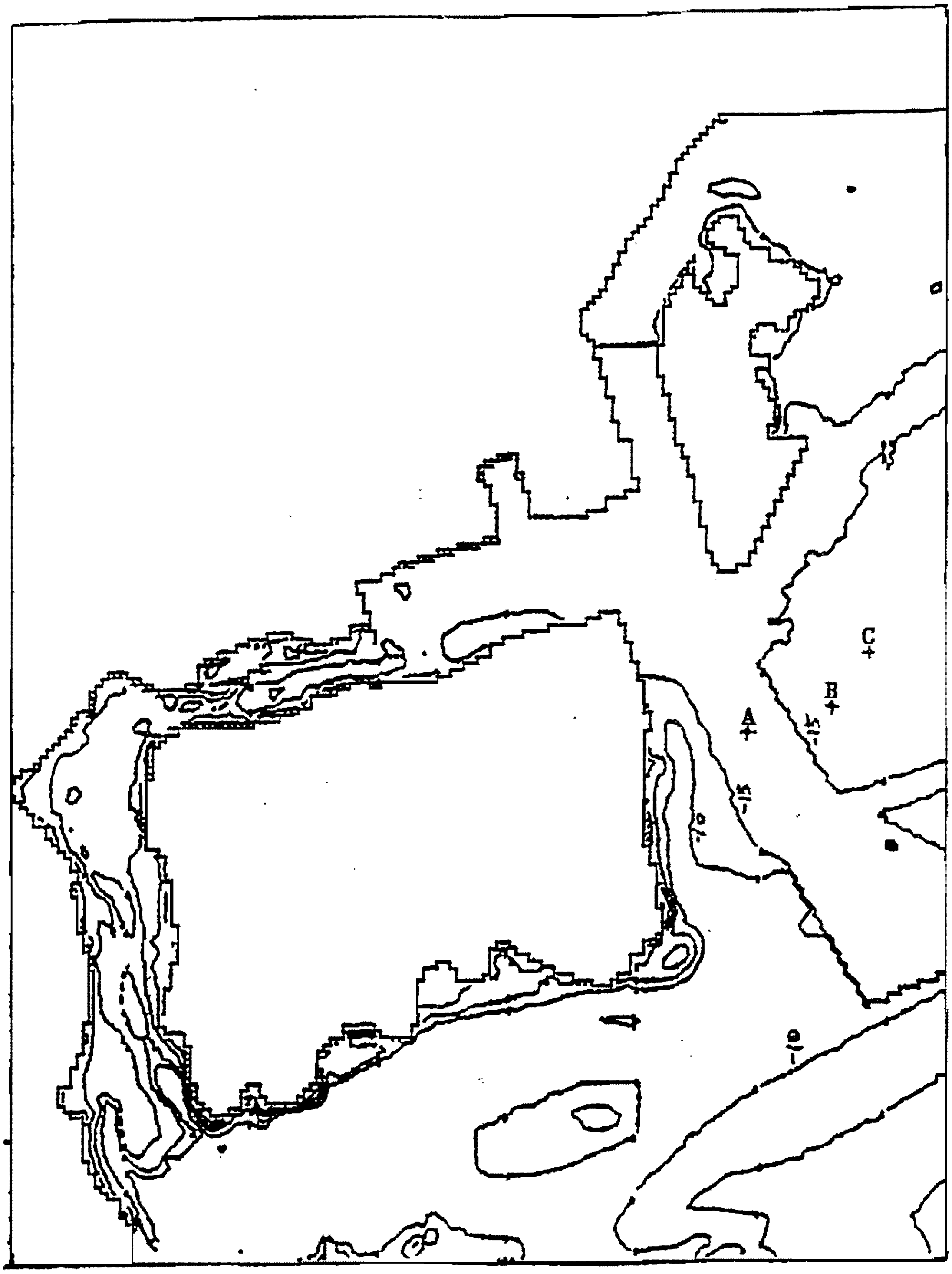


FIG 11 LOCATION OF ADDITIONAL FIXED VELOCITY STATIONS

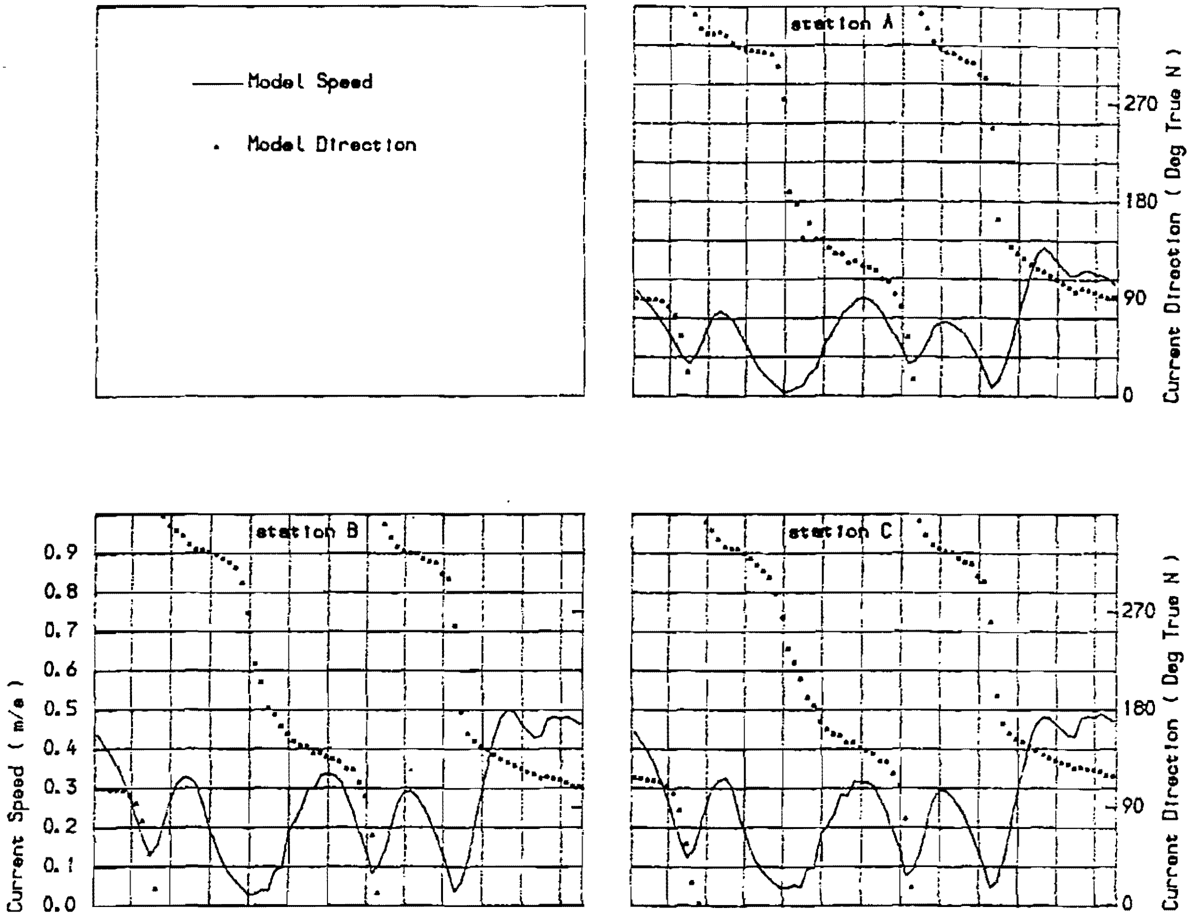


FIG 12 TERMINAL 8 SCHEME SETY - SIMULATED VELOCITIES, STATIONS A,B,C

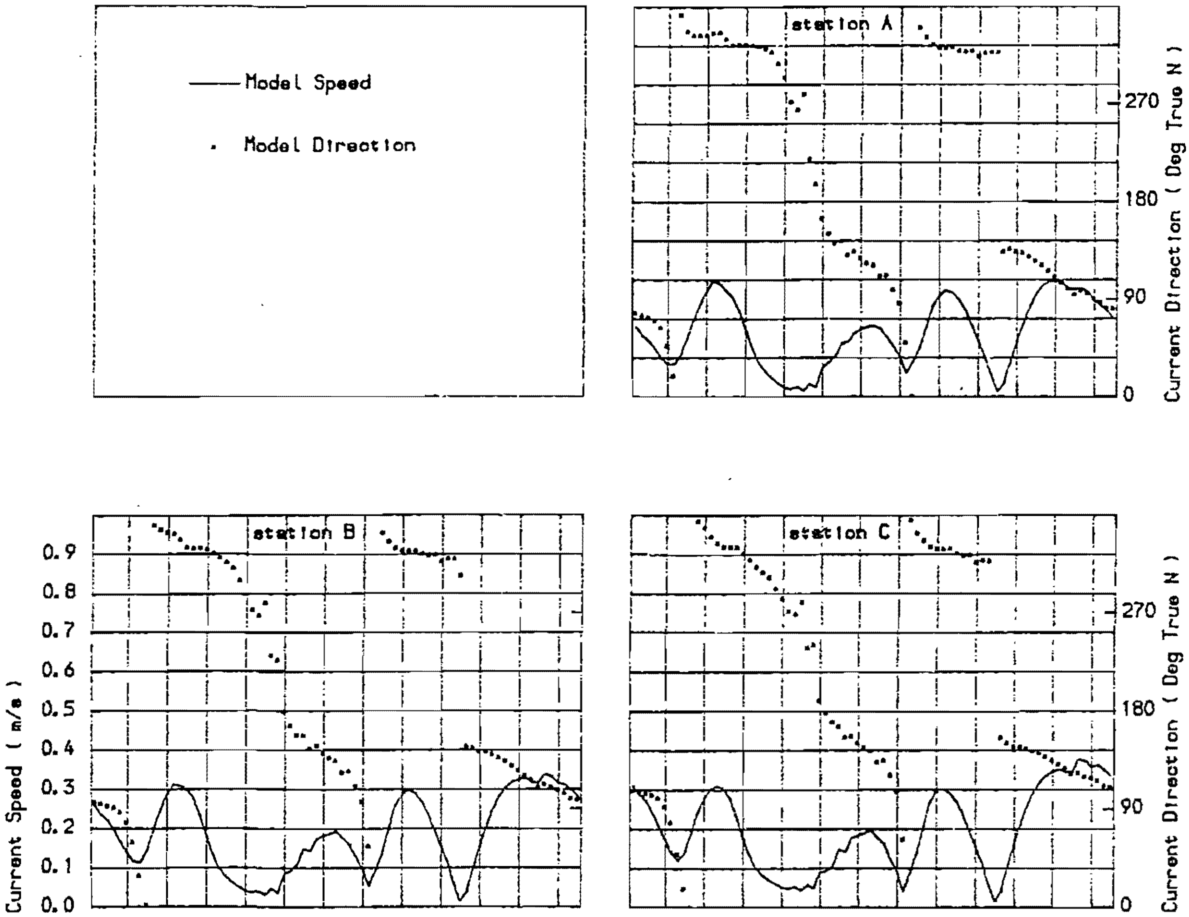


FIG 13 TERMINAL 8 SCHEME Blk - SIMULATED VELOCITIES, STATIONS A,B,C

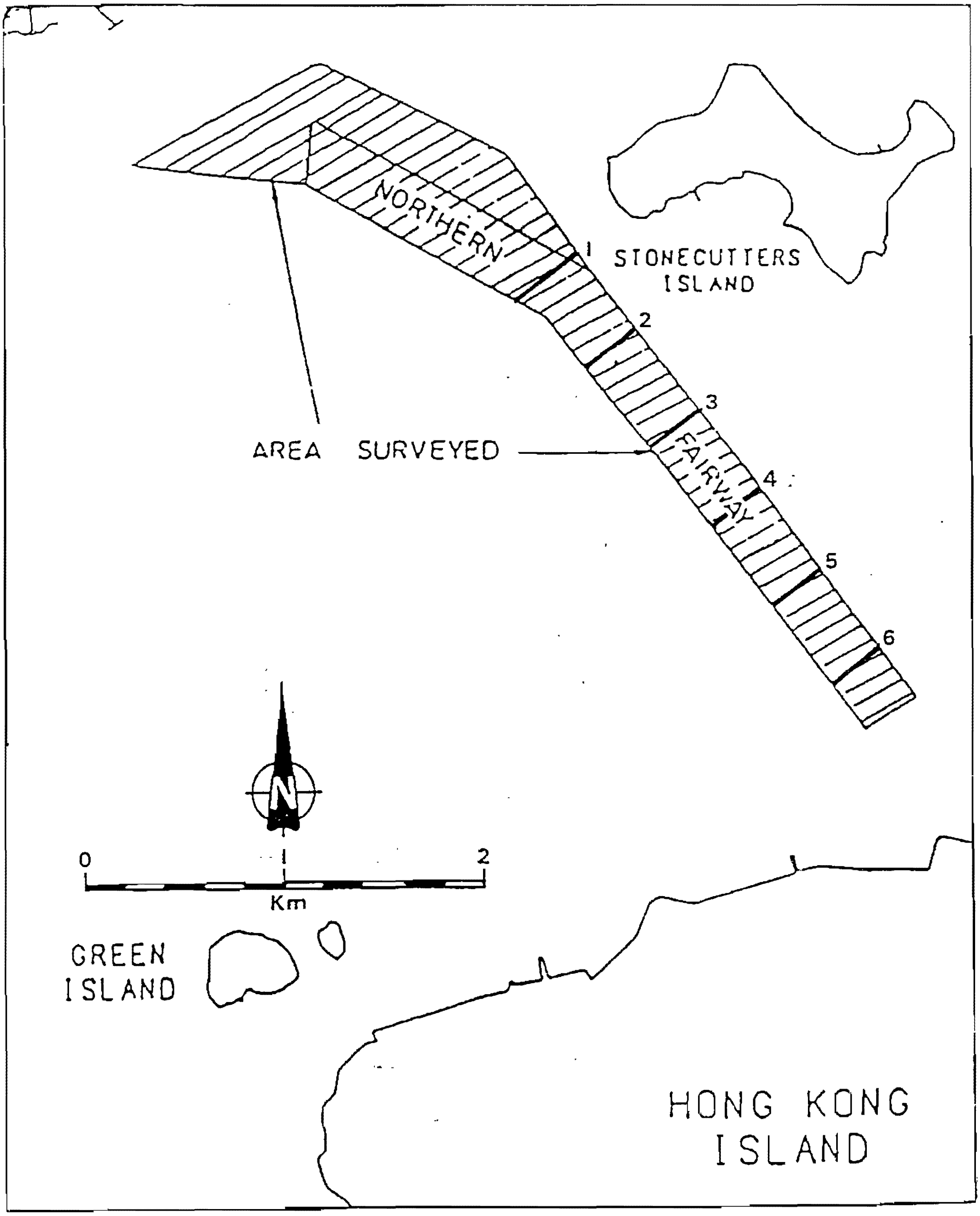


FIG 14 LOCATION OF THE NORTHERN FAIRWAY DREDGED CHANNEL (Ref 6)

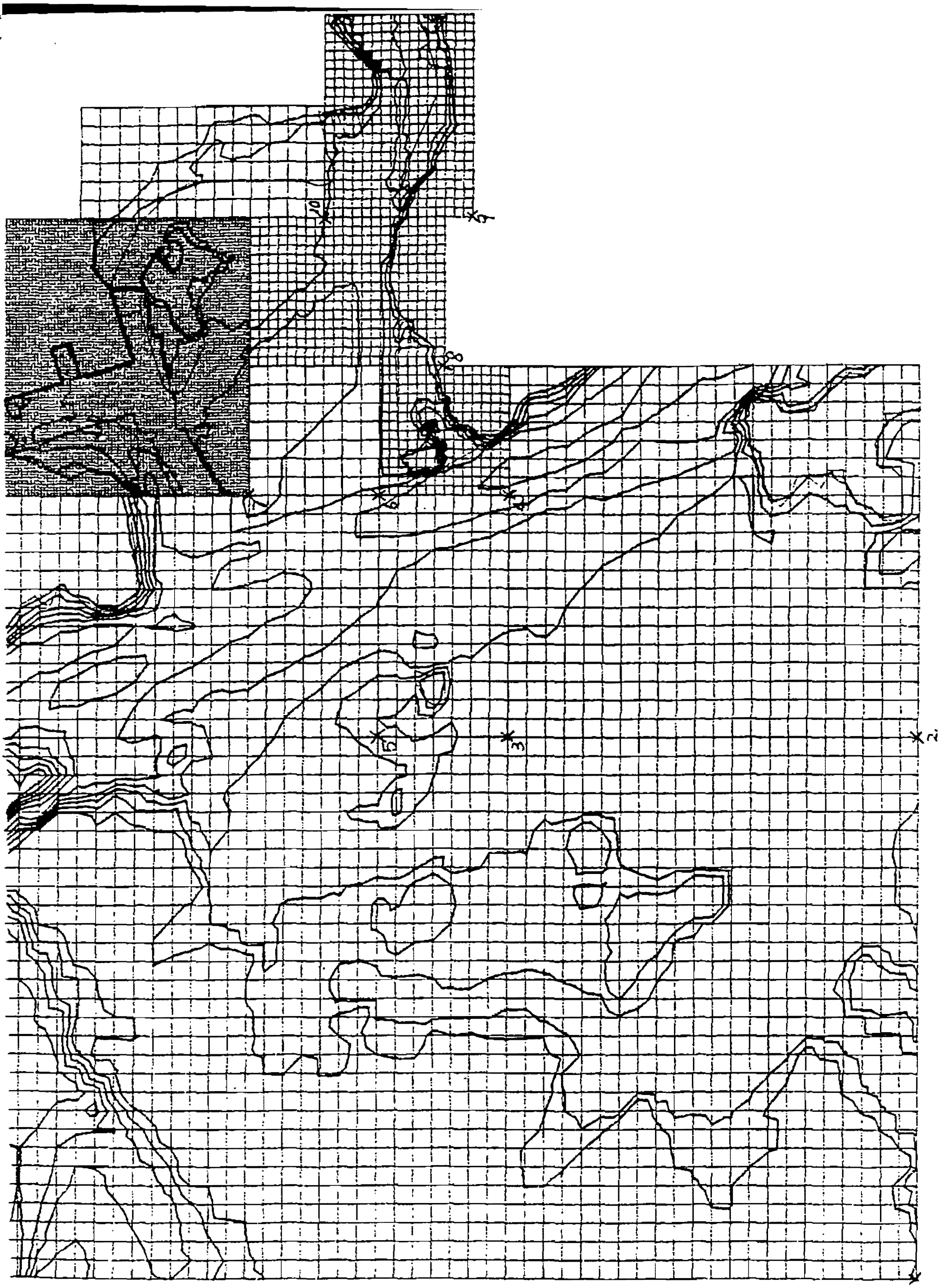


FIG 15 THE PORTRAY MODEL GRID AND MODEL AREA

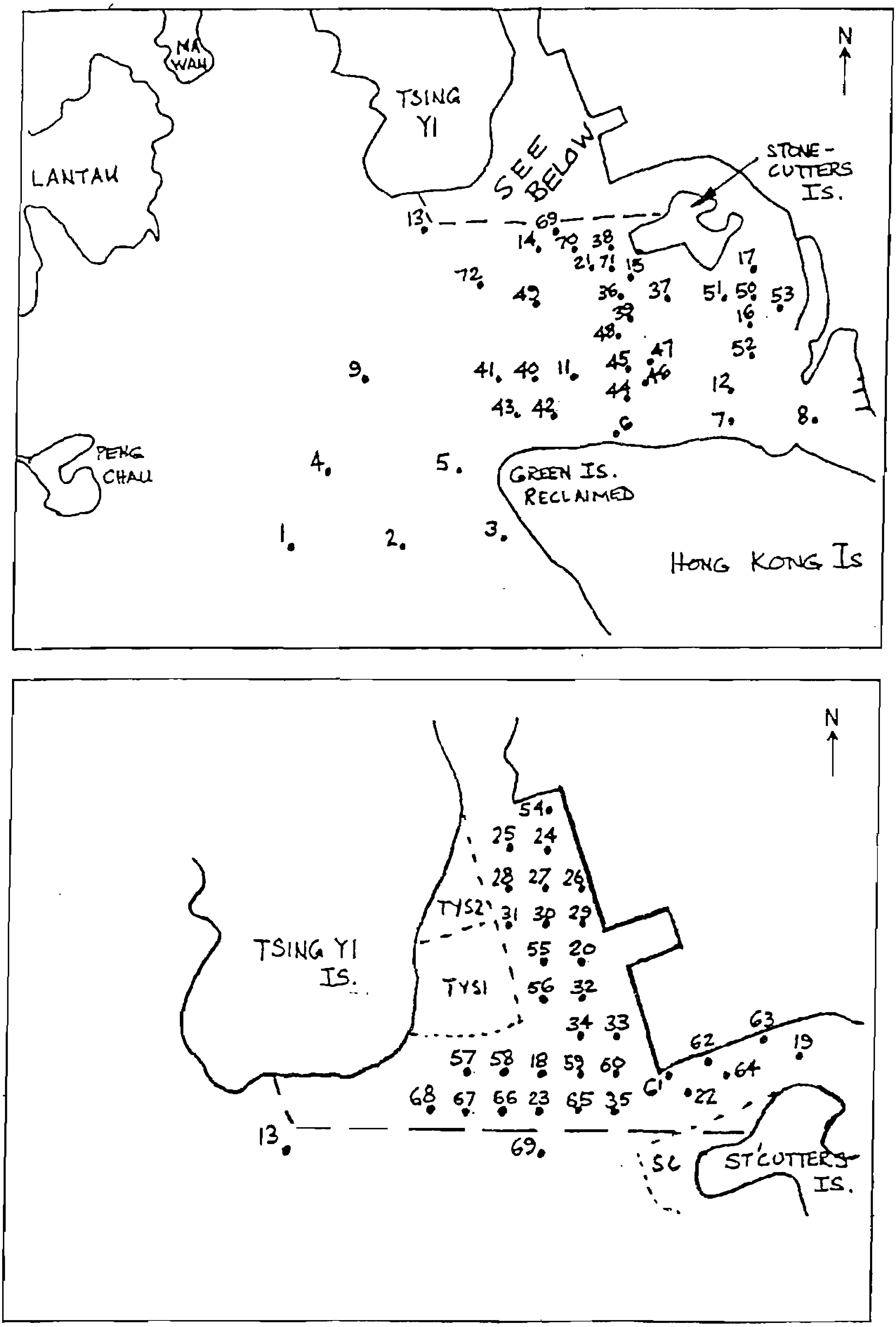


FIG 16 WAVE HEIGHT COMPARISON POSITIONS

APPENDIX 1

TABULATED WAVE HEIGHTS AND WAVE RAY DIAGRAMS PROVIDED BY THE PORT WORKS DIVISION, CESD

KEY TO MODEL RUNS

IDENTIFICATION NUMBER	CONDITIONS SIMULATED
Previous Model Runs	
Base	Base Layout, RC=1.0, 50/1yr
Base	Base Layout RC=1.0, 1/1yr
81	CT8 Reclamation, RC=1.0, 50/1yr
82	CT8 Reclamation, RC=0.8, 1/1yr
91	CT8 & CT9 Reclamation, RC=1.0, 50/1yr
92	CT8 & CT9 Reclamation, RC=0.8, 1/1yr
93	As '91', RC=0.4 on South CT9, west & South CT8
94	As '92', RC=0.4 on South CT9, west & South CT8
94a	As '94', dredging added between Ct7 & CT8
New Fairway Simulations	
89	CT8 & CT9 Reclamations, RC=1.0
89a	As '89' but RC=0.4 SE Tsing Yi, SW Face of CT8

BASE SCHEME

50/YEAR, REFLECTION COEFFICIENT OF 1.0 AT CONTAINER BERTHS

GRID	I	J	HSMEAN	HSMEANFAC
3	3	1	0.627	0.715
3	11	1	0.624	0.711
4	3	3	0.706	0.805
3	5	5	0.690	0.787
3	12	5	0.714	0.814
8	1	7	0.264	0.301
8	14	8	0.175	0.199
9	6	12	0.000	0.000
5	7	3	0.571	0.651
4	2	12	0.638	0.727
6	18	3	0.000	0.000
8	13	12	0.181	0.206
5	10	11	0.809	0.922
7	13	13	0.417	0.476
7	7	46	0.000	0.000
8	15	19	0.217	0.247
7	85	49	0.000	0.000
7	19	31	0.414	0.472
7	64	37	0.206	0.235
7	25	49	0.364	0.415
7	31	7	0.245	0.279
7	46	31	0.265	0.303
7	19	25	0.430	0.490
7	19	67	0.418	0.477
7	13	67	0.543	0.619
7	25	61	0.517	0.590
7	19	61	0.547	0.624
7	13	61	0.701	0.799
7	25	55	0.930	1.060

BASE SCHEME (Continued)

50/YEAR, REFLECTION COEFFICIENT OF 1.0 AT CONTAINER BERTHS

7	19	55	0.463	0.528
7	13	55	0.934	1.065
7	25	43	0.469	0.534
7	31	37	0.352	0.402
7	25	37	0.479	0.546
7	31	25	0.441	0.502
7	43	1	0.468	0.533
7	58	1	0.307	0.351
7	37	13	0.439	0.500
8	2	20	0.366	0.417
6	3	3	0.478	0.545
6	1	3	0.629	0.718
6	4	1	0.548	0.624
6	2	1	0.488	0.557
8	2	11	0.315	0.359
8	2	14	0.254	0.289
8	4	13	0.261	0.298
8	4	15	0.211	0.240
8	1	18	0.389	0.444
6	3	7	0.403	0.459
7	61	1	0.217	0.247
7	76	1	0.064	0.072
8	15	16	0.189	0.216
10	1	4	0.127	0.144
7	19	72	0.454	0.518
7	19	49	0.440	0.502
7	19	43	0.641	0.731
7	7	31	0.489	0.557
7	13	31	0.402	0.459
7	25	31	0.388	0.442
7	31	31	0.440	0.502
7	43	34	0.348	0.396
7	49	37	0.411	0.468

BASE SCHEME (Continued)

50/YEAR, REFLECTION COEFFICIENT OF 1.0 AT CONTAINER BERTHS

7	58	40	0.556	0.633
7	52	34	0.267	0.305
7	25	25	0.510	0.581
7	13	25	0.693	0.790
7	7	25	0.714	0.814
7	1	25	0.517	0.590
7	19	19	0.422	0.481
7	25	13	0.459	0.523
7	37	7	0.177	0.202
5	13	8	0.793	0.904
8	10	17	0.116	0.132

BASE SCHEME

1/YEAR, REFLECTION COEFFICIENT OF 1.0 AT CONTAINER BERTHS

GRID	I	J	HSMEAN	HSMEANFAC
3	3	1	1.271	1.487
3	11	1	1.306	1.527
4	3	3	1.222	1.429
3	5	5	1.216	1.423
3	12	5	1.152	1.347
8	1	7	0.763	0.893
8	14	8	0.501	0.586
9	6	12	0.365	0.427
5	7	3	1.022	1.196
4	2	12	0.613	0.717
6	18	3	0.000	0.000
8	13	12	0.386	0.452
5	10	11	0.979	1.146
7	13	13	0.940	1.100
7	7	46	0.000	0.000
8	15	19	0.367	0.430
7	85	49	0.000	0.000
7	19	31	1.105	1.293
7	64	37	0.351	0.411
7	25	49	0.882	1.031
7	31	7	0.352	0.412
7	46	31	0.309	0.362
7	19	25	0.757	0.886
7	19	67	0.856	1.001
7	13	67	1.591	1.862
7	25	61	0.576	0.673
7	19	61	0.653	0.764
7	13	61	0.552	0.645
7	25	55	0.667	0.780

BASE SCHEME (Continued)

1/YEAR, REFLECTION COEFFICIENT OF 1.0 AT CONTAINER BERTHS

7	19	55	0.662	0.775
7	13	55	0.537	0.628
7	25	43	0.546	0.639
7	31	37	0.505	0.590
7	25	37	0.874	1.023
7	31	25	0.795	0.930
7	43	1	0.509	0.596
7	58	1	0.443	0.518
7	37	13	0.160	0.188
8	2	20	0.628	0.735
6	3	3	0.756	0.885
6	1	3	0.633	0.740
6	4	1	0.668	0.781
6	2	1	0.598	0.700
8	2	11	0.880	1.029
8	2	14	0.568	0.664
8	4	13	0.495	0.579
8	4	15	0.582	0.682
8	1	18	0.758	0.886
6	3	7	0.708	0.829
7	61	1	0.772	0.904
7	76	1	0.460	0.538
8	15	16	0.322	0.376
10	1	4	0.356	0.416
7	19	72	0.701	0.820
7	19	49	0.415	0.485
7	19	43	0.579	0.677
7	7	31	0.836	0.978
7	13	31	0.433	0.506
7	25	31	0.253	0.296
7	31	31	0.248	0.290
7	43	34	0.113	0.132
7	49	37	0.504	0.590

BASE SCHEME (Continued)

1/YEAR, REFLECTION COEFFICIENT OF 1.0 AT CONTAINER BERTHS

7	58	40	0.353	0.413
7	52	34	0.591	0.691
7	25	25	0.473	0.554
7	13	25	0.859	1.005
7	7	25	0.641	0.750
7	1	25	1.061	1.241
7	19	19	0.405	0.474
7	25	13	0.354	0.414
7	37	7	0.645	0.754
5	13	8	0.978	1.145
8	10	17	0.407	0.476

SIMULATED WAVE HEIGHTS 1/1yr EVENT - NO RE-ALIGNED FAIRWAY
(Continued)

NO	GRID	I	J	HS_FAC82	HS_FAC92	HS_FAC92A	HS_FAC94	HS_FAC94A
30	7	19	55	0.649	0.000	0.000	0.000	0.000
31	7	13	55	0.628	0.000	0.000	0.000	0.000
32	7	25	43	0.496	0.583	0.479	0.583	0.479
33	7	31	37	0.449	0.392	0.561	0.055	0.560
34	7	25	37	0.951	1.029	0.613	0.916	0.613
35	7	31	25	1.165	1.233	1.166	1.009	0.994
36	7	43	1	0.621	0.738	0.665	0.591	0.489
37	7	58	1	0.684	0.737	0.686	0.569	0.563
38	7	37	13	0.415	0.741	0.455	0.315	0.266
39	8	2	20	0.735	0.971	0.846	0.776	0.738
40	6	3	3	0.925	0.989	0.981	0.879	0.887
41	6	1	3	0.816	0.839	0.848	0.750	0.754
42	6	4	1	0.814	0.878	0.884	0.784	0.796
43	6	2	1	0.773	0.794	0.779	0.697	0.697
44	8	2	11	1.029	1.272	1.311	1.076	1.084
45	8	2	14	0.664	0.966	0.898	0.741	0.730
46	8	4	13	0.579	0.843	0.739	0.635	0.613
47	8	4	15	0.682	0.861	0.794	0.696	0.725
48	8	1	18	0.886	1.102	0.976	0.929	0.903
49	6	3	7	0.889	1.061	1.010	0.833	0.824
50	7	61	1	0.910	0.975	1.036	0.918	0.920
51	7	76	1	0.538	0.584	0.588	0.541	0.541
52	8	15	16	0.376	0.464	0.434	0.374	0.365
53	10	1	4	0.416	0.527	0.532	0.437	0.456
54	7	19	72	0.805	0.292	0.384	0.292	0.384
55	7	19	49	0.330	0.000	0.000	0.000	0.000
56	7	19	43	0.592	0.000	0.000	0.000	0.000
57	7	7	31	0.978	1.255	1.174	1.015	1.015
58	7	13	31	0.507	0.898	0.777	0.563	0.592

SIMULATED WAVE HEIGHTS 50/1yr EVENT - NO RE-ALIGNED FAIRWAY
(Continued)

NO	GRID	I	J	HS_FAC81	HS_FAC91	HS_FAC91A	HS_FAC93	HS_FAC93A
30	7	19	55	0.487	0.000	0.000	0.000	0.000
31	7	13	55	1.046	0.000	0.000	0.000	0.000
32	7	25	43	0.520	0.672	0.771	0.689	0.771
33	7	31	37	0.320	0.348	0.317	0.357	0.318
34	7	25	37	0.542	0.542	0.572	0.556	0.524
35	7	31	25	0.571	0.544	0.544	0.498	0.485
36	7	43	1	1.225	0.699	0.701	0.562	0.549
37	7	58	1	0.345	0.613	0.545	0.294	0.262
38	7	37	13	0.615	0.573	0.551	0.522	0.505
39	8	2	20	0.406	0.624	0.586	0.466	0.451
40	6	3	3	0.595	0.706	0.711	0.577	0.569
41	6	1	3	0.753	0.784	0.806	0.738	0.722
42	6	4	1	0.627	0.709	0.706	0.654	0.637
43	6	2	1	0.602	0.689	0.684	0.590	0.572
44	8	2	11	0.359	0.780	0.743	0.468	0.447
45	8	2	14	0.289	0.659	0.651	0.376	0.365
46	8	4	13	0.301	0.502	0.464	0.351	0.336
47	8	4	15	0.249	0.559	0.484	0.325	0.293
48	8	1	18	0.423	0.661	0.648	0.493	0.481
49	6	3	7	0.506	0.687	0.708	0.517	0.511
50	7	61	1	0.284	0.557	0.560	0.307	0.300
51	7	76	1	0.250	0.331	0.352	0.143	0.168
52	8	15	16	0.197	0.289	0.255	0.195	0.184
53	10	1	4	0.159	0.251	0.277	0.164	0.163
54	7	19	72	0.481	0.354	0.333	0.363	0.333
55	7	19	49	0.500	0.000	0.000	0.000	0.000
56	7	19	43	0.721	0.000	0.000	0.000	0.000
57	7	7	31	0.529	0.851	0.851	0.635	0.619
58	7	13	31	0.457	0.784	0.785	0.534	0.523

SIMULATED WAVE HEIGHTS   50/1yr EVENT - NO RE-ALIGNED FAIRWAY
(Continued)

NO	GRID	I	J	HS_FAC81	HS_FAC91	HS_FAC91A	HS_FAC93	HS_FAC93A
59	7	25	31	0.442	0.442	0.483	0.454	0.450
60	7	31	31	0.536	0.499	0.517	0.512	0.517
61	7	43	34	0.072	0.000	0.000	0.000	0.000
62	7	49	37	0.000	0.000	0.000	0.000	0.000
63	7	58	40	0.000	0.000	0.000	0.000	0.000
64	7	52	34	0.000	0.000	0.000	0.000	0.000
65	7	25	25	0.501	0.518	0.501	0.512	0.496
66	7	13	25	0.790	1.075	1.073	0.872	0.850
67	7	7	25	0.774	1.024	1.024	0.885	0.862
68	7	1	25	0.588	0.595	0.629	0.604	0.594
69	7	19	19	0.393	0.710	0.721	0.499	0.489
70	7	25	13	0.560	0.700	0.783	0.589	0.598
71	7	37	7	0.336	0.543	0.589	0.247	0.228
72	5	13	8	0.915	0.914	0.911	0.926	0.903
73	8	10	17	0.209	0.253	0.276	0.152	0.154

SIMULATED WAVE HEIGHTS   1/1yr EVENT - NO RE-ALIGNED FAIRWAY

NO	GRID	I	J	HS_FAC82	HS_FAC92	HS_FAC92A	HS_FAC94	HS_FAC94A
1	3	3	1	1.487	1.494	1.495	1.487	1.487
2	3	11	1	1.534	1.541	1.535	1.525	1.525
3	4	3	3	1.429	1.429	1.429	1.429	1.429
4	3	5	5	1.422	1.433	1.429	1.415	1.415
5	3	12	5	1.365	1.378	1.361	1.346	1.341
6	8	1	7	0.893	1.198	1.226	0.955	0.961
7	8	14	8	0.586	0.656	0.660	0.565	0.565
8	9	6	12	0.357	0.409	0.359	0.392	0.392
9	5	7	3	1.197	1.227	1.241	1.196	1.206
10	4	2	12	0.743	0.745	0.743	0.719	0.719
11	6	18	3	0.000	0.000	0.000	0.000	0.000
12	8	13	12	0.486	0.510	0.577	0.462	0.470
13	5	10	11	1.155	1.268	1.282	1.161	1.164
14	7	13	13	1.100	1.240	1.224	1.126	1.123
15	7	7	46	0.000	0.000	0.000	0.000	0.000
16	8	15	19	0.430	0.503	0.510	0.444	0.445
17	7	85	49	0.000	0.000	0.000	0.000	0.000
18	7	19	31	1.323	1.653	1.618	1.318	1.277
19	7	64	37	0.000	0.000	0.000	0.000	0.000
20	7	25	49	0.903	0.007	0.436	0.007	0.436
21	7	31	7	0.441	0.740	0.736	0.529	0.488
22	7	46	31	0.000	0.000	0.000	0.000	0.000
23	7	19	25	0.896	1.011	1.042	0.910	0.914
24	7	19	67	0.904	0.398	0.237	0.398	0.237
25	7	13	67	1.786	0.000	0.000	0.000	0.000
26	7	25	61	0.641	0.387	0.019	0.387	0.019
27	7	19	61	0.764	0.000	0.000	0.000	0.000
28	7	13	61	0.611	0.000	0.000	0.000	0.000
29	7	25	55	0.771	0.266	0.434	0.266	0.434

SIMULATED WAVE HEIGHTS 1/1yr EVENT - NO RE-ALIGNED FAIRWAY
(Continued)

NO	GRID	I	J	HS_FAC82	HS_FAC92	HS_FAC92A	HS_FAC94	HS_FAC94A
30	7	19	55	0.649	0.000	0.000	0.000	0.000
31	7	13	55	0.628	0.000	0.000	0.000	0.000
32	7	25	43	0.496	0.583	0.479	0.583	0.479
33	7	31	37	0.449	0.392	0.561	0.055	0.560
34	7	25	37	0.951	1.029	0.613	0.916	0.613
35	7	31	25	1.165	1.233	1.166	1.009	0.994
36	7	43	1	0.621	0.738	0.665	0.591	0.489
37	7	58	1	0.684	0.737	0.686	0.569	0.563
38	7	37	13	0.415	0.741	0.455	0.315	0.266
39	8	2	20	0.735	0.971	0.846	0.776	0.738
40	6	3	3	0.925	0.989	0.981	0.879	0.887
41	6	1	3	0.816	0.839	0.848	0.750	0.754
42	6	4	1	0.814	0.878	0.884	0.784	0.796
43	6	2	1	0.773	0.794	0.779	0.697	0.697
44	8	2	11	1.029	1.272	1.311	1.076	1.084
45	8	2	14	0.664	0.966	0.898	0.741	0.730
46	8	4	13	0.579	0.843	0.739	0.635	0.613
47	8	4	15	0.682	0.861	0.794	0.696	0.725
48	8	1	18	0.886	1.102	0.976	0.929	0.903
49	6	3	7	0.889	1.061	1.010	0.833	0.824
50	7	61	1	0.910	0.975	1.036	0.918	0.920
51	7	76	1	0.538	0.584	0.588	0.541	0.541
52	8	15	16	0.376	0.464	0.434	0.374	0.365
53	10	1	4	0.416	0.527	0.532	0.437	0.456
54	7	19	72	0.805	0.292	0.384	0.292	0.384
55	7	19	49	0.330	0.000	0.000	0.000	0.000
56	7	19	43	0.592	0.000	0.000	0.000	0.000
57	7	7	31	0.978	1.255	1.174	1.015	1.015
58	7	13	31	0.507	0.898	0.777	0.563	0.592

SIMULATED WAVE HEIGHTS 1/1yr EVENT - NO RE-ALIGNED FAIRWAY
(Continued)

NO	GRID	I	J	HS_FAC82	HS_FAC92	HS_FAC92A	HS_FAC94	HS_FAC94A
59	7	25	31	0.196	0.437	0.271	0.299	0.271
60	7	31	31	0.248	0.375	0.106	0.281	0.100
61	7	43	34	0.068	0.306	0.000	0.041	0.000
62	7	49	37	0.000	0.000	0.436	0.000	0.176
63	7	58	40	0.000	0.000	0.000	0.000	0.000
64	7	52	34	0.000	0.000	0.000	0.000	0.000
65	7	25	25	0.285	1.011	0.750	0.545	0.416
66	7	13	25	0.931	1.231	1.250	1.005	1.002
67	7	7	25	0.710	0.962	0.982	0.654	0.642
68	7	1	25	1.241	1.044	1.035	1.165	0.977
69	7	19	19	0.474	0.797	0.874	0.411	0.451
70	7	25	13	0.303	1.083	1.052	0.486	0.510
71	7	37	7	0.760	0.910	0.751	0.541	0.604
72	5	13	8	1.145	1.202	1.175	1.128	1.122
73	8	10	17	0.503	0.613	0.628	0.511	0.544

SIMULATED WAVE HEIGHTS WITH THE RE-ALIGNED FAIRWAY

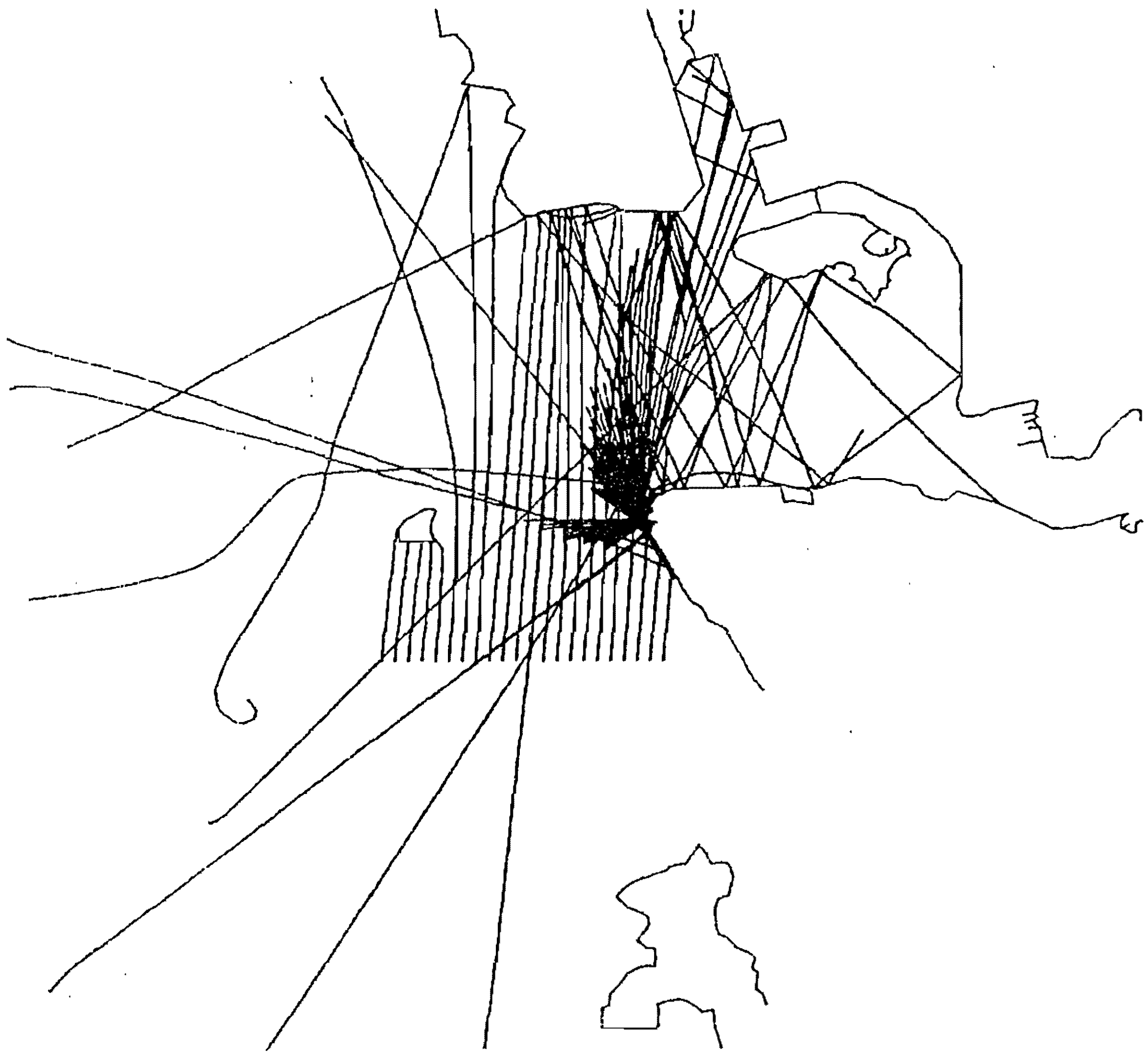
				50/1yr	1/1yr	50/1yr	1/1yr
NO	GRID	I	J	HS89.1	HS89.2	HS89a.1	HS89a.2
1	3	3	1	0.708	1.487	0.701	1.481
2	3	11	1	0.789	1.537	0.762	1.526
3	4	3	3	0.834	1.431	0.834	1.431
4	3	5	5	0.774	1.429	0.765	1.409
5	3	12	5	0.896	1.380	0.858	1.341
6	8	1	7	0.725	0.744	0.433	0.535
7	8	14	8	0.214	0.524	0.147	0.524
8	9	6	12	0.160	0.443	0.160	0.340
9	5	7	3	0.626	1.206	0.625	1.187
10	4	2	12	0.643	0.810	0.616	0.784
11	6	18	3	0.000	0.000	0.000	0.000
12	8	13	12	0.322	0.624	0.225	0.578
13	5	10	11	1.009	1.132	1.000	1.121
14	7	13	13	1.050	1.410	0.560	1.348
15	7	7	46	0.000	0.000	0.000	0.000
16	8	15	19	0.279	0.587	0.246	0.517
17	7	85	49	0.000	0.000	0.000	0.000
18	7	19	31	0.765	1.069	0.508	1.037
19	7	64	37	0.000	0.000	0.000	0.000
20	7	25	49	0.235	0.752	0.097	0.919
21	7	31	7	0.441	0.476	0.215	0.324
22	7	46	31	0.000	0.000	0.000	0.000
23	7	19	25	0.500	1.410	0.456	1.347
24	7	19	67	0.418	0.461	0.418	0.461
25	7	13	67	0.000	0.000	0.000	0.000
26	7	25	61	0.349	0.063	0.349	0.063
27	7	19	61	0.000	0.000	0.000	0.000
28	7	13	61	0.000	0.359	0.000	0.000
29	7	25	55	0.419	0.000	0.350	0.238

SIMULATED WAVE HEIGHTS WITH THE RE-ALIGNED FAIRWAY
(Continued)

				50/1yr	1/1yr	50/1yr	1/1yr
NO	GRID	I	J	HS89.1	HS89.2	HS89a.1	HS89a.2
30	7	19	55	0.000	0.000	0.000	0.000
31	7	13	55	0.000	0.000	0.000	0.000
32	7	25	43	0.792	1.547	0.568	1.355
33	7	31	37	0.315	0.685	0.315	0.685
34	7	25	37	0.952	0.575	0.927	0.574
35	7	31	25	0.528	1.273	0.441	1.076
36	7	43	1	0.544	1.001	0.476	0.924
37	7	58	1	0.486	0.425	0.276	0.425
38	7	37	13	0.365	0.524	0.302	0.318
39	8	2	20	0.456	1.046	0.274	0.958
40	6	3	3	0.580	0.884	0.457	0.768
41	6	1	3	0.815	0.875	0.770	0.781
42	6	4	1	0.616	0.998	0.521	0.892
43	6	2	1	0.691	0.845	0.640	0.786
44	8	2	11	0.654	1.129	0.350	1.043
45	8	2	14	0.534	0.784	0.293	0.686
46	8	4	13	0.506	0.798	0.265	0.713
47	8	4	15	0.559	0.804	0.284	0.712
48	8	1	18	0.488	1.090	0.276	1.055
49	6	3	7	0.732	1.030	0.541	0.872
50	7	61	1	0.718	0.601	0.524	0.515
51	7	76	1	0.479	0.704	0.427	0.613
52	8	15	16	0.191	0.554	0.176	0.554
53	10	1	4	0.587	0.492	0.554	0.480
54	7	19	72	0.518	0.520	0.518	0.520
55	7	19	49	0.000	0.000	0.000	0.000
56	7	19	43	0.000	0.000	0.000	0.000
57	7	7	31	1.109	0.855	0.707	0.684
58	7	13	31	0.827	0.858	0.494	0.585

SIMULATED WAVE HEIGHTS WITH THE RE-ALIGNED FAIRWAY
(Continued)

				50/1yr	1/1yr	50/1yr	1/1yr
NO	GRID	I	J	HS89.1	HS89.2	HS89a.1	HS89a.2
59	7	25	31	0.471	0.722	0.463	0.722
60	7	31	31	0.523	0.997	0.523	0.945
61	7	43	34	0.000	0.115	0.000	0.000
62	7	49	37	0.000	0.000	0.000	0.000
63	7	58	40	0.000	0.000	0.000	0.000
64	7	52	34	0.000	0.000	0.000	0.000
65	7	25	25	0.648	0.723	0.562	0.723
66	7	13	25	1.101	0.807	1.045	0.563
67	7	7	25	0.564	0.441	0.349	0.196
68	7	1	25	0.796	1.268	0.812	1.266
69	7	19	19	0.515	0.714	0.408	0.612
70	7	25	13	0.542	0.743	0.557	0.569
71	7	37	7	0.567	0.853	0.256	0.575
72	5	13	8	0.831	1.087	0.825	1.043
73	8	10	17	0.327	0.506	0.290	0.497



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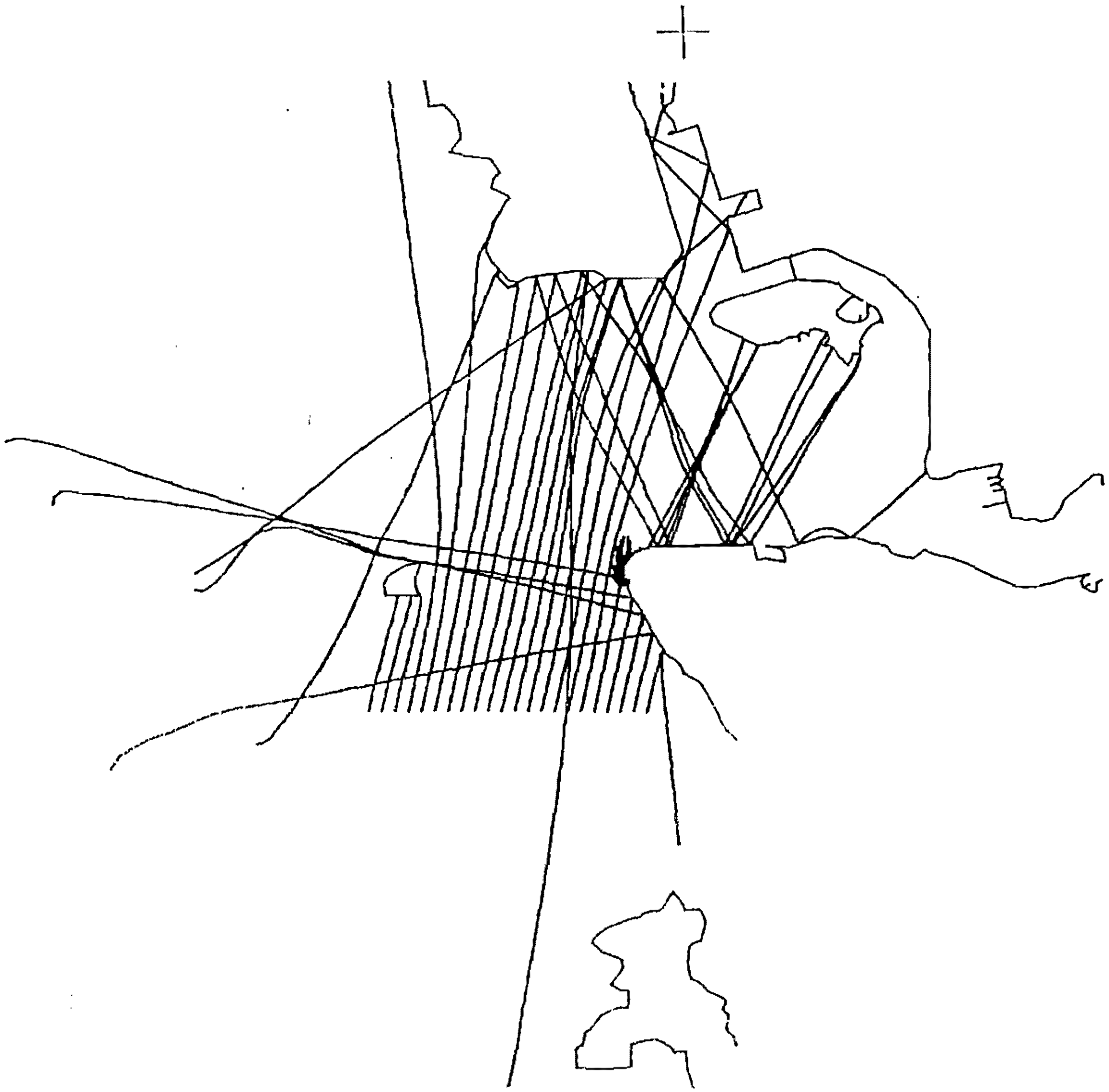

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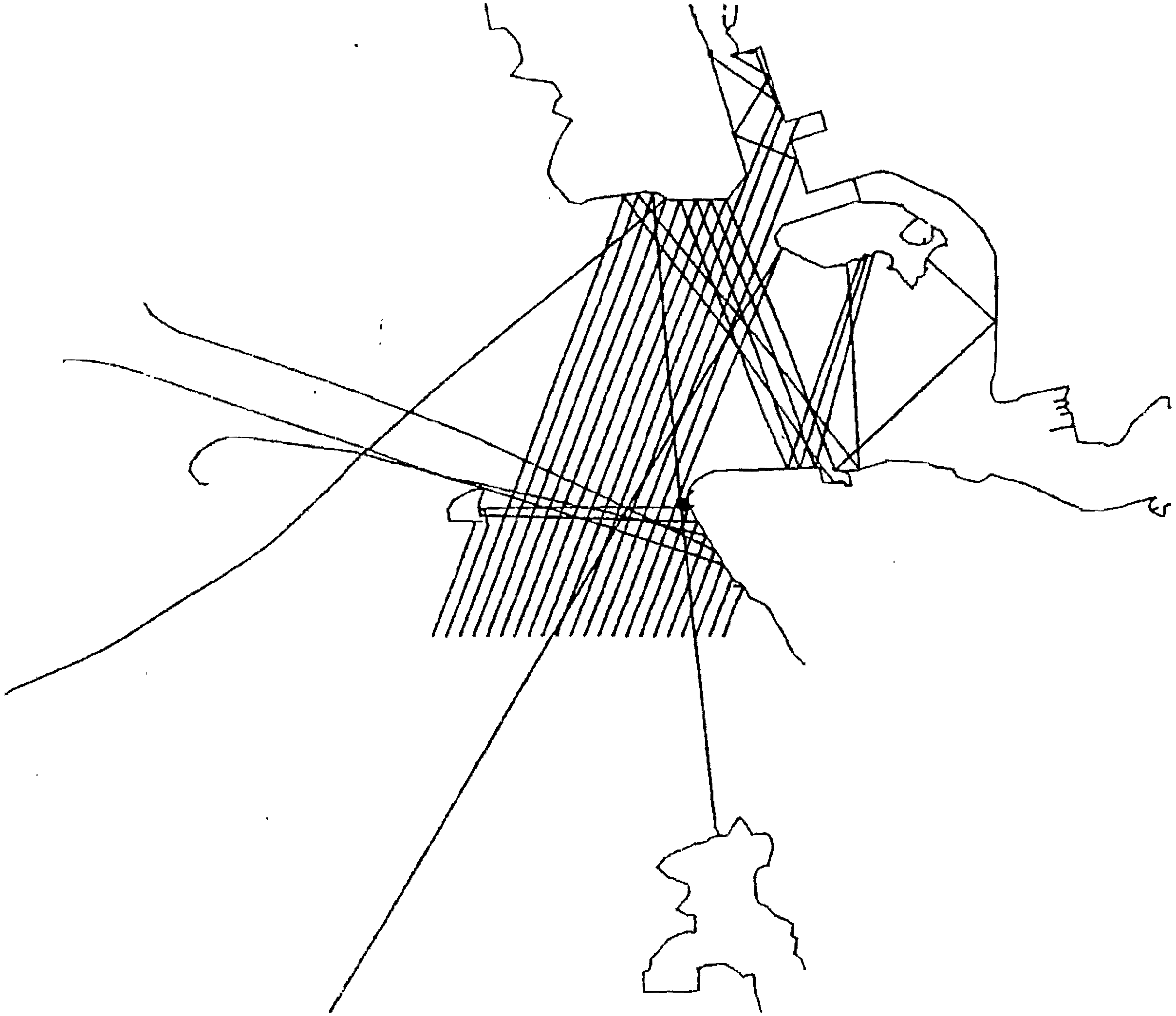

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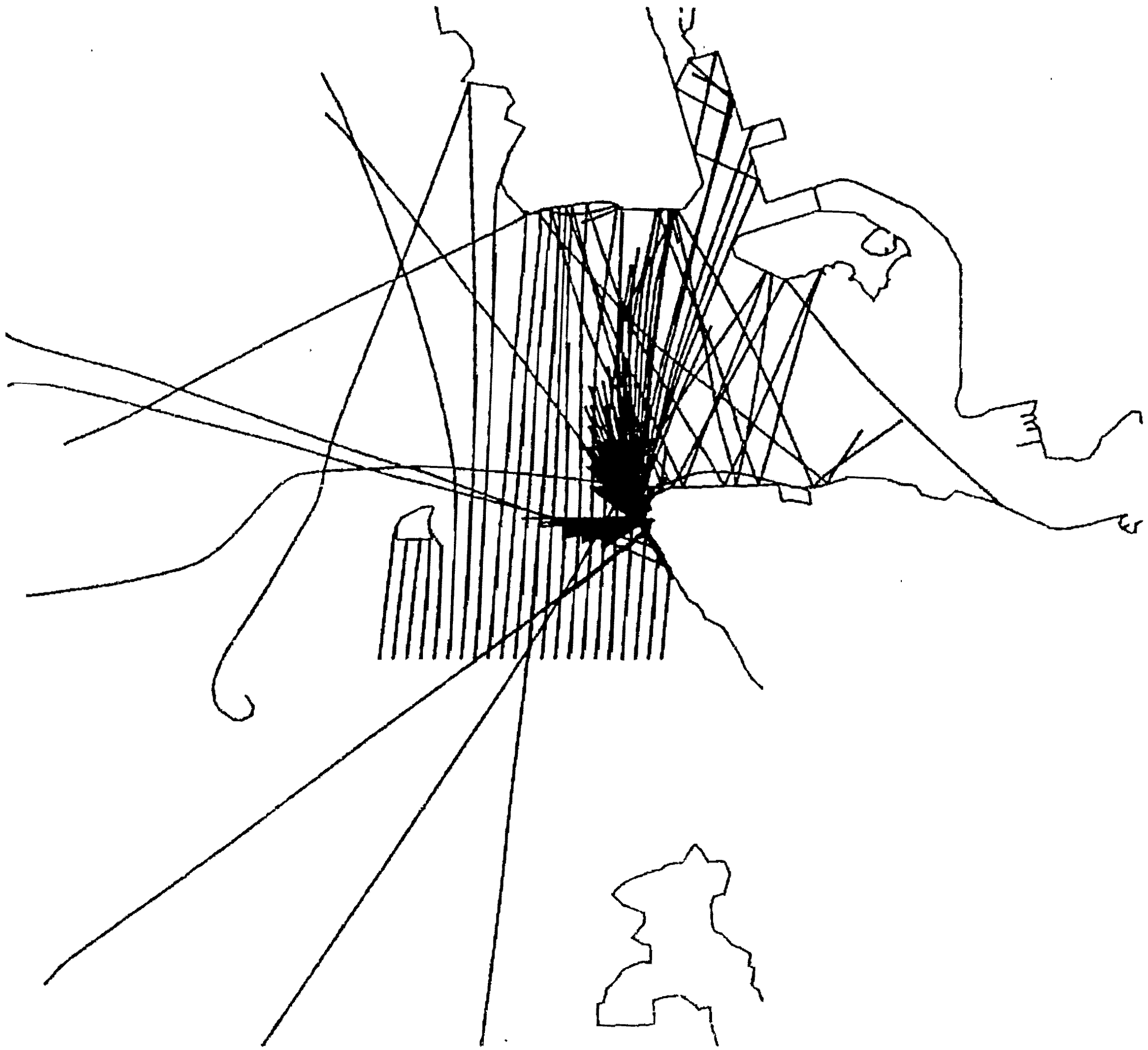

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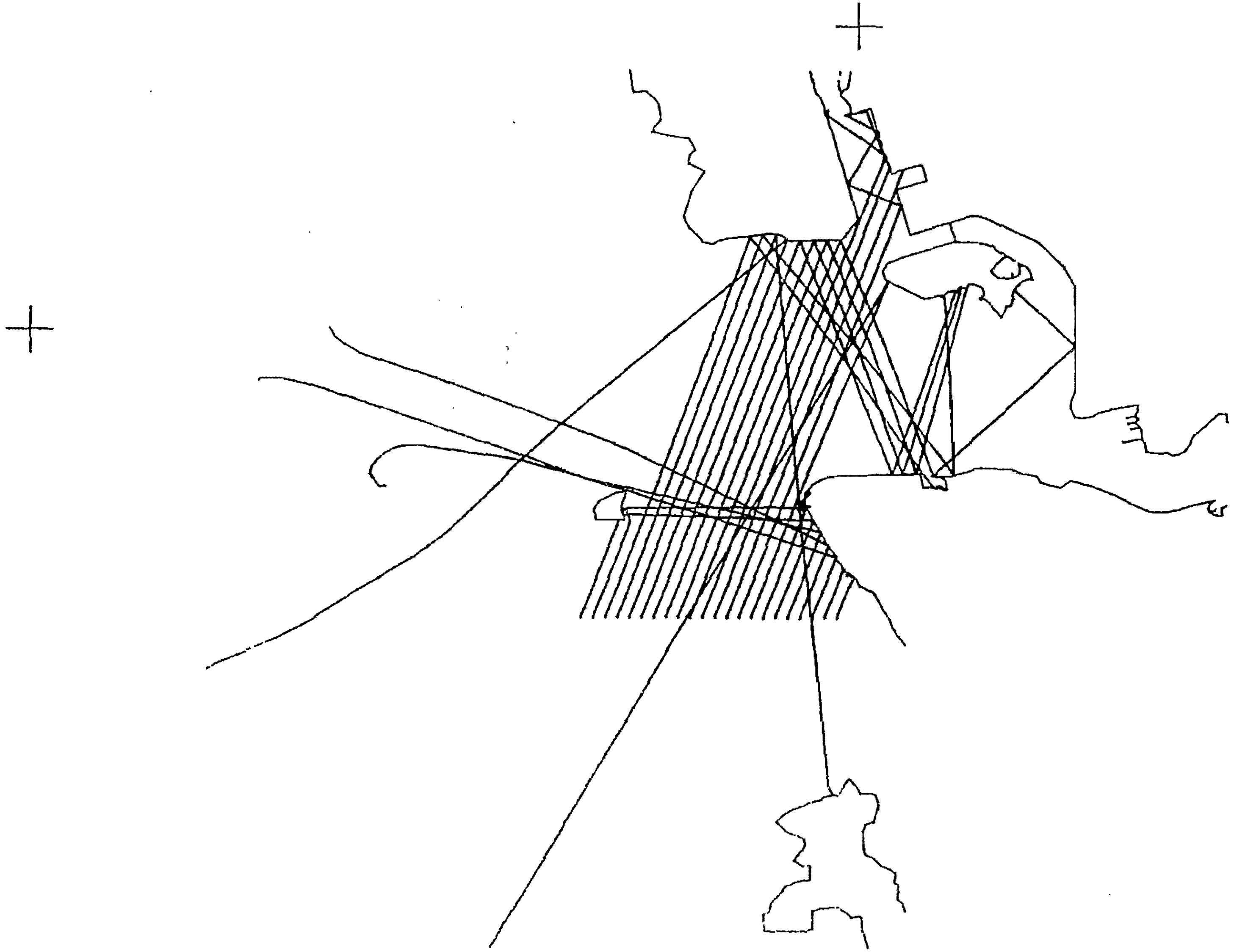

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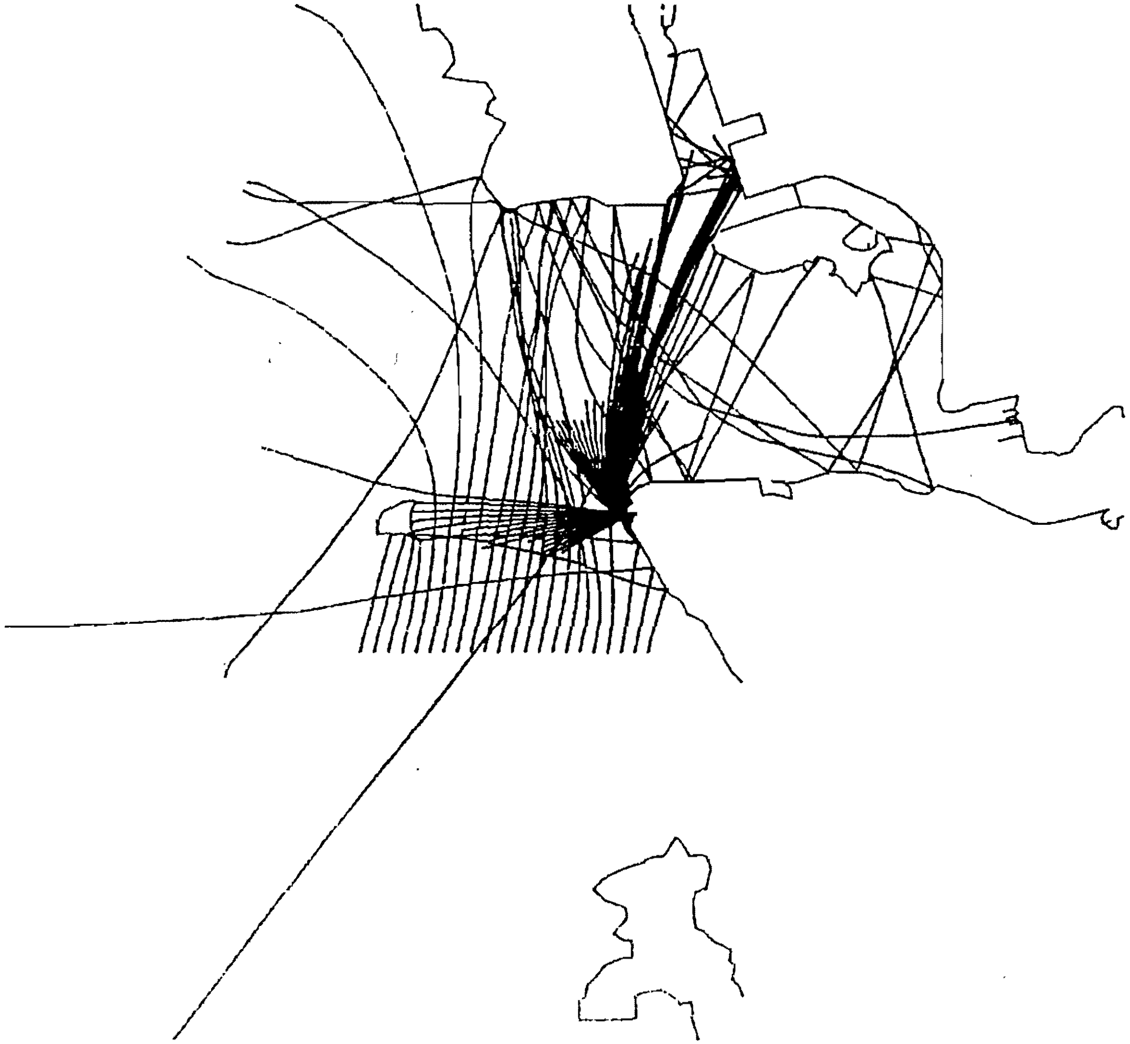

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APPENDIX C

RISK ASSESSMENT

CONTENTS

FIGURES

APPENDIX C

RISK ASSESSMENT

C.1 Introduction

C.1.1 Background

Tsing Yi contains a number of hazardous sites classified as PHIs. These are:

Mobil Oil Terminal
Hong Kong Oil Terminal
CRC South Terminal
Esso Terminal
Caltex Terminal
Shell Terminal (under construction)

All of these handle and store large quantities of LPG, various fuels, oils and solvents. There are additionally some lower hazard facilities which are not classified as PHIs and which, therefore, do not impose planning constraints. These are:

Dow Chemical
TCVT
Chemical Wastes Treatment Facility (construction and operation contract awarded)
CRC's Nga Ying Chau Terminal

A risk assessment of all facilities has previously been carried out and published by the Government in 1989 as the Tsing Yi Island Risk Reassessment (TYRR). That study covered both present facilities and some future developments but not the SETY development. Subsequently, the risk assessment for the proposed Container Terminal 8 (CT8) development was carried out, which involved consideration of alternative layouts and locations. A decision was taken by the Hong Kong Government to site CT8 on Stonecutters Island rather than on Tsing Yi Island, leaving open the possibility of constructing a further container terminal (CT9) on Tsing Yi Island. This has been incorporated in the plans for the redevelopment of South East Tsing Yi. The results of the TYRR and CT8 risk assessment studies were sufficiently clear that they could be taken into account from the outset or in the early stages of planning the SETY development. This is described in the following Section.

C.1.2 Review of Previous Risk Assessments

Of the PHIs listed above, four are adjacent to the SETY development area. From north to south, these are:

Mobil Oil Terminal
Hong Kong Oil Terminal
CRC South Terminal
Esso Terminal

The previous risk assessments of these are reviewed below.

The planned CWTF, which is contiguous with the CT9 back-up areas, is (as stated above) not classified as a PHI site, however, it is the subject of a risk assessment recently carried out which may have some bearing on the CT9 development. Reference should be made to the report on that assessment once it has been accepted by the Hong Kong Government.

a) Mobil Oil Terminal

A number of risk mitigation measures have been taken since the TYRR, such as the demolition and removal of some spheres which were among the main risk generators. However, based on the results from the TYRR the CT8 Study report concluded that both individual and societal risk guidelines would prevent the CT8 development, with no possibility of reducing the risk to acceptable levels in an economically viable way. The same would certainly apply to the SETY development since this is to extend further north than CT8 would have done and thus bring substantial extra population within the risk zone generated by the Mobil Terminal. Although CT8 was eventually sited elsewhere, planning of the SETY development incorporates reprovisioning of Mobil's facilities to Area 17 at the southwest of Tsing Yi and closure of the present site. The Mobil Oil Terminal is therefore not considered further in this risk assessment.

b) Hong Kong Oil Terminal

The TYRR showed that the 10^{-5}/year individual risk contour due to the Hong Kong Oil Terminal extended well beyond its site boundary and that the societal risk would also exceed the Interim Risk Guidelines. Previous recommendations for improvements in management systems and LPG inventory limitation have been implemented. However, to meet the Interim Risk Guidelines for SETY would require complete removal of the LPG storage, without which the site would not be considered viable. This effectively means that Hong Kong Oil will cease all operations on the present site and indeed the land use planning for SETY development assumes reprovisioning away from the SETY development area; the Terminal is therefore not considered further.

c) CRC South Terminal

The CRC site on the SE corner of Tsing Yi represents the most significant constraint on the SETY development once the Hong Kong Oil and Mobil facilities are reprovisioned. However, it was shown in the CT8 Study that it should be possible to ensure that the CT8 development satisfies the Interim Risk Guidelines provided remedial measures and planning precautions were taken, even with reprovisioning CRC's Nga Ying Chau facilities to the main site to consolidate them there. As a starting point for the present Study this is assumed to apply to the SETY development which, in the vicinity of CRC, will be similar in land use and worker densities.

The TYRR showed that the Interim Risk Guideline for individual risk is already satisfied by CRC and that the societal risk guideline is satisfied with the existing population, however as discussed in the CT8 Study report the addition of significant numbers of workers on CT8 would cause the societal risk guideline to be breached. Several possible ways of mitigating this were discussed in detail for CT8, as a result of which suggested remedial measures and planning constraints were incorporated in the analysis. Briefly, these were:

- Improvements of safety management have already been carried out and the results to date indicate that the Management Factor of 1.0 can be achieved within the timescale of the construction.
- Improved storage facilities through reprovisioning of LPG storage from the existing above-ground spheres of 1000 te capacity to mounded bullets of lesser capacity (500 te assumed), affording protection from external incidents, in particular fires which could lead to a BLEVE.
- Zoning of land use to ensure that closest to the LPG facility, which affords the highest risk, the allocated land use has low worker density, with progressively higher density uses permitted with increasing distance from the site.

For this Study, the same reduction in management factor is assumed, i.e. to 1.0. It has been agreed with the Steering Group that reprovisioning of LPG storage, which generates the largest hazard effect distances, should (as for CT8) be taken to be to 4 x 500te mounded bullets positioned as far away from the SETY development area as practical, given the need to keep the existing LPG storage operational pending reprovisioning. The reprovisioned oil storage, presently at Nga Ying Chau, should be on the reclaimed land to the east and south of the existing site, acting as a buffer between the LPG storage and the SETY development (oil storage tanks present only low offsite risk of fatality). The CWTF is to be immediately to the north-east of the CRC site: as this is planned to be a low risk site, it will also act as a buffer.

The effect of this is a gradation from high-risk LPG tanks to medium-risk oil tanks to (assumed) low-risk CWTF, then onto the SETY development area. There are limited compatible high-value land uses for property adjacent to major hazards and chemical industry use is most appropriate in terms of awareness of and preparedness for major hazard incidents. Within the CT9 area (given that all SETY development close to CRC's site is connected with CT9), there should be a gradation from low population density adjacent to the CRC site to higher densities further away. The Preferred Land-Use Option as presented takes account of this in allocating lorry parking to Sites 22 and 23, with the CFS well away from CRC. The overall effect is that these constraints combine low population density with management and employee awareness of chemical hazards (e.g. control of ignition, emergency response).

It should be noted that, from the CT8 Study, the zone within the 10^{-5}/year contour of individual risk is greater in area with the LPG storage reprovisioned than with the existing spheres and, hence, extends off the (enlarged) site; however, the societal risk is further within the Interim Guidelines even with the extra population due to CT8. It was recommended that the worker density within the 10^{-5}/year contour be kept as low as practical, bearing in mind the undesirability of having sterile land: this should ensure that the societal risk remains acceptable, while the hazard zone in the event of a major incident involving the LPG storage is significantly reduced by the reprovisioning.

d) Esso Terminal

The Esso Terminal, although not contiguous with the SETY development area, potentially imposes planning constraints on the development due to the hazard zone generated by the existing LPG storage spheres. The CT8 risk assessment was carried out on the basis of reprovisioning Esso's LPG storage to 5 x 500te mounded bullets as the only means of effecting significant risk reduction, the safety systems having been found to be mostly satisfactory with little scope for improvement beyond measures recommended in the TYRR. It has been agreed that this reprovisioning is to be assumed for the present Study.

C.1.3 Requirements for SETY Risk Assessment

The Risk Assessment for SETY is to consist of a Quantitative Risk Assessment for the CRC and Esso PHI sites assuming reprovisioning of LPG storage on both sites and improvement of safety management by CRC and using the SETY layout and population densities set out and agreed as the Preferred Land-Use Option.

There is concern that reprovisioning of CRC's LPG storage will not be completed by the time land reclamation adjacent to their site commences and that, therefore, workers carrying out the reclamation will be exposed to unacceptable risk levels. In view of the fact that construction work for CT9 will bring a significant number of extra people into the area adjacent to CRC's site, increasing the societal (FN) risk (N-wise rather than F-wise), also taking into account the desire to keep risks "as low as reasonably practicable" (ALARP), it is recommended that measures be taken to reduce the risk to construction workers. As discussed in Section C.6, fireproof coating of the LPG spheres will provide additional time for emergency response in the event of a potential BLEVE incident. Application of fireproof coating to the spheres may be accepted as an interim risk reduction measure by Gas Standards Office (Gas SO) pending reprovisioning.

The inclusion in this Study of a qualitative review on the use of the coating has been requested by Gas SO.

The south end of the SETY development is to include a terminal for a DGF to transport, off the island, LPG and fuel oils presently carried from the PHI sites on Tsing Yi by road tanker through residential areas of the island and across the bridges connecting it with the New Territories. A qualitative review of the risks arising at the terminal has been requested for inclusion in this Study.

One important conclusion of the TYRR was that BLEVEs of LPG storage spheres are one of the principal contributors to risk, principally on account of the large hazard zone generated. In recent discussions, attention has focused on whether the assumptions on the thermal impact criterion and the expected proportions of fatalities used in that Study are appropriate or are overly conservative. Gas SO and Tsuen Wan Development Office have agreed that the assumptions made in that Study should be adopted in the present Study.

C.2 Risk Assessment Criteria

C.2.1 Discussion of Risk Assessment Criteria

a) Definition

Risk is commonly evaluated by two measures: **individual risk** and **societal risk**. Both measures are required by the Hong Kong Government.

Individual risk has been defined by the UK Institution of Chemical Engineers as:

> **"The frequency at which an individual may be expected to sustain a given level of harm from the realisation of specified hazards".**

It is calculated at individual points and often presented as an iso-risk contour plot overlaid on a map of the area of concern.

The same Institution has defined **societal risk** as:

> **"The relationship between frequency and the number of people suffering from a specified level of harm in a given population from the realisation of specified hazards".**

Societal risk is calculated for the exposed population being considered; it is often presented in the form of a plot showing the cumulative frequency of accidents involving N or more people sustaining the specified level of harm (e.g. fatality) per year (F-N curves).

Quantitative Risk Assessment (QRA) is a means of making numerical estimates of the risk from hazardous activities using an accepted methodology and making a rational evaluation of their risk implications. Taking each of these words in turn:

- the **quantitative** nature of the assessment provides a precise and objective means of assessing the risk from hazardous activities;
- it can be used to calculate both **individual** and **societal risk** as defined above;
- **assessment** of the calculated risk against agreed criteria is required in order to make decisions.

b) Hong Kong Government Criteria

The Hong Kong Government has established **Interim Risk Guidelines** for **Potentially Hazardous Installations** (PHIs). These are intended for new PHIs, the expansion of existing ones and control of future development adjacent to PHIs. The proposed SETY development falls into the last-named category.

It should be noted that, first of all, these are not Regulations but **guidelines**; this suggests that they are one of several inputs to the decision-making progress and that they will not be interpreted absolutely rigidly. Secondly, they are **interim** guidelines, indicating that they are not yet fixed but open to possible future refinement. However, as they are the criteria enforced at present, the assessment and recommendations will be based on them.

The "**level of harm**" used in the guidelines is **fatality**.

The substance of the guidelines is that developments in the vicinity of PHIs will be restricted if either of the following criteria is violated:

* *the Individual Risk of fatality exceeds the level of 1 x* 10^{-5} *per year.*

* *the Societal Risk of fatality exceeds the limits shown in Figure 9.4.*

An individual risk contour of 1 x 10^{-5} per year is adopted to give an indication of the extent of the restricted developments. Societal risk levels below 10^{-9} per year are considered to be non-credible.

Where a new development is in the vicinity of more than one PHI, it must meet the Interim Risk Guidelines for each PHI site separately.

The criteria apply to offsite populations and refer to **involuntary** risk. Staff involved in the hazardous activity may be considered to be benefitting directly from the activity and accepting the risk voluntarily (assuming they are properly educated about it); they should also have specific training to cope with realised hazards, reducing their exposure to risk.

The population for whose protection the criteria apply, therefore, include nearby residents, occupants of schools and hospitals, people passing on roads and workers on nearby sites.

c) Use of Risk Criteria

Risk criteria are the standards which are used to make value judgements about numerical risk estimates produced by a QRA. As such, they provide a means of relating quantitative measures of risk to qualitative criteria and thence setting them alongside other qualitative value judgements (e.g. "desirability of development").

The value judgement made in a decision-making process must necessarily reflect some kind of consensus regarding what is 'acceptable' or 'tolerable' for the area of jurisdiction of the decision-makers: this is a social and political judgement rather than a technical one. Individuals will invariably differ in what they regard as 'acceptable' or 'tolerable', which introduces an element of uncertainty into the criteria established as the basis of decision making.

A further uncertainty lies in the risk estimates themselves: this uncertainty is often estimated to be an order of magnitude.

In view of these uncertainties, which the decision makers should bear in mind, risk criteria can only suggest judgements. Risk criteria should, therefore, be used as guidelines for decision making rather than as inflexible rules; this appears to be the position of the Hong Kong Government.

d) Relation to Risk Constraints

The risk criteria are as follows:

Severe:	Individual Risk contour of 10^{-5} per year encroaching on much of SETY development area, AND/OR Societal Risk (including that to the SETY population) intolerable according to Guideline
Significant:	Individual Risk contour of 10^{-5} per year encroaching on a small part of SETY development area, requiring minor layout or PHI site modification
Limited:	Individual Risk contour of 10^{-5} does not encroach on SETY site

e) Multiple PHI Sites

The proposed SETY development area is likely to be affected by several PHI sites. The Hong Kong Government's Interim Risk Guidelines have previously been taken to apply to each PHI site individually, rather than the cumulative effect of all PHI sites impinging on a particular point or area. Although no formal notification has been given that the Interim Guidelines are to be interpreted as applying to the cumulative risk rather than that from each individual PHI site, Gas SO have requested that individual risk should also be considered on a cumulative basis. Cumulative individual risk from PHIs has, therefore, also been presented.

C.2.2 Selected Evaluation Criteria

The following Risk Criteria as per the Hong Kong Government Interim Risk Guidelines, will be applied in this Study:

Individual Risk:	**10^{-5} per year** for Tolerable Risk
Societal Risk:	**As shown in Figure 9.4** for Tolerable Risk

These criteria will be applied to each PHI site individually. The population considered will be residential, student, hospital, working (excluding the PHI sites but including the SETY development area) and traffic. The cumulative risks from all the PHI sites will also be presented.

Individual Risk will be calculated on the basis of a person being out-of-doors and present for 100% of the time, with no mitigation for being indoors or evacuating.

Societal Risk will take account of some people being indoors and the consequent mitigation of effects. The proportions of people indoors and the mitigation will be presented in the Study report, and are expected to be consistent with the TYRR and the Container Terminal 8 Risk Study.

Risks lying within a band two orders of magnitude below the Tolerable Risk criteria (an ALARP region) will also be noted with recommendations made as appropriate.

C.3 Background Data

C.3.1 Introduction

In order to undertake the Risk Assessment for the SETY development, a full specification of population, ignition sources and local meteorology is necessary. The basic information for this

Study has been taken from the TYRR. Certain modifications were necessary to represent the SETY development and associated changes to existing land use in the vicinity.

C.3.2 Population Data

a) Base Data

The base population employed in this Study is that developed for the TYRR and taken to be for 1991. This was based on averaging the populations between working and non-working hours.

b) Additional Populations

Little modification to the existing population has been required; however, new population for the SETY development area has been added to the database. This is based on the data given in Section 3 relating to the preferred land-use option. Also, the following sites were included in the TYRR as hazardous industries possibly posing offsite risks:

- Dow Chemicals (working population 79)
- TCVT (working population 162)
- Chemical Wastes Treatment Facility (working population 235 on day shift)

Their working populations have, therefore, been added to the database.

The same procedure as used for the TYRR has been applied for working populations (i.e. on the industrial sites): these have been assumed to be present for 10 hours per day, 5½ days per week. Transport populations are based on average flows, assumed present all the time. The new Technical College is assumed to have the specified 5000 students and 700 'workers' (presumably mostly teaching staff) present for the same duration as workers.

It is noted that the population densities specified for the CT9 back-up areas (viz. lorry parking and MT depot) and the CFS correspond exactly to the 'revised densities' specified in Table III.1 of the CT8 risk assessment Study report. These densities took into account management control as discussed in c) below; however the basic densities were derived from the expected working populations (i.e that required for operational reasons) and areas. The densities developed for CT8 were based on operational requirements and have been used to determine the boundaries between 'low-', 'medium-' and 'high-' density land uses as follows:

Low density	: ≤ 15 workers/ha
Medium density	: 15 to 30 workers/ha
High density	: > 30 workers/ha

These were applied in order to recommend appropriate land uses in the vicinity of CRC's site so as to meet the zoning requirements discussed in Paragraph C.1.2 (c).

Special treatment is applied to CT9 and to the CFS since many more workers will be present outside the day shift than on other industrial sites.

CT9 itself is to operate a 3-shift system. According to data supplied by Hong Kong International Terminals, around 750 people are to be employed there full-time. Of these about 150 will be present during the day shift only (80-90 engaged in engineering activities in the workshop, around the site and on board vessels at the quays; the remainder in the office and control buildings); the remainder will be divided between 3 shifts (with more on the day shift than on the other two shifts), anywhere around the sites including perhaps 25 in the control building. In addition, up to 200 casual labourers per shift may be taken on; an average of 100 is assumed. Based on these data, average populations have been calculated (for consistency with the TYRR Study) as follows:

AREA OF SITE	AVERAGE POPULATION
Administration Building	25
Control Building	20
Workshop	20
Anywhere around site	290

There have been suggestions that the workshop should be at the southern end of the CT9 site so as to allow more space for the northwards extension of the quayside into Area 5. For the SAFETI analysis, the location shown on current and earlier plans - i.e. at the northern end - has been retained. This is because of the impact on the ignition source distribution of the southern location, discussed below (Paragraph C.3.3).

The 904 workers specified for the CFS are considered to be a maximum and will apply for the daytime (office hours) only; the remainder of the time, 75% of this number are expected to be present. Therefore, 904 people have been taken to be present for the same duration as other working populations (see above) and 678 (75% of 904) for the remainder of the time.

People in vehicles on the planned CRA4 route will also add to the population exposed to risk and are included on the same basis as in the TYRR. Based on traffic data, it has been estimated that an average of 2300 vehicles per hour will pass along this, with an average occupancy of about 3 people per vehicle (taking into account the traffic mix which includes buses); their average speed is assumed to be about 40 miles per hour (20 m/s). The resulting population is calculated to be 10 people per 100 m Section of CRA4.

c) Effect of Management Control

For the CT8 Risk Assessment, the difference in response to a major hazard incident between residential and CT8 Terminal populations was discussed. As a result of this, the population densities entered for CT8 (including CFS) into the database were reduced by 25% from the given numbers. This reduction has already been incorporated into the numbers given for SETY; therefore, no further reduction has been applied. The population densities used in the CT8 and CT9 studies are shown in the following table.

AREA OF SITE	POPULATION DENSITY (per hectare)		
	CT8 as given	CT8 revised	CT9 as given
MT Depot	37.5	28	28
Vehicle Parking	12	9	9
CFS	301	226	226

d) Effect of Changed LPG Tanks

The possible mounding of LPG bullets on the CRC and Esso sites considered for CT8 has now been accepted as necessary for the SETY development; the discussion of its effects on likely numbers of fatalities due to a BLEVE incident which was presented in the CT8 Risk Assessment report applies here also. However, as it deals with the thermal impact criterion used and the proportions of fatalities indoors and outdoors rather than the absolute numbers of people present, this is discussed below (Section C.4) in the context of the impact calculations.

e) Population Used for Risk Assessment

The population used for the SETY Risk Assessment as finally developed, taking into account all the above, has been allocated to 100m x 100m grid squares. The distribution is presented in schematic form in Figure C.1.

C.3.3 Ignition Sources

The ignition source database used in the TYRR has been used as the basis for the SETY Study. Some modifications and additions have been made to take account of potential ignition sources on the SETY development area, as now described.

The risk calculation program in SAFETI associates a probability of ignition with all populated areas, in proportion to the population density, to take account of the possibility of ignition due to normal human activities (eg smoking). Therefore, the changes to the population database described in Paragraph C.3.2 above will lead to changes in the associated ignition probabilities.

The development will lead to the rerouting of traffic passing along the Section of Tsing Yi Road north of the proposed CRA4 alignment along a new road running further east: the location of the ignition source associated with this road has been moved accordingly. The CRA4 road itself is an extra ignition source: the ignition probability resulting is calculated from the data given in Paragraph C.3.2 above.

Certain activities associated with CT9 will give rise to a greater probability of ignition than that resulting from the population alone: welding in the workshops, intermittently around the terminal area itself and also in the container repair area; lorries moving around the lorry parking areas. Ignition sources have been specified for all of these.

The location of the workshop merits particular attention since welding is expected to take place there for a significant proportion of the time and is a strong ignition source. An alternative location to that shown on plans supplied has been proposed, namely at the southern tip of the CT9 terminal area. This would put it just inside the hazard zone for the dispersing gas cloud from a catastrophic rupture of an LPG bullet on the CRC site and, thus, give rise to a high ignition probability for the cloud. However, only a catastrophic rupture of a full 500 te storage tank (occurring with a total frequency, for 4 tanks on CRC's site, of about 10^{-5}/year) would give rise to dispersion continuing this far; this would occur only with a wind roughly from the west of at least 5 m/s, which together only occur 0.035% of the time; furthermore earlier ignition is likely given the intervening ignition sources present; the probability of an ignited cloud as a result of the workshop would, therefore, be below 10^{-10}/year which is negligible. The contribution to individual and societal risks from placing the workshop at the southern end of CT9 can, therefore, be discounted.

The resulting ignition source distribution is shown schematically in Figure C.2.

C.3.4 Meteorology

The SETY development will not have any significant effect on the local meteorology compared with that developed in detail for the TYRR. No changes have, therefore, been made to the wind direction/weather class distributions or to the ambient atmospheric parameters used. The former are given in Table C.1; the latter, identical to those previously used, are as follows:

Ambient Temperature : 23°C
Relative Humidity : 78%
Ground Temperature : 17°C
Surface Roughness Length : 0.1 m

Table C.1 **Meteorological Frequency Data Used in Risk Assessment**

DIRECTION	WEATHER CLASS						TOTAL
	I 2.5 m/s B	II 1.0 m/s D	III 3.5 m/s D	IV 7.0 m/s D	V 3.0 m/s E	VI 1.0 m/s F	
016°-045°	0.002	0.013	0.008	0.000	0.008	0.018	0.049
046°-075°	0.009	0.014	0.029	0.002	0.015	0.020	0.089
076°-105°	0.015	0.017	0.076	0.010	0.043	0.031	0.192
106°-135°	0.042	0.026	0.116	0.020	0.038	0.035	0.277
136°-165°	0.000	0.000	0.000	0.000	0.000	0.000	0.000
166°-195°	0.000	0.000	0.000	0.000	0.000	0.000	0.000
196°-225°	0.027	0.022	0.041	0.001	0.028	0.028	0.147
226°-255°	0.002	0.004	0.001	0.000	0.001	0.005	0.013
256°-285°	0.004	0.006	0.005	0.000	0.003	0.007	0.025
286°-315°	0.003	0.015	0.015	0.000	0.008	0.014	0.055
316°-345°	0.005	0.018	0.029	0.003	0.012	0.018	0.085
346°-015°	0.003	0.150	0.013	0.001	0.012	0.023	0.067
TOTAL	0.112	0.150	0.333	0.037	0.168	0.199	1.000

C.4 Quantitative Risk Assessment

C.4.1 PHI Site Modifications

Failure case identification and specification was carried out as part of the TYRR for the CRC and Esso sites and was presented in detail in the intermediate reports covering the risk assessments of those sites; it is not repeated here. However, some modifications were introduced for the CT8 Study in order to ensure that risks (especially societal risks) associated with the development would be below the Interim Risk Guidelines. Further modifications are required for the present Study. The modifications affect the failure cases specified for the following:

- LPG Storage
- CRC Tanker Unloading
- CRC Site Pipework
- CRC Oil Storage
- Management Factors

The modifications made to these, both for CT8 and for this Study, are summarised below. The remaining failure cases, specified for the following, are assumed unchanged:

- Esso tanker unloading
- Esso site pipework
- Esso oil storage
- Existing CRC oil storage at South Terminal
- Road tanker and drum loading

a) LPG Storage

The most important modification made for the CT8 Study was the replacement of failure cases pertaining to LPG spheres by cases pertaining to mounded LPG bullets as the most effective means of improving the LPG storage tank design. The potential hazards associated with above-ground bare steel spheres include BLEVEs caused by either a pool fire surrounding the sphere or a jet fire resulting from an ignited leak impinging on the sphere: these were calculated to have a frequency approximately half that of a catastrophic rupture (which can also lead to a BLEVE if ignited immediately) and, therefore, to be significant contributors to the risk in both consequence and frequency terms. Both these causes of a BLEVE are removed by enclosing the storage tanks in a mound.

The frequencies of failures of mounded bullets were considered in detail for the TYRR as Shell's site already has such storage: it was decided that the failure frequencies for catastrophic ruptures, large leaks and small leaks of mounded bullets should not be changed from those for the equivalent failures of spheres.

As a result of these considerations, the failure cases shown in Table C.2 below were specified for each mounded tank on the CRC and Esso sites. Assuming bullets with 500 te capacity (as agreed with Hong Kong Government for this Study), 4 such mounded tanks on CRC's site and 5 on Esso's would be required to replace the existing storage. The Catastrophic Rupture and Large Leak failure cases apportion the total frequency between three different inventories taking into account the average pattern of use generated by the number of tanks.

Table C.2: Failure Cases for Each Mounded LPG Storage Bullet

FAILURE TYPE	PERCENTAGE OF MAXIMUM INVENTORY	BASE FREQUENCY*	
		CRC	ESSO
Catastrophic Rupture	100	2.63×10^{-6}	2.75×10^{-6}
	50	1.23×10^{-6}	1.0×10^{-6}
	20	2.63×10^{-6}	2.75×10^{-6}
	Total Frequency	6.5×10^{-6}	6.5×10^{-6}
Large Leak (150 mm equivalent diameter)	100	3.93×10^{-6}	4.1×10^{-6}
	50	1.84×10^{-6}	1.5×10^{-6}
	20	3.93×10^{-6}	4.1×10^{-6}
	Total Frequency	9.7×10^{-6}	9.7×10^{-6}
Small Leak (25 mm equivalent diameter)	50	1.33×10^{-4}	1.33×10^{-4}

* This is the frequency **before** application of the Management Factor.

The expected **location** of the bullets on the CRC site has been changed from that used for the CT8 Study to a position about 100 m to the east and 30 m to the south of the existing bullets. The bullets on the Esso site have, for the purposes of this analysis, been located in the same place as the existing spheres.

b) CRC Tanker Unloading

Much of the SETY development is to be on reclaimed land. Land reclamation in the vicinity of the CRC site will move the shoreline south of its present line; consequently, a new jetty will be constructed. The failure cases specified for the CRC jetty (viz. of tankers and of tanker-to-shore transfer facilities) have been relocated to the new jetty position.

c) CRC Site Pipework

As a result of the changed locations of both LPG storage and the jetty, the pipework connecting these and the pipework from LPG storage to the bulk tanker loading station will be rerouted. Figure C.3 shows the revised routes assumed for this Study. The failure cases themselves are assumed unchanged; their frequencies are dependent on the length of pipework involved and have been adjusted accordingly.

d) CRC Oil Storage

The TYRR recommended relocation of CRC's Nga Ying Cha oil storage facility to their South Terminal. For the CT8 Study, it was assumed that this will have been done and that the oil storage tanks concerned will be on the reclaimed land to the east of the existing site. The failure cases previously specified for the Nga Ying Cha terminal (pool fire following failure of storage tanks) were retained unchanged except for location. This is retained in the present Study.

e) Management Factors

For CT8, it was assumed, as discussed in Paragraph C.1.2 (c), that CRC's safety management systems could be improved within the timescale of the project so that the Management Factor applied globally to all failure frequencies could be reduced from 3.5 to 1.0: the improved value is used in this Study also.

In the TYRR it was assumed that Esso's Management Factor could be improved from 1.45 to 0.75; this latter value was used for the CT8 Study and is used in this Study also.

C.4.2 Consequence Analysis

a) Introduction

Modelling of the atmospheric dispersion and other consequences of all the releases (failure cases) specified was carried out using the program CONSEQ in the SAFETI package described fully in the TYRR Study.

It is helpful to look at the effect distances resulting from those failure cases which could cause effects on the SETY development area, i.e. beyond the PHI site boundaries: such results show the areas which would be affected by those incidents (that is, the hazard effect zones) and, hence, within which emergency response would be required. The hazard zones resulting from the largest incidents were used to support the risk-based arguments for limiting the worker density in the areas of the SETY development close to the PHI sites.

LPG Incidents

Given the good separation of LPG facilities from the SETY development achieved by the land-use zoning discussed in Paragraph C.1.2 (c), only the larger failures of these can have any effect. Those with the greatest effect distances are:

- Catastrophic Rupture of mounded LPG storage tank when full (500 te)
- Catastrophic Rupture of full LPG tank on ship at CRC jetty (550 te)
- Catastrophic Rupture of full LPG tank on ship at Esso LPG jetty (1500 te)

The possible outcomes of either release are:

- Immediate ignition leading to Fireball
- Delayed ignition leading to Flash Fire
- Delayed ignition leading to Explosion
- No ignition

The hazard zones are defined as follows.

BLEVE/Fireball: a circular area centred on the failed tank whose radius is the distance to the agreed thermal impact criterion, a radiation dose level of 375 kJ/m^2, within which 100% fatalities for people out-of-doors is assumed. This is assumed independent of weather conditions since ignition takes place before the released cloud has been blown away from the release point and dispersed by the wind.

Flash Fire: the extent of the cloud, as determined by the LFL contour, at the time the cloud is ignited by ignition sources encountered as it drifts away from the release point and disperses. For a catastrophic rupture, the cloud is assumed in the dispersion modelling to be circular throughout, with its centre at a distance from the release point determined by the windspeed and time since release. The extent of the hazard zone relative to the release point (i.e. the distance from the release point to the downwind edge of the cloud) depends on when the cloud is ignited; the output from SAFETI can be used to determine the maximum effect distance for each weather condition.

Explosion: two concentric circular areas whose radii are the distances from the centre of the cloud (= centre of explosion for catastrophic ruptures) to the limits of two zones of building damage: the inner one (R_1) representing heavy building damage and the outer one (R_2) representing light building damage. The distance of the centre of the cloud from the release point is determined by the windspeed and the time following release at which the cloud is ignited by ignition sources encountered as it drifts away from the release point and disperses. This distance added to the damage zone radii determines the maximum effect distance and depends on the weather condition.

For late ignition, it should be noted that ignition may take place well before the cloud reaches its maximum distance from the release point, in which case the furthest effect distance from the release point will be less than the maximum defined above which can, therefore, be regarded as upper limit distances which determine the outer-edge of the risk zone for that release.

The maximum effect distances (hazard zone extents) for a catastrophic rupture of a full-mounded bullet on either the CRC or Esso sites are given in the Table C.3 following; the maximum effect distances for a catastrophic rupture of a full LPG tank on a ship at the Esso LPG jetty are given in Table C.4 following.

Table C.3 Maximum hazard effect distances for catastrophic rupture of a full (500 te) mounded LPG bullet

OUTCOME OF RELEASE		HAZARD EFFECT RADIUS (m)	
		RELATIVE TO CLOUD CENTRE	RELATIVE TO RELEASE POINT
BLEVE/Fireball		-	805
Flash Fire		445	960
Explosion	Heavy Building Damage	410	925
	Light Building Damage	815	1330

Table C.4 Maximum hazard effect distances for catastrophic rupture of a full (1500 te) tank on ship at ESSO LPG jetty

OUTCOME OF RELEASE		HAZARD EFFECT RADIUS (m)	
		RELATIVE TO CLOUD CENTRE	RELATIVE TO RELEASE POINT
BLEVE/Fireball		-	1270
Flash Fire		680	1390
Explosion	Heavy Building Damage	590	1300
	Light Building Damage	1175	1885

Note:

1. All effect distances for Flash Fire and Explosion in the above Tables occur with 'D' stability, windspeed = 7.0 m/s. It is notable that it is this weather class, with the highest windspeed, rather than that with 'F' stability, which gives the maximum effect distances. It is often assumed that very stable conditions (i.e. 'F' stability) gives the longest dispersion distances. This is, however, not the case here and arises from the combination of the release being instantaneous rather than continuous and the fact that the dispersion is modelled as dense rather than passive throughout; dense gas dispersion being only weakly dependent on stability.

2. The maximum inventory for a ship at CRC's jetty is 550 te or 10% greater than for the mounded tank: the maximum effect distances will correspondingly be a little greater.

3. At CRC's site, the mounded tank failure is about 7 times more likely than the ship tank failure due to the frequency of tanker visits; at Esso's, the mounded tank failure is about 100 times more likely than the ship tank failure due the very infrequent nature of visits of this ship.

Pool Fire Incidents

Even the largest pool fires anticipated (with an area equivalent to a circle of 116 m diameter) give rise to much shorter effect distances than the largest LPG incidents; however, as oil storage will extend up to the boundary between the CRC site and CT9 the maximum effect distance is of concern. The hazard zone of a **pool fire** is an ellipse (rather than a circle because the flames are tilted by the wind) whose centre is usually offset from the pool centre, defined by the distance to an agreed thermal impact criterion, a radiation level of 12.5 Kw/m^2. The maximum effect distance is in the downwind direction due to the flame tilt.

The maximum effect distances for the smallest and largest pool fires modelled for CRC are given in the following table.

Table C.5: Maximum Hazard Effect Distance for Pool Fires on CRC Site

POOL DIAMETER (m)	MAXIMUM EFFECT DISTANCE FROM POOL CENTRE (m)	WIND SPEED (m/s)
23	46	3.0
116	147	3.0

C.4.3 Risk Assessment

a) Risk from CRC Site

Individual Risk

Contours of individual risk are shown in Figure 9.1. Compared with the original Tsing Yi Risk Re-assessment, the area within the 10^{-5}/year contour of individual risk is greater due to a combination of three factors:

- replacement of 2 LPG spheres with 4 mounded storage tanks, with a consequent doubling of the frequencies of catastrophic ruptures and leaks and, hence, a greater risk close to the site;

- relocation of CRC's jetty further to the SE and further from the LPG storage;
- concentrating CRC's oil storage at their South Terminal by relocating that presently at the Nga Ying Chau Terminal: this has a localised effect close to the extra oil storage in the SE part of the extended CRC site, adjacent to the CT9 lorry parking.

The area within the 10^{-5}/year risk contour extends onto the area designated for lorry parking associated with CT9, enclosing about 2.9 ha. Since the Interim Risk Guideline is thereby exceeded, measures to minimise the exposure to risk of lorry drivers within that area should be considered: this is discussed in C.4.4 below. Part of the CWTF site also lies within this area but, as this is a chemical facility, it is considered that personnel thereon will be aware of the nature of major chemical hazards and will be well trained in emergency response by comparison with other SETY workers; hence, the risk to which they are exposed would in fact be lower.

As found in the CT8 Study, replacement of spheres by mounded bullets and the consequent reduction in the single-tank inventory from 1000 te to 500 te leads to a significantly reduced area within the 10^{-6}/year, 10^{-7}/year and 10^{-8}/year risk contours. CT9 lies almost entirely outside the 10^{-7}/year contour, while the same contour approximately bisects the CFS area. Part of CRA4 lies within the 10^{-8}/year risk contour; this also roughly corresponds to the BLEVE hazard zone for a full 500 te mounded bullet. The industrial site occupied by Outboard Marine and a small part of that occupied by Tai Tung also lie within this zone.

Societal Risk

The societal risk is shown in Figure 9.4. This lies within the Interim Risk Guideline (also shown), though for the most part by only about half an order of magnitude and for fatalities in the 200 - 300 range rather closer. The land use designated for the SETY development in the vicinity of CRC's site is, therefore, acceptable: this shows the effectiveness of designating low density use to this area.

Discussion

While the CRC site will not fully meet the Interim Risk Guidelines in that individual risk greater than 10^{-5}/year occurs over a significant area off the site, the land use accepted as the Preferred Option (on the basis of a wide range of parameters of which PHI risk was only one) is optimal from the point of view of risk in that it minimises the exposed population. The PHI risk generated by CRC, therefore, imposes no constraints on the development beyond those already incorporated in developing the Preferred Land-Use Option.

However, the risks as calculated above make 2 important assumptions:

- The LPG storage will be reprovisioned to mounded tanks;
- The safety management systems and other remedial measures already suggested in the Tsing Yi and CT8 risk studies are carried out.

In order for the development to proceed on the basis of the above risk results, both must be carried out before full CT9 operation commences.

b) Risk from Esso Site

The greater distance of Esso's site from the SETY area means that the individual risk, shown in Figure 9.2, is at least one order of magnitude below that from CRC. The 10^{-5}/year contour encloses part of CRC's site while the 10^{-6}/year contour extends onto the CT9 lorry parking area.

Similarly, the societal risk, shown in Figure 9.4, lies for the most part at least one order of magnitude below the Interim Risk Guidelines, approaching only slightly closer in the 100 - 300 fatalities range.

The PHI risk generated by Esso, therefore, imposes no constraints on the SETY development beyond those already incorporated in developing the Preferred Land-Use Option, provided that the assumed reprovisioning of LPG storage and improvements to management systems are carried out in advance of CT9 commencing full operation.

c) Cumulative Risk from Esso and CRC Sites

The contours of cumulative individual risk for the two sites are shown in Figure 9.3. For the SETY development area, these indicate a slight enlargement of the area within the 10^{-5}/year contour to 3.5 ha (excluding CWTF, for reasons discussed in a) above). This does not change the conclusions on appropriate land use for this zone since it is a part only of the designated lorry parking area. The other risk contours are identical with those from the CRC site alone. The PHIs adjacent to the SETY Development Area, therefore, impose no additional constraints on the SETY development when considered together.

d) Risk to Workers on CT9 Lorry Parking and CWTF Sites

Risk values at specified locations, taking into account realistic levels of occupancy for individuals on these sites, have been calculated from the risk contours as presented.

Assumptions

Lorry Drivers present 2 hours/day, 6 days/week on CT9 Lorry Parking.
Site Workers present 8 hours/day, 6 days/week on CT9 Lorry Parking and on CWTF.

These assumptions lead to the following Occupancy Factors :

Lorry Drivers :	0.071 (7.1%)
Workers :	0.286 (28.6%)

Results

Lorry Drivers on CT9 Lorry Parking

Range approximately 1.4 x 10^{-6}/year adjacent to CRC down to 7.1 x 10^{-8}/year adjacent to CRA4.

Workers on CT9 Lorry Parking

Range approximately 5.7 x 10^{-6}/year adjacent to CRC down to 2.8 x 10^{-7}/year adjacent to CRA4.

Workers OUTdoors on CWTF

Typically 5.7 x 10^{-6}/year.

Workers INdoors on CWTF

This is difficult to calculate since the individual risk is calculated for someone OUTdoors all the time and since the mitigation factor for being indoors varies according to hazard and, therefore, risk depends on contribution of different hazards at each point. Percentage fatalities for people outdoors and indoors used were as follows :

HAZARD		PERCENTAGE FATALITIES	
		OUTDOORS	INDOORS
BLEVE/Fireball		100%	5%
Flash Fire		100%	20%
Pool Fire		50%	10%
Explosion	Inner Zone	100%	75%
	Outer Zone	50%	25%

For BLEVE and Pool Fire, an individual has to be within line-of-sight of the incident; therefore, the above percentages are the proportions assumed to be so. Flash Fire and Explosion can affect anyone indoors.

The risk to an individual indoors on the CWTF will have contributions for all the above except pool fires. Therefore, the exact mitigation cannot be calculated without knowing the risk contribution from every possible outcome of every possible incident with a large enough hazard range to reach the buildings on the site : these are Catastrophic Ruptures of LPG storage tanks on CRC and Esso sites and Catastrophic Ruptures of LPG tanks on ships at the CRC jetty, all of which can lead to fireball, explosion or flash fire. From the incident frequencies and event trees, we calculate that on the 10^{-5}/year risk contour in the middle of CWTF, the (absolute) risk contribution due to all fireball outcomes is 5.7 x 10^{-5}/year (i.e. 57% of the total), the remaining risk being due to delayed ignition leading to flash fire or explosion. From this and from the above mitigation factors and occupancies, we can show that the actual risk to an individual indoors on the CWTF site at a location roughly on the 10^{-5}/year risk contour (as calculated for individuals out-of-doors and present continuously) is no greater than about 4 x 10^{-7}/year.

C.4.4 Conclusions and Recommendations

o Providing the existing LPG spheres are reprovisioned as mounded bullets, the PHIs adjacent to the SETY Development Area impose no additional constraints on the SETY development beyond those already taken into accound in the land-use planning. This applies when the PHIs are considered either individually or cumulatively.

o The designated land uses adjacent to the PHIs are appropriate given the basic intention to develop the SETY area without leaving land sterilised by existing facilities.

o Risk reduction measures beyond those already recommended for CRC and Esso would not be economically practical.

o Increases in worker densities beyond those specified for the Preferred Land-Use Option should not, applying the ALARP principle to societal risk, be permitted on the CT9 lorry parking, Outboard Marine and CFS sites.

o The already-recommended reprovisioning of LPG storage and improvements in management systems on both the CRC and Esso sites must be carried out before full operation of CT9 commences.

o An Emergency Response Plan should be drawn up for the lorry parking areas, the southern basin serving the DGF, CWTF and other users and for the Outboard Marine and multi-storey CFS sites to ensure prompt and effective action to minimise the risk to workers in these areas in the event of a major hazard incident on the PHI sites (including the LPG jetties). As far as possible, this should include making drivers of lorries serving CT9 aware of the hazards posed by these sites. The Emergency Response Plan should be in line with current Fire Services Department procedures.

o In view of the close proximity of Dow's and CRC's jetty and the potential for conflicting movements leading to a collision involving a laden LPG tanker delivering to CRC (although such an event is estimated to be of low frequency in view of the number of vessel visits per year involved), attention should be given to control of marine operations in the vicinity. Particular attention should also be paid to the DGF pier.

C.5 Review of Risks from Dangerous Goods Ferries

C.5.1 Description

At present, dangerous goods transported to or from Tsing Yi Island by road are:

o LPG by bulk tanker off island
o LPG in cylinders carried by truck off island
o Motor gasoline (petrol) by bulk tanker off island
o Chlorine for pumping station

These are carried over either of the two existing bridges (chlorine passes only over the southern one); their transit across the island invariably takes them through densely-populated residential areas.

As part of the SETY development it has been decided to include a DGF pier in a basin at the southern end of the island which all DG lorries would be required to use. Such a service is already provided by the Central to Jordan Road Ferries connecting Hong Kong Island with Kowloon which obviates the need for DG lorries to pass through the Cross Harbour Tunnel. The ferry used is a normal car ferry of which only the lower deck is used and which is dedicated to the DG traffic.

DGFs serving Tsing Yi would remove LPG and petrol traffic from residential areas since this could in all cases be routed away from residential areas via Tsing Yi Road. Unlike at Central and Jordan Road, the DGF pier would only be used for the DGF itself, while adjacent piers will be for industrial users only.

DGFs from Tsing Yi could serve the existing DGF piers at both Jordan Road and Central and could also serve the New Territories if a further DGF pier were established there. Based on the existing DGF operation, one DGF could be expected to carry up to 8 vehicles; most of the traffic would be during working hours. It is probable that the pier could handle 2 such ferries per hour if required.

The total annual traffic from the PHI sites as used for the TYRR Study is summarised in Table C.6: this also gives the daily equivalent assuming 6 days per week operation. Clearly the bulk of this is LPG cylinder trucks and petrol bulk tankers, with bulk LPG tankers accounting for about 6% of the total movements per year, 27% of the LPG traffic by tonnes throughput and 9% of the total tonnage throughput.

On the basis of this traffic, the need for it to board a ferry going to the right destination and the concentration of traffic into working hours, it is estimated that a typical waiting time for a DG truck could be 1 hour. Therefore, at peak times there might be 2 LPG bulk tankers, 20 LPG cylinder trucks and 8 petrol tankers waiting to board ferries, leading to significant quantities of flammable materials being present.

In the remainder of this Section, possible types and causes of failure are reviewed for the DG traffic using the ferry (i.e. laden trucks arriving/departing by road, waiting to board, boarding and awaiting ferry departure) and the consequences of these evaluated, based on previous studies involving DG transport in Hong Kong. Where possible, the likely frequencies of such incidents have been quantified.

Table C.6 **Annual DG Traffic by Road off Tsing Yi Island Considered for Risk Assessment**

SITE	TYPE OF TRAFFIC					
	LPG BULK TANKERS		LPG CYLINDER TRUCKS		PETROL BULK TANKERS	
	Number/yr	Shipment Size (t)	Number/yr	Shipment Size (t)	Number/yr	Shipment Size (t)
Esso	620	7.5	6200	1.1	8990	7
	1550	4	2170	0.6		
CRC	280	8	10800	2	1600	7.5
HK Oil	260	5	11000	1		
Mobil	2600	5	13000	1	7425	7.5
Caltex	560	5	21000	1.4	6500	13
Total/yr	5870		64170		24515	
Total/day	19		207		79	

C.5.2 Failures Associated with DGF

In the TYRR, the following types of failure leading to significant releases/incidents were identified:

F1: BLEVE of LPG cylinders on truck
F2: Catastrophic rupture of bulk LPG tanker, igniting immediately as a fireball or subsequently as a flash fire or explosion
F3: Leak from bulk LPG tanker, igniting immediately as a jet fire or subsequently as a flash fire or explosion
F4: Spill from bulk petrol tanker, ignited as a pool fire

The causes and frequencies of such incidents will depend on where and how they occur:

- Collision with another vehicle on arrival/while manoeuvering to park
- Collision with another vehicle or site fixtures while driving onto DGF
- Poor manoeuvering onto DGF leading to collision with entrance
- While parked, awaiting DGF to right destination
- After boarding DGF, awaiting departure

These may be viewed and summarised as follows:

1. Spontaneous failure
2. Direct impact
3. Rollover

With the strong possibility of both LPG and petrol bulk tankers waiting together for a ferry, 'knock-on' incidents involving escalation of the initial incident should also be considered. The most significant one is a petroleum pool fire engulfing an LPG bulk tanker with no or ineffective emergency action being taken to prevent this leading to a BLEVE. To the above list may, therefore, be added:

F5: BLEVE of bulk LPG tanker as a result of engulfment in pool fire

Strictly, Case F1 is also a knock-on as it was considered to result from a fire impinging on the cylinders.

C.5.3 Consequences Analysis

In this Section, the consequences of releases F1-F5 above are analysed in a similar way to those of the most serious incidents on the CRC and Esso PHI sites: that is, the maximum hazard effect distances are presented. These are given in Table C.7 for all outcomes of these events modelled by SAFETI (i.e. considered possible). Regarding LPG bulk tankers, results are given for the largest size modelled in the TYRR, viz. 8 tonnes.

Overall, an 8 tonne LPG bulk tanker gives the largest hazard effect distances. For BLEVEs and flash fires, these are plotted in Figure 9.6 which shows three circles as follows:

A: BLEVE hazard zone, defined as in Paragraph C.4.2 (a).

B: Maximum extent of flash fire at furthest possible distance from release point, determined by LFL of cloud as defined in Paragraph C.4.2 (a) - i.e. relative to ' cloud centre as given in Table C.7 - under worst weather conditions.

C: Maximum extent of hazard zone resulting from flash fire as defined in Paragraph C.4.2 (a) - i.e. maximum distance relative to release point as given in Table C.7 - under worst weather conditions

The equivalent hazard zones for explosions are not shown since they are considered much less likely than flash fires, by a factor of 9.

Table C.7 Maximum Hazard Effect Distances for Incidents at DGF

EVENT		OUTCOME		HAZARD EFFECT RADIUS (m)		WEATHER CONDITION (See Note 1)
				RELATIVE TO CLOUD CENTRE	RELATIVE TO RELEASE POINT	
F1	LPG cylinders BLEVE	BLEVE		-	26	-
F2 F5	Catastrophic rupture or knock-on BLEVE of 8 te bulk LPG tanker	BLEVE/Fireball		-	94	-
		Flash Fire		78	202	D/7
		Explosion	Heavy Building Damage	102	226	D/7
			Light Building Damage	205	329	D/7
F3	Large leak from 8 te bulk LPG tanker	Flash Fire		-	55	D/7
		Explosion	Heavy Building Damage	See Note 2		
			Light Building Damage			
F4	Spill from petroleum tanker	Pool fire (20 m diameter)		-	46	D/3.5,F/1

Notes

1. Weather conditions are specified as : Stability/Windspeed (windspeed in m/s)

2. The maximum flammable mass is about 50 kg. The model in SAFETI is not valid for masses of less than 100 kg; based on calculation for a mass of 100 kg, the effect distance would be considerably smaller than that for a flash fire.

Figure 9.6 shows that a BLEVE will affect the immediately adjacent piers and a small part of the lorry parking area. It could conceivably cause a knock-on BLEVE of an adjacent LPG bulk tanker if one were present but the combined hazard zone would probably not be significantly larger. A flash fire due to subsequent ignition of the drifting cloud could at worst engulf a 2 ha area of the lorry parking area (about 20 people) but will not reach as far as CRA4; earlier ignition and risk to adjacent vehicles (or rather, to their drivers) at the DGF waiting area is more likely (a flash fire of a cloud released instantaneously or over a few seconds will be of too short a duration to cause a knock-on event).

The DG Ferry pier is, therefore, situated acceptably with regard to the consequences of the most likely significant incidents.

C.5.4 Frequency Analysis

Records of incidents occurring in relation to the existing DG ferry pier operations in Hong Kong have been sought from several possible sources: no such records have been found. It has not, therefore, been possible to carry out a full frequency analysis for the cases defined above since the components due to the causes particular to the terminal cannot be determined with confidence, being too dissimilar from road traffic accident statistics. Therefore, only the frequencies of spontaneous failures can be estimated: these are given below but should be treated as lower bounds to the likely frequency.

Case F1: LPG Cylinders BLEVE

This incident could be caused by an ignited leak from an LPG cylinder impinging on several other cylinders or else a spill from a petrol tanker ignited as a pool fire engulfing the cylinders; however, in the latter case the pool fire hazard zone is larger than that of the BLEVEs (see Table C.7) so need not be considered. Based on the TYRR, the Risk Assessment of Liquid Chlorine Transport and other studies, the frequency of this incident is estimated at 1.7 x 10^{-4}/year.

Case F2: Catastrophic Rupture of LPG Bulk Tanker

No records of such an incident not associated with a road traffic accident have been found. In the TYRR, frequencies are given for such incidents at LPG loading bays on the PHI sites; alternatively, they may be taken as similar to the generic frequency of a catastrophic rupture of a pressure vessel: 6.5 x 10^{-6}/year. Allowing for a 1-hour waiting time at the terminal leads to a total frequency of 4.4 x 10^{-6}/year, divided between the different sizes of tankers used (see Table C.6).

Case F3: Large Leak from LPG Bulk Tanker

An unpublished report by UK SRD applies a fault-tree analysis to a typical LPG tanker: this shows that the leak frequency is dominated by gasket failures. Assuming a typical tanker in Hong Kong has the same number of gaskets (4) as assumed by HSE, the leak frequency can be estimated as 1.5 x 10^{-5}/year.

Case F4: Pool Fire following large spill from Petrol Bulk Tanker

An unpublished analysis of incident records by SRD/UKPIA shows 7 incidents having occurred as a result of spontaneous failures (the remainder all due to road traffic accidents), all of less than 150 kg; the estimated frequency per tanker-km was estimated as 1.68 x 10^{-8}. Since the occurrence of spontaneous failures should be independent of whether the tanker is actually travelling on the road, assuming a typical average speed enables conversion of this to a rate per hour. Poisson statistics can be employed to give an estimate both of the probability of ignition (given that none of the 7 incidents was ignited) and an estimate of the probability of a 'large' spill in the future: only a large spill, ignited, is considered here to give a pool fire of significant size (taken as 20 m). Assuming (for UK experience) an average speed of 60 kph gives a frequency at the terminal of 7.3 x 10^{-5}/year. However, as referred to in Paragraph C.5.2 such a fire could cause a BLEVE of an LPG bulk tanker, which would give rise to a larger hazard effect zone (Table C.7). Therefore, removing the frequency of this type of incident (see below) gives a modified frequency of 7.0 x 10^{-5}/year.

Case F5: BLEVE of LPG Bulk Tanker

Assuming a pool fire, as described above, will engulf an LPG bulk tanker if one is waiting nearby to board the ferry, a BLEVE will occur if emergency action to prevent this is either ineffective or is not carried out. On average, both types of tanker will be present simultaneously for a proportion of the time given by the ratio of the annual traffic of each; on this basis, assuming a probability of 0.2 that emergency action is ineffective or does not take place, the BLEVE frequency is 3.5 x 10^{-6}/year.

These frequencies are summarised in the following table. Again, it is stressed that these should be regarded as lower bounds rather than best estimates; use of them to calculate the risk would, therefore, be conservative.

Table C.8 Estimated Lower Bound Frequencies for Incidents at DGF Terminal on Tsing Yi Island

EVENT		FREQUENCY/year
F1	LPG cylinders BLEVE	1.7 x 10^{-4}
F2	Catastrophic rupture of bulk LPG tanker (all sizes)	4.4 x 10^{-6}
F3	Large leak from bulk LPG tanker (all tanker sizes)	1.5 x 10^{-5}
F4	Pool fire following spill from bulk petrol tanker	7.0 x 10^{-5}
F5	BLEVE of bulk LPG tanker (all sizes)	3.5 x 10^{-6}

C.5.5 Discussion

The consequence zones are best assessed in the context of the risks from the PHI sites. Therefore, the hazard effect zones have been superimposed on the cumulative individual risk shown in Figure 9.3: the combined plot is presented as Figure 9.6. This shows that these hazard zones lie entirely within the 10^{-6}/year risk contour, which was used as a second-order determinant of acceptable land use. It was recommended that the location of the basin be such as to contain the risk generated by the DGF terminal within the existing risk zone rather than extending it. The results presented in Figure 9.6 show that this condition is likely to be satisfied by the location defined for the Preferred Land-Use Option. The proposed DGF terminal, therefore, imposes no further constraints on the SETY development beyond those already incorporated in developing the Preferred Land-Use Option.

Since the consequence zones presented in Paragraph C.5.3 could extend onto the lorry parking area, and since the frequencies given in Paragraph C.5.4 are comparable with those of equivalent events on Tsing Yi PHI sites and are lower bounds, proper precautions must be taken to minimise the likelihood of a release and to minimise the likelihood of such a release having serious consequences.

C.5.6 Conclusions and Recommendations

- Effective traffic management is recommended to minimise the likelihood of DG vehicle collisions, involving supervision of all vehicle movements on the DGF terminal, i.e. of arrival, parking and movement onto ferry.

- Parking management is recommended to ensure that:

  (i) Petroleum and LPG bulk tanker parking is **segregated**
  (ii) Bulk tankers are adequately **separated** from one another

- Effective emergency plans should be developed, probably requiring drivers to stay with their vehicles, so that in an emergency, vehicles can be moved as quickly as possible to pre-specified locations away from the scene of the incident.

- Appropriate fire protection systems are needed, both water (for LPG incidents) and foam (for petroleum incidents).

C.6 Review of Effect on Risk of Fireproofing Liquid Petroleum Gas (LPG) Spheres

C.6.1 Introduction

In the CT8 Risk Assessment, the merits of reprovisioning LPG storage to mounded bullets were considered and the risk reduction resulting from this calculated. The results showed clearly that such reprovisioning would reduce significantly the area within the 10^{-7}/year contour of individual risk at the expense of increasing the area within the 10^{-5}/year contour (due to the larger number of storage tanks involved: 4 as against 2 spheres). Overall this was agreed to be a worthwhile improvement as it ensured that the Interim Risk Guideline for societal risk could be met. Similarly, the present Study has shown that the same holds for the SETY development.

The benefit of mounding the bullets is that they are protected as far as possible from external incidents, specifically thermal radiation, flame impingement and missile impacts. Thermal radiation or flame impingement on a bare steel sphere can cause a BLEVE if the correct emergency measures are not taken; BLEVEs were found to be the dominant contributors to the risk at the 10^{-6}/year level. A missile impact would be likely to cause a catastrophic rupture or a leak: the former could lead to a BLEVE- like incident while the latter could ignite as a jet fire which could in turn impinge on another sphere and cause a BLEVE.

The scheduling of the SETY development in principle allows for 6 months elapsing between completion of CRC's reprovisioning and commissioning of the southerly CT9 sector (i.e. the part of the development immediately adjacent to the CRC site and, hence, within the risk zone generated by it). However, in view of possible uncertainties in CRC's reprovisioning programme, it appears that interim risk reduction measures may be necessary. One mitigation measure considered was the application of an insulating coating to provide protection to large bare steel LPG spheres. A request has, therefore, been made by Gas SO that this report should include a qualitative review of thermal protective coating, proposed as a means of risk reduction. It has also been stated by Gas SO that such a coating can only be considered as an interim means of risk reduction, not as a permanent solution.

For the TYRR, thermal radiation and direct flame impingement on a bare steel sphere from both jet fires and pool fires were considered as possible causes of a BLEVE incident. One means of providing protection to steel members and vessels exposed to potential thermal radiation or direct flame impingement is to apply an insulating coating. There are a number of such insulating coatings available.

The performance of such coatings to non-impinging thermal radiation or to pool fire impingement is relatively well documented. Performance of specific materials is written up and available from the manufacturers. Of increasing concern has been the performance of such coatings to jet fire impingement. Impinging pressurized jet fires impose a double loading on insulating coatings. Firstly, the heat transfer is far higher with jet flames than with pool fires, imposing a greater load on the insulation; secondly, the mechanical shear associated with a several hundred metre per second jet may also dislodge otherwise effective insulation.

C.6.2 Performance of Thermal Protective Coatings: the SOFIPP Tests

a) Description of Tests

Recently, Shell Research Ltd has conducted jet impingement experiments in the UK, jointly sponsored by the United Kingdom Offshore Operators Association (UKOOA) and by the UK Department of Energy (DEn). The programme was entitled SOFIPP: Shell Offshore Flame Impingement Protection Programme. The three reports describing this work "are all freely available upon request" according to the Preface to the SOFIPP Reports. The jet trials were conducted on various steel structural members, with and without protection. Two types of insulation were reviewed, cementitious and intumescent.

The jet flame used in the full-size experiments was carefully defined, based on an earlier European Commission sponsored programme involving Shell Research Ltd and British Gas to characterize LPG and natural gas jet flames. The jet flame was ignited onto a sonic discharge from a 20 mm orifice with about 60 barg upstream pressure, giving a flow of 3 kg/s. This generated a flame length of 20 m, about 2 m wide in its middle. The test specimen was located about 9 m from the jet source.

The structural members tested were of two types: tubular and universal column section.

It should be noted that these experiments were in the nature of demonstrations of the fire protection properties of the materials rather than proving or certification.

b) Test Results

Unprotected Steel Member

The measured rate of temperature increase was about 180°C per minute. A maximum temperature of 1010°C was obtained at the rear of the specimen after about 16 minutes. There was no cooling of the specimen (e.g. as might occur in a full LPG sphere due to the liquid contents). The specimen was under no structural load but started to sag under its own weight after 12 minutes.

Intumescent Coating

The intumescent coating employed was Chartek Type III epoxy intumescent coating, provided by Textron Speciality Materials. The specification to Textron was to provide a coating that would prevent the steel from reaching 300°C during a one-hour test. The manufacturer determined the required thickness and retention system. Textron applied 13 mm thickness to the tubular and 14 mm to the column member flanges and web.

The response of the Chartek during the jet fire was to start to char immediately and thence to glow red hot. Fissures formed on the char as is common on furnace tests of this material. Some parts of the char blew away exposing the retaining mesh. The structural member lost more char than did the tubular section, ultimately exposing bare metal. The maximum temperature of the tubular member at the end of the one hour test was 369°C. The structural column had a similar temperature response for most of the test (mostly 200-300°C) until near the end when pieces of the char were lost and the temperature rose to 857°C.

Overall it was concluded that the Chartek provided good protection (i.e. temperature held below 300°C) for both members for about 45 minutes.

Cementitious Coating

The cementitious coating was Mandolite 550 supplied by Mandoval Coatings Limited. This was applied to a depth of 34 mm on the tubular member and 33 mm on the flanges and web of the universal structural member. A water-repellant and top coat paint were also applied.

The response of the Mandolite coating was as per the required specification. Both specimens were held below 300°C for the one-hour test period. The tubular member reached 190°C and the universal member 217°C. There was no evidence of disbonding of the coating at the junction with the steel but the outer coating was calcined and rather weakly held.

C.6.3 Performance of Thermal Protective Coatings: Other Tests

The manufacturers of Chartek III quote in their publicity material various other tests and also certifications achieved. The certifications, which are for offshore use, are from Lloyd's Register of Shipping, Norwegian Petroleum Directorate (NPD), Underwriters Laboratories Inc. (UL) and Det Norske Veritas (DNV). NPD's and UL's tests were for hydrocarbon pool fires; the test conditions for the other certifications are not stated but were presumably also pool fires. Various sets of tests with jet fire impingement have been carried out: by Saga, BP and British Gas: all are claimed to show effective fire protection during tests of up to four hours.

It is recommended that these be checked with the manufacturer for details and that the test results be obtained and examined in more detail before any decision is made.

It should be noted that, despite the emphasis in these tests on the offshore industry, Chartek has found wide application in onshore situations also.

C.6.4 Implications for Tsing Yi Site Application

It is clear from the general data provided by manufacturers, which cover thermal radiation and pool fire exposure, and now from the SOFIPP experiments, that insulating coatings can provide good thermal protection for steel. The duration of protection varies depending on the type and strength of heat source but jet fire impingement would be the worst loading. It is also noted that the failure frequency analysis for sphere BLEVEs in the Tsing Yi and other studies showed that jet fire impingement accounts for over 50% of the frequency of such incidents.

Thus, in the absence of other loads (e.g. overpressure, fragments), steel vessel legs and the shell itself should be protected for the times observed above for jet fire impingement. It is generally thought that mild steel members loaded to near code limits at ambient temperature would exceed their ultimate tensile strength when heated to 550-600°C. The duration of protection beyond the times noted above cannot be guaranteed. Thus, the value of the coatings must be evaluated in terms of the 45 minutes to 1 hour plus obtained from the experiments. These applied to a 20 mm hole at 9 m distance. Closer spacing or larger holes would be expected to apply greater load to any coating, with probable earlier failure. Similarly, smaller holes or greater spacing should give longer times.

The possibilities for emergency action during a period of 45 minutes to 1 hour are considered below:

1. Pump out LPG inventory to some other safe location

   This could only be to an adjacent sphere, to a ship or to LPG trucks. LPG trucks used in Hong Kong have at most 10 tonnes' capacity and require at least 30 minutes to fill; therefore, they offer no potential to reduce the inventory of 1000 tonne spheres in the available time. An LPG ship might provide the capacity to empty a 1000 tonne sphere, but it is unlikely that, at the distance available to the CRC or Esso jetties, a large LPG vessel would be able to remain safely at berth: almost certainly it would immediately depart. During a recent ethylene leakage incident in Singapore, the site involved was unable to persuade locally available vessels to berth and remove the ethylene inventory and the leak persisted for two days (fortunately without igniting). The potential to transfer contents to another sphere may be possible but it too may be equally involved in the incident as the LPG spheres are all adjacent. There is no interconnection between the Esso and CRC spheres allowing LPG to be transferred to an uninvolved site.

2. Apply Cooling Water

   The Hong Kong Fire Services Department will soon have two stations located near to the southern part of Tsing Yi. Therefore, fire assistance should be readily available within a short period: 6-8 minutes is the target. Given the fire pumps on the site, a rapid hookup of fire pumps and monitors should be possible and additional firewater can be applied to the spheres. However, all spheres already have water deluge to the NFPA recommended value of 10 litres/minute/m^2.

   Thus, additional fire fighting water can be applied directly to any areas of special flame impingement or to making foam to extinguish pool fires. It is likely that firewater monitors would tend to dislodge jet fire weakened insulation; therefore, there would be some loss in effectiveness of the insulating coating. This would be made up by the water monitor jets provided they could be maintained on the same place continuously.

   In a massive jet fire, it is likely that water monitor jets would simply be displaced by the much stronger hydrocarbon jet.

   Cooling water application alone cannot guarantee to prevent a BLEVE in a large fire situation, although it can be effective for smaller ones. Thus, while it may provide some additional response time, thermal insulation plus water sprays still cannot guarantee no BLEVE.

3. Evacuate Affected Areas

   It may be feasible to evacuate to safety quite large numbers of people associated with the SETY development in a period of 45 minutes to 1 hour. Such people are all in a working situation (i.e. no babies, elderly, infirm or asleep) and under some management control, therefore, evacuation should be feasible, particularly if emergency planning for the SETY development allows for such an incident. As the incident is or could lead to a BLEVE, the direction of evacuation will be directly away from the sphere without any consideration of wind direction.

It is believed that a properly developed and occasionally practised evacuation plan could be effective in these circumstances.

In conclusion, the effect of insulation should be greatest in its ability to provide Fire Services Department with additional time to mount a successful evacuation operation. Insulation, even with additional water sprays, cannot guarantee to prevent a BLEVE incident.

C.6.5 Blast and Fragment Effects

It should be noted that thermal insulation does not provide protection for blast overpressure or fragments. These can arise from other incidents on the site or on the adjacent PHI site. The Feysin incident was caused by a knock-on from a prior incident. Also, many releases in the Mexico City disaster were caused by overpressure or fragment effects.

It is believed that the mounded storage vessel approach provides greater protection against blast or fragment effects than an insulated sphere. Also, the mound itself, provided it is adequately engineered, should provide protection against thermal radiation from both pool and jet fires.

As blast and fragment type incidents may occur without significant warning times, it may be that the Fire Services Department will not yet be present, nor will evacuation be feasible. These incidents are much less likely than thermally induced BLEVEs.

C.6.6 Conclusions and Recommendations

It may be concluded that thermal insulation of either the intumescent or cementitious types do provide good thermal protection to steel structural members or to steel shells against jet flame impingement. Compared with unprotected steel shells which might fail in less than 15 minutes, it is considered that sufficient extra time should be available to implement, in full, a prior well-developed emergency plan. This applies only to the fire impingement mechanism for vessel BLEVE failures, which, however, represent about 75% of the total BLEVE probability on CRC's site.

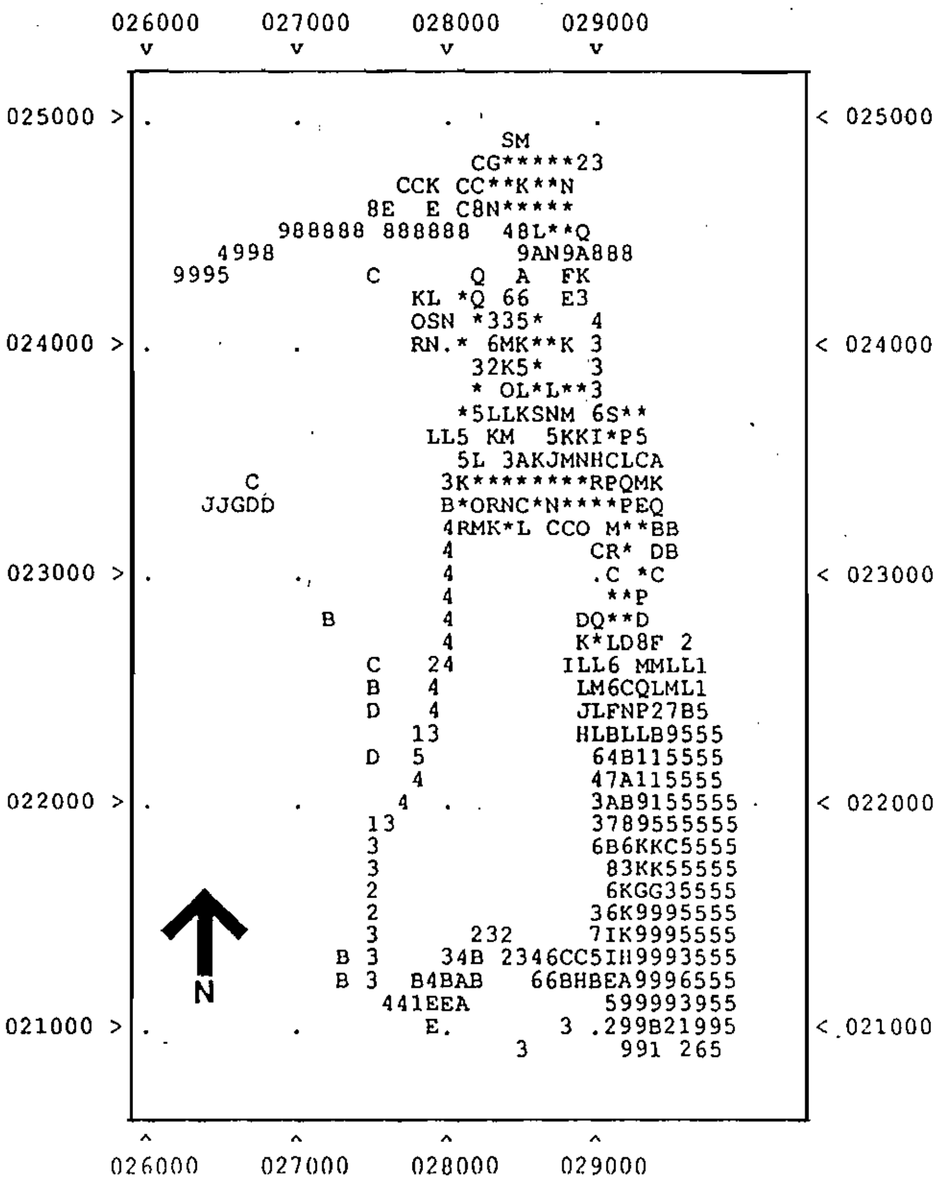
Therefore, it appears that a well applied thermal coating would provide a good interim measure of protection to the large LPG spheres on the CRC and Esso sites. (Note that Textron require that their intumescent coating Chartek III be applied by "approved and trained applicators who are fully conversant with the material and its use": this ensures that it meets its performance specification and provides the protection expected.) This will not be through preventing the mechanism of BLEVEs, which might still happen, but by the removal of the affected people (i.e. those within the potential hazard zone) to a place of safety. However, as not all failure modes are not protected, specifically overpressure and fragment induced failures, it will be necessary in the longer term to mound the LPG spheres as required by Gas SO.

The conclusions and recommendations can be summarised as follows;

- A well applied thermal coating would provide a good interim measure of protection to the large LPG spheres on the CRC and Esso sites.
- An effective emergency plan to deal with a BLEVE incident should be developed and occasionally practised.
- As not all failure modes are protected, specifically overpressure and fragment induced failures, it will still be necessary in the longer term to mound the LPG spheres as required by Gas SO.

KEY

Population range	letter code
0 - 0	0
1 - 1	1
2 - 2	2
3 - 3	3
4 - 4	4
5 - 5	5
6 - 6	6
7 - 7	7
8 - 8	8
9 - 9	9
10 - 10	A
11 - 20	B
21 - 30	C
31 - 40	D
41 - 50	E
51 - 60	F
61 - 70	G
71 - 80	H
81 - 90	I
91 - 100	J
101 - 200	K
201 - 300	L
301 - 400	M
401 - 500	N
501 - 600	O
601 - 700	P
701 - 800	Q
801 - 900	R
901 - 999	S
1000 ->	*



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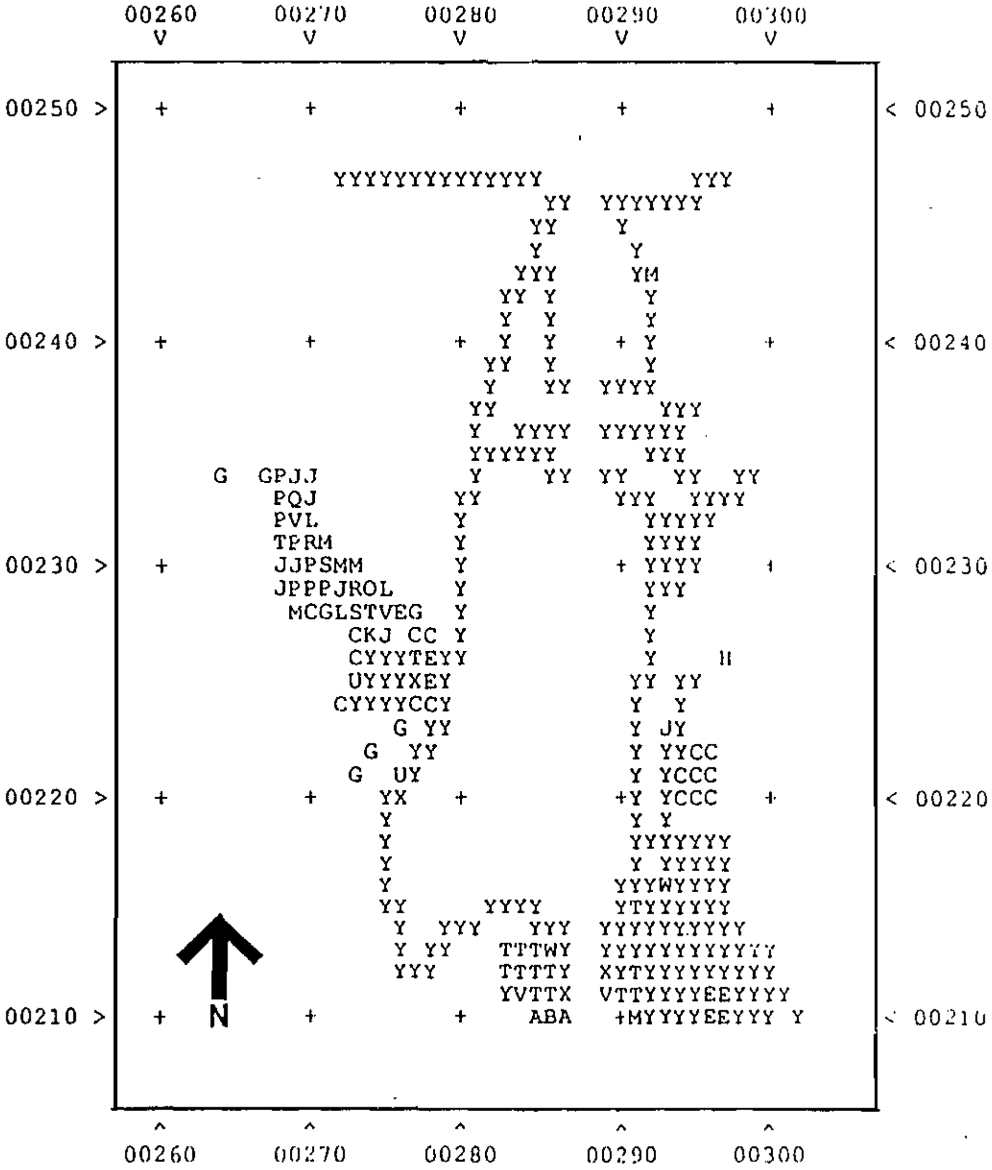
.         .         .         .
                        SM
                      CG*****23
                 CCK CC**K**N
               8E  E C8N*****
         988888 888888  48L**Q
     4998                9AN9A888
  9995         C      Q  A  FK
                  KL *Q 66  E3
                  OSN *335*   4
.    .    .       RN.* 6MK**K 3
                      32K5*   3
                      * OL*L**3
                     *5LLKSNM 6S**
                   LL5 KM  5KKI*P5
                     5L 3AKJMNHCLCA
       C            3K********RPQMK
    JJGDD           B*ORNC*N****PEQ
                    4RMK*L CCO M**BB
                    4         CR* DB
.         .         4         .C *C
                    4          **P
            B       4        DQ**D
                    4        K*LD8F 2
               C   24       ILL6 MMLL1
               B   4         LM6CQLML1
               D   4         JLFNP27B5
                  13         HLBLLB9555
               D  5           64B115555
                  4           47A115555
.         .      4  .         3AB9155555
               13             3789555555
               3              6B6KKC5555
               3               83KK55555
               2               6KGG35555
               2              36K9995555
               3      232     7IK9995555
             B 3    34B 2346CC5IH9993555
             B 3  B4BAB   66BHBEA9996555
                441EEA         599993955
.         .        E.       3 .299B21995
                         3      991 265
```

FIGURE C1 : SCHEMATIC MAP OF TSING YI POPULATION USED FOR SAFETI ANALYSIS

KEY

Probability range	Letter code
0.00 < P <= 0.04	A
0.04 < P <= 0.08	B
0.08 < P <= 0.12	C
0.12 < P <= 0.16	D
0.16 < P <= 0.20	E
0.20 < P <= 0.24	F
0.24 < P <= 0.28	G
0.28 < P <= 0.32	H
0.32 < P <= 0.36	I
0.36 < P <= 0.40	J
0.40 < P <= 0.44	K
0.44 < P <= 0.48	L
0.48 < P <= 0.52	M
0.52 < P <= 0.56	N
0.56 < P <= 0.60	O
0.60 < P <= 0.64	P
0.64 < P <= 0.68	Q
0.68 < P <= 0.72	R
0.72 < P <= 0.76	S
0.76 < P <= 0.80	T
0.80 < P <= 0.84	U
0.84 < P <= 0.88	V
0.88 < P <= 0.92	W
0.92 < P <= 0.96	X
0.96 < P <= 1.00	Y

(This shows only the locations and the probability that the source is active.)



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        00260     00270     00280     00290     00300
          V         V         V         V         V

00250 >   +         +         +         +         +      < 00250

                      YYYYYYYYYYYYYY         YYY
                                    YY YYYYYYY
                                   YY   Y
                                   Y     Y
                                  YYY    YM
                                 YY Y     Y
                                 Y  Y     Y
00240 >   +         +         +  Y  Y   + Y       +      < 00240
                                YY  Y     Y
                                Y   YY YYYY
                               YY          YYY
                               Y  YYYY YYYYYY
                               YYYYYY     YYY
              G  GPJJ          Y    YY YY   YY  YY
                  PQJ         YY        YYY  YYYY
                  PVL         Y           YYYYY
                  TPRM        Y           YYYY
00230 >   +       JJPSMM      Y         + YYYY    +      < 00230
                  JPPPJROL    Y           YYY
                   MCGLSTVEG  Y           Y
                       CKJ CC Y           Y
                       CYYYTEYY           Y    H
                       UYYYXEY           YY YY
                      CYYYYCCY           Y  Y
                          G YY           Y JY
                        G  YY            Y YYCC
                       G  UY             Y YCCC
00220 >   +         +    YX   +         +Y YCCC   +      < 00220
                         Y               Y Y
                         Y               YYYYYYY
                         Y               Y YYYYY
                         Y              YYYWYYYY
                         YY     YYYY    YTYYYYYY
                          Y  YYY   YYY YYYYYYYYYY
                          Y YY   TTTWY YYYYYYYYYYYY
                          YYY    TTTTY XYTYYYYYYYYY
                                 YVTTX VTTYYYYEEYYYY
00210 >   +         +         +    ABA  +MYYYYEEYYY Y    < 00210

          ^         ^         ^         ^         ^
        00260     00270     00280     00290     00300
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FIGURE C2: SCHEMATIC MAP OF IGNITION SOURCE DISTRIBUTION USED FOR SAFETI ANALYSIS

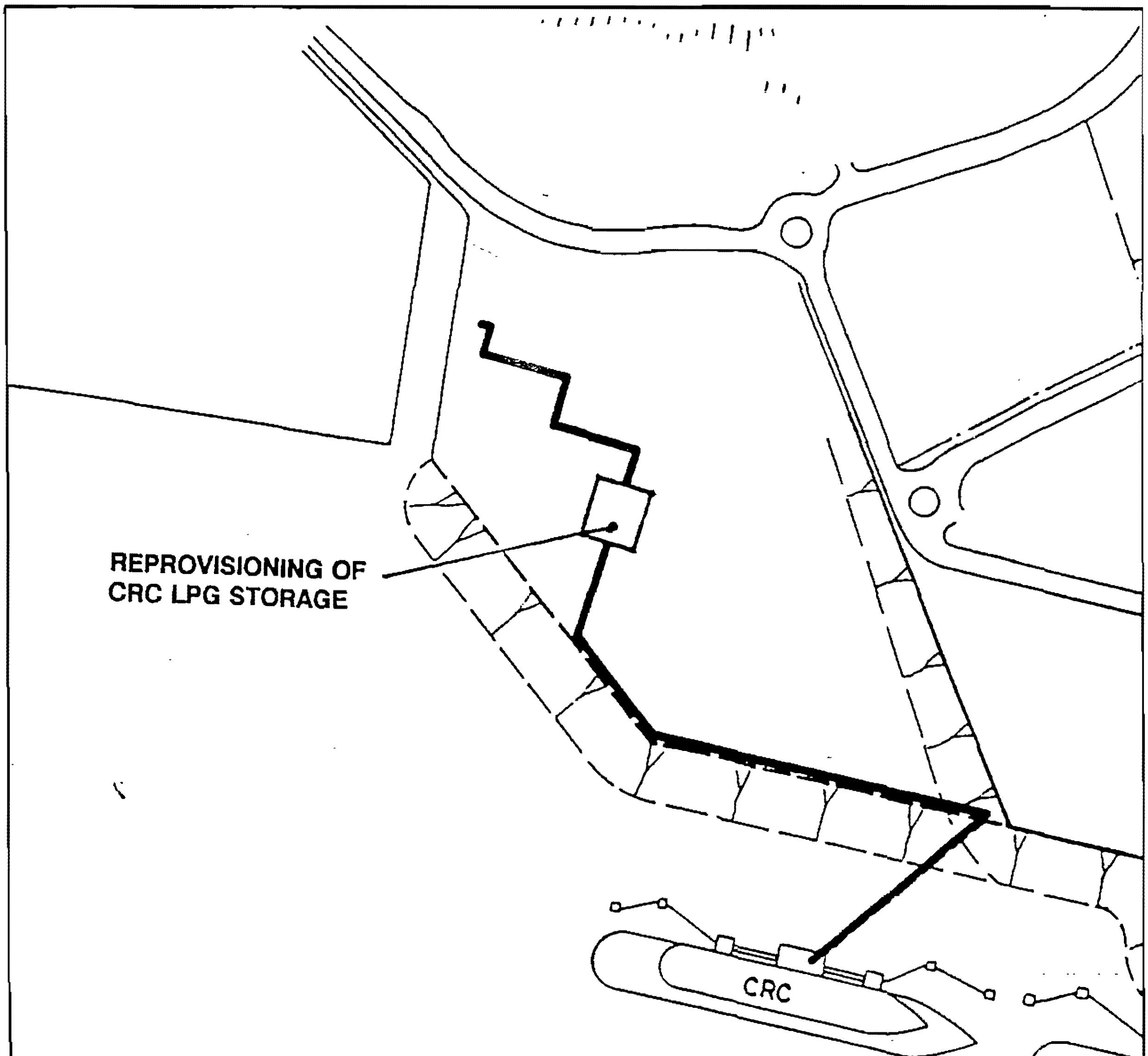


FIGURE C3: REVISED PIPEWORK ROUTINGS ASSUMED FOR CRC SITE

APPENDIX D

NOISE IMPACT ASSESSMENT

APPENDIX D NOISE IMPACT ASSESSMENT

Table D.1 Construction Noise Criteria for Activity Other Than Percussive Piling

Noise Sensitive Receiver	Facade Noise Level Limit		
	L_{Aeq} (30 mins)	L_{Aeq} (5 mins)	
TSING YI	Day 0700 - 1900	Evening 1900 - 2300	Night 2300 - 0700
Cheung Ching Estate	75	65	50
Mayfair Gardens	75	65	50
Technical Institute	75	65	50

The day time construction noise limit is to be 75 dB(A) or 5 dB(A) above background, whichever is higher.

Table D.2 Construction Noise Criteria For Percussive Piling Activity

Noise Sensitive Receiver	Facade Noise Level Limit (L_{Aeq} 5 mins)	
TSING YI	Day 0700 - 1900	Night 1900 - 0700
Cheung Ching Estate	85	Prohibited
Mayfair Gardens	85	Prohibited
Technical Institute	75	Prohibited

Table D.3 Site Operation Noise Criteria

Noise Sensitive Receiver	Facade Noise Level Limit (L_{Aeq} 5 mins)	
TSING YI	Day & Evening 0700 - 2300	Night 2300 - 0700
Cheung Ching Estate	61	55
Mayfair Gardens	61	55
Technical Institute	61	55

1. Daytime ANL = 70 dB(A) L_{Aeq} background = 56 dB(A) L_{A90} (ref: CT8 Study). Difference between freefield L_{A90} and facade L_{Aeq} = 5 dB(A). Hence L_{A90} condition is critical.

2. Night time ANL = 60 dB(A) L_{Aeq} background = 51 dB(A) L_{A90} (ref: CT8 Study). Hence ANL condition is critical.

Table D.4 Road Traffic Noise Criteria

Noise Sensitive Receiver	Noise Level Limit (L_{A10} 1 hour)
Dwelling	70
Technical Institute/School	65
Hospital	55

APPENDIX E

AIR QUALITY ASSESSMENT

APPENDIX E AIR QUALITY ASSESSMENT

Table E.1 Hong Kong Air Quality Objectives

Parameter	Average Concentration μgm^{-3}				
	1-Hour	8-Hour	24-Hour *	3 Month	Annual
SO_2	800		350		80
CO	30000	10000			
NO_2	300		150		80
TSP	500 **		260		80
RSP			180		55
Lead				1.5	

* Not to be exceeded more than once per year

** In addition to the above established legislative controls, it is generally accepted that an hourly average TSP concentration of 500 μgm^{-3} should not be exceeded. Such a control limit is particularly relevant to construction work and has been imposed on a number of construction projects in Hong Kong in the form of contract clauses.

Table E.2 Background SO_2 Concentrations (μgm^{-3}) on Tsing Yi Prior to and Following the Introduction of the Fuel Regulations

Day	May 90	June 90	July 90	Aug 90	Sep 90	Oct 90
1		67	9	32	38	47
2		328	18	19	18	57
3		59	44	38	51	38
4		18	17	13	25	24
5		121	52	11	97	21
6		144	41	29	36	16
7		29	16	41	18	23
8	147	19	9	18	17	53
9	317	77	50	61	21	60
10	241		33	75	11	64
11	47			44	6	42
12	43	72		11	26	40
13	94	26		67	25	47
14	510	80	48	31	37	21
15	403		19		35	41
16	160		20		20	40
17	118		16	24	46	43
18	69		25	16	48	44
19	123		56	12	57	52
20	194		33	18	36	55
21	267	141	58	20		35
22	216	46	36	43		73
23	271	39	51	112		57
24	373	5	114	63		34
25	383	23	106	38		14
26	141	36	66	23	49	30
27	48	48	129	34	43	28
28	203	31	41	21	43	25
29	164	29	14	45	49	33
30		21	11	33	30	52
31	51		28	36		49
Average	199	76	41	35	35	41

Table E.3 Worst Case First Floor 1-hour Concentrations (μgm^{-3})

Receiver	TSP μgm^{-3}	Wind Direction
1	110	90°
2	130	100°
3	280	140°
4	280	60°
5	460	40°
6	150	170°
7	230	160°

Table E.4 Worst Case 1-hour NO_2 Concentrations (μgm^{-3}) at Sensitive Receivers Arising from 1996 Traffic Flows for Wind Directions 0-180°

	0	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180
1	0.0	0.8	5.0	7.2	83.9	57.8	17.3	14.3	12.9	11.8	11.1	10.7	10.6	7.3	5.0	5.2	7.0	10.0	11.2
2	0.0	5.1	5.6	17.6	95.6	68.8	17.1	14.7	12.7	11.0	10.2	10.2	11.1	11.4	8.8	5.5	5.0	5.3	7.0
3	6.7	7.6	21.2	98.4	128.3	59.2	24.3	15.7	12.9	10.8	10.4	10.3	10.3	10.7	11.5	12.5	4.0	2.5	2.5
4	9.7	11.0	65.1	130.4	142.0	70.5	22.0	15.8	15.5	14.8	12.7	11.4	11.4	11.6	12.3	13.6	14.1	4.3	2.9
5	12.5	24.5	103.2	136.4	190.4	138.3	75.8	35.3	34.0	33.7	34.4	36.7	39.4	34.2	32.2	35.5	39.0	40.2	15.7
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	46.0	79.7	39.3	16.9	6.3	4.1	5.6	4.1	14.8	10.4	11.4	2.0
7	4.5	3.6	2.7	2.2	2.0	1.9	1.8	1.9	50.0	92.1	80.5	68.6	32.6	30.7	23.5	24.0	14.6	6.4	3.5

Table E.5 Worst Case 1-hour NO_2 Concentrations (μgm^{-3}) at Sensitive Receivers Arising from 2001 Traffic for Wind Directions 0-180°

	0	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180
1	0.0	0.8	5.0	7.6	71.4	45.0	22.2	17.4	14.1	12.4	11.3	10.7	10.7	12.9	9.1	9.5	12.7	18.1	20.0
2	0.0	5.1	5.6	18.7	81.2	53.7	17.4	17.9	13.7	10.5	9.3	9.2	10.6	10.7	10.9	10.0	9.0	9.6	12.6
3	6.7	7.5	25.4	89.5	102.4	53.6	32.2	17.1	11.5	7.8	7.3	7.1	7.0	7.3	7.8	8.5	5.2	4.5	4.6
4	9.6	13.0	72.4	110.8	114.0	56.6	19.7	14.9	14.4	12.5	9.6	8.1	8.0	8.1	8.6	9.5	10.0	5.6	5.3
5	12.8	36.7	119.4	123.2	154.9	114.5	66.0	34.3	32.8	32.3	32.8	34.7	36.9	32.2	30.7	33.8	37.2	38.4	21.8
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	34.4	58.8	29.2	12.6	4.8	3.7	6.2	3.2	13.2	9.5	9.1	3.6
7	4.9	4.0	3.0	2.5	2.2	2.1	2.1	2.2	37.9	68.8	60.7	52.3	28.6	34.6	22.9	24.3	12.3	7.6	6.2

Table E.6 Worst Case 1-hour NO_2 Concentrations (μgm^{-3}) at Sensitive Receivers Arising from Industry for Wind Directions 0-180°

	0	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	14.7	27.5	14.3	24.0	1.5	0.0	10.5	30.3	22.7	1.9	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.2	15.1	25.5	21.8	14.3	17.9	1.1	0.5	16.3	23.2	13.8
3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	12.0	13.6	15.8	38.9	21.8	3.4	11.5	3.1	2.5	11.2
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.6	21.0	21.1	13.3	24.2	26.6	3.7	9.4	5.9
5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.2	24.5	24.5	10.5	20.3	14.7	8.4
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	19.5	14.2	14.9	8.6
7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.3	20.1	14.2	8.9	11.2

Table E.7 Worst Case 1-hour NO_2 Concentrations (μgm^{-3}) at Sensitive Receivers Arising from 1996 Traffic and Industry for Wind Directions 0-180°

	0	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180
1	0.0	0.8	5.0	7.2	83.9	57.8	17.3	15.0	27.6	39.3	25.3	34.8	12.1	7.3	15.5	35.6	29.7	11.9	11.2
2	0.0	5.1	5.6	17.6	95.6	68.8	17.1	14.7	15.0	26.1	35.7	32.0	25.4	29.4	9.9	6.0	21.3	28.5	20.8
3	6.7	7.6	21.2	98.4	128.3	59.2	24.3	15.7	13.0	22.7	24.0	26.2	49.3	32.5	14.8	23.9	7.2	5.0	13.8
4	9.7	11.0	65.1	130.4	142.0	70.5	22.0	15.8	15.5	14.8	18.3	32.4	32.5	25.0	36.5	40.2	17.9	13.7	8.8
5	12.5	24.5	103.2	136.4	190.4	138.3	75.8	35.3	34.0	33.7	34.4	36.7	41.6	58.7	56.7	45.9	59.3	54.9	24.1
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	46.0	79.7	39.3	16.9	6.3	4.1	5.6	4.6	34.3	24.6	26.3	10.6
7	4.5	3.6	2.7	2.2	2.0	1.9	1.8	1.9	50.0	92.1	80.5	68.6	32.6	30.7	25.8	44.1	28.7	15.3	14.7

Table E.8 Worst Case 1-hour SO_2 Concentrations (μgm^{-3}) at Sensitive Receivers Arising from Industry for Wind Directions 0-180° as predicted at 5m height

	0	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.4	110.5	206.9	107.5	181.0	11.0	0.1	78.9	228.5	170.7	14.6	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.9	114.0	191.7	163.9	107.6	135.0	8.2	3.6	122.9	175.0	104.0
3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	90.0	102.5	119.3	293.1	164.1	25.3	86.3	23.6	18.8	84.5
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	42.0	158.0	158.7	100.4	182.1	200.6	28.1	71.1	44.4
5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.9	184.5	184.3	78.8	153.1	110.5	63.0
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.4	146.9	107.0	112.2	64.8
7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.2	151.4	106.7	66.8	85.5

Table E.9 Worst Case 1-hour SO_2 Concentrations (μgm^{-3}) at Sensitive Receivers Arising from Industry for Wind Directions 0-180° as predicted at 40m height

	0	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	21.2	28.1	22.9	24.2	1.0	0.0	7.0	14.0	7.8	0.6	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.4	16.5	18.5	20.7	18.0	9.9	0.5	0.5	16.5	12.9	9.1
3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.7	6.8	8.6	14.6	22.4	8.2	17.1	4.6	7.2	22.6
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.5	6.0	8.9	12.1	16.1	16.2	6.8	18.3	18.4
5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	8.2	17.0	15.7	25.3	11.9	23.6
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	34.6	30.4	27.5	21.7
7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.7	47.4	33.8	21.2	34.8

Calculation of Dust from unpaved roads

Calculated from:

$$E = k(1.7)\left(\frac{s}{12}\right)\left(\frac{S}{48}\right)\left(\frac{W}{2.7}\right)^{0.7}\left(\frac{w}{4}\right)^{0.5}\left(\frac{365-p}{365}\right)\ (kg\ veh^{-1}\ km^{-1}) \qquad (1)$$

where: E = emission factor
k = particle size multiplier (dimensionless) (A value of 0.80 was used)
s = silt content of road surface material (%)
S = mean vehicle speed, km/hr
W = mean vehicle weight, Mg
w = mean number of wheels
p = number of days with at least 0.254 mm of precipitation per year

Dust from material handling

$$E = k\ (0.0009)\left(\frac{s}{5}\right)\left(\frac{U}{2.2}\right)\left(\frac{H}{1.5}\right)\left(\frac{M}{2}\right)^{-2}\left(\frac{Y}{4.6}\right)^{-0.33}\ (kg\ tonne^{-1}) \qquad (1)$$

where: E = emission factor
k = particle size multiplier (dimensionless) (A value of 0.73 was used)
s = material silt content (%)
U = mean wind speed, m/s
H = drop height, m
M = material moisture content (%)
Y = dumping device capacity, m^3

Dust from wind erosion of active storage piles

$$E = 1.9\left(\frac{s}{1.5}\right)\left(\frac{365-p}{235}\right)\left(\frac{f}{15}\right)\ (kg\ day^{-1}ha^{-1}) \qquad (3)$$

where: E = total suspended particulate emission factor
s = silt content (%)
p = number of days with ≥ 0.25 mm of precipitation per year
f = percentage of time that the unobstructed wind speed exceeds 5.4 m/s at the mean pile height

The following assumptions were used:

(1) PCWA

1.	Site area	8.6 ha
2.	Stockpile area	4.3 ha
3.	Average distance travelled by vehicles per trip	0.5 km
4.	Average quantity of fill moved in a 12 hour working day	2900 m^3/d

5.	Daily vehicle movements on site	240
6.	Average vehicle speed	8 kph

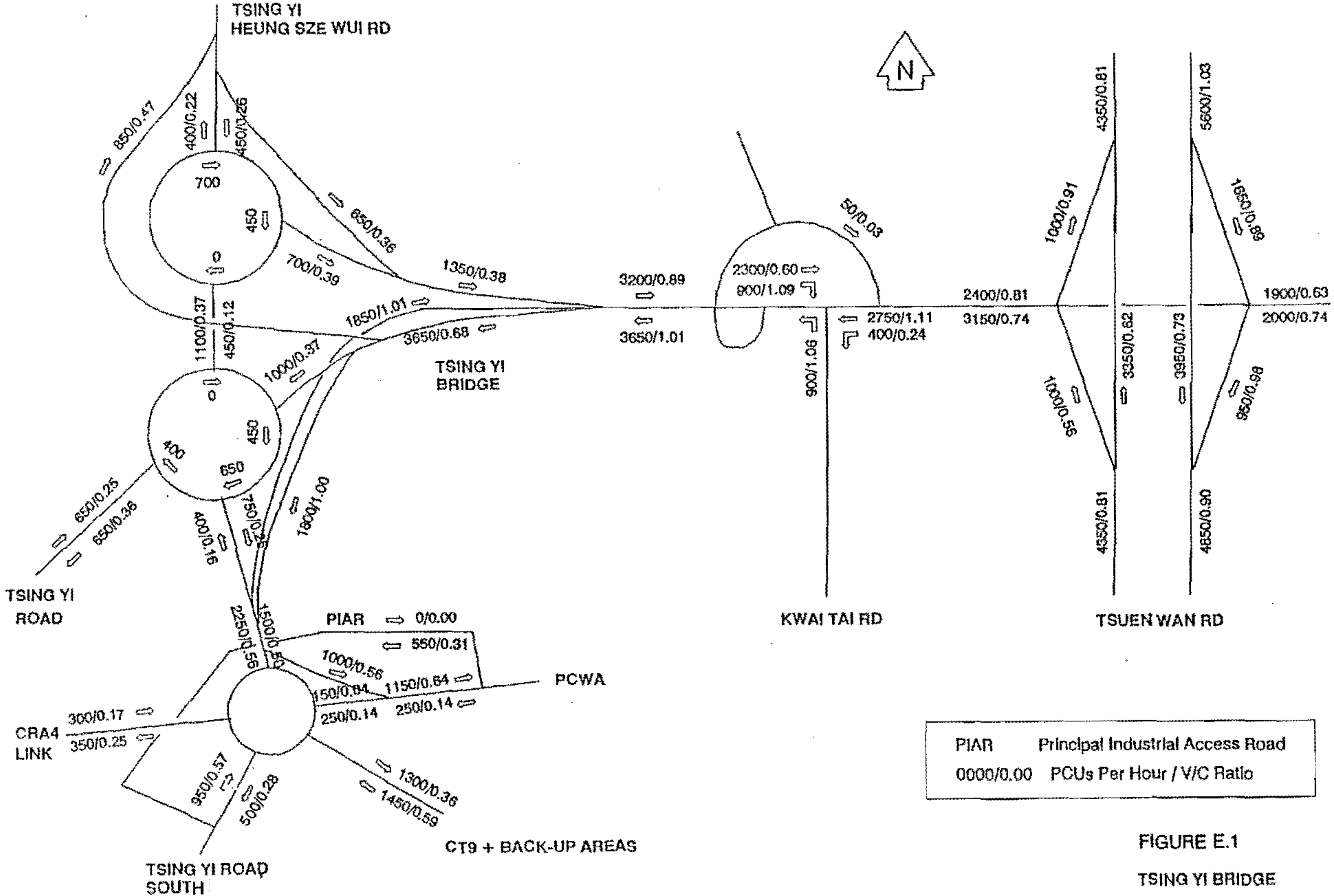
(2) Roundabout

1.	Site area	0.9 ha
2.	Stockpile area	0.3 ha
3.	Average distance travelled by vehicles per trip	0.3 km
4.	Average quantity of fill moved in a 12 hour working day	2000 m^3/d
5.	Daily vehicle movements on site	167
6.	Average vehicle speed	8 kph

SO_2 and NO_2 Estimation from industrial sources

Table 5.8 WP9 (Source:PADS Vol 13, Air Quality Studies , Emissions and Baseline Conditions, 1989) provides fuel usage at Aberdeen, taken as being representative of an industrial area. The coal consumption was converted to an equivalent fuel oil usage (assuming coal would not be used on the SETY development) using the table of calorific values as given in Table 1, PADS Vol 13. The sulphur content of fuel oil was assumed to be 0.5% w/w, hence equivalent to 1.0 % SO_2 w/w. Fuel oil equivalent usage at Aberdeen was calculated to be 6747700 kg, hence SO_2 production was 67477 kg. Assuming 360 working days per year and a 10 hour working day an emission of 5.2 gs^{-1} was calculated. This was used as the basic input to the ISCST model for dispersion modelling.

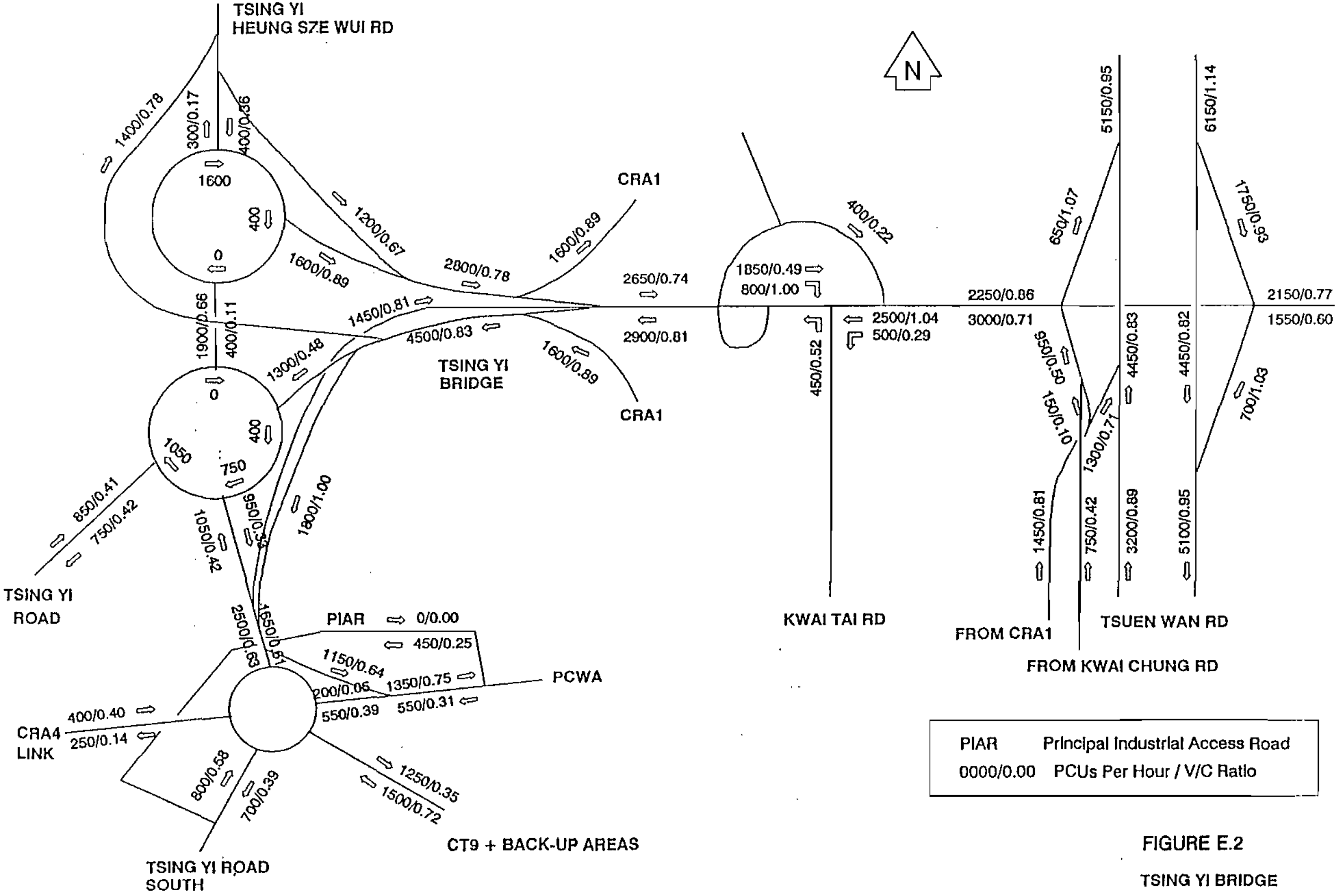
The same calculation was performed for NOx based on emission factors as given in Table 2, PADS Vol 13. USEPA AP-42 Vol 1 Table 1.3.1 indicates that 5% of NOx is NO_2 from all boiler types other than residential. A conservative overall conversion factor of 20% was adopted, allowing for further for atmospheric conversion before reaching receivers. (This is consistent with the traffic conversion factor). Again 360 working days/year and 10 hours per day were assumed. An overall emission factor of 0.69 g/s was thus calculated.



PIAR	Principal Industrial Access Road
0000/0.00	PCUs Per Hour / V/C Ratio

FIGURE E.1

TSING YI BRIDGE
1996 MORNING PEAK

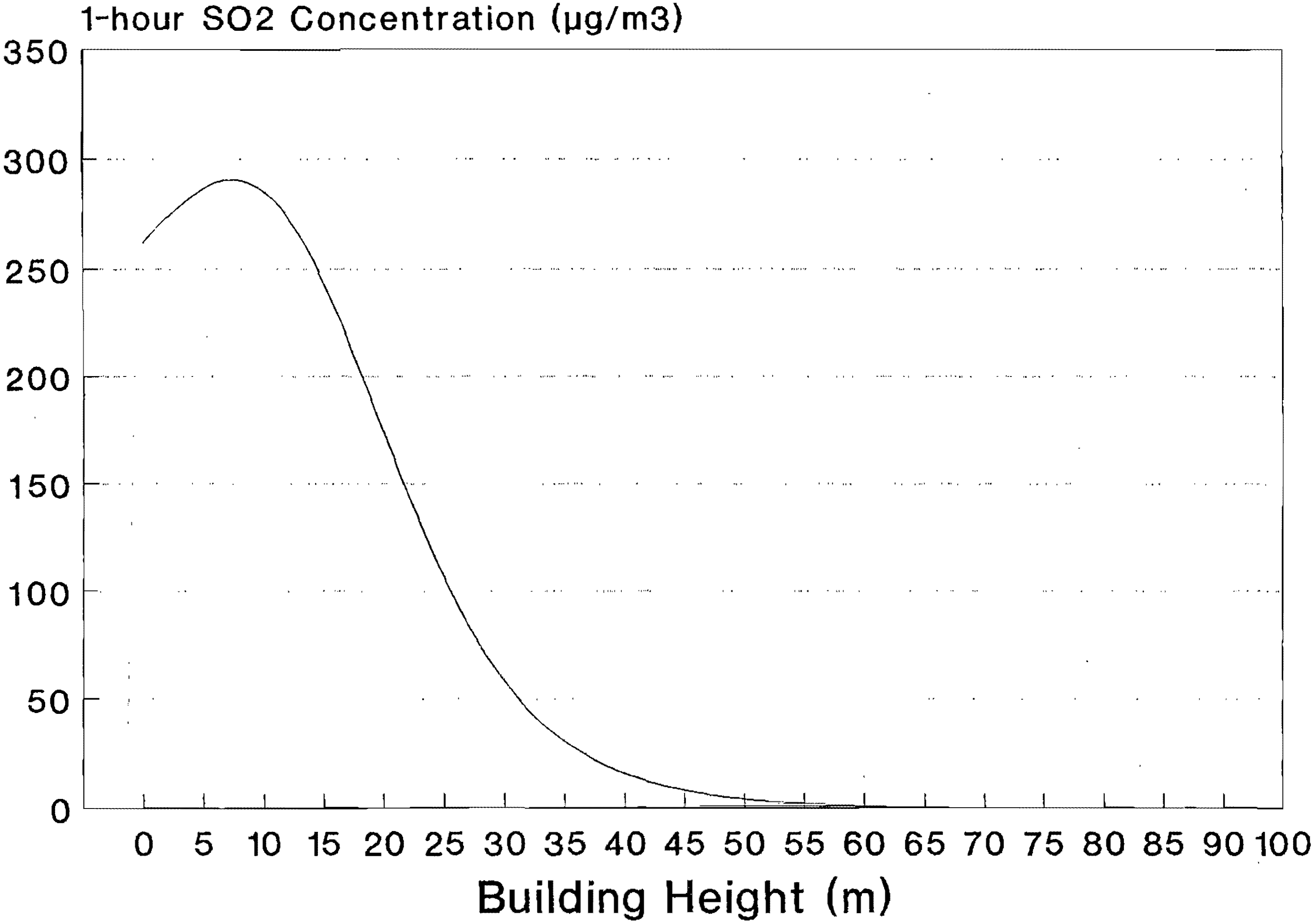


PIAR	Principal Industrial Access Road
0000/0.00	PCUs Per Hour / V/C Ratio

FIGURE E.2

TSING YI BRIDGE
2001 MORNING PEAK

Figure E.3 SO2 Concn at Receiver 3



APPENDIX F

WATER QUALITY ASSESSMENT

APPENDIX F WATER QUALITY ASSESSMENT

APPENDIX F.1

Water Quality and Sediment Criteria

Table F1 Proposed Water Quality Objectives for Victoria Harbour Water Control Zone

Beneficial Use	Dissolved Oxygen	Ammonia-N	Inorganic-N	*E. coli*
3	>60%[1]	0.021 mg/l[2]		
6	>30%[1]			20,000/100ml[3]
General			<0.5 mg/l[4]	

1. Dissolved oxygen limit refers to 90% of sampling occasions (originally 95%)

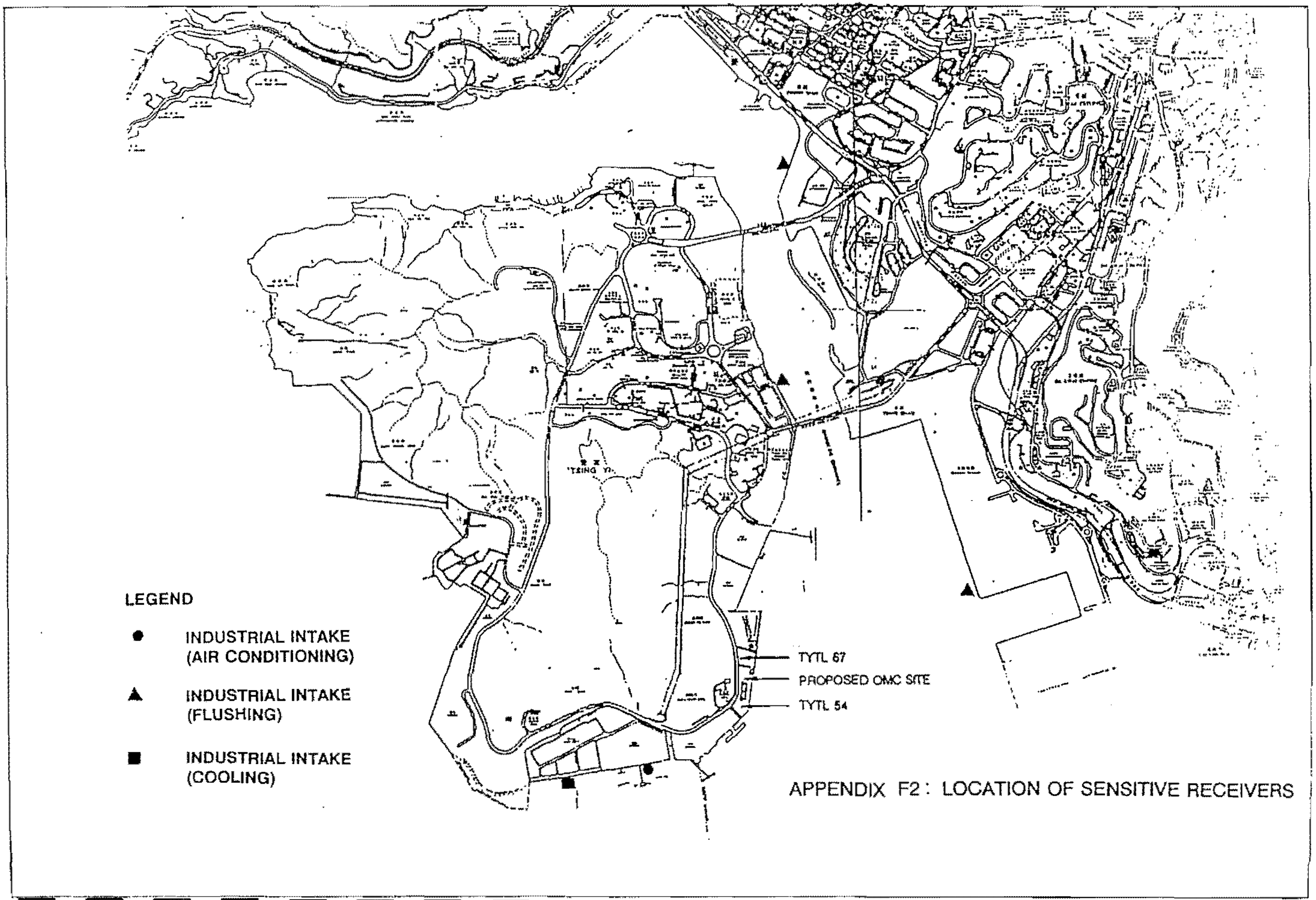
2. Ammonia-N (NH_3-N) limit is equivalent to 0.25-0.5 mg/l ammoniacal-N (NH_4-N) depending on temperature and salinity.

3. *E. coli* limit refers to 90% of samples taken over a year.

4. Inorganic-N limit is a depth and annual average.

Table F2 Interim Threshold Guideline Values for Significant Sediment Contamination

Heavy metal	Cu	Cd	Cr	Ni	Pb	Zn	Hg
Concentration (mg/kg dry wgt).	500	15	500	500	200	2000	5



APPENDIX F2 : LOCATION OF SENSITIVE RECEIVERS

APPENDIX F.3

Calculations indicating the potential pollutant loads associated with dredging in the Rambler Channel.

Input data and assumptions were as follows;

Volume of dredged material		18 Mm^3
Losses to water column on dredging[1]		3%
Marine mud	- Specific gravity[2]	2.17
	- Dry weight ratio[2]	0.41
	- COD (mg/kg d.s)[2]	23,000
	- NH_3N (mg/kg d.s)[3]	13

1. Deep Bay Guidelines for Dredging, Reclamation and Drainage Works
2. Average of EPD results for sediment monitoring stations in the Rambler Channel (bulk samples)
3. Average of EPD results for sediment monitoring stations in the Rambler Channel (<63μm samples)

The 18 Mm^3 of dredged material is assumed to consist entirely of marine mud. Using the above data and assumptions the following values were calculated:

Total mass of marine mud dredged	16 M tonnes
Mass of dispersed solids	480,400 tonnes
COD exerted by dispersed solids	11,050 tonnes
Assuming BOD:COD ratio = 0.5, BOD exerted	5,525 tonnes
NH_3N load	6.2 tonnes

On the basis of a 6 day working week for 82 weeks, this gives the following potential loads to the water column:

SS	976 tonnes day
COD	22 tonnes/day
BOD	11 tones/day
NH_3-N	0.01 tonnes/day[2]

APPENDIX F.4

Concentrations of heavy metals in surface samples of marine mud from the SETY Reclamation Area (T9MD1 - T9CPT6) and Kellett Bank (T9VC1 - T9VC2)

Sample I.D.	Copper content, mg/kg	Cadmium content, mg/kg	Chromium content, mg/kg	Lead content, mg/kg	Nickel content, mg/kg	Zinc content, mg/kg	Mercury content mg/kg
T9MD1 0-0.5m	742 (618)*	3	137	103	91	238	0.2
T9MD3 0-0.5m	323	1	58	76	37	175	0.3
T9MD4 0-0.5m	977 (841)*	2	151	93	80	221	0.2
T9MD5 0-0.5m	567 (609)*	1	88	77	62	196	0.2
T9MD8 0-0.5m	108	0.7	26	78	17	156	0.41
T9MD10 0-0.5m	144	0.9	38	63	26	140	0.46
T9CPT1 0-0.5m	306	1.1	49	70	32	133	0.39
T9CPT3 0-0.5m	147	1.0	40	84	25	151	0.59
T9CPT5 0-0.5m	13	0.7	6	45	6	61	0.01
T9CPT6 0-0.5m	230	1.1	42	66	26	148	0.42
T9VC1 0-0.5m	28	0.9	24	1350	26	125	0.52
T9VC2 0-0.5m	137	1.1	35	91	32	316	0.50

* repeat analysis

APPENDIX F.5

Calculations showing the daily oxygen flux associated with the embayed area in the Rambler Channel.

An oxygen demand associated with benthic sediments equivalent to 7g/m^2/d was assumed as a worst case, this being representative of conditions in the Kai Tak Nullah. The natural reaeration rate (r_R) was estimated from the equation:

$$r_R = K_r (C_s - C) * V * 10^{-3}$$

where K_r = reaeration coefficient (/d)
C_s = dissolved oxygen saturation concentration (mg/l)
C = dissolved oxygen concentration (mg/l)
V = volume of water in embayment (m^3)

A value of 0.23 was taken for K_r on the basis of values adopted previously for Hong Kong waters (e.g. in the WAHMO and SHRUG studies). A value of 7.43 mg/l was taken for C_s for the Rambler Channel at 22°C and a salinity of 30,000 mg/l. The results of the calculation are presented below.

Oxygen Demand		kg/d
a)	Tsing Yi STW effluent 25,853 m^3/d at 200 mg/l BOD = 5,170	
	assuming 70% BOD remains in suspension (based on a typical BOD removal of 30% during primary sedimentation) and 30% BOD settles within the embayment and contributes to benthal demand = 3,619	
	assuming 15% suspended BOD loss with tidal exchange = 3,076	3,076
b)	Tidal flow 315,000 m^2/d at 1.1 mg/l BOD = 346	346
c)	Benthal demand 7 g/m^2/d over 150,000 m^2 = 1,057	1,057
	TOTAL	**4,479**
Oxygen supply		
a)	Tidal flow 315,000 m^3/d at 5.3 mg/l DO = 1,670	1,670
b)	Natural reaeration 0.23 (7.43 - 4.1) x 2,100,000 = 1,608	1,608
	TOTAL	**3,278**

Assuming that part of the total incoming BOD load is satisfied by the DO in the incoming water (1,670 kg/d), substitution of the remaining BOD load (2,809 kg/d) into the reaeration equation results in a water column DO concentration of 1.62 mg/l.

APPENDIX F.6

Predicted loads and flows arising from the CT9 and non CT9 areas calculated using factors derived in the Sewage Strategy Study

Table F3 **Predicted flows and loads of domestic sewage arising from employed population of CT9 and non-CT9 areas on SETY reclamation**

Flow (m^3/d)	Load (kg/d)					
	SS	BOD	COD	TKN	NH_3-N	*E. coli* (count/d)
1372	778	778	1601	153	91	8.01 x 10^{14}

* Population = 17,873 employees
5,000 students at Technical Institute

* Load factors = SSS year 2001

Table F4 **Predicted flows and loads of process effluent arising from industry on non-CT9 areas on SETY reclamation, assuming an unrestricted industrial mix.**

%	industry	employees	load (kg/d)						
			Flow (m^3/d)	SS	BOD	COD	TKN	NH_3-N	*E. coli* (count/d)
15	Hi-tech	1,878	1,878	158	235	1,040	59	39	-
25	Manufacturing	3,130	13,741	1,045	2,748	6,639	-	-	-
25	Machinery	3,130	3,130	263	391	1,734	98	65	-
10	Food	1,252	1,290	746	1,059	1,963	52	-	-
10	Textiles	1,252	10,955	2,473	4,343	10,337	79	-	-
15	Chemicals	1,878	8,244	627	1,649	3,983	-	-	-
100		12,520	39,238	5,312	10,425	25,696	288	104	-

* Population = 11,237 Industrial (A) employees
1,284 Industrial (B) employees

* Load factors = SSS year 2001, where "hi-tech" industry load factors are assumed equivalent to SSS "machinery" category and "chemicals" industry load factors are assumed equivalent to SSS "manufacturing" category

* Industrial mix = based on that at Tai Po and Yuen Long Industrial Estates, and as used for predicting process effluent arisings at Junk Bay Third Industrial Estate (Tseung Kwan O Study of Opportunities for Further Development, 1990).

Table F5 Predicted flows and loads of process effluent arising from industry on non-CT9 areas on SETY reclamation, assuming all "hi-tech" type industry

Industry	Employees	Flow (m^3/d)	Load (kg/d)					
			SS	BOD	COD	TKN	NH_3-N	*E. coli* (count/d)
hi-tech	12,521	12,521	1,052	1,565	6,937	392	260	-

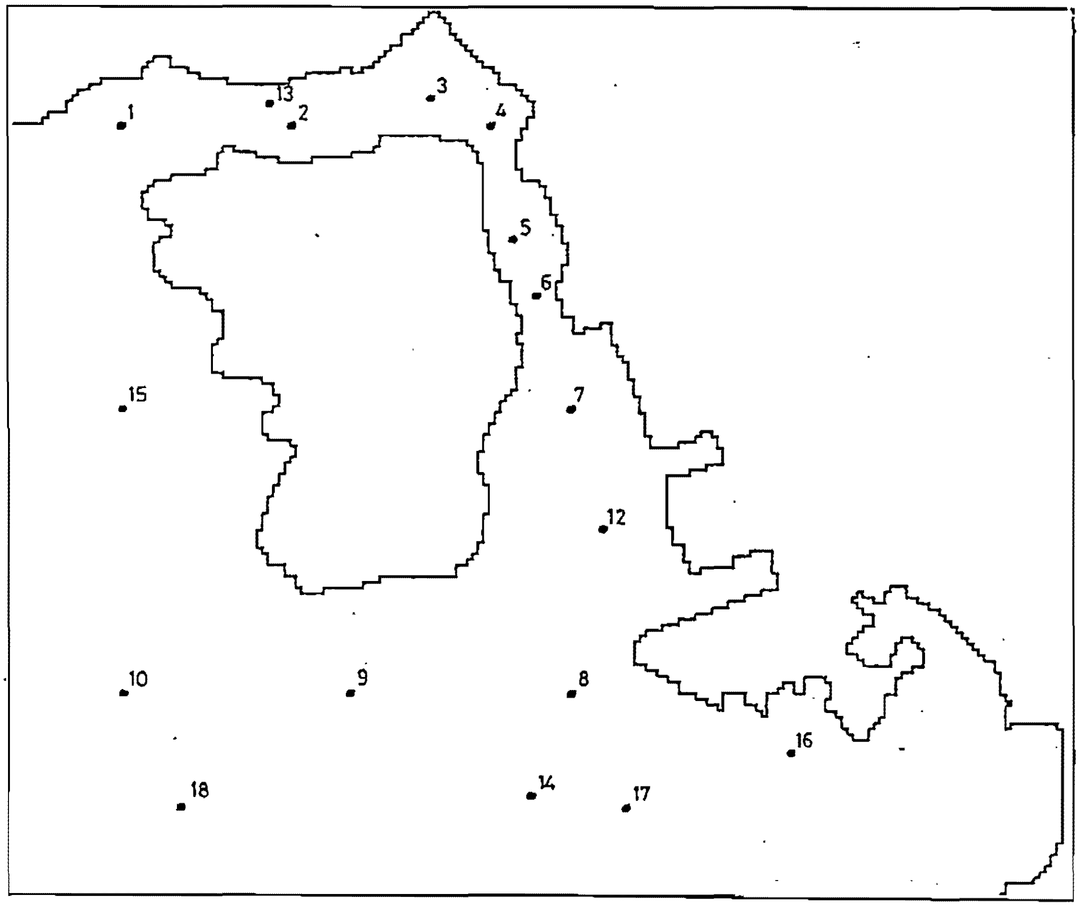
* Population = 11,237 Industrial (A) employees
1,284 Industrial (B) employees

* Load factors = SSS year 2001, where "hi-tech" industry load factors are assumed equivalent to SSS "machinery" category

Table F6 Total predicted flows and loads of domestic sewage and industrial process effluent from SETY Reclamation for "hi tech" or unrestricted industrial development

Industry	Flow (m^3/d)	Load (kg/d)					
		SS	BOD	COD	TKN	NH_3-N	*E. coli* (count/d)
"hi-tech" only	13,893	1,830	2,343	8,538	545	351	8.01×10^{14}
unrestricted development	40,610	6,364	11,990	32,633	680	364	8.01×10^{14}

APPENDIX F 7 LOCATION PLAN SHOWING WATER QUALITY MODELLING STATIONS



APPENDIX F8 CALCULATED MEAN VALUES OF WAHMO WATER QUALITY RESULTS, STATIONS 1-18 OF DO,BOD, AMMONIACAL NITROGEN, OXIDISED NITROGEN AND E-COLI

	BASE CASE	CASE 1		CASE 2		CASE 3	
		NEW DATA		94-95: RAMBLERS CHANNEL		96-97: STONECUTTER	
	mean	mean	%diff.	mean	%diff.	mean	%diff.
D.O.							
1	81.86	82.88	1.2	82.90	1.3	83.21	1.6
2	79.13	81.31	2.8	81.33	2.8	81.78	3.3
3	72.81	77.59	6.6	77.67	6.7	79.44	9.1
4	68.48	74.82	9.3	74.98	9.5	78.28	14.3
5	64.56	71.86	11.3	72.11	11.7	77.26	19.7
6	62.30	69.91	12.2	70.22	12.7	76.59	22.9
7	58.31	65.82	12.9	66.26	13.6	75.03	28.7
8	57.70	64.79	12.3	65.03	12.7	68.15	18.1
9	71.96	75.36	4.7	75.37	4.7	75.46	4.9
10	82.18	82.67	0.6	82.67	0.6	82.68	0.6
11			ERR		ERR		ERR
12	56.06	63.95	14.1	64.41	14.9	73.13	30.5
13	79.62	81.61	2.5	81.63	2.5	82.03	3.0
14	63.92	68.33	6.9	68.36	7.0	68.67	7.4
15	78.48	80.82	3.0	80.82	3.0	80.97	3.2
16	47.22	50.35	6.6	50.53	7.0	49.98	5.8
17	58.48	63.72	9.0	63.82	9.1	64.76	10.7
18	80.78	80.84	0.1	80.84	0.1	80.84	0.1
	68.46	72.74	6.3	72.88	6.5	75.19	9.8
Amm. N							
1	0.031	0.030	-2.7	0.030	-2.7	0.029	-4.4
2	0.028	0.026	-7.6	0.027	-5.7	0.025	-11.4
3	0.046	0.038	-17.8	0.038	-16.0	0.028	-38.5
4	0.067	0.058	-14.1	0.058	-12.9	0.028	-58.5
5	0.086	0.079	-8.4	0.083	-4.4	0.028	-68.1
6	0.098	0.094	-4.9	0.097	-1.6	0.028	-71.7
7	0.139	0.155	11.5	0.162	16.7	0.028	-80.2
8	0.096	0.087	-9.8	0.090	-6.2	0.096	0.0
9	0.048	0.041	-13.6	0.041	-13.6	0.041	-13.6
10	0.032	0.031	-3.3	0.031	-3.3	0.031	-3.3
11			ERR		ERR		ERR
12	0.097	0.096	-0.3	0.104	7.5	0.041	-57.8
13	0.028	0.026	-4.9	0.026	-3.9	0.026	-5.9
14	0.069	0.059	-14.1	0.060	-12.9	0.063	-9.0
15	0.041	0.036	-12.0	0.036	-12.0	0.035	-14.0
16	0.146	0.150	2.2	0.152	3.5	0.216	47.2
17	0.084	0.075	-11.3	0.075	-10.9	0.080	-5.1
18	0.033	0.033	-0.8	0.033	-0.8	0.033	-0.8
	0.069	0.065	-4.8	0.067	-2.2	0.050	-26.9
Oxd. N							
1	0.039	0.038	-4.1	0.038	-4.1	0.038	-4.8
2	0.042	0.041	-4.5	0.041	-4.5	0.039	-7.0
3	0.054	0.047	-13.0	0.047	-12.5	0.042	-22.5
4	0.065	0.053	-18.0	0.053	-18.0	0.044	-31.4
5	0.073	0.058	-19.7	0.059	-18.2	0.047	-35.7
6	0.078	0.063	-19.4	0.064	-17.6	0.049	-37.7
7	0.088	0.072	-17.6	0.075	-14.8	0.050	-42.6
8	0.105	0.083	-21.0	0.084	-20.5	0.077	-26.7
9	0.069	0.059	-13.4	0.059	-13.4	0.059	-13.4
10	0.041	0.039	-4.0	0.039	-4.0	0.039	-4.0
11			ERR		ERR		ERR
12	0.094	0.075	-20.4	0.076	-19.3	0.054	-42.5
13	0.042	0.040	-5.2	0.040	-5.2	0.039	-6.5
14	0.093	0.080	-14.0	0.080	-14.0	0.079	-14.6
15	0.050	0.044	-13.4	0.044	-13.4	0.043	-14.0
16	0.143	0.129	-9.5	0.131	-8.1	0.134	-5.9

17	0.108	0.092	-15.0	0.092	-14.5	0.089	-17.0
18	0.044	0.044	-1.8	0.044	-1.8	0.044	-1.8
	0.072	0.062	-14.0	0.063	-13.2	0.057	-21.2
Inorg. N.							
1	0.070	0.068	-3.5	0.068	-3.5	0.067	-4.6
2	0.071	0.067	-5.7	0.067	-5.0	0.065	-8.8
3	0.100	0.085	-15.2	0.086	-14.1	0.070	-29.8
4	0.132	0.111	-16.0	0.111	-15.4	0.072	-45.2
5	0.159	0.138	-13.6	0.142	-10.7	0.074	-53.3
6	0.176	0.156	-11.3	0.161	-8.7	0.076	-56.7
7	0.227	0.227	0.2	0.237	4.5	0.078	-65.7
8	0.202	0.170	-15.7	0.174	-13.7	0.174	-13.9
9	0.116	0.101	-13.5	0.101	-13.5	0.101	-13.5
10	0.073	0.071	-3.7	0.071	-3.7	0.071	-3.7
11			ERR		ERR		ERR
12	0.191	0.171	-10.2	0.180	-5.7	0.095	-50.3
13	0.069	0.066	-5.1	0.066	-4.7	0.065	-6.2
14	0.162	0.139	-14.0	0.140	-13.5	0.142	-12.2
15	0.091	0.079	-12.8	0.079	-12.8	0.078	-14.0
16	0.289	0.279	-3.6	0.283	-2.2	0.350	21.0
17	0.192	0.166	-13.4	0.167	-13.0	0.169	-11.8
18	0.077	0.076	-1.4	0.076	-1.4	0.076	-1.4
	0.141	0.128	-9.5	0.130	-7.9	0.107	-24.0
B.O.D.							
1	0.900	0.859	-4.6	0.855	-5.0	0.825	-8.3
2	1.081	0.944	-12.7	0.942	-12.8	0.909	-15.9
3	1.694	1.377	-18.7	1.358	-19.9	1.094	-35.4
4	2.249	1.898	-15.6	1.848	-17.8	1.206	-46.4
5	2.732	2.498	-8.6	2.405	-11.9	1.237	-54.7
6	3.006	2.875	-4.4	2.757	-8.3	1.270	-57.8
7	3.779	4.254	12.6	4.036	6.8	1.310	-65.3
8	2.060	2.103	2.1	2.057	-0.1	2.057	-0.1
9	1.108	1.004	-9.4	1.003	-9.5	0.993	-10.4
10	0.845	0.826	-2.3	0.826	-2.3	0.825	-2.4
11			ERR		ERR		ERR
12	2.764	3.001	8.6	2.875	4.0	1.463	-47.1
13	1.047	0.924	-11.8	0.923	-11.9	0.894	-14.6
14	1.389	1.289	-7.2	1.284	-7.5	1.316	-5.2
15	0.974	0.897	-7.9	0.896	-8.0	0.879	-9.7
16	2.587	2.725	5.3	2.702	4.4	3.807	47.1
17	1.654	1.597	-3.4	1.583	-4.3	1.633	-1.3
18	0.864	0.856	-0.9	0.856	-0.9	0.856	-0.9
	1.808	1.760	-2.6	1.718	-5.0	1.328	-26.5
E.Coli. (Geo. mean)							
1	1682.8	1538.4	-8.6	1538.2	-8.6	1468.7	-12.7
2	1014.0	947.4	-6.6	954.2	-5.9	939.4	-7.4
3	3273.2	2866.7	-12.4	2892.8	-11.6	2154.9	-34.2
4	6587.5	6081.2	-7.7	6080.5	-7.7	3073.8	-53.3
5	8093.3	8007.0	-1.1	7958.0	-1.7	2032.9	-74.9
6	10076.3	10367.3	2.9	10250.4	1.7	1823.6	-81.9
7	37368.1	48427.2	29.6	47834.2	28.0	1549.9	-95.9
8	5684.0	6341.9	11.6	6287.2	10.6	5267.9	-7.3
9	95.8	47.0	-50.9	46.9	-51.1	35.2	-63.3
10	11.2	9.9	-11.1	9.9	-11.1	8.9	-20.5
11			ERR		ERR		ERR
12	9544.1	13091.9	37.2	12887.8	35.0	2672.1	-72.0
13	1174.0	1096.0	-6.6	1102.9	-6.1	1089.7	-7.2
14	320.9	240.3	-25.1	239.1	-25.5	275.5	-14.2

15	64.7	44.7	-30.8	44.5	-31.1	21.0	-67.5
16	15831.7	18630.1	17.7	18606.9	17.5	35012.5	121.2
17	1789.8	2220.9	24.1	2206.8	23.3	2108.6	17.8
18	10.5	10.6	1.8	10.6	1.8	9.9	-4.9
	1254.3	1194.7	-4.8	1191.0	-5.0	668.7	-46.7

Figures presented are arithmetic means, except E-coli which is a geometric mean

APPENDIX G

LIGHTING GLARE

APPENDIX G LIGHTING GLARE

The basic formulae for calculation of lighting glare are:

(1)

$$GR = 27 + 24Log\ (\frac{L_{vl}}{L_{ve}{}^{0.9}})$$

Where GR : Glare rating

L_{vl} : Veiling luminance produced by the luminaires.

L_{ve} : Veiling luminance produced by the environment.

(2)

$$L_{vl} = 10 \sum_{i-1}^{n} \frac{E_{eyei}}{\theta i^2}$$

Where E_{eyei} : illuminance on the observers' eye in a plane perpendicular to the line of sight, produced by the ith light source, in lux.

θ_i : angle between the observers' line of sight and the direction of light incidence of the ith light source in the eye in degrees.

n : total number of light sources.

(3)

$$L_{ve} = 0.035 \times E_{hor \cdot av} \times \frac{r}{\pi}$$

Where $E_{hor.av}$: average horizontal area illuminance

r : reflectance of the area assuming diffuse reflection

Assessment scale for glare rating

GR	Interpretation
90	unbearable
80	
70	disturbing
60	
50	just admissible
40	
30	noticeable
20	
10	unnoticeable

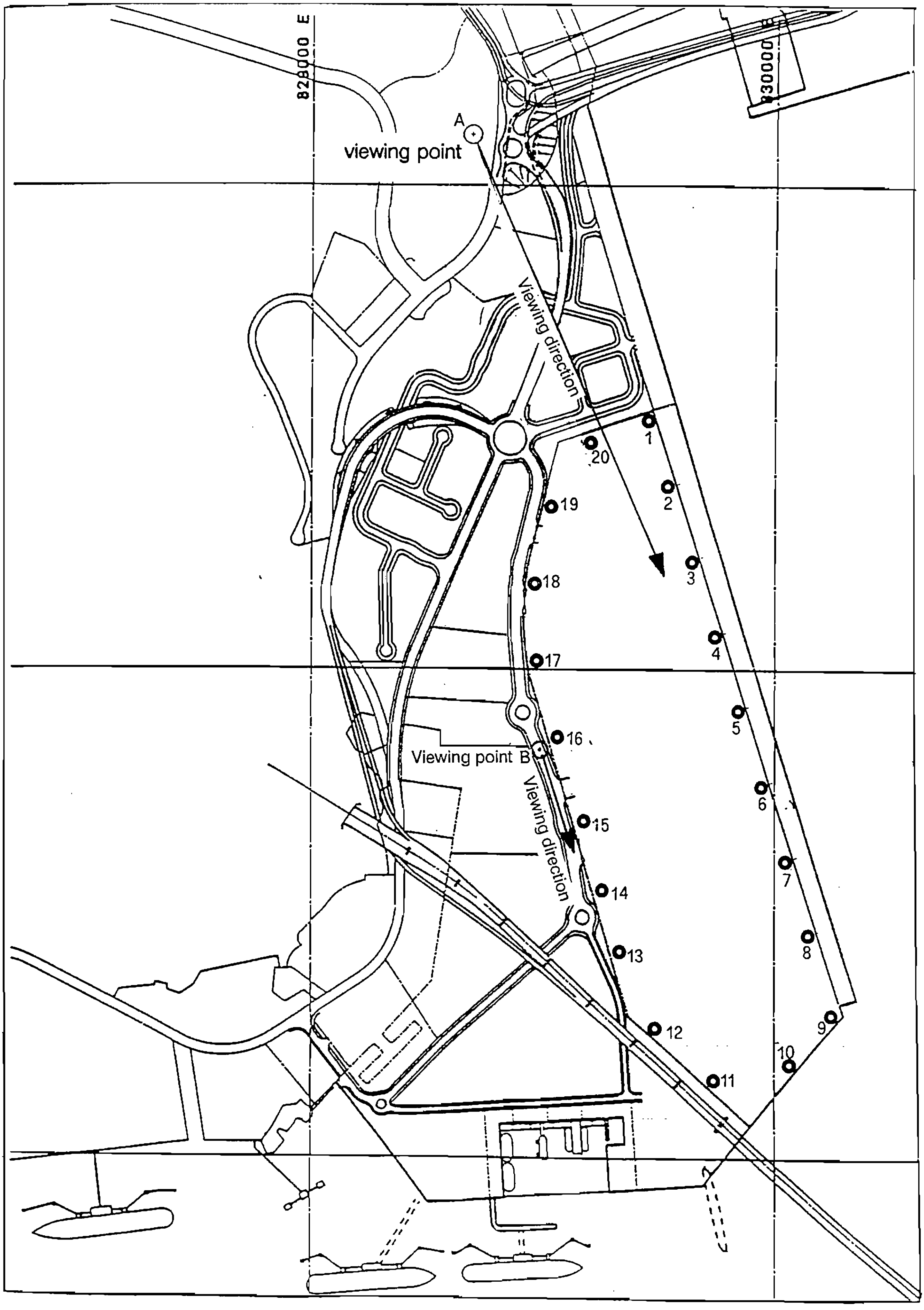


FIGURE G1: PROPOSED LOCATION OF LIGHTING TOWERS

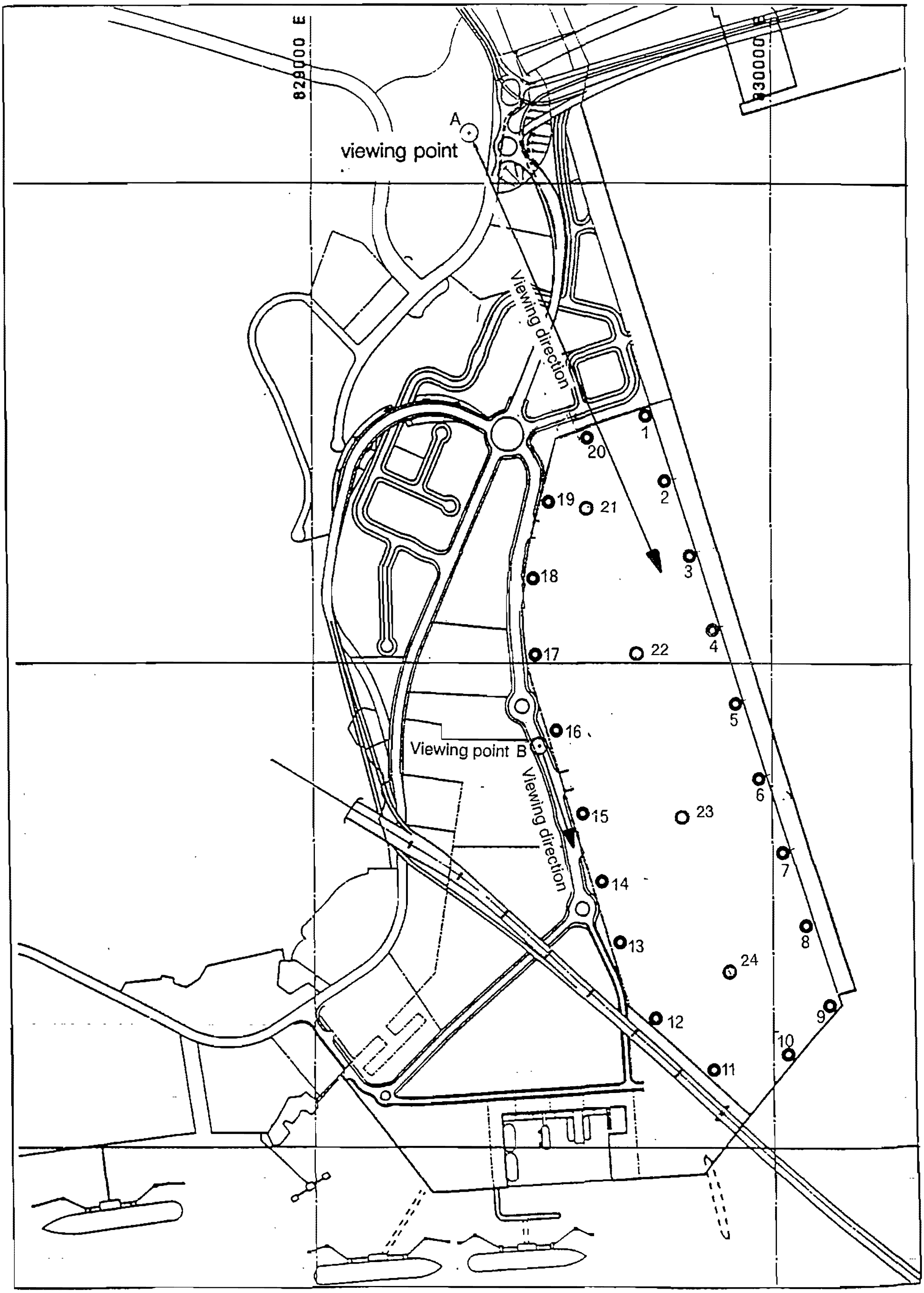


FIGURE G2: PROPOSED ALTERNATIVE LOCATION OF LIGHTING TOWERS

APPENDIX H

ENVIRONMENTAL GUIDELINES

CONTENTS

Appendix H

Environmental Guidelines

The Environmental Assessment has identified a number of impacts likely to arise from the construction and operation of the SETY development. In order to maintain these impacts at acceptable levels, a number of environmental controls have been recommended in Section 9.7 for inclusion in contract documents, lease conditions and short term tenancy agreements.

The EA study has demonstrated as far as possible on the basis of the available design information that the control limits specified can be achieved by adoption of certain mitigation measures or combinations of mitigation measures. Since there are various ways in which the specified environmental limits may be achieved, it is not recommended that specific mitigation measures are defined, but that lessees or tenants are made aware, e.g. by provision of the study reports, of the types of measures which could be adopted in order to achieve the required limits.

Examples of such measures are given in this appendix. They are guidelines only and do not represent an exhaustive list of all mitigation measures which could be adopted. It will be the responsibility of each contractor, lessee or tenant to derive the most appropriate set of mitigation measures to achieve the environmental limits required by law and those additionally specified in construction contracts, leases or tenancy agreements.

H.1 *Noise*

H.1.1 Construction

- The preliminary assessment presented in Section 9.2 indicates that there will be significant night time restrictions on the construction activities. Low noise techniques should be adopted where practicable, e.g. use of hand-held breakers and portable compressors complying with ECC Directives 84-537 and 84-533 respectively, and all equipment must include best practicable noise control to minimise the restrictions. Advice on this can be obtained from equipment manufacturers and DEP.

- The following techniques are preferred on noise grounds:

    - Cutter-suction dredging
    - Reverse circulation bored piling for the bridge and elevated roads

- The borrowing contractor should schedule blasting work into the daytime hours only.

H.1.2 Operation

- Area-equipment sound power level limits are shown in Table 9.2.8 for the various areas in the SETY port development. These limits provide an indication of the magnitude and distribution of allowable sound power level which has been calculated to give acceptable noise levels at the NSRs. It should be noted that demonstrating compliance with these levels does not necessarily imply compliance with the noise level limits. As stated in Section 9.7, compliance with the noise levels limits should be demonstrated by a predictive noise level assessment to the satisfaction of DEP.

- The RTG mode of operation is preferable, although it is considered practicable to specify sufficient noise control to ensure the acceptability of the Mixed mode. Straddle carrier noise control would be required, and should comprise enclosure of the diesel engine and silencing of the exhaust and ventilation openings.

- The design of the multi-storey CFS must include consideration of the noise issues. An internal spiral roadway is preferable. Ventilation systems should be enclosed, intakes and discharges should be silenced or directed away from the NSRs.

- The noise of the quay crane movement warning systems has been observed to be excessive. Alternative silent systems, such as interlocked guards or microwave detection should be investigated for suitability and approval for their use sought from Labour Department.

- Use of ships and quay cranes public address systems has been observed to be ill-disciplined. Suitable regulations should be enforced to prevent unnecessary use.

H.2 *Air*

H.2.1 Construction

- The contractor should be required to minimise nuisance arising from generation of total suspended particulates (referred to as 'dust' hereafter) as a result of his activities.

- In the process of material handling, any material which has the potential to create dust should be treated with water or wetting agent sprays.

- Air pollution control systems installed on dust-generating plant should be operated whenever the plant is in operation.

- Where dusty materials are being discharged to vehicle from a conveying system at a fixed transfer point, a three-sided roofed enclosure with a flexible curtain across the entry should be provided. Exhaust should be provided for this enclosure and vented to a fabric filter system.

- Any vehicle with an open load carrying area used for moving materials which have the potential to create dust should have property fitting side and tail boards. Materials having the potential to create dust should not be loaded to a level higher than the side and tail boards, and should be covered by a clean tarpaulin. The tarpaulin should be properly secured and should extend at least 300 mm over the edges of the side and tail boards.

- Other than for surcharging purposes, stockpiles of sand and aggregate greater than 20 m^3 should be enclosed on three sides, with walls extending above the pile and 2 meters beyond the front of the pile. In addition, water sprays should be provided and used both to dampen stored materials and when receiving raw material.

- The contractor should frequently clean and water the site to minimize the fugitive dust emissions.

- The contractor should restrict all motorized vehicles to a maximum speed of 8 km per hour and confine haulage and delivery vehicle to designated roadways inside the site. Areas of roadway longer than 100 m where movement of motorized vehicles exceeds 100 vehicular movements/day should be furnished with a flexible pavement surfacing.

H.3 *Water*

H.3.1 Construction

- Cutter suction dredgers should be operated to minimise overbreak and sedimentation around the cutter head.

- Barges and hopper dredgers should be:

  - sized to give adequate clearance and prevent turbidity generation from prop wash
  - loaded without splashing dredged material into the surrounding water, and with adequate freeboard to prevent overflow of dredged material by wave action
  - fitted with tight-fitting seals to prevent leakage from the bottom of the vessel during transport.

- Silt curtains, made of resistant permeable membrane or geotextile and fitted with floats and weights should be made available for the protection of cooling water intakes, in the event that suspended solids concentrations in the vicinity of the intakes exceed a tolerable threshold limit of 150 mg/l. Silt curtains should be designed and installed taking tidal range and potential navigational obstruction into account.

- The contractor should be required to ensure accurate positioning of vessels before dumping of dredged mud within the permitted disposal area and should be required to submit proposals on accurate position fixing in his methods statement.

- Additional precautions will be required when handling and disposing of contaminated mud. DEP (Waste Management Group) should be consulted regarding appropriate disposal sites and methodology.

- Silt traps should be provided to reduce the suspended solids content of site runoff. Water used for dust suppression purposes at batching plants, wheel and vehicle washing facilities should be passed through a settlement tank and reused, with no direct discharge.

APPENDIX I

EVALUATION OF CONCEPTUAL LAND USES

CONTENTS

APPENDIX I

EVALUATION OF CONCEPTUAL LAND-USE OPTIONS

1. Introduction

The Study Brief required the development of a range of conceptual land uses for south-east Tsing Yi from which a preferred land-use option was to be selected. It also required that the preferred land-use option allowed, as far as possible, maximum flexibility with regard to final shape, area and disposition of container berths and adjacent back-up facilities whilst also identifying opportunities for new development and mitigation of the environmental impact on existing sensitive receivers.

Based on the objectives given in the Study Brief a set of evaluation criteria were identified for each of the study work streams. The relative importance of each criterion within its own workstream or group was assessed and the importance of each group weighted relative to the other groups.

As a result of discussions with both the Working Group and Steering Group, the relative weightings of certain of the environmental criteria were revised. The weightings used in this evaluation are those subsequently endorsed by the Steering Group.

2. Conceptual Land-Use Options

Following an assessment of existing and committed land-use and development opportunities and constraints, a number of conceptual land use options for the new development areas were identified. These comprised 3 options in the north of the study area and 2 options in the south. Those to the north were termed "new land-use options" while those to the south were termed "reprovisioning options", since the latter concerned the reprovisioning of existing marine access rignts.

For the "new land use options", the following three industrial scenarios were formulated for evaluation:

(a) An Industrial Park Emphasis [Option A]

In this option, the priority was to achieve a comprehensive and well serviced I(B) zone area to accommodate a low-rise, high-tech industrial park managed along similar lines as those in Tai Po and Yuen Long Industrial Parks.

(b) A General Industrial Emphasis [Option B]

In this option, a high proportion of the new land-use opportunities were designated for flatted factory I(A) type development accommodating 'clean' industries.

(c) A District Recreational Emphasis [Option C]

This option was a variation of a portion of the area included in both options B and C above. This area is currently part of the Mobil Oil site. Being located in front of Mayfair Garden and the proposed Technical College it was intended to provide both active and passive recreation and act as a buffer use in complying with environmental guidelines. A conceputal layout was prepared, based on a possible resiting of the proposed Sports Complex in Area 3.

The reprovisioning options along the southern seawall were decided very simply as:-

(a) No dedicated Dow facility [Option X];

(b) Dedicated Dow facility [Option Y].

3. Method of Comparison

Since the evaluation exercise was essentially a qualitative exercise, requiring a high degree of professional judgement, the majority of the criteria could only be measured against a predetermined scale from 1 to 10. In some cases tangible parameters were used.

The evaluation compared the three new Land-use Options A, B and C by converting the value or measure of each criterion to a score such that the highest score represented the best solution for that particular criterion. The total score for all criteria was arranged as a percentage and indicated which of the schemes, on balance, was to be preferred.

A similar comparison was carried out for the Reprovisioning Options X and Y, ie the "without" dedicated berthing facilities and the "with" dedicated berthing facilities for Dow Chemicals.

4. Overall Comparison

From the comparison of the three new land-use options, Land-use Option B, which contained the high proportion of flatted-factory-type development, was identified out as the least preferred option. Comparison of the other two options was very close with Land-Use Option A, the Industrial Park Emphasis, scoring slightly better than the Recreational Emphasis in Land-Use Option C.

Option A was therefore selected as the Preferred Land-Use Option from evaluation of the three options according to the criteria and weighting factors agreed by the Steering Group. In reaching this conclusion, three points were noted. Firstly, that the difference in weighted scores between Option A and Option C was small, to the extent of almost being insignificant. This was considered reasonable, since it simply highlighted the choice between optimising environmental compatibility alongside that of revenue potential, assuming acceptable transport thresholds for each option. Secondly, although Option B did not appear to be totally unacceptable in relation to its weighted scores, when examined in terms of its environmental and traffic impact only, the difference between it and the other options became far more marked. Thirdly, although Option A scored the highest, certain advantages in each of the other two options, were considered worthy of further consideration in finalising the Preferred Land-Use Option. Option B, for example, included sites with a wider range of industrial mix. Likewise, in Option C, the location of an open space in front of the existing sensitive uses was desirable in terms of the acceptability of the Preferred Option to concerned local residents and environmental action groups.

With this in mind, it was proposed that further minor refinements of the land-use arrangements in Option A would be examined and prepared.

The results from the comparison of the two reprovisioning options pointed conclusively to the preference of not providing Dow Chemical with a dedicated berthing facility. This was primarily due to the hazard effect zone for the DGF pier (in Option Y) possibly extending onto the Route 3 (CRA4) Bridge. However, as Government indicated a requirement for a development plan with the capacity to provide for a dedicated Dow facility, the matter was reviewed. Subsequently, it was found possible to provide a dedicated Dow facility accessed by a trestle off the basin breakwater while keeping the reprovisioning basin in the Option X position. Had this alternative been evaluated, the scores would have been very much closer although Option X would have won marginally.

A detailed review of the various options is given in the following pages. Tables I.1 and I.2 present the relative scores for the Land-Use Options and the Reprovisioning Options respectively.

Environmental Impacts

E1 *PHI Risk*

There were no PHI risks which affected Land-use Options A, B or C and therefore this criterion was not applicable in the selection of a preferred option. An equal score was given.

Reprovisioning Option X would cause the DGF pier risk zone to fall within the areas of restricted worker density (i.e. within the 10^{-5}/year and 10^{-6}/year risk contours) which restrict certain areas to activities such as lorry parking. An average score was given.

Reprovisioning Option Y was considered unsatisfactory due to the possible encroachment of the hazard effect zone for a DGF pier incident onto the Route 3 (CRA4) bridge and therefore scored poorly.

E2 *Noise*

Land-use Option B was the least preferred due to the highest traffic noise and generation of noise from land-use components, there being the greatest allocation to industry. This was predominantly industry type A, in multi-storey units. However, it did provide the greatest shielding of residential areas from terminal operations.

Land-use Option A fell between Options B and C in terms of traffic noise and generation of noise from the land-use option. The 'high tech' industry type B should not generate as much noise as industry type A. This option provided limited shielding of residential areas from terminal operations.

Land-use Option C was preferable due to the lowest traffic noise from the land-use components, there being a lower land allocation to industry. However, it provided the least amount of shielding of residential areas from terminal operations.

There were no noise impacts applicable to the selection of the preferred reprovisioning option. Both options were given an average score.

E3 *Air Quality*

Land-use Option B was considered least preferable on the grounds of providing highest industrial GFA and worker numbers, and hence highest traffic generation. Considerable areas were allocated to industry type A in multi-storey units which may have had potential adverse impacts if emissions could not be limited or controlled as part of lease conditions.

Land-use Option A was considered preferable to Option B but not as satisfactory as Option C. Industrial GFA, numbers of workers, and hence traffic emissions were intermediate between the two other options. Industry was mostly of type B, which should not have had significant atmospheric emissions.

Land-use Option C was considered the preferable option, as it had the lowest industrial GFA and number of workers, and therefore generated marginally less traffic than Option A and B. There was least industrial development, hence atmospheric emissions would be lower and the industrial areas were sited further from the residential receivers. However, the sports stadium represents a sensitive receiver and may itself subject to adverse impacts from adjacent industry.

There were no air quality impacts applicable to the selection of the preferred reprovisioning option. Both options were given an average score.

E4 *Water Quality*

Land-use Option B was again considered the least favoured option, having the largest number of workers and hence generating the highest domestic sewage loads. Industry also had the potential for generation of maximum loads, although this should have been controllable through limitations on lease conditions and the statutory requirements of the Water Pollution Control Ordinance.

Land-use Option A was considered preferable to Option B but not as satisfactory as Option C. Industrial GFA and numbers of workers, hence potential domestic sewage and industrial process effluent generation, fell between the two other options. Industry was mostly of type B, which would be expected to give rise to lower pollutant loads than industry type A.

Land-use Option C was the favoured option, having the lowest number of workers in the area, hence generating the lowest domestic sewage loads. Land allocation to industry was lowest thus minimising the potential for industrial discharges.

There were no water quality impacts applicable to the selection of the preferred reprovisioning option. Both options were given an average score.

E5 *Lighting Glare*

Land-use Option C had the lowest density of surrounding buildings and may not have provided adequate shielding for the surrounding residential areas. It, therefore, scored poorly.

For Land-use Option A, the west side of the terminal was surrounded by high multi-storey industrial buildings and the glare disturbance to the nearby residents would be reduced due to the blockage of light by these buildings. It was awarded an average score.

For Land-use Option B the density of the industrial buildings was higher than that of Option A; thus the light blockage effect was improved and the glare disturbance reduced. A higher score was awarded.

There were no lighting glare impacts applicable to the selection of the preferred reprovisioning option. Both options were given an average score.

Land-Use Planning

LP1 *District Planning Compatibility*

In PADS, the Study area was designated for port development and related uses. In Metroplan, port related and medium density industrial uses were the predominant uses proposed. Metroplan also proposed a Sports Centre and Open Space adjacent to Mayfair Garden. Land-use Option A provided sites for medium density industrial developments but not a Sports Centre or Open Space adjacent to Mayfair Garden. Despite this, Option A was considered reasonably compatible with primary strategic planning intentions and as a result scored well.

Similar to Option A, Land-use Option B provided for a mixture of port-related and industrial uses. Although highly compatible with primary strategic planning intentions in both PADS and Metroplan, Option B also did not provide for a Sports Centre or Open space in front of Mayfair Garden. Despite this, Option B was considered reasonably compatible with primary strategic planning intentions and as a result scored well.

The large District recreational facility in Land-use Option C distinguished this option from the other two options. Although compatible in this respect with Metroplan proposals, it was unlikely that this planning intention could be justified in District demand terms. Option C therefore scored slightly lower than the other two options. The remainder of the industrial sites were similar in compatibility terms as Options A and B.

There was no difference between Reprovisioning Options X and Y in terms of their compatibility with district planning intentions. Therefore, both options were given an average score.

LP2 *Environmental Contribution*

Land-use Option A included land uses and site arrangements which on the one hand helped to minimise the environmental impact of CT9 on the sensitive receivers, and on the other hand, were visually and functionally compatible with such uses. The proposed medium rise buildings were located close to CT9, while the Industrial Park buildings, which included low rise, clean industrial uses, were located in front of such sensitive uses. Therefore, Option A was considered reasonably compatible in land-use terms.

Land-use Option B was similar to Option A in that Industrial (A) developments on Sites 8 (c) and 10 (a) served as a buffer between CT9 and the residential and educational uses. Compared with Option A, Option B had a high proportion of 1(A) uses on surrounding sites. The proximity of such medium rise development to the sensitive uses, coupled with the likely flatted factory nature of the operations contained therein, made Option B the least compatible option in environmental terms.

Land-use Option C would have enhanced the visual and functional amenity immediately in front of Mayfair Garden compared with uses in the other two options. This was considered beneficial in land-use terms. It would also partially have helped to moderate local objections on further industrial development in front of such developments, and as such, Option C scored higher than the other two options.

This criterion was not applicable to the preferred reprovisioning option because the environmentally sensitive uses would not be affected by uses in the reprovisioning basin and both options were given an average score.

LP3 *Physical Design Opportunities*

Land-use Option A was compatible with existing landscape and landform but did not particularly enhance the existing landscape or landform.

Land-use Option B was similar to Option A, in that it was compatible with existing landscape and landform but did not particularly enhance the existing landscape or landform.

Such a large landscaped and recreational area as in Land-use Option C would have helped to maintain a degree of 'openness' in the immediate area, but, would have served only marginally to enhance overall compatibility.

This criterion was not applicable to the preferred reprovisioning option because the basin area was small and on newly reclaimed land. Therefore, both options were given an average score.

LP4 *Land Optimisation*

In terms of development potential, Land-use Option A, being substantially I(B) industry with a plot ratio of 2.5, was not an optimum use compared with the theoretical maximum development potential of a 9.5 PR. With a higher number of smaller sites, Option A would also have been less optimum than Option B as a higher proportion of land was used for road space.

As Land-use Option B included a large proportion of I(A) development sites with a 9.5 PR, land optimisation was higher than the other two Options.

The arrangement of Option X resulted in a less optimal land configuration as two irregular shaped sites were created east and west of the reprovisioned basin. On the other hand, the eastern location of the reprovisioned basin in Option Y produced better site configuration in the form of a large usable site west of the basin. Therefore, compared with Option X, Option Y allowed for a better optimisation of available land resources and scored higher.

LP5 *Land-use Flexibility*

The designation of a large area as Industrial Park in Land-use Option A suggested comprehensive planning by a single operator which in turn suggested less overall flexibility for accommodating later changes in land use other than those which were compatible with the Industrial Park objectives.

As Land-use Option B contained numerous large sites likely to be developed individually over time, opportunities to accommodate future land use changes were higher in comparison with Options A or C.

The large site area (8 ha) and internal arrangements of Land-use Option C were likely to lessen opportunities to accommodate future changes in land use, both within the site and in respect of necessary changes in the surrounding area. It was therefore awarded a lower score.

All options over provided for off-port back-up areas which could help to alleviate shortfalls elsewhere (at the expense of increased traffic on Tsing Yi Bridge) or have provided opportunities for other low worker density use.

In Option X, two sites of irregular shape are created east and west of the reprovisioning basin. The provision of these two sites is considered less flexible than provision of the large site west of the Basin in Option Y. As such, Option Y is scored higher than Option X.

LP6 *Reprovisioned Land-use Efficiency*

This criterion was not applicable to the preferred land-use option and all three options were given an average score.

The arrangement in Option X resulted in slightly shorter road and service linkages between the basin and the existing uses compared with the eastern location of the basin in Option Y. Option Y was therefore less efficient, in linkage terms, than Option X and thus, Option X scored slightly higher.

Port Planning

PP1 *Back-up Areas*

All options provided the same amount of back-up area, equal to or exceeding that required for Container Terminal 9 as follows:-

	Required	Provided
Empty container storage and repair	6	6.59
Lorry parking	16	25.42
Multi-storey CFS	4	4.18

As such all options scored equally

PP2 *Lighter Frontage*

All options provided a Public Cargo Working Area comprising a berthing face of 520 metres which is less than the need identified in Metroplan of 690 metres.

PP3 *Terminal Efficiency*

All options provided for a 60ha terminal area which is adequate for the specified throughput of 1.6 million TEU/year. This included a 5% overprovision of terminal area to compensate for any loss in operational efficiency due to the land constraint in the north-west corner which prevents a rectangular-shaped terminal area. As such, all options scored equally.

PP4 *Reprovisioning Suitability*

The layout of the marine reprovisioning basin for Outboard Marine, Tai Tung, CWTF and the DGF was the same for Land-use Options A, B and C which scored equally. In addition, all options catered for a dedicated CRC berth.

Reprovisioning Option Y, however, provided for a dedicated Dow Chemical berthing facility whereas Reprovisioning Option X did not. Option Y was not preferred as it placed another operator within the flash fire hazard zone of the DGF. With three tanker berths (Esso, CRC and Dow) all in close proximity, there was also an increased risk that vessel facilities or vessels would be damaged in an incident such as an aborted berthing. Option Y scored slightly less than Option X.

Costs

EC *Total Engineering & Infrastructure Costs*

The cost of dredging, reclamation and edge structures would be the same for Land-use Options A, B and C.

Reprovisioning Option Y would cost slightly more than Option X as a result of the dedicated Dow Chemical berthing facility the cost of which it is assumed would be borne by Government. The additional cost was however expected to represent only a very small percentage of the total SETY development.

EC *Total Resumption & Compensation Costs*

These costs were undetermined at that stage in the Study but were assumed to be the same for all options.

R *Potential Revenue*

Valuations based on the increases in construction costs and the current market conditions were carried out and the land revenues for Land-use Options A, B and C were estimated as follows:-

Option A	Option B	Option C
$740M	E980M	$510M

Traffic Impacts

T1 *Traffic Volumes*

Land-use Option B was the least preferred as the very high volumes of generated traffic would have led to limited spare capacity and possibly over capacity at junctions along Kwai Tsing Road and Tsing Yi Bridge. This option scored poorly.

Land-use Option A scored better but was still not entirely satisfactory because high traffic volumes would have led to limited spare capacity at junctions along Kwai Tsing Road and Tsing Yi Bridge.

Land-use Option C scored better still as the associated lower traffic volumes would have resulted in some spare capacity at junctions.

Traffic volumes were unaffected by either of the two reprovisioning options which were given an average score.

T2 *Distributive Effects*

The distributive effects remained constant, irrespective of various land-use options or the reprovisioning options. They were all given average scores.

Programme

P1 *Confidence in meeting 1st berth date*

Confidence in achieving the first berth commissioning date was not influenced by Land-use Options A, B and C or by Reprovisioning Options X and Y. The Brief required that commissioning of the first berth occured no later than November 1994. At that stage, it was believed that achieving this deadline was unrealistic and so all options scored poorly.

P2 *Phasing of Reprovisioning*

Phasing of reprovisioning was not affected by Land-use Options A, B and C, but was influenced by Reprovisioning Options X and Y. If a dedicated Dow Chemical berth facility was required, overall reprovisioning would become more extensive increasing phasing constraints and construction congestion. Option Y scored less favourably as a result.

P3 *Expeditious Completion of Development*

Development completion corresponded with the commissioning of the last container terminal or reprovisioned marine facility. The overall programme was constrained by various factors such as site availability, decommissioning of PHIs, road improvements and reprovisioning of existing services. In general, these factors were independent of land-development options. Reprovisioning Option Y, however, with a dedicated Dow berthing facility had a higher risk of construction delays and so scored slightly less favourably than other options.

Table I1: SETY Study : Evaluation of Land-use Options

Group & Weighting (%)	Ref	Criterion	Weighting	Unit	Measure A	Measure B	Measure C	Score % A	Score % B	Score % C
Environmental Impacts (25)	E1	PHI Risk	0.35	Scale	10	10	10	2.92	2.92	2.92
	E2	Noise	0.30	Scale	6	4	8	2.50	1.67	3.33
	E3	Air Quality	0.15	Scale	6	5	7	1.25	1.04	1.46
	E4	Water Quality	0.15	Scale	6	5	7	1.25	1.04	1.46
	E5	Lighting Glare	0.05	Scale	5	7	3	0.42	0.58	0.25
Land-Use Planning (25)	LP1	District Planning Compatibility	0.10	Scale	8	8	6	0.91	0.91	0.68
	LP2	Environmental Contribution	0.40	Scale	7	4	8	3.68	2.11	4.31
	LP3	Physical Design Opportunities	0.10	Scale	5	5	7	0.74	0.74	1.02
	LP4	Land Optimisation	0.30	Scale	6	8	3	2.65	3.53	1.32
	LP5	Land-use Flexibility	0.05	Scale	6	7	4	0.44	0.52	0.29
	LP6	Reprovisioned Land-use Efficiency	0.05	Scale	5	5	5	0.42	0.42	0.42
Port Planning (15)	PP1	Back-up Areas	0.10	ha	39.5	39.5	39.5	0.50	0.50	0.50
	PP2	Lighter Frontage	0.20	m	520	520	520	1.00	1.00	1.00
	PP3	Terminal Efficiency	0.40	Scale	8	8	8	2.00	2.00	2.00
	PP4	Reprovisioning Suitability	0.30	Scale	8	8	8	1.50	1.50	1.50
Costs (15)	EC	Total Engineering & Infrastructure Costs		$M	Equal		Equal			
	RC	Total Resumption & Compensation Costs		$M	Equal		Equal			
	R	Potential Revenue	1.00	$M	740	980	510	4.98	6.59	3.43
Traffic Impacts(10)	T1	Traffic Volumes	0.75	Scale	4	2	6	2.50	1.25	3.75
	T2	Distributive Effects	0.25	Scale	5	5	5	0.83	0.83	0.83
Programme (10)	P1	Confidence in meeting 1st berth date	0.40	Scale	1	1	1	1.33	1.33	1.33
	P2	Phasing of Reprovisioning	0.40	Scale	8	8	8	1.33	1.33	1.33
	P3	Expeditious completion of Development	0.20	Scale	6	6	6	0.67	0.67	0.67
		Total Score						33.82	32.48	33.70

Table I2: SETY Study : Evaluation of Reprovisioning Options

Group & Weighting (%)	Ref	Criterion	Weighting	Unit	Measure		Score %	
					X	Y	X	Y
Environmental Impacts (25)	E1	PHI Risk	0.35	Scale	5	2	6.25	2.50
	E2	Noise	0.30	Scale	5	5	3.75	3.75
	E3	Air Quality	0.15	Scale	5	5	1.88	1.88
	E4	Water Quality	0.15	Scale	5	5	1.87	1.87
	E5	Lighting Glare	0.05	Scale	5	5	0.62	0.62
Land-Use Planning (25)	LP1	District Planning Compatibility	0.10	Scale	5	5	1.25	1.25
	LP2	Environmental Contribution	0.40	Scale	5	5	5.00	5.00
	LP3	Physical Design Opportunities	0.10	Scale	5	5	1.25	1.25
	LP4	Land Optimisation	0.30	Scale	4	6	3.00	4.50
	LP5	Land-use Flexibility	0.05	Scale	4	5	0.56	0.69
	LP6	Reprovisioned Land-use Efficiency	0.05	Scale	5	4	0.69	0.56
Port Planning (15)	PP1	Back-up Areas	0.10	ha	39.5	39.5	0.75	0.75
	PP2	Lighter Frontage	0.20	m	520	520	1.50	1.50
	PP3	Terminal Efficiency	0.40	Scale	8	8	3.00	3.00
	PP4	Reprovisioning Suitability	0.30	Scale	8	7	2.40	2.10
Costs (15)	EC	Total Engineering & Infrastructure Costs		Scale	8	7	8.00	7.00
	RC	Total Resumption & Compensation Costs		$M	Equal	Equal		
	R	Potential Revenue	1.00	$M	Zero	Zero	0.00	0.00
Traffic Impacts(10)	T1	Traffic Volumes	0.75	Scale	5	5	3.75	3.75
	T2	Distributive Effects	0.25	Scale	5	5	1.25	1.25
Programme (10)	P1	Confidence in meeting 1st berth date	0.40	Scale	1	1	2.00	2.00
	P2	Phasing of Reprovisioning	0.40	Scale	8	7	2.13	1.87
	P3	Expeditious completion of Development	0.20	Scale	6	5	1.09	0.91
		Total Score					51.99	48.00

APPENDIX J

STEERING GROUP AND WORKING GROUP MEMBERSHIP

APPENDIX J

SOUTH-EAST TSING YI PORT DEVELOPMENT PLANNING & ENGINEERING FEASIBILITY STUDY FOR CONTAINER TERMINAL NO. 9 (SETY STUDY)

STEERING GROUP MEMBERSHIP LIST

Department	Name	Post
TDD	Mr K C Yeung (Chairman)	PM/TW
TDD	Mr P B Keown	DPM/TW
TDD	Mr B H Coultous	CE/PD
Plan. D	Mr I T Brownlee	DPO/TW
Plan. D	Mr G J Roberts	STP/CT
W. Br	Mr R J Harris	CE/NAW
CNTA	Mr P Tang	DO/K&T
BLD	Mr C H So	DLO/K&T
MD	Mr R A Kent	PMO/P
TD	Mr G Wells	E/PAD
PDB	Mr I B Dale	DS/PDB
EMSD	Mr E T Leddy	SE/Gas SO
EPD	Mr E W K Lam	E(EA) 16
CESD	Mr T L Loong	CE/PW
HyD	Mr T N Cheng	SE(2)/R3

SOUTH-EAST TSING YI PORT DEVELOPMENT PLANNING & ENGINEERING FEASIBILITY STUDY FOR CONTAINER TERMINAL NO. 9
(SETY STUDY)

WORKING GROUP MEMBERSHIP LIST

Department	Name	Post
TDD	Mr P B Keown	DPM/TW
TDD	Mr B H Coultous	CE/PD
TDD	Mr Chris Choi	E/CT
Plan. D	Mr G L Roberts	STP/CT
Plan. D	Mr. Jimmy Leung	STP/K&T
BLD	Ms Eugina Fok	SES/K&T
MD	Mr N B Smith	SMO/P
TD	Mr G Wells	E/PAD
HyD	Mr C F Chan	E/Route 3
CESD	Mr P F Ma	E/CPE
DSD	Mr K M Siu	E/TY
EMSD	Mr Lewis Ho	E/GS
EPD	Mr Edward Lam	E(EA)/16
CNTA	Mr Rex Chang	ADO/D
FSD	Mr S L Lau	CFO

APPENDIX K

RESPONSES TO COMMENTS ON DRAFT FINAL REPORT

APPENDIX K Responses to Comments on Draft Final Report

Contents

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Director of Buildings and Lands	BLD 1/KT?DV/90 II	25 June 1991	K1
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Commissioner of Police	(59) in CP/T/TMB 151/67 XV	4 July 1991	K5
Director of Environmental Protection	in EP 1/G/42 Annex 1 (EPD 1)	8 July 1991	K6
Director of Electrical & Mechanical Services (GSO)	(33) in GSO/47/NT/TY/02 II	11 July 1991	K8
Project Manager (Tsuen Wan)	( ) in TW 2/350CL/5	11 July 1991	K10
Secretary, Port Development Board	PDB 5/110/90 III	11 July 1991	K14
Chief Engineer/Route 3	(2) in HR3 7/3/91 VI	11 July 1991	K16
Director of Fire Services	(40) in FSD 1/790/90	11 July 1991	K18
Director of Marine	(33) in PA/S 909/47/11(6)	12 July 1991	K19
District Lands Officer, Kwai Tsing	(9) in DLO/KT 1/155/90 III	12 July 1991	K21
Director of Environmental Protection	EP1/G/42 Annex 1 (EPD 2)	12 July 1991	K23
Chief Engineer, Port Works Civil Engineering Office, Civil Engineering Services Department	(18) in PWO 33/2428/90 IV	10 July 1991	K28
Chief Engineer/Mainland South Drainage Services Department	(44) in D(MS) 10/5/26	12 July 1991	K29
District Planning Officer/Tsuen Wan	(69) in PD/TW 2/350OCL/4 II	12 July 1991	K30
Chief Engineer/Route 3 Highways Department	( ) in HR3 7/3/91 VI	15 July 1991	K32
Chief Engineering/Lighting, Lighting Division, HyD	(9) in HL 08/18	11 July 1991	K33
Chief Engineer/Mainland South Drainage Services Department	(45) in D(MS) 10/5/26	15 July 1991	K34
Chief Highway Engineer (D&M)/NT Highways Department	( ) in HNT KCL 9	15 July 1991	K36
Director/NAPCO	(46) in PADS/PCO 4/11/24	12 July 1991	K37
Chief Engineer/Planning Water Supplies Department	WWO 432/3051/90	16 July 1991	K38
Commissioner for Transport	CT/PAD 171/200-10 III	19 July 1991	K39
Secretary for Transport	TRAN 4/06/122 (90)	19 July 1991	K43
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Director of Industry	(82) in ID 305/10 VII	15 July 1991	K46
Principal Government Geotechnical Engineer	(13) in GCP 1/4/457	19 July 1991	K47
Director of Environmental Protection	EPI/G/42 Annex 1 (EPD 3)	26 July 1991	K49
Director of Environmental Protection	EPI/G/42 Annex 1 (EPD 4)	26 July 1991	K50
Director of Environmental Protection	EPI/G/42 Annex 1 (EPD 5)	26 July 1991	K51

Page Ref in Draft Final Report	**Comments**	**Responses**
Director of Buildings and Lands, Ref: BLD 1/KT?DV/90 II, Date: 25 June 1991		
Page 2.9 Section 2.5 (and 13.4)	"Decision 3" provides for the conclusion of negotiations with existing water-front users by 1/2/92. Assuming finalisation of the Report by mid-August and DPC/LDPC adopted thereof without major amendment, by say - September, then <u>even</u> if finance was readily available, four months to complete and document negotiations with these major private Companies is grossly inadequate. One year would be a more realistic term. The Report should acknowledge this and briefly consider the implications.	It was understood that preliminary negotiations between Government and existing waterfront users had commenced during this Study. Programme A assumed, therefore, that these negotiations could be finalised in phase with Statutory Procedures, ie by 1st February 1991 (over a 9 month period) allowing one month to then finalise development tender documents. It is expected that any delay in finalising these negotiations would lead to a commensurate delay in the development award (programmed on or before 9th July 1992) and subsequent container berth commissioning. If, as DBL/BLD suggests, 1 year is required to finalise development tender documents (from the adoption of the Final Report by DPC/LDPC in early September 1991) then first berth commissioning could not be expected until mid December 1995 which is aproximately 6 months later than shown in Programme A. It should be noted that this report recommended that an extension of 6 months to all commissioning dates shown in Programme A be allowed for in the Development Lease Conditions to enable a more acceptable programme confidence level. (Refer to Section 12.9 and the table at the end of this Appendix)
Page 3.3 Para 3.3.3	Re. Hong Kong Oil, penultimate line, please desist from using the word "relocated" in favour of "decommissioned". This also applies elsewhere in the Report.	Noted. We have amended to "removed" as was intended.
Page 4.6 Para 4.6.1	Re. Dow Chemical, it is quite correct that the Report should address their marine access requirements however I remain unconvinced that an exclusive dedicated pier is the answer. We should be encouraging multi-user marine facilities whenever possible. There is no doubt in my mind that the Dow solution is hospitality rights with CRC on their proposed new super-pier and I am aware that Dow and CRC are already talking. The problem is that Dow are fully aware of the exclusive pier option and hence are reluctant negotiators with CRC. Government/ Consultants need to harden our stance on this issue to achieve the desired effect, i.e. force them to the negotiating table.	Earlier on in the Study, the preferred development option contained a shared-use facility for DOW. However, on the advice of SES/KT,BLD, the Steering Group directed that a dedicated pier be carried through to the DFR as a fall-back position for Government. The Report, however, notes that this pier could be for shared use with others if so decided. A Government decision (at DPC level) is needed as to whether:- - a separate pier should be provided - if it is, whether it should be sole user or shared with others.

	In addition, CRC, who have gained access (?) to your draft plan showing the two piers are naturally upset since it negates the provisionally agreed site configuration for their expansion area. I would not wish to see this provisional agreement prejudiced bearing in mind the recognised desirability of clearing Nga Ying Chau.	The plan was provided by Government. The Steering Group was fully aware of the possible conflict, but in the absence of any approved CRC plans, the Study plans were endorsed.
Page 11.6 Section 11.8	I would like to see this Report please.	The draft Financial Appraisal was issued to PM(TW) on 27.6.91.
Page 12.8 Para 12.7.3	In this section, and indeed elsewhere in the Report, please do not assume disposal of CT 9 by tender, the manner of disposal will be considered nearer the day. For your purposes perhaps the word "award" should more appropriately be "grant" and in addition, as referred to above, the "grant" by July 1992 does not seem possible in the light of the residual marine/land issues discussed in Paragraph 2.5.	Noted. Text now refers to "development tender award or development grant " to cover both possibilities. See response to Section 2.5.

Responses to Comments on Draft Final Report

Page Ref in Draft Final Report	Comments	Responses
District Officer (Kwai Tsing) Ref: KC D/2/38 IV Date: 3 July 1991		
Chapter 8	We can see two areas which the Kwai Tsing District Board and pressure groups in Tsing Yi will make the best use of in objecting to the siting of CT 9 on Tsing Yi Island on traffic and environmental grounds. Firstly, there is no practical solution to the traffic problem that will happen in 1996 under the "worst case scenario" and such scenario may well happen if the growth of the container trade continues at the present rate such that CT 9 may well be fully developed before CRA4 of Route 3 is completed by 2001. Also, it is unlikely that Ting Kau Bridge will be in place by 1996. In fact, the real situation may be much worse than the "worst case scenario" as the CRA 1 of Route 3 may not be fully completed by 1996. Strictly speaking, the Route 3 CRA1, CRA4 and the Ting Kau Bridge fall outside the scope of the study. However, I do not see how we can present a strong case to the public without addressing this problem. Without the completion of these to synchronise with the development of CT 9, the duplicate South Bridge will evidently not be able to prevent serious congestion in Kwai Tsing and Tsuen Wan as a result of traffic generated by CT 9.	The 1996 "worst case scenario" was generally accepted as the worst case for the purposes of this Study. This is because it is assumed that Route 3 is not in place and that all of the SETY developments are fully operational. Land use and highway network input assumptions were specified by the Study Brief at the beginning of the Study. Since then, it has become apparent that the "worst case scenario" will not occur due to the proposed timing of the reclamation and the opening of the container berths. Para 2.2.9 summarizes the construction programme and states that the more reasonable Programme A will commission berths from June 1995 to July 1997 at approximately eight month intervals. The phasing of the development within the industrial areas has not, however, been addressed in this Study, but it is likely that sites will not be fully developed and occupied until 1998/1999. Route 3 CRA1 Kwai Chung Section is currently programmed to be in place by mid-1996. This will provide direct slip road connections to and from the eastern end of Tsing Yi Bridge thereby providing relief to Kwai Tsing Road and, in particular, to the Kwai Tsing Road/Kwai King Road junction. On the basis of the above, by mid 1996 only one or two berths of CT9 will be operational. It is unlikely that all of the industrial sites will be occupied. Therefore, the 1996 model tests are considered to represent a "worst case scenario" which is highly unlikely to occur. The CRA4 alignment of Route 3 is <u>not</u> programmed to be completed by 2001. It is currently assumed to be needed as a bypass to the CRA1 alignment in 2011. As stated, the Ting Kau Bridge section of Route 3 CRA1 will not be in place by 1996. It is now programmed to be completed by 1998. This scenario has been tested in the Route 3 Preliminary Design - Phase II Study by the SPHW consultancy team for Highways Department. The tests included the proposed SETY developments and the results were documented in the Route 3 Technical Report No.31: Delayed Ting Kau Bridge, April 1991. The results of the test were presented to the Kwai Tsing District Board by Highways Department in February 1991.

Sections 9.2 and 9.3	Secondly, no practical solution is proposed to mitigate traffic noise resulted from vehicles passing in and out the Terminal and through local roads on the Island although the HKPSG at some locations are exceeded. As regards air pollution, there may be questions on whether the traffic emissions comply with the AQOs.	Mitigation of traffic noise is discussed in Para 9.2.5, Page 9.15. As indicated in Para 9.3.2, Page 9.2, air quality modelling showed that traffic emissions will not cause the AQOS to be exceeded.

Responses to Comments on Draft Final Report

Page Ref in Draft Final Report	Comments	Responses
Commissioner of Police Ref: (59) in CP/T/TMB 151/67 XV Date: 8 July 1991		
Page 8.12 Para 8.9.1	Tsing Yi South Bridge Whereas the duplicate bridge is very welcome and the proposal implementation schedule fully endorsed, there is no indication as to the condition and estimated life span of the existing bridge, which must be a critical factor.	We are pleased to note endorsement of the proposed implementation schedule. Advice from HyD (Struct) indicated that there was no concern over the condition or serviceability of the existing bridge. Para 7.4.1 has been expanded to explain this point.
Page 8.24 Para 8.12	Route 3 CRA1 The points concerning the inter-dependency of CRA1 and the Duplicate South Bridge (para 7.4.3) are well taken; it is felt, however, that the point concerning the capacity of local roads to accommodate SETY developments without Route 3 (CRA1) could be more emphatic, in recommending that the SETY developments should not proceed without Route 3 (CRA1).	The emphasis on the implementation of local road improvements and Route 3 (CRA1) was deliberately played down in recognition of Government's action in proceeding with the Route 3 project.
Page 7.2 Para 7.2.3	Access to Container Terminal etc The recommendation of a minimum dual-2 lane carriageway for SETY Port Road, with an additional queuing lane, is most welcome and fully endorsed.	Noted.
Chapter 8	Construction Phase Impact I can see no reference to the likely impact, on existing traffic movements, caused by land-based construction activity. This is of particular concern with regard to construction of the Duplicate Bridge and the double-roundabout.	The impact of construction traffic was not part of the Study Brief. It will, however, be addressed in the preliminary design for the Duplicate South Bridge.

Responses to Comments on Draft Final Report

Director of Environmental Protection Ref: in EP 1/G/42 Annex 1 (EPD 1) Date: 8 July 1991

Page Ref in Draft Final Report	**Comments**	**Responses**
Section 9.2	Reference is made to the Draft Final Report (June 1991), the subsequent meeting on 21.6.91 from the Consultants, and the fax messages of 24.6.91 and 4.7.91 from the Consultants.	
	It is noted that there has been minor changes in the tables showing the traffic noise levels associated with the effects of covering certain road sections.	
	From the figures as presented in CES's fax of 4.7.91, the major noise contributions from the various road sections could be deduced as follows:	The noise contributions deduced for different sections are correct (to within 0.2DBA).

Major contributor	Traffic noise levels as deduced from Table 9.2.9 NSR3	NSR4	NSR6
Old Tsing Yi Road	70.6	72.4	-
New Tsing Yi Road North	66.5	70.4	-
Tsing Yi Heung Sze Wui Rd.	-	-	72.2
Slip 3-5	-	-	69.5

	It appears from the above figures and the topographical features of the NSRs concerned that some other form of mitigation might also be possible. Whilst I noted that the proposed road covers achieve a certain noise reduction at the NSRs, other simpler or cheaper alternatives attaining similar target(s) would certainly be desirable. Therefore, I would like the Consultants to advise if the following alternatives are effective / feasible and the respective cost implication:	Noted.

NSR 3 Cheung Ching South

Whether the combined traffic noise level could be brought down to the HKPSG standard by applying pervious asphalt to the Old Tsing Yi Road;	Calculations show that use of pervious asphalt for the Old Tsing Yi Road alone would only reduce noise levels to 71dBA. This level is still above the HKPSG Standard. With suitable barriers along New Tsing Yi Road (below) the predicted level is 70dBA ie. at the HKPSG limit. The 'reduced set' of mitigation measures proposed in the revised DFR text would reduce levels to 68dBA.

NSR 4 Ching Tao House

Whether the noise reduction resulted from applying pervious asphalt to Old Tsing Road coupled with road side barriers along the New Tsing Yi Road North could achieve a similar noise reduction as given by covering the Old Tsing Yi Road; and,	Use of the above pervious asphalt for the Old Tsing Yi Road together with barriers along New Tsing Yi Road could reduce levels at NSR 4 to approx 74dBA, slightly above the level given by the proposed mitigation package. However, to achieve this reduction, we believe the barrier would have to be at least 5-6m high, and may therefore, not be practical on this section of road. Use of this option would also not achieve the 3dBA improvement relative to the no SETY development option considered desirable by EPD.

NSR 5 Cheung Ching North

Whether cantilever type barriers along the Tsing Yi Heung Sze Wui Road and the slip road 3-5 are practical and effective in noise mitigation. I have reservation in accepting the revised text per the Consultants' fax of 4.7.91 for Para 9.2.5 on "Mitigation Measures" until it has been demonstrated that the proposed covers are the best viable and effective options.	We believe that, to effectively screen the north carriageway of Tsing Yi Heung Sze Wui Road only would require a barrier 8-10m high; to screen the whole road would require a barrier approx 20m high. The elevated slip road will screen part of Tsing Yi Hung Sze Wui Road but will not screen the whole section under consideration. Consequently we do not believe this to be a practicable option.

Responses to Comments on Draft Final Report

Page Ref in Draft Final Report	Comments	Responses
Director of Electrical & Mechanical Services (GSO) Ref:(33) in GSO/47/NT/TY/02 II date: 11 July 1991		
Appendix C	All figures relevant to the Appendix are missing.	Figures in the '9' series are in the Main Report at the end of Chapter 9. Figures C.1 and C.2 were inadvertently omitted but had previously been presented as Figures 3.5 and 3.6 in Working Paper No.9. They are now included.
Page C.2 Para C.1.2(a)	Add the following as the opening sentence: "A number of risk mitigation measures have been taken since the TYRR i.e. the demolition and removal of some spheres which were part of the main risk generations. However, based on .....".	Suggested amendment noted. Text has been changed.
Para C.1.2(c)	Replace the first sub-paragraph of the second paragraph by: "Improvements of safety Management have already been carried out and the results to date indicate that the Management Factor of 1.0 can be achieved within the timescale of construction.	Ditto
Page C.5 Para C.2.1(b)	Amend the first sub-paragraph of the first paragraph to: "the Individual Risk of fatality exceeds the level of 1 x 10^{-5} per year".	Ditto
	Add the following before the second paragraph: "Individual risk contour of 1 x 10^{-5} year is adopted to give an indication of the extent of the restricted developments. Societal risk levels ....".	Ditto
Page C.6 Para C.2.2 - Last Paragraph	ALARP region is not defined in Section C.1.3 and the last paragraph should therefore be amended as follows: "Risk lying ..... (an ALARP region) will also .....".	Ditto
Pages C.7, C.17, C18 Para C.3.2(b), (c), C.4.3(c), C.4.4	With reference to your comments in the letter of 20.6.91 to PM/TW and our corresponding reply on 9.7.91, these sections may need amendments.	C.3.2(c) - the last sentence has now been deleted. C.4.3(c) - The second sub-para has now been deleted. C.4.4 - The 3rd bullet point has now been replaced by the following:- "Increase in worker densities beyond those specified in Technical Paper No.3 for the Preferred Land Use Option should not, applying the ALARP principle to societal risk, be permitted on the CT9 Lorry Parking, Outboard Marine and CFS sites".

Page C.22 Para C.5.2	The result of the F2 scenario with immediate ignition should be fireball, not BLEVE. The text should be amended accordingly as previously stated by us and agreed to.	Noted. Text amended.
Page C.23 Table C.7	The outcome of F2/F5 should be amended to BLEVE/Fireball. Furthermore, the corresponding hazard distance was 52m in the Working Paper No.9 but this time it is now quoted to be 94m. Please clarify.	Agreed. There was an error in Working Paper No.9. The correct hazard distance is 94m.
Page C.24	The numbering for C.6.4 should read C.5.4.	Agreed. Text amended.
Page C.25	Should the section mentioned in line 1 be C.5.2?	Yes. Text amended.
Page C.25 Table C.8	Typo error. For F1 case, the event should be BLEVE.	Agreed. Text amended.
Page C.25 Para C.5.5	The last paragraph does not given clear recommendations to reduce the hazards associated with the DGF whilst the recommendations in the Working Paper No.9 have not been included. I would suggest the recommendations made in the Working Paper No.9 be included to replace the last paragraph.	The recommendations are in Para 9.1.4 of the Main Report. However, for consistency they have now been repeated in the Appendix, Para C.4.4. Similarly fireproof coating recommendations have been added as Para C.6.6.
Page C.26 Para C.6.2(a)	The correct abbreviation for the Department of Environment should be utilised.	Agreed. Text amended.

Comments on Section 9.1 of Main Report

Page 9.1 Para 9.1.1 - Sub-para 4	Please see comment (4) on Appendix C.	Noted. Text amended.
Page 9.3 Para 9.1.3 - Sub-para 4	Please see comment (6) on Appendix C.	In the conclusions and recommendations below Table 9.1.1, the main sentence of the 4th bullet point should read as for C.4.4 above. The additional sentence referring to Figure 9.5 should remain.
Page 9.5 Para 9.1.4	It has been mentioned in Appendix C that chlorine is one of the DGS transported to/from Tsing Yi Road but it is not included here. The text should be amended to reflect the true situation as a matter of consistence.	"Chlorine for pumping station" has been added to the list at the start of Para 9.1.4.
Page 9.5 Para 9.1.4A	Typo error. Kj should read kJ.	Agreed. Text amended.
Figure 9.6	The consequence zones of events B and C appear to be reversed with reference to Section 9.1.4.	Agreed. Figure amended.

Responses to Comments on Draft Final Report

Page Ref in Draft Final Report	Comments	Responses
Project Manager (Tsuen Wan) Ref:( ) in TW 2/350CL/5 date: 11 July 1991		
Page 5.1 Section 5.1	A short reference should be appended to the effect that CT8 was subsequently disposed of as a 4-berth terminal and therefore the effective number of container berths on the Tsing Yi reclamation has been reduced to 4.	Noted. Sub-para 6 has been amended to read; "The effects of adding up to 5 container berths on the Tsing Yi reclamation and 3 container berths on Stonecutters Island were examined with respect .... ". Sub-para 9 has been amended as follows:- "Container Terminal No.8 on Stonecutters Island was subsequently disposed of as a 4-berth terminal and therefore the effective number of container berths earmarked by Government for the Tsing Yi reclamation has been reduced to 4. The Brief has therefore required .... ".
Page 6.4 Section 6.4	A cross-section for the proposed breakwater should be given.	A cross section of the breakwater has been included in the Final Report.
Page 6.15 Section 6.9	A note should be included for the caisson retaining wall option in that the wave reflection coefficient will be higher than 0.4 and therefore its use should be looked at critically.	Noted. A line has been added to para. 6.9.1 Sub-para 3 following line 2 as follows: "By eliminating the use of sloping revetment in the heavy wave zone, this system would have the disadvantage of reflecting significantly more wave energy back into the Rambler Channel than the Deck on Piles option. The incorporation of slotted wave chambers in the caisson system would, however, avoid this problem".
Page 6.18 Section 6.10	Clarification is required regarding the reclamation levels for the PCWA and southern seawall. It may be worthwhile mentioning other methods of rock armour design, e.g. Van Der Meer's approach, which may indicate smaller rock armour sizes.	The apron level given in Para 6.9.2 for the PCWA should read +4.5mPD. Similarly in Para 6.10.1 the reclamation level given for the seawall should read +4.5mPD. On Figure 6.12, the level given for the top of reclamation to container terminal sections should read +5.0mPD. The following has been added to the end of sub-para 2 in Para 6.10.1: "It should be noted that these designs are based on Hudson's formula and are preliminary only. Although potentially significant savings could be achieved in the detailed design phase using more refined design methods, this is not expected to obviate the need for precast concrete armour".
Fig 7.8	Consideration should be given to utilizing more of the existing nullah through the Mobil site such that the 15m reserve will be directed to join the 25m reserve beneath the 5-legged roundabout.	Agreed. Figure 7.8 revised to show alignment of existing nullah to south-east.

Fig 7.9	Can the Tsing Yi sewer outfall extension be combined with the pretreatment outfall extension and if so, can the cost of this item in table 11.5 be deleted?	Subject to agreement by DSD, it would be possible to combine the two outfalls; however, it is considered prudent to identify these items separately at this stage. The cost of a combined outfall or twin outfall is likely to be similar in any case.
Page 8.5 Table 8.4	Kwai Chung Circumferential Road will not be in place in 1996. Presumably the 1996 and 2001 traffic figures will be amended.	Noted. The removal of Kwai Chung Circumferential Road from the 1996 tests was agreed at the Working Group Meeting on 3rd October 1990. Table 8.4 and the 1996 traffic figures have been amended. There is no change to the 2001 traffic figures.
Pages 8.13 & 8.19 Tables 8.12 & 8.15	The V/C ratios for the northbound ramp to Tsuen Wan Road from Texaco Road do not tie up with those shown in fig 8.3 & 8.6.	Noted. The relevant figures and tables have been amended.
Fig 8.4	Turning movements should also have been included at the J/O Kwai On Road and Kwai Chung Road.	Noted. Turning movements have been added.
Page 9.7 Para 9.2.2 -	A limit of 5 dB(A) below the ANL as defined in the NCO would be appropriate for application to the industrial area as a whole.	Noted.
Page 9.7 Para 9.2.4 -	A drawing showing the locations of industrial buildings and proposed container stacks assumed in the noise assessment should be included.	The precise locations and heights of all barriers (industrial buildings, container stacks etc) used in the acoustic modelling are given in the computer print out given to EPD. The general locations of container stacks are shown on Figure 4.2 and the general locations of buildings, on Figures 10.3/4.
Page 9.10	Traffic figures used to predict traffic noise levels are inconsistent with the traffic figures given in Figures 8.2 and 8.5 of the DFR.	The traffic noise figures presented in the DFR were based on vehicle flows presented in Working Paper No 8. Vehicle flows were revised at a later stage for the DFR. These revisions were not considered to result in significant changes to overall noise levels. Flows increased slightly on Old Tsing Yi Road and on the slip road to Tsing Yi Heung Sze Wui Road, but decreased on the New Tsing Yi Road and southbound Tsing Yi Heung Sze Wui Road. The changes would not be expected to affect the mitigation requirements.
Page 9.11 Table 9.2.4	I suggest to append the following at the end of the second paragraph below the Table : "This is due to the diversion of traffic from Tsing Yi Road onto the new Container Port Road".	Agreed. Text amended as stated except "Container Port Road" to be "New Tsing Yi Road".
Page 9.18 Para 9.2.5 -	Besides DTYB No.1, will the application of pervious asphalt on DTYB No.2 also help to alleviate traffic noise levels? I am not aware of EPD's second noise limit criterion.	Use of pervious asphalt will reduce noise levels due to traffic on DTYB2 but the benefit is small because of the lower traffic flows. The reduced noise limit (referred to in para 5) had been discussed with EPD at an earlier stage in the Study, and had previously been stated in Para 4.2.5, Page 4-4 of Working Paper No.9 "Environmental Assessment".

Page 9.18 Table 9.2.11	Options for covering either highway sections 1 and 3 individually for government's consideration should also be included to give the relative benefits.	Options for covering either highway sections 1 or 3 achieve no reduction in noise levels at NSR, 5 and 4 respectively, in comparison to the "with SETY, no mitigation" case. These options are not recommended for Government's consideration.
Page 9.19 Para 9.2.7	Please indicate recurrent maintenance costs for covering sections of highways. The requirement of cost effective measures should be based on cost per dB reduction per dwelling but this has not been addressed.	This is outside the scope of this Study but might be included in the further work as recommended for detailed design stage.
Page 9.35 Section 9.6	In the 3rd paragraph, there is a definite statement that "The SETY reclamation will be constructed under one main contract ...." This should be amended to "...... may be constructed ....".	Text amended to read " .... is proposed to be ......".
Page 10.14 Table 10.6	Does the column on estimated workers indicate additional workers as a result of the SETY development? Is the figure of 1867 for site 21 inclusive of existing workers, for example?	The estimated workers in Table 10.6 refers to the additional workforce. The figure of 1867 for Site 21 does not include existing workers, since it is assumed that the site will be redeveloped for more intensive use.
Page 11.1 Section 11.2	An assumption should be made for marine borrow area at South Tsing Yi.	The DFR has assumed Outer Deep Bay as the source of marine borrow fill because of the uncertainties associated with the South Tsing Yi source. In particular South Tsing Yi has been largely given over to the Terminal 8 developer whose control of pits designated for use to date would overlap with Terminal 9 reclamation works. Provided access could be negotiated by Government for the Terminal 9 developer, additional pits would also need to be earmarked for Terminal 9 to make up for the expected shortfall of 10 million cu m or alternatively additional borrow areas provided. It is acknowledged that South Tsing Yi is the closest and therefore preferred source. The Outer Deep Bay assumption, which is representative of other relatively distant sources such as Soko Island and Po Toi is conservative for project costing and programming. Nevertheless, project costing has been adjusted to assume South Tsing Yi as requested. We do not recommend that any adjustment be made to the programming in view of the already accelerated rate of reclamation activities.
Page 11.5 Table 11.5	(i) There should be some costs associated with site formation for the PIA Road (West);	Agreed. Costs associated with the site formation have been omitted and are estimated to be HK$15 million. Table 11.5 has been amended accordingly.
	(ii) Foul drainage, being a part of roadworks, should be included as works entrusted to the developer;	Noted. Text amended.
	(iii) Clarification is required of how the $232.0M for PHI reprovisioning is made up?	The estimate for PHI reprovisioning costs include civil, electrical and mechnical installations required to relocate existing ESSO and CRC, LPG storage spheres and the cost of coating the existing spheres as

a temporary measure. The cost estimate break-down (including 6% for preliminaries and 10% contingencies) is as follows:-

ITEM	DESCRIPTION	COST (HK$M)
CRC	Install 4 No. mounded bullets of 500te capacity	102.1
ESSO	Install 5 No. mounded bullets of 500te capacity	128.8
COATING	Temporary coating of 5 no. spheres	4.0
REVISED TOTAL		234.9

Fig 12.2	(i)	The latest date for the demolition of the Mobil pier should be included;	(i)	An activity for Mobil Pier demolition has been included in the programme with completion by 13th March 1996 corresponding to the commencement of filling in the Berth 1 area.
	(ii)	The date for the commissioning of Berth B3 should be amended;	(ii)	The commissioning dates for Container Berths such as Berth 3 are dependent on prior completion of the quay wall and terminal pavements. In the case of Berth 3, commissioning awaits completion of pavements on 28th May 1996. No amendment is therefore necessary.
	(iii)	The activities for the dredging of Rambler Channel and reprovisioning of the Tsing Yi STW outfall should overlap.	(iii)	The STW outfall activity will require localised dredging and filling works and a note to this effect will be added to Figures 12.2 and 12.3.
Fig 13.4		The area proposed to be dredged should be marked up.		Noted. Figure amended.

Responses to Comments on Draft Final Report

Secretary, Port Development Board Ref: PDB 5/110/90 III date: 11 July 1991

Page Ref in Draft Final Report	**Comments**	**Responses**
Page 2.2 Para 2.2.2 2nd sub-para.	Synergy effect of adjacent berths will be lost should the terminal be developed and operated by more than one operator. Apart from the adjustment of terminal areas and layouts, the target throughput may also be affected.	Noted and agreed, but target throughput at 10% above minimum required provides for some margin if berths are split.
Page 2.7 Para 2.2.9	The target dates set out in the Brief were based on a 3-berth terminal for CT-8. It should be noted that the disposal arrangement for CT-8 is now a 4-berth terminal with an estimated annual throughput of 1.6m TEUs. In this respect, the first berth of CT-9 will now be required around mid-1995. Perhaps this should be reflected in this section or section 2.2.9.	Agreed. The following additional lines will be added to sub-para 1 after the 2nd sentence. "The original target dates were based on the assumption of a 3-berth terminal for CT8. As the subsequent disposal of Terminal 8 was made on the basis of 4 berths, Marine Department currently forecast that the first CT9 berth will now not be required until mid-1995". The following line will be added to end of sub-para 1. "Programme A, therefore, meets the current forecast requirements by Marine Department for first berth commissioning". Please also refer to the table at the end of this Appendix.
Page 2.8 Section 2.3	under WAHMO modelling. Section 6.3 of Appendix B3 mentioned that, if CT-9 reclamation is of vertical seawall type, big increase in wave heights is envisaged and this may lead to unacceptable condition for the berths and their approaches. Perhaps this point should also be included in Section 2.3, and the proposed remedial measures should also be highlighted in Section 2.4.	Noted. The following will be added to Section 2.3, sub-para 6. "WAHMO results also indicated that if vertical walls are used for the CT9 reclamation, significant additional increases in wave heights would result and may lead to unacceptable operating conditions in these areas. Sloping seawalls are, therefore, proposed under quay structures". The following will also be added to Section 2.4. "Sloping seawalls are recommended under Terminal 9 quay deck to avoid significant increase in wave heights due to wave reflection".
Page 4.6 Para 4.6.1	under Dow Chemical. I am a bit concerned that for the shipment of 3,000 to 4,000 tonnes of monomer with an expected annual capacity for some 200,000 tonnes, a dedicated 75,000 dwt berth is to be reserved for this facility appears to be excessive. In particular this proposed berth location is very near to the re-aligned fairway and the size of tankers to be manoeuvred at this berth may have impact on the container traffic to and from the container terminals. In this respect, it is	

	recommended that the maximum size of tanker for this dedicated jetty is to be reconsidered should a jetty is to be reserved for Dow Chemical.	
Appendix J	The name "K.T. Lo" should be replaced by "I.B. Dale".	Noted. Amendment made.

Responses to Comments on Draft Final Report

Page Ref in Draft Final Report	**Comments**	**Responses**
Chief Engineer/Route 3, Highways Department Ref:(2) in HR3 7/3/91 VI date: 11 July 1991		
Page 2.5 Para 2.2.6	The importance of the timing of the Route 3 (CRA1) to the SETY development is noted. I think the Kwai Chung Section of CRA1, which is to the south of Pillar Island, rather than the Rambler Channel Bridge as stated in the 1st paragraph, should be the focal point is this argument. At present the CRA1 Kwai Chung Section is scheduled to be completed by mid-1996 but not 2001 as stated in the 2nd paragraph. Should the Duplicate Tsing Yi Bridge (DTYB) be completed prior to CRA1 Kwai Chung Section, traffic on DTYB will have to be channelled through Kwai Tsing Road. Route 3 consultants had suggested an interim arrangement which was passed to PM/TW previously for reference. It is worth developing this interim arrangement in the context of DTYB detailed design.	Noted. Para 2.2.6 refers to the assumptions behind the 1996 and 2001 forecasts. The 1996 forecasts represent the "worst case" scenario prior to the opening of Route 3 later that year. The 2nd paragraph states that CRA1 will be completed by 2001. This statement refers to the model tests rather than to the completion of the road; however, the text has been amended to clarify the point and highlight the importance of the Route 3 Kwai Chung Section.
Page 3.5 Para 3.3.4	Please insert a paragraph stating that Area 4b may be used as the permanent relocation site for the existing WSD staff quarter which is affected by the CRA1 Rambler Channel Bridge.	Reference to WSD staff quarters in Area 4b has been omitted at the direction of the Steering Group.
Page 4.3 Section 4.5	(i) We insist that a road reserve should be indicated for the CRA4 alignment and its sliproads on any land-use plans in association with SETY development. It should not pre-empt that the sites over which the route will pass will definitely be for lorry parks. Since the route will only be needed by the turn of the century as scheduled at present, it is quite possible the landuse of the sites will be changed from now to then.	Noted. Figures amended.
	(ii) CRA4 and its slip road should also be included in Table 4.1 and Fig.4.2 for the same reasons above.	Noted. Text amended.
Fig. 6.14	On the assumption that the typical seawall as shown in Fig. 6.14 will be used along the edge of the reclamation where CRA4 will pass through, please note that the cope line should not be more than 900m apart from the CT8 reclamation and that the rock fill including the filter layer should not be extended beyond 35m measured from the cope line. The above requirements are needed to ensure feasibility of CRA4 construction.	Acknowledged. The proposed detail of the seawall shown in Figure 6.14 satisfies these requirements.

Page 7.4 Para 7.2.7	We have no objection to the temporary accesses to link the Principle Industrial Access to the five legs roundabout as an interim measure by utilizing the road reserve for slip roads to CRA4. To avoid future confusion, road reserve for CRA4 slip road should be properly documented in the landuse records.	Noted.
Page 7.6 Para 7.3.2	(i) As stated above the CRA1 Kwai Chung Section (Lai Chi Kok Bypass in the Report) is scheduled for completion by mid-1996 not end of 95. (ii) The Rambler Channel Bridge is part of Tsing Yi Section of CRA1 which is scheduled for completion by end-1996.	Noted. Text amended. Noted.
Page 9.15 Para 9.2.5	It is recommended in the Report that traffic noise can be reduced by coverage of certain road sections. However, there is no mention on the means of removal of polluted air trapped inside the covered roadway. Should mechanical ventilation equipment be required, the capital and maintenance cost of these equipment be required, the capital and maintenance cost of these equipment should be estimated and included in the cost comparison. The consultant's attention is drawn to the investigation to the air quality impacts due to the operation of the ventilation equipment on the adjacent residents. The visual impact of the covers should also be addressed as well. Schematic layouts and elevations showing the covered roadway in relation to the residential block would be useful.	Only one road section recommended under the full mitigation scheme to achieve the HKPSG limit of 70dB(A) would be fully boxed. All other sections would be covered with a cantilevered barrier, open at the side away from NSRs. These sections would not require ventilation. The requirement to ventilate the boxed section would be determined at detailed design Stage, if this mitigration option was adopted. Mitigation options for road traffic noise are being investigated with regard to the Duplicate Tsing Yi South Bridge. Schematic layouts would be produced at preliminary design stage.
Page 10.14 Table 10.6	In the remark column for site No. 21, 22a, 22b, 22c, 23a and 23b, please add "road reserve for future CRA4".	Noted. Table amended to include only Sites 21, 22b, 23a and 23b as Sites 22a and 22c are not affected.

Responses to Comments on Draft Final Report

Page Ref in Draft Final Report	Comments	Responses
Director of Fire Services Ref: (40) in FSD 1/790/90 date: 11 July 1991		
Page 7.9 Para 7.4.3	To specify the provision of fire hydrants for the Duplicate South Bridge, I suggest to include the following text, which is copied from Working Paper No. 7, para. 3.7 of page 6, to the 5th line between the words 'utilities' and 'to' of the 1st paragraph on Utilities, page 7.9 of Draft Final Report:- '(e.g. low voltage electricity cables for street lighting, high voltage cables, a water main for fire hydrants, gas mains, other water mains and telecommunications)'.	Agreed. Text added.

Responses to Comments on Draft Final Report

Director of Marine Ref: (33) in PA/S 909/47/11(6) Date: 12 July 1991

Page Ref in Draft Final Report	**Comments**	**Responses**
Page 4.4 Para 4.6.1	Whilst the text makes reference to the 8 water front users, these are not actually shown on Fig. 4.3; and	Reference should have been to Figure 3.2. Text amended.
	Perhaps a definitive site for the fireboat berth has now been allocated.	We understand that the location for the fireboat berth, at the northern end of the promenade has recently been agreed with RSD. Text amended.
Page 4.7 Para 4.6.3	It is noted from Table 4.2 that vessels 3000 DWT may use the CWTF. On this basis the depth of water inside the basin should be -6.15mCD.	The limiting size for CWTF vessels in Table 4.2 is incorrect and will be amended to 1200 DWT. This does not affect the results of the additional Marine Impact Study. It is noted only limited information on the CWTF is available. EPD have advised that the vessel (dumb barge) is anticipated to have a maximum loaded displacement of 2400 to 2700 tonnes. With the current uncertainly regarding vessel size, it will be necessary to review the depth provided within the basin at detailed design stage. In the first instance, a revised basin floor level of -6.15mPD can be used to give a minimum water depth of 6 metres.
Page 5.3 Para 5.2.2(viii)	The average number of calls for a 1,000 MPT should more correctly be 1,500.	Agreed. Text amended.
Page 5.7 Section 5.4	(a) It would be helpful if the paragraph assessing siltation could include the Kwai Chung Basin area.	Noted. Text added.
	(b) It is noted that the wave heights at the existing quay face at Terminals 1 to 7 are expected to be increased by 30%. The consultant should assess how this will affect cargo operations of vessels alongside.	Wave increases were predicted along most of the length of the existing berths and were for 50/1 year and 1/1 year returns periods and approximate wave periods of 5.5 and 10 seconds. These waves were generated using swell propogated into the Study Area. A detailed assessment of this impact is outside the scope of the Study. It is known however, that no significant operating difficulties are currently experienced at Terminals 1 to 5. Parts of Terminals 6 and 7 are more exposed and may already experience downtime or difficulties particularly following the passage of a typhoon or during a south-west monsoon. On a qualitative basis, it is to be expected that the predicted 30% increases in wave heights will increase downtime or difficulties at least at some of the existing container berths.

Page 5.7 Section 5.4	It is felt that some reference should be made to the necessary use of fully mobilised dredgers engaged in the extraction of marine fill to minimise obstruction to other vessels and maintain navigational capabilities.	Noted. Text added as follows; "In view of the anticipated overlap of reclamation works at CT8 and CT9, and in order to minimise interface with marine traffic generally, it is recommended that the CT9 lease conditions require that only fully mobilised dredgers be used wherever work near to or within shipping channels is executed.
Page 7.11 Para 7.6.1	The reference to "Lamma Channel" at the end of the page should be "Lema Channel".	Agreed. Text amended.
Page 7.12 Para 7.6.4	Proposed that the last sentence be replaced by "However, in line with PADS proposals the Marine Department recommended that the area of Kwai Chung be dredged to -15mCD (including -0.5mCD for dredging tolerance). The apportionment of such dredging costs to be determined bearing in mind any benefits to be accrued to existing operators. It will be necessary to remove ...."; also	Proposed text agreed in principle except it should read: ..... be dredged to -15mCD (including 0.5m allowance to offset maintenance dredging). The apportionment .... During the Study, Marine Department requested a minimum dredged level of -14.5mCD. Port Works subsequently requested an additional 0.5m dredging (ie -15.0mCD) to offset maintenance dredging (Refer Para 2.2.3). The Study assumes a minimum dredged level of -15.0mCD which corresponds to Terminal 7 entrustment and proposed Terminal 8 dredging. These comments will be reflected in additional text included in Chapter 5.
	Fig. 13.3 shows the Rambler Channel dredging down to -15mCD, have the consultants determined whether this will have any adverse effect on Terminals 1,2,3 and 5 <u>IF</u> the operators do not wish to deepen their alongside facilities.	The existing Rambler Channel seabed level is believed to vary between -12.0 and -15.0 mCD. Rambler Channel dredging to -15.0mCD will entail deepening only up to 3m and no closer than 50 metres clear of the existing quay faces with a mud batter allowance of say 1 in 5 outside this 50m zone. A scour blanket is also recommended over this batter area to prevent erosion. This work is, therefore, relatively remote from the existing terminal structures and is not expected to have any adverse effects on their integrity. It will then be up to the operators to dredge up to their quay faces if they so wish.
Page 9.28 Para 9.4.4	The consultants should include a paragraph assessing the possible effect of siltation on Kwai Chung Basin during the construction phase. This will be required to address the concern of the existing terminal operators. This is particularly important as Section 9.4.8 has highlighted that the dredging operation may result in high suspended solids generation.	Noted. Text added to Section 5.4.
Appendix B3 Page 1 Section 2	It seems that the reference to "Fig. 2" in the 1st para. should be "Fig. 1".	Agreed - Reference amended.
Appendix C Page C19 Para C.4,4 3rd para. from the top	While movements of ocean-going Vessels are Monitored by the Vessel Traffic Centre, at the moment, there is no mechanism to impose a direct control on the proposed DGF.	Noted.

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Page Ref in Draft Final Report	Comments	Responses
District Lands Officer, Kwai Tsing Ref: (9) in DLO/KT 1/155/90 III Date: 12 July 1991		
General	Assuming the Final Report for SETY is completed by mid-August, and will be adopted by DPC/LDPC in September, it appears that the timing specified in the report regarding the programme for CT-9 and associated issues is inadequate. I will address each item separately.	It was understood that preliminary negotiations between Government and existing waterfront users had commenced during this Study. Programme A assumed, therefore, that these negotiations could be finalised in phase with Statutory Procedures, ie by 1st February 1991 (over a 9 month period) allowing one month to then finalise development tender documents. It is expected that any delay in finalising these negotiations would lead to a commensurate delay in the development award (programmed on or before 9th July 1992 and subsequent container berth commissioning. If, as suggested, 1 year is required to finalise development tender documents (from the adoption of the Final Report by DPC/LDPC in early September 1991) then first berth commissioning could not be expected until mid December 1995 which is approximately 6 months later than shown in Programme A. Please also refer to the table at the end of this Appendix.
Page 2.11 Para 2.5	As mentioned above, the timing proposed to conclude negotiations with existing Waterfront users by 1st February is unrealistic. This also applies to the re-provisioning of a separate pier for Dow Chemical.	Ditto.
	Please note that it will take 1 year to finalise the documents for CT9 (whether by tender or PTG), hence with this timing, the first berth operation date will be October/November 1995. This date does not appear to coincide with the Key Dates suggested in the Report.	Ditto.
Page 3.4 Para 3.3.3	<u>China Resources Co. Ltd Oil Depot</u> :-	
	Please note that the company has submitted an application for an exchange and the site configuration appears to affect the adjoining proposed Marine Basin, hence it may be necessary to revise paragraph 4.6.5.	The possibility of minor conflict between SETY and CRC proposals was acknowledged by the Steering Group who in view of the relative timings directed the Study to proceed on the basis shown in the DFR. Any conflicts can be ironed out prior to the commencement of the design phase.
	Processing of CRC expansion scheme is now making good progress, therefore the SETY study should take full account of this proposal.	Ditto.
Page 3.5 Para 3.3.4	<u>V.H.F. Marker</u>	Noted.
	The Civil Aviation Department are now planning to relocate the marker on a new position (as shown on the attached plan) instead of the TCVT site.	

Page 4.2 Section 4.2	Although the proposed layout illustrated in the text is designed for a single operator, with the experience of CT-8 it may be necessary to consider alternative layout for a multi-operator terminal such that their requirements can be stipulated in the lease conditions later on.	Although the Study recognised that a multi-operator scenario would necessitate revisions to the layout and more land for the Terminal itself, the Steering Group directed that only a single-operator scenario be examined in detail. Nevertheless the Section has been expanded.
Page 6.22 Section 6.13	It is necessary to specify the timing required for the works area in order that sufficient notice can be given to the existing tenant.	On the basis of Programme A, the proposed works area (Site 14) would need to be available on or before 1st January 1993 prior to the award of the Developer's construction contract and allowing 3 months for programme variations.
Page 9.1 Para 9.1.2	It is necessary to up-date the study basis due to CRC's expansion plan.	The Study basis was agreed by the Steering Group long before the CRC proposals were made known.
Page 9.35 Section 9.6	If there is any guide lines on the environmental controls, it would be best that these guide-lines be included in the lease conditions by listing such under the Technical Schedules.	Agreed. Guidelines have been included in the Technical Schedule.
Page 12.1 Section 12.1	As mentioned previously, the first berth commission date should be revised in the text.	See first response above.
Page 12.5 Section 12.4	There is a typing error on <u>Hoi Kong</u>.	Agreed. Amended
Page 12.8 Para 12.7.3	As mentioned previously, the timing regarding Statutory Procedures and execution of documents should be revised. This applies to both Programmes A and B.	See first response above.
Page 13.3 Section 13.4	Timing should be revised.	Ditto.
Appendix I	On the Steering Group Membership List, the representative from BLD should be Mr. C.H. So, DLO/K&T.	Noted. Amended

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Page Ref in Draft Final Report	Comments	Responses
Director of Environmental Protection Ref: EP1/G/42 Annex 1 (EPD 2) Date: 12 July 1991		
General comments		
Monitoring	It is noted that under the sections dealing with "Recommendations for Monitoring" section 3.4.3 of the brief have not been met fully. Whilst in part the monitoring aspects have been generally specified no detailed specifications of the equipment, monitoring stations etc are provided. Further, the audit and Action Plan aspects are glossed over passing most of the work over to the prospective tenderers/lessees. More detail was anticipated at this stage for inclusion in the Design Memorandum.	Further to a meeting with EAPG on 5 July to clarify the requirements for auditing, an additional section has been drafted for the final report. This includes examples of appropriate action plans and outlines the requirements for auditing. The draft section is being circulated for comment under separate cover. At the present stage of the development where detailed design information is unavailable, it is not sensible to specify precise monitoring locations; these should be determined as appropriate at detailed design stage when construction phasing and scheduling is known. The requirement for monitoring is normally specified in the Technical Schedule rather than the Design Memorandum.
Page 2.9 Para 2.3 Sub-para 14	Land use can only be classified as compatible with the incorporation of suitable mitigation measures.	Noted. Text will be amended to read" .... assessments completed to date have shown that, providing recommendations on mitigating environmental impact and risk are adopted, the development will be compatible ....".
Page 2.10 Para 2.4 Sub-para 15	Effectiveness of barriers is not indicated in the DFR.	The word "barrier" was used here in a generic sense. This will be replaced with "screening (barriers, cantilevered barriers and boxed section)". The effectiveness of covers in terms of noise reduction at NSRs is addressed in Para 9.2.5.
Page 2.10 Para 2.4 Sub-para 16, 2.11 Para 2.5 last Sub-para	The cost benefit analysis should be carried out by considering not only the economic aspect but also the effectiveness of the measures and the population benefit from them.	Noted.
page 2.10 Para 2.4 Sub-para 17	Anything specified in the lease conditions must be practical and enforceable.	Noted.
Page 4.2 Para 4.2 Sub-para 6 and Figure 4.2	What is the tentative height and noise benefit of the multi-storey narrow block? Will it be an office building?	The multi-storey block will be an office building, as indicated in the previous sentence and shown on Figure 4.2. Its height will be approximately 15m. The actual noise benefit of this office block alone has not been calculated specifically; however, its screening effect has been incorporated within the acoustic model.

Page 4.7 Para 4.6.3	It was suggested in the 3rd para that a few low level flushing culverts in the breakwaters will be constructed in the basin. Please elaborate on their efficiency in maintaining a good flushing effect within the basin.	Low-level openings in the breakwater should help to prevent accumulation of bottom deposits at the western end of the basin furthest from its mouth. The distance over which deposited material would have to be moved by tidal action to remove it from the basin would be less and the likelihood of a build up of potentially polluting organic deposits will hence be reduced.
Page 8.11 Para 8.8	As the traffic noise prediction methodology involves the peak traffic flow parameters in veh/h, %HV .... etc, it will be necessary to translate the present form in terms of veh/h .... etc for reference. This information may be supplemented separately from the Final Report.	This information has already been provided as an attachment to a letter from MSW (ref 90809/2Q/2252, dated 16 July 1991 copied to Noise Policy Group.
Section 9.1 PHI	We have no further comments on this Section.	Noted.
Section 9.2 Noise Page 9.6 Para 9.2.2 Sub-para 4 and Appendix D	The daytime construction noise limit of 75 dB(A) or 5 dB(A) above background is only applicable to activities in the 'unrestricted' hours under the NCO.	Noted.
Page 9.7 Para 9.2.2 last Sub-para	The requirement for a noise limit in the lease conditions is supported.	Noted.
Page 9.7 Para 9.2.4	Are the predicted noise levels inclusive of the attenuation due to the nearby industrial buildings?	Noise levels given in Table 9.2.1 are inclusive of the attenuation due to the industrial area buildings. Noise levels without the screening from industrial buildings are shown in Table 9.2.3. An addition will be made to the text at top of Page 9.9 to clarify this.
Page 9.11 Para 9.2.5	It is preferable to have specific recommendations on the type of quiet equipment to be used. For example, the use of hand-held breakers and portable compressors complying with the EBC Directives 84-537 and 84-533 respectively.	Noted. These requirements will be included in the environmental guidelines section on construction noise.
Page 9.12 Para 9.2.5 Sub-para 2	who should be responsible for considering the protection of sensitive receivers by double glazing .... etc.?	Double glazing would only be required if all other practicable noise control measures failed to achieve compliance with the required levels for construction noise. In practice, we do not believe this is likely. The construction contractor is required to demonstrate that his planned work will comply with the lease conditions.
Page 9.14 Para 9.2.5 Table 9.2.8	The areas of concern and the notional noise source positions should be shown on a drawing for illustrative purpose.	Areas of concern, as indicated by the NSRs, are shown on Figure 9.7. Sound power levels for the terminal noise sources are distributed over appropriate areas of the terminal; there are a total of 250 source locations used in the acoustic model. All source location coordinates used were given in the computer print out submitted to EPD.

Pages 9.15 - 9.19	Separate comments via my fax of 8.7.91 have been given. Additional comments are:	Comments made by fax of 8.7.91 have been responded to in a letter from MSW (ref 90809/2Q/2252 dated 16 July 1991) copied to Noise Policy Group. Additional responses are as follows:
	(a) What is the year for traffic noise assessment?	(a) The year for traffic noise assessment is 2001
	(b) Is there any other practical noise control solutions other than road covers and the use of pervious asphalt?	(b) The letter above refers
	(c) It is understood that the selected NSPs are for indicative purpose and represent the worst affected ones in their neighbourhood.	(c) These assumptions are correct
	(d) It should be noted that the HKPSG is the minimum level and the noise level should be improved upon whenever possible.	(d) Noted The Final Report text will be amended to clarify items (a) and (c).
Page 9.20 Section 9.3 Air and Page 9.35 Section 9.6	It's noted that the approach of environmental controls as recommended in WP 9 (Environmental Assessment) has been changed without DEP's prior notification. I disagree with the approach of implementation of environmental controls through performance specification/ environmental limits as compared with method specification. Also it is not in line with EPD's general approach to works contracts of other project.	DEP were consulted regarding performance rather than method specifications (please refer to minutes of the Second Environmental Working Group Meeting, 30 April 1991, Section 5.3.3, Post Meeting note).
	It is true that there are various ways in which specified environmental limits may be achieved and implementation through environmental limits would permit contractors to select the most cost effective combination of methods to carry out the work, and hence not recommend specific mitigation measures are defined as part of contract conditions. However, the spirit of environmental protection is not just to attain the minimum requirements but to attain a best environment with the available means. It is our experience that contractors (especially the smaller ones) usually do not know what kinds of dust suppression measures could achieve the environmental limits. As such, detailed method specification is the most appropriate approach.	Specific mitigation measures have been defined for each parameter in Appendix H "Environmental Guidelines". These will be made available to the lessee, who can in turn make them available to the contractor. The lease condition relating to monitoring (Para 9.7.6) will be supplemented with the following sentence in order to emphasise this; "The method statement should be prepared by the lessee or works contractor, as appropriate, using the recommendations on monitoring and action included in the SETY Study report."
	I cannot see how the contractors can be made aware of the findings of the study report without written into contract conditions.	
Page 9.25 Para 9.3.4	In general, the minimum frequency for TSP monitoring is once every 6 days instead of once per week.	Noted. Text amended.
	The direct dust meters, which give a real time checking, as recommended in WP 9 (Environmental Assessment) have been omitted in the final report. Please clarify.	The direct reading dust meters under consideration were the optical type. Further inquiries regarding these meters indicate that they are suited to applications where

		particles are of regular size and shape, and hence have consistent light scattering properties. The use of optical meters is not recommended for general dust monitoring due to the irregularity of particles, and the subsequent difficulties of calibration. The use of such equipment is no longer recommended, hence its exclusion from the DFR.
Page 9.37 Para 9.6.3	I have no objection that details of baseline and compliance monitoring programmes, reporting schedules, and action plan be specified later by the successful tenderers as proposed by the consultant. However, it is preferable to have monitoring work details written into the lease condition, and a draft should be submitted to DEP for approval.	Please see response to first comment on "Monitoring:.
Page 9.27 Section 9.4 Water Page 9.28 Para 9.4.4	(a) We noted that mud samples are being analyzed. It would be helpful if some procedural disposing stratifies of contaminated mud, not suitable for dumping on the gazetted dumping grounds, are devised.	(a) Information on the heavy metal content of surface marine mud samples from the SETY reclamation area and from Kellett Bank has been forwarded to EPD. Under the existing guideline limits, some of the marine mud from the SETY area would be classified as contaminated and would not be acceptable for disposal at a gazetted dump site. It is understood that, should the recommendation of EPD's Contaminated Spoil Management Study be adopted, contaminated mud may be required to be disposed of in disused borrow pits such as those in Outer Deep Bay. Dumped material may be required to be capped with clean sand. An additional section will be included in the FR on this topic.
	(b) The phasing of programme should incorporate remedial measures to avoid water quality deterioration in the embayed areas.	(b) The reclamation phasing cannot be altered to avoid embayment formation because of the tight construction schedule which is necessary to meet the first berth commissioning date, as required by Government.
Page 9.36 Para 9.6.2	Since the greatest noise concern is the access road impacts on existing sensitive receivers, it is alarming to note that the total omission of this aspect from this section. A mechanism must be found to implement the agreed measures and this must be undertaken by the developer of CT9 as a whole. Perhaps in this case the CT9 operators should take on the overall site management in an organization analogous to the HKIEC to undertake these measures on behalf of and recover costs from all the lessees.	It is understood that this issue is now being addressed under the Duplicate Tsing Yi Bridge Study, and that traffic noise mitigation requirements will be included in contracts for the bridge and associated roads. The FR text will be amended to clarify this point.
Page 9.38 Para 9.6.5	Whilst the glare aspects are addressed in the EA Study, I suggest that the lease should state the GR ceiling which have been reflected in the revised Summary for EPCOM submission. Please incorporate	Noted. The GR ceilings for residential areas and roads, as specified in the EPCOM summary, will be included in the FR.

	this in the FR.	
Chapter 10	A summary table of all the recommended buffer requirement for sensitive uses as identified during the assessment is helpful for future landuse implementation.	A summary of the relevant recommended buffer distances for land uses, according to HKPSG is given below.

Polluting Uses	Sensitive Uses	Buffer Distance
Multi-storey industrial buildings	residential areas, schools	100m
Multi-storey industrial buildings	commercial and GIC uses	30m
Industrial chimneys*	sensitive uses	within 500m, consult EPD
Industrial chimneys*	high-rise buildings	200m
Industrial chimneys*	active open spaces	10-100m
Trunk roads and primary distributors	active open spaces	20m
District distributor	active open spaces	10m
Local distributor	active open spaces	5m
Trunk roads	residential uses	20m
Primary distributors	residential uses	300m 50m (with screening)
Secondary distributors	residential uses	180m 40m (with screening)

* Industrial chimneys have been included for completeness. However, due to recommendations regarding industry types and restrictions on the use of liquid and solid fuels, industrial atmospheric emissions are not considered to be a major problem.

	The consultant has not response to APG's comments on their response to comments on WP 9.	Responses to APG;s comments on responses to comments on WP9 have been provided under separate cover.

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Page Ref in Draft Final Report	Comments	Responses
Chief Engineer, Port Works Civil Engineering Office, Civil Engineering Services Department **Ref: (18) in PWO 33/2428/90 IV Date: 10 July 1991**		
Page 2.3 Para 2.2.3 - last Sub-para	It is stated that 'Wave heights near existing Kwai Chung terminals are also predicted to increase'. Perhaps it is advisable to mention whether this increase will have any adverse effects on the operation and structural stability of the existing terminals.	Wave increases were predicted along most of the length of the existing berths and were for 50/1 year and 1/1 year return periods and approximate wave periods of 5.5 and 10 seconds. These waves were generated using swell propogated into the Study Area. A detailed assessment of this impact is outside the scope of the Study. It is known, however, that no significant operating difficulties are currently experienced at Terminals 1 to 5. Parts of Terminals 6 and 7 are more exposed and may already experience downtime or difficulties particularly following the passage of a typhoon or during a south-west monsoon. On a qualitative basis, it is to be expected that the predicted 30% increase in wave heights may increase downtime or difficulties at some of the existing container berths for the very limited periods when south-westerly swells occur.
Page 6.4 Para 6.4.1 - 3rd Sub-para	The revised CE Manual Vol VII Port Works Chapter 2 is updated in July 1990 instead of Jan 1991 as stated in the report.	Noted. Text amended.
Page 6.23 Section 6.14 - last Sub-para	It may be worthwhile to consider preloading the area with Seawise University wreck beneath during the construction stage to minimize the possible high settlement as a result of the collapse of tanks.	Agreed. A note to this effect has been added.
	I note that a design wave height of H_{10}, which is 1.27 times the significant wave height H_s, is being adopted in the preliminary design and cost estimation of all marine structures. However, it is stipulated in CE Manual Vol VII Chapter 2 that the average maximum wave height H_{max}, which is 1.9 times H_s, should be used for design of all marine structures except for rubble structures. This may have significant effects on your cost estimation of the proposed marine structures.	The Container Terminal and PCWA edge structure designs have allowed for H_{max}. The text, however, which was incorrect has been amended as follows:- Wave height H_{max} 4.35m (Quay Structures) H_{10} 2.91 (Revetment)

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Page Ref in Draft Final Report	**Comments**	**Responses**
Chief Engineer/Mainland South Drainage Services Department Ref: (44) in D(MS) 10/5/26 date: 12 July 1991		
Page 7.12 Para 7.6.2 -	Detailed design of the STW has been completed. Tenders for the construction of the STW will be invited shortly. The construction work is expected to be completed by early 1994.	Noted. Text amended to reflect this updated information.
Page 7.12 Para 7.6.3 -	The first stage of the STW provides preliminary treatment, not primary treatment to sewage. Expansion of the STW is urgently required to meet the increasing quantity of sewage inflows. While the relevant PWP item was not included in the 1990 RAS, PM (Tsuen Wan) was considering advancing the project by inclusion of the PWP item in the 1991 RAS.	Noted. Text amended This action is supported.
Page 7.12 Para 7.6.4 -	Our view on this topic was expressed in a joint meeting with PM (Tsuen Wan) and EPD on 24.5.91.	Noted.
	It is perhaps worth reiterating that if existing works is affected by new works, then the reprovisioning of the existing works should be the responsibility of the authority undertaking the new works with the agreement of the maintenance authority, in this case CE/Sewage Treatment, DSD. The agreement of EPD on the water quality aspects should also be sought.	Noted.
Page 13.2 Para 13.3.3 -	Early expansion of the STW to accommodate flows from various sources, including that from SETY is supported. However, EPD and PM (Tsuen Wan)'s support and action is vital for the funding of the expansion works.	Agreed
Page 13.2 Para 13.3.4 -	Comments in item (c) is also relevant. Reprovisioning of the outfalls at Tsing Yi or Kwai Chung are not within the scope of existing PWP items undertaken by Design Division, DSD.	Agreed
Appendix F.4 -	Primary sedimentation is not available at the commissioned Tsing Yi STW. Will it affect the oxygen demand calculations? This is a joint reply from CE/Design, CE/Sewage Treatment and CE/Mainland South of Drainage Services Department.	As indicated in previous response to comments on Working Paper 9, the oxygen balance calculations do not assume primary sedimentation at Tsing Yi STW. Reference to sedimentation relates to processes occurring naturally within the embayed area itself, not the STW.

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Page Ref in Draft Final Report	Comments	Responses
District Planning Officer/Tsuen Wan Ref: (69) in PD/TW 2/350CL/4 II Date: 12 July 1991		
Page 6.12 Section 6.6	Has consideration been given to the use of land based fill sources, for example the Sham Tseng Potential Urban Development Area. Should the requirement to bring the CT9 development on stream change to a later date, this option may be feasible. It has the benefit of reducing the need for marine fill and forming development platforms as well.	The very tight implementation programme specified in the Brief effectively precludes consideration of large-scale land-based sources of fill, except for rock. Even if there was a delay to the required timing of CT9, it would take many years to fill from a land-based source and create very severe traffic congestion unless there was a convenient barge loading jetty nearby.
Page 7.3 Para 7.2.4	The report should address in some detail the interim road layouts and staging for the realignment of Tsing Yi Road to run through the SETY reclamation. This is particularly important in relation to the Tsing Yi Road in front of the proposed Technical Institute in Area 23. It is desirable that this section of Tsing Yi Road be closed as soon as possible.	Agreed. It would be desirable to realign Tsing Yi Road in time for commissioning of the 1st Berth or as soon thereafter as possible. Chapter 12 to be amended accordingly, with recommendation added to Section 2.4.
Page 9.37 Para 9.6.2	In relation to the recommendations on levels of noise from industrial buildings, the means by which the operational noise limits are to be apportioned amongst individual units within buildings should be elaborated. It is my recollection that this issue was discussed at some length at a Working Group meeting and it was concluded that it would not be feasible to implement through current legislation and lease controls. If there is a requirement for legislative amendments or additional licensing mechanisms this should be stated.	The noise limit for the whole industrial area should be apportioned equally among the individual industrial sites. Taking into account that the individual industrial sites wil not affect the NSRs equally, it is estimated that the required noise limit for each of the 12 industrial sites currently planned would be 10 dB(A) below the limits given in Table D.3, Appendix D, ie. 51 dB(A) during the day and 45 dB(A) at night. The developer of each industrial site would be required to plan the type and location of any noisy external plant on his buildings to achieve such limits, and would be required to demonstrate this at the planning stage. These limits should be achievable with the use of quiet equipment and the barrier and distance attention available. The sub-divided limit is obviously dependent on the number of industrial sites; if this should change at a later stage in the development, the sub-limits should be altered accordingly. Ideally, the sub-limits should be defined at a later stage when the nature of the industrial area is known in greater detail; the sub-limits could then be divided more equitably between the different industrial buildings, based on their likely need for external plant, and their orientation with respect to the NSRs.

		The operational noise limits proposed are planning limits, to be used in the planning stage, as indicated above. DPO's concern that enforcement of such limits beyond the planning stage is not feasible under the current legislation and lease controls is noted. An additional clause has, therefore, been recommended prohibiting the post-construction installation of noisy external plant on building facades with line of sight to the NSRs. This should be easy to inspect and enforce as necessary.
Page 10.11 Section 10.6	Reference is made to the fact that there is an upper threshold upon levels of new development at SETY on account of the traffic capacity constraint and environmental concerns. With respect to the former, it would be appropriate to quote the upper limit of development so that in future when detailed lease and development schedules are being considered we will have a framework within which to work. It would be preferable if this could be stated in several measures such as GFA, PCU, or workers.	The total development intensity in terms of GFA is given in Table 10.6. This level of development potential can be regarded as the upper limit within the Study Area. Traffic model tests were carried out during the development of the conceptual land-use plan. An iterative process of adjusting land use plans and model runs was established to determine a level of development intensity with trip generation that can be accommodated by the planned transport infrastructure. The traffic model tests have shown that acceptable traffic operations can be achieved if the proposed development intensity is adopted as the maximum level for the study area.
Fig. 10.2	Site 11b is shown zoned "0" when in fact it is currently zoned "CR". It should be shown as a proposed change of zoning to "0".	Agreed. Figure 10.2 amended.
	An additional plan should be prepared to show the simplified statutory zonings proposed. Para 3.2.3 of the Study Brief requires the preparation of amendments to the ODP as well as the OZP and supporting documentation. This supporting documentation should clearly specify the rationale behind the zoning proposals.	Layout Plans at 1:2000 scale will be prepared pending comments on the DFR. These plans will show the land-use designation annotated in a manner consistent with current ODPs. A 1:10,000 scale Outline Zoning Plan showing proposed amendments and new zonings, accompanied by a brief explanatory statement will also be prepared.

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Page Ref in Draft Final Report	Comments	Responses
Chief Engineer/Route 3, Highways Department Ref: ( ) in HR3 7/3/91 VI Date: 15 July 1991		
Page 7.9 Para 7.4.3	It is not preferable to run utilities within the cellular void. All utilities should be incorporated in specially designed troughs which must not affect the structural performance of the bridge or pose any potential hazard to the public.	Agreed. It was always the intention that all utilities should be incorporated in specially designed troughs. The reference to the cellular void was merely a contingency measure in the event that the troughs proved of insufficient size at some future date.
	It also seems that the size of the proposed troughs may not be enough to incorporate all existing overhead high voltage cables.	It is understood that as a result of the latest requirements from the various interested parties in connection with the preliminary design, the size of the proposed utilities troughs have been increased.
Page 10.13 Section 10.7	Parapet planters are not acceptable from a structural maintenance point of view.	A similar comment was made earlier in the Study in connection with Working Paper No.8. At the time, the Steering Group directed that in view of the environmentally sensitive nature of the area, the proposal to incorporate parapet planters which are intended to soften the visual impact of the proposed elevated road structure should be retained. Maintenance problems associated with such planters would be considered at preliminary design stage with HyD.

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Page Ref in Draft Final Report	Comments	Responses
Chief Engineering/Lighting, Lighting Division, Highways Department Ref: (9) in HL 08/18 Date: 11 July 1991		
Page 9.35 Section 9.5	A glare rating of not exceeding 25 should be achieved when viewing from the adjacent residential areas and the nearby public roads. Though GR 34 is "noticeable" it really affects quite a number of residents in the nearby estates.	The calculated glare rating of 34 referred to in the DFR was based on an average illuminance of 25 lux for the terminal. If the GR is to be reduced to 25 without reducing the average illuminance to an unacceptable level, the number of lighting towers will have to be increased in compensation. Cut-off louvres will have to be employed to provide stricter glare control and more precise aiming of the light fittings to control the aim of the beams will be necessary. Although we remain of the opinion that a GR of 34 is acceptable, we have added a statement in the Final Report drawing attention to CE/L, HyD's viewpoint. We have also added an additional figure into Appendix G to indicate a possible lighting tower confligiuration providing an average illuminance of 25 lux at a glare rating of 25.

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Page Ref in Draft Final Report	Comments	Responses
Chief Engineer/Mainland South, Drainage Services Department, Ref: (45) in D(MS) 10/5/26 Date: 15 July 1991		
Page 9.27 Section 9.4 Page 13.2 Para 13.3.3	The DFR notes that the Tsing Yi STW Stage II Extension should cater for an additional 40,600 cu.m/day of flow (predominantly industrial process effluent) for the SETY Development. This is assumed to be ADWF. The SETY Consultants have previously indicated a range of 10,000 - 50,000 cu.m/day with the flows being highly sensitive to the type of industry to be located in the SETY Port Development. This figure of 40,600 cu.m/day seems to be at the upper end of the flow estimates, and constitutes an increase of 10% in the design ADWF for the SSDS planning horizon of 2021 in this tunnel branch. As such, it would probably be necessary to redesign and optimise the SSDS Stage I west tunnels in due course. It must however be stressed that due to the surcharged nature of the SSDS conveyance system and sediment transport constraints, problems may occur if provision is made for flows which are not realised in practice, though this may be overcome by the addition of seawater to make up any shortfall entailing significant additional running cost.	As indicated in Para 9.4.5, the figure of 40,000 m^2/d given for SETY process effluent is an "upper estimated ceiling". As observed in DSD's comment, the potential flow could be much larger, depending on the types of industries taking up residence. Appendix Table F.6 of the DFR indicates a reduced flow of approximately 14,000 m^3/d for "hi-tech" industry only. The intention of the land use planning was that industry on SETY should be predominantly "clean" hi-tech, but there appears to be no regulatory mechanism by which other types of industry can be excluded. It is quite possible that the upper ceiling will not be reached, but in the absence of definite restrictions on industry types, it is considered prudent that provision is made to accommodate the worst-case predicted flows.
Page 7.11 Para 7.6.1	It should be noted that before being accepted for discharge directly into the SSDS system it would be necessary for the flows to receive pretreatment to the standard specified in the SSDS Stage I Report, i.e. 90-95% removal of inorganic sediment of size 0.25mm or larger and fine screening through screens of maximum 6mm aperture.	Noted. Additional text inserted.
	Tsing Yi STW and Kwai Chung STW will be connected to SSDS Stage I tunnel system and not to Stage II.	Noted. Text amended.
	The implementation programme for SSDS Stage I has still to be confirmed, but the current programme shows it being commissioned in 1996.	Noted. Text amended.
	Decommissioning of existing submarine outfalls is obviously dependent upon EPD(WPG) policy.	Agreed.

Page 7.12 Para 7.6.3	Whilst it may be correct to say that under the SSDS network the site requirements for Tsing Yi STW Stage II Extensions will be reduced, it must be recognized that at the same time the Tsing Yi site has been identified as a key production shaft site in the SSDS Stage I - Kowloon System for constructing the tunnel section between Kwai Chung and Stonecutters Island. The minimum works area required during construction is 5000 sq.m for a period of 3 years starting in 1991 (see attached plan). Access must be maintained to the production shaft site at all times during construction. In addition, a permanent collection shaft connecting to the existing STW will be required to be constructed within this works area, the position of which will have to be determined once the layout of the extended STW is known.	Agreed. In preparing the Outline Zoning Plan and Land Use Plan it has been assumed that the existing boundary of the Tsing Yi STW would remain.
	The above SSDS requirements must be taken into consideration when planning for expanding the existing facilities to cater for the Stage II Extensions and SETY development requirements.	Agreed.
Page 7.13 Para 7.6.4	If temporary discharge arrangements for screened and degritted flow are considered acceptable by EPD in the interim period before commissioning of Stage I of the SSDS in terms of water quality, then it is likely these would be acceptable as the long term SSDS emergency overflows.	Noted.

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Chief Highway Engineer (D&M)/NT, Highways Department Ref: ( ) in HNT KCL 9 Date: 15 July 1991

Page Ref in Draft Final Report	Comments	Responses
Page 4.1 Para 4.2, 3rd Sub-para	"31,000 TEUs/<u>ha</u>"	Agreed. Text amended.
Page 7.3 Para 7.2.5, 2nd Sub-para	It is not sure the exact location of the access road as shown in Fig. 7.1, for example. Some amplification may clear doubt. However, a carriageway of 7.0m width appears a bit odd. Should it be 7.3m?	This is a dedicated access road onto the breakwater for the sole use of Dow Chemical. It is not a public highway. A width of 7.0m is considered adequate.
Page 7.8 Para 7.4.3, 3rd Sub-para	It appears that Fig. 7.4 should read "Fig. 7.6".	Agreed. Text amended.
Page 9.15, Para 9.2.5	"Coverage" as a noise mitigation measure is discussed in general terms, with no concrete proposal. We therefore reserve our comments when more solid proposals are available.	Coverage has been defined as "cantilevered barriers or boxed sections over the road" in Para 2 on Page 9.15. Specific requirements for noise mitigation structures should be defined at the detailed design stage.

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Page Ref in Draft Final Report	Comments	Responses
Director/NAPCO Ref: (46) in PADS/PCO 4/11/24 Date: 12 July 1991		
	I have nil return.	Noted.

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Chief Engineer/Planning, Water Supplies Department Ref: WWO 432/3051/90 Date: 16 July 1991

Page Ref in Draft Final Report	Comments	Responses
Page 2.5 Para 2.2.5 Sub-para 6	Tai Po Treatment Works, which is existing, will not be a source of supply for Tsing Yi. It is believed to be an inaccurate quotation from previous correspondence containing a statement "a proposed treatment works in Tai Po".	Noted. Text to be amended to "Yau Kom Tau (Stage II) currently under construction and the proposed treatment works to be sited in Tai Po District have been identified ....".
Page 7.16 Para 7.7 Sub-para 4 to 6	i). Commissioning of the proposed treatment works in Tai Po will probably be deferred to 2000.	The change in commissioning date is noted. Delay in commissioning could restrict the full development of the industrial sites and should be considered during detailed planning of the industrial area.
	ii). Although it is true that part of the water demand in SETY development can be met by Yau Kam Tau Treatment Works Stage II, it is not certain whether supply as much as 50% of the ultimate demand can be provided.	Noted. Text amended to " .... could provide up to 50%".
	iii). For the sake of planning for the improvement to the trunk feed systems associated with water supply to the SETY development we would like to have more information on how the estimated demand of 40,000 to 50,000 m^3/day is arrived at and how likely the demand will realize.	As indicated in Para 9.4.5, the figure of 40,000 m^2/d given for SETY process efficient is an "upper estimated ceiling". As observed in DSD's comment, the potential flow could be much larger, depending on the types of industries taking up residence. Appendix Table F.6 of the DFR indicates a reduced flow of approximately 14,000 m^3/d for "hi-tech" industry only. The intention of the land-use planning was that industry on SETY should be predominantly "clean" hi-tech, but there appears to be no regulatory mechanism by which other types of industry can be excluded. It is quite possible that the upper ceiling will not be reached, but in the absence of definite restrictions on industry types, it is considered prudent that provision is made to accommodate the worst-case predicted flows.

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Page Ref in Draft Final Report	**Comments**	**Responses**
Commissioner for Transport Ref: CT/PAD 171/200-10 III Date: 19 July 1991		
Figure 4.2	Reference to Figure 4.2 suggests that the provision for container vehicle parking within the terminal may not be adequate. Compare the relative size of Terminal 9 with that of existing container terminals (Figure 4.1)	Some of the congestion problems at existing terminals arise from their having the entrance gate houses too close to the main road. The entrance gate house to CT9 is set back inside the Terminal providing a substantial queueing area (for 180 container vehicles) off Sety Port Road. A further 180 waiting spaces are provided inside the secure zone. These are considered adequate for CT9 and are equivalent to those being provided for CT8 and proportionally exceed those on other terminals with respect to number of berths and terminal areas.
Figures 4.2 and 7.1	Referring to Figure 4.2 and Figure 7.1 it is suggested that consideration be given to providing private car access to CT9 carpark via the Principle Industrial access (East) Road instead of SETY Port Road, to avoid any blockage of the entrance from queuing of container vehicles waiting to enter the adjacent ingress to the Terminal.	As stated above the queuing area provided is considered adequate to prevent blockage of the entrance; however, "yellow boxes" could be painted as an extra precaution. On the other hand, and bearing in mind that the terminal buildings act as a partial barrier, access off PIA(E) would introduce an awkward right turn close to roundabout R2. The route to the car park would then cause interface problems with terminal operations.
Page 7.2 Para 7.2.3. 4th Sub-para 3rd line	I suggest that "1.2m. wide marginal strips (0.6m either side)" be replaced by "2No. 0.6m wide marginal strips".	Agreed. Text amended.
Page 7.3 Para 7.2.4. 1st Sub-para 5th line	I suggest that "1.2m wide marginal strips" be replaced by "1.2m width of marginal strips".	Text amended to read "two 0.6m wide marginal strips".
Page 7.4 Para 7.2.8 2nd Sub-para	"Wiu" should be replaced by Wui.	Agreed. Text amended.
Page 7.5 Para 7.2.9. 1st Sub-para 1st line	I suggest "Current bus services" be replaced by "Current transport services". Insert "scheduled" before "Public Light Bus service".	Agreed. Text amended.
Figure 7.1	should also indicate location of Area 22c.	Agreed. Figure amended.
Page 7.6 Para 7.4.1 3rd Sub-para	This raises the previously unmentioned possibility of demolishing the existing structure and replacing it with a single larger structure, but does not satisfactorily explain the considerations which have led to the rejection of this alternative course of action.	Noted. Para 7.4.1, 3rd sub-para has been expanded to read:- Consideration was given to replacing the existing Tsing Yi South Bridge by either a single larger structure or new twin structures. This arose primarily because some concern had been expressed by the Working Group over the condition of the existing bridge and its remaining

		existing bridge and its remaining operational life. It is likely that a replacement system would produce a slightly better traffic engineering solution of the overall junction layouts. However, HyD (Struct) advised that they were satisfied with the structural integrity of the existing bridge and that, with proper maintenance, there was no need to consider any further the possible replacement of the structure on structural performance grounds. A replacement system would be more expensive to construct; it would involve the demolition of the existing bridge, extensive temporary diversions of existing traffic and services (from the existing bridge) and possibly the construction of some temporary structures. The relatively small benefit to the final traffic movements did not justify the additional expenditure involved.
Page 7.7 Para 7.4.3	The consultants for the Duplicate Tsing YI South Bridge have proposed modified lane widths for Duplicate Bridges No.1 and No.2. Would the Consultants for the "CT9 Study" like to comment?	We understood that minor modifications have been recommended during the preliminary design; however these do not affect the results of this Study.
Page 8.3 Table 8.2.	Presumably the 3rd and 4th columns should be headed EMPLOYMENT.	Agreed. The table has been amended.
Figures 8.2 and 8.5	With reference to Figures 8.2 and 8.5, the traffic flow on the southbound slip road from Tsing Yi Bridge is almost up to capacity at 1950 PCUs and 1800 PCUs for the years 1996 and 2001 respectively. In addition, the entrance to CT9 is fairly close to the roundabout R3. Any queue of container vehicles waiting to access CT9 will block the slow lane of New Tsing Yi Road and hence the slip road. The report should consider the possibility of widening the slip road to 2 traffic lanes.	The forecast traffic flows of 1950 PCUs and 1800 PCUs for the southbound slip road indicate a high demand for this movement. Demand in excess of capacity can easily be accommodated by traffic using the roundabout (R2) at the end of the bridge and turning left. In both the 1996 and 2001 model runs some traffic was also forecast to use the roundabout to make this turn. V/C ratios for the approach to the roundabout from the bridge are only 0.24 in 1996 and 0.31 in 2001. It is, therefore, unnecessary to widen the southbound slip road from one to two lanes. It is anticipated that the queuing of container vehicles can be accommodated within the terminal itself and, therefore, queues should not block back onto the SETY Port Road.
	In view of the importance of the Kwai King Road/Kwai Tsing Road junction, could the consultants suggest some interim measures which would relieve traffic congestion at this point, prior to the completion of Route 3 (CRA1)?	This matter is currently being addressed in the preliminary design for the Duplicate South Bridge which has identified the possibility of providing an additional east to west straight through lane on Kwai Tsing Road. This can be achieved by changing the lane configuration for the approach from the east and widening the westbound carriageway west of Kwai King Road to three lanes. The approach from the east can be changed from two lanes left and two lanes straight-ahead to one lane left and three lanes straight ahead. Widening the westbound carriageway from two to three lanes will allow for the full utilization of the three straight-through lanes thereby increasing the overall junction capacity.

		Model tests have been carried out for this configuration for both 1996 and 2001. The 2001 tests result in good forecast operating conditions and reserve capacity. The 1996 tests also result in good operating conditions and reserve capacity. However, due to the removal of the large forecast delay, the junction improvement has attracted more vehicles to use Tsing Yi South Bridge thereby causing problems at the Tsuen Wan Road/Kwai Tsing Road/Hing Fong Road junction. The forecast problems at the Tsuen Wan Road/Kwai Tsing Road/Hing Fong Road junction are smaller than the ones previously reported for the Kwai Tsing Road/Kwai King Road junction before the proposed improvement. It should, however, be noted that the 1996 tests are considered to represent the "worst case" scenario. Due to the scale and nature of these changes, the results of the model tests with the junction improvement have now been incorporated into the text of the final report. Please refer to the final report for further details. It should, however, be noted that the precise details of the junction layout and widening are to some extent preliminary and the final configuration will also depend on interfaces with Route 3 and the airport railway.
Page 8.24 Para 8.12 3rd Sub-para	Refers to a district traffic study to optimise operations on the local road network. Are the consultants able to explicitly recommend such a study?	The last comprehensive study of Tsuen Wan and Kwai Tsing districts was carried out in 1983 under the Tsuen Wan Transport Study. Since then, several studies have included analysis of future transport demands in parts of this area. In particular, the CT8 Study included access to and from the container port area, Tsing Yi South Bridge and junctions along Hing Fong Road. The Route 3 Preliminary Design Study has focused attention on the main trunk roads and district distributors in Tsuen Wan, and the SETY Study has looked at Tsing Yi, access to and from Tsing Yi and part of North Kwai Chung. All of these studies have used the CTS-2 Model as their basis with areas of interest refined in greater detail by use of SATURN models. Therefore, large areas such as Tsuen Wan town centre and North Kwai Chung around Castle Peak Road have not been studied in detail. Recently several district traffic studies have jointly been carried out by Government and consultants in areas of Kowloon and Hong Kong Island. A district study of Tsuen Wan would now seem appropriate to analyse existing and forecast traffic conditions in detail particularly in Tsuen Wan town centre and in North Kwai Chung.

Page 8.8 Table 8.7	Presumably "Annual Container Throughout" should read "Annual Container Throughput".	Noted. Text amended.
Page 8.9 Para 8.6 2nd Sub-para	"genration" should read "generation".	Noted. Text amended.
Page 8.15 Table 8.13 2nd Sub-para	Heading VC/Ratio should read V/C Ratio.	Noted. Text amended.
Page 8.15 Para 8.9.1 3rd Sub-para	Should the reference to the "right" turn from Kwai King Road onto the approach to the bridge actually be the "left" turn?	Yes, Text amended.
Page 8.2.1 Para 8.10.2	6th line "on" should read "one".	Noted. Text amended.
Page 8.5 Para 8.4.5 2nd Sub-para	Would the consultants add a comment relevant to the consequences for traffic congestion in the event of the airport railway not being in operation by 2001?	Sensitivity tests concerning the airport railway not being in operation by 2001 are outside the Study Brief. Should Government wish the Consultants to carry out such tests, additional transport model runs could be made as part of as separate study. Without the benefit of such tests, the possible outcome of this scenario could be: (i) Increased traffic across Tsing Tsuen and Tsing Yi bridges due to the removal of Tsing Yi station served by the local stopping service. (ii) Increased traffic on Route 3 (CRA1) and on Tsing Yi North Coastal Road due to an increase in cars, taxis and buses to the airport. Whether all of the roads and junctions in the vicinity of the approaches to the airport will be able to accommodate such increase in traffic would require detailed analysis with the aid of the CTS-2 Model and SATURN.

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Secretary for Transport Ref: TRAN 4/06/122 (90) Date: 19 July 1991		
Page 8.7 Para 8.4.8	Would the airport related trips be a function also of the volume of freight carried?	Airport related trips are also a function of the volume of freight carried and have been included in the CTS-2 Model forecasts. Such trips were not discussed in para. 8.4.8 as they contribute a small proportion to the total airport related trips which are primarily passenger related.
Page 8.15 Para 8.9.1 (line 15)	Should the 'right' turn from Kwai Chung Road be 'left' turn?	Yes. Text amended.
Page 8.16 Para 8.9.3	The study assumed that the improved Lung Cheung Road/Ching Cheung Road would be in place by 1996. Now that this project is not included in the Airport Core Programme, I suggest testing the traffic implication of not having this improvement by 1996.	Noted. Sensitivity tests concerning the traffic implications of elements of the Airport Core Programme are outside the requirements of the Study Brief.
Page 8.21 Para 8.10.2	Assuming that Tsing Yi North Coastal Road (TYNCR) would be in place by 2001, congestion was forecast on the slip road which links Tsing Yi with Tsing Yi North Bridge eastbound (volume/capacity ratio of 1.03). Now that the TYNCR is also not in the Airport Core Programme, I suggest testing the traffic implication of not having this by 2001.	Noted. Sensitivity tests concerning the traffic implications of elements of the Airport Core Programme are outside the requirements of the Study Brief. In relation to the eastbound slip road into Tsing Tsuen Bridge, traffic conditions would actually be improved if TYNCR were not in place. This is because the slip road would be able to operate, as it does currently, as two full traffic lanes forming the start of the bridge. Congestion would not, therefore, occur at this location. However, the additional traffic using Tsing Tsuen Bridge, West Tsing Yi Road and the Route 3 (CRA1)/West Tsing Yi Interchange to get to the Lantau Fixed Crossing could possibly cause problems at the Tsing Tsuen Bridge Roundabout, West Tsing Yi Road/Fung Shui Wo Road, West Tsing Yi Road/Ching Hong Road junction, and at the Route 3 (CRA1)/West Tsing Yi Interchange itself. Further model tests would be required to evaluate this scenario in detail.

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Page Ref in Draft Final Report	Comments	Responses
Director of Planning	**Ref: PADS D/POR/301 Date: 16 July 1991**	
Page 2.2 Para 2.2.2	It is extremely likely that other waterfront users will be attracted to the site for the PCWA and the adjacent Industrial Area, and it is therefore considered that this site should be constructed to accommodate other uses such as mid-stream operations.	In March 1991, STP/CT directed that the Consultants continue to assume a PCWA in this area, and that the use of this water frontage and adjacent land would be reviewed at a later date.
Page 2.3 Para 2.2.4	The southern sloping sea wall, with no decking over, is extremely wasteful of valuable waterfront space. It is considered essential to deck this length in order to provide wharfage and to provide backup land behind for servicing etc.	Marine operations on the southern seawall were not considered for the relocation of existing waterfront users due to the high exposure to seas from south, which would lead to less efficient operations and possibly some downtime. As such, a marine basin has been recommended for these operations and for the proposed Dangerous Goods Ferry. It would however, be feasible to provide, or allow construction of, additional quay lengths, for new waterfront users, along the southern seawall (in particular to the west of the marine basin) and this has been acknowledged in para 4.6.4 with regard to the CRC expansion. Potential users should, however, be made aware of the possible operating restrictions.
Page 2.7 Para 2.2.9	The construction programme A is unacceptable in that if it is to be the actual programme, and with the current (forecast) requirement for berth 1 of CT 10 by April 1997, the final berth of CT 9 would be 'misplaced'.	The forecast for the first container berth at CT10 is presumably based on a 4-berth CT9. Thus irrespective of whether the first berth on CT10 is forecast to be required by April 1997, the last CT9 berth is still also required, though perhaps earlier. As discussed in Section 12.9, programmes with significantly earlier commissioning dates, such as Programme B, would be more vulnerable to delays and have lower confidence levels. Programme B dates are basically too optimistic to assume in any realistic planning exercise. Please also refer to the table at the end of this Appendix.
Page 2.8 Para 2.3	800m of PCWA were originally requested (refer to para. 12 of the Development Statement): is this not possible?	With a 4-berth CT9 scenario and the maximum limits of the reclamation, which satisfy the 800m and 900m clearances to Terminals 2 to 6 and Terminal 8 respectively, the maximum length for the PCWA is 640 metres. It has been agreed that only the southern 520m length be used for berthing to avoid those marine operations in the more retricted channel area adjacent to Terminal 5 (refer Section 4.3).
Page 4.4 Para 4.6.1	Why has it been assumed that marine reprovisioning of Hoi Kong (areas 9a & 14) and presumably also areas 4a and 26a, all of which are used for mid-stream container handling, is not required. These STT's	In line with current Government policy, there was no requirement to reprovision the existing STT's. However, the importance of some of their activities, particularly the mid-stream handling, is recognised and if

	perform a necessary function and certainly should be reprovisioned.	Government wished to find alternative locations for them, it is considered that, in view of the current uncertainty over the requirement for a PCWA on SETY, waterfront sites could be made available within Site 5. Furthermore, if needed, part of one of the lorry parking areas such as Site 22b could be reserved for container storage. The actual site area required, phasing and the risk hazard constraints would need to be re-examined in selecting the reprovisioning site.
	With the above comments there would need to be some amendment made to the land use plans.	
Pages 12.7 and 12.9 Sections 12.7 and 12.8	It would make comparisons easier if standard descriptions were used e.g. is 'Reclamation' in 12.7.2 the same as 'Filling' in 12.8.2	Noted. "Reclamation" has been amended to "Filling" in this case.
	During the phasing plan, it would be useful if the areas which could be made available for temporary uses, and their time of availability could be identified.	Noted.
	Is there any difference is cost between Programme A and Programme B? If so this should be clearly identified.	Programme B would attract a significant cost premium compared with Programme A because of the additional equipment (notably dredging and filling equipment) associated with overlapping activities. (Refer Para 12.8.1) A note of this cost implication has been added to the text.
	Ref. to 5) above para. 2.2.3 of the brief requires all facilities and installation affected by CT 9 to have recommendations for reprovisioning, and para. 37 of the Development Statement confirms this with relation to temporary container-related uses.	Noted.

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Director of Industry	**Ref: (82) in ID 305/10 VII Date: 21 June 1991**	
	I am glad to note that in the Draft Final Report, proposals have been made for the reprovisioning of waterfront facilities for both Outboard Marine Asia Ltd. and Dow Chemicals Co. which will be adversely affected by the CT9 reclamation. I also note that negotiations with these firms will be concluded by 1 February 1992 to enable finalization of development tender conditions.	Noted. The DFR recommended that negotiations should be concluded by 1.2.92. Comments from other Government Department express the view that this date is most unlikely to be met.
	I hope the negotiations will be satisfactory concluded on time. In this regard, I shall be grateful for your confirmation that any reprovisioning proposals in the report could be subject to modifications in consultation with the industrial firms having regard to their specific requirements.	It is considered that as the Report is essentially conceptual in nature, any specific requirements of the industrial firms would be taken into account at the detailed design stage.

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Page Ref in Draft Final Report	Comments	Responses
Principal Government Geotechnical Engineer Ref: (13) in GCP 1/4/457 Date: 12 June 1991		
Page 2.3 Para 2.2.4	I suggest that the first sentence in the second paragraph should be changed to "The development is estimated to require marine disposal of 16 million cu m of mud while 35 million cu m of marine fill and 1.6 million cu m of rockfill from a land-based borrow will have to be provided."	Agreed. Text amended.
Page 6.3 Para 6.3.4	For the preliminary design of the seawall, design wave heights (H_{10}) corresponding to the highest 10% of waves have been used with significant wave periods (T_s) which are calculated from the highest 33% of waves. The combination of parameters appears to be inconsistent.	This combination is correct.
Page 6.5 Para 6.4.1	Table 6.1 uses H_s for wave and storm surge level calculations whereas H_{10} has been used in the seawall design in Para 6.3.4. I suggest that the Consultants should given some background for the choice of different wave heights.	For storm surge a more frequent wave (Hs) was used as the consideration was inundation. For revetment design Port Works Division design criteria has been used, namely H_{10}.
Page 6.8 Section 6.5	A gradient of 1 on 2 (26.6°) is allowed for the side slopes for the dredged trenches in mud. This may not be adequate and should be reviewed with the actual soil conditions and the wave forces under probable weather conditions at the detailed design stage.	Agreed.
Page 6.21 Para 6.12.1(i)	The statement that "The interface with SETY reclamation is, however, unlikely to require dredging of mud in the CWTF seawall area due to the presence of approximately 360 piles associated with the existing CWTF pier" requires clarification, in view of the statement in paragraph 6.12.2 about the possible difficulties of removing the piles. Do the Consultants mean that the presence of the piles renders dredging impractical or unnecessary?	The presence of the existing pier piles at the CWTF site is expected to make removal of mud impractical if these piles cannot be removed.
Page 6.21 Para 6 .12.2	I do not see how the piles at the Mobil and HK Oil piers can be removed down to the alluvium level without first dredging the marine mud. However, if the marine mud can be dredged with the piles left in place, there is no need to remove the piles, as the hydraulic fill can easily be placed in the spaces between the piles.	Total pile removal is desirable to avoid future problems with subsequent land development which is likely to include piled structures. In the event that total pile removal is not possible the Developer would be required to remove piles down to the dredged level (alluvium) to minimise the chances of future piling interference.

Page 6.22 Para 6.14	With regard to the potential for collapse of tanks in the wreck of the "Seawise University", it may be possible, if the locations of the tanks were known, to penetrate and infill them with a suitable grout mixture, thus preventing any future collapse. The potential for a successful operation of this nature obviously rests on the ease of locating the tanks, but there is a potential cost benefit if future settlement can be avoided.	The exact location of the tanks (and their condition) is unknown. Locating them and then grouting could be a time-consuming and expensive operation. The proposal by CESE(PW) to preload the area may be a more cost effective method of minimising future settlement.
Figures 6.2 and 6.8	The limit of the CT9 reclamation is shown to the west of 830 000e in these two figures, while all other figures show reclamation beyond 830 000E.	Noted. Figures 6.2 and 6.8 will be amended.

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Director of Environmental Protection Ref: in EP 1/G/42 Annex 1 (EPD 3) Date: 26 July 1991

Page Ref in Draft Final Report	**Comments**	**Responses**
Page 7.11 Para 7.6.1 Sub-para 2 Line 5	A typo "benefit".	Noted.
Page 7.11 Para 7.6.1 Sub-para 2 Line 7	Please amend "end 1995" to "early 1996", and "in early 1996" to "by mid 1996".	Noted. Text amended.
Page 7.11 Para 7.6.1 Sub-para 2 Last line	Amend "lamma" to "Lema".	Noted. Text amended.
Page 7.12 Para 7.6.3	The Tsing Yi STW only provides preliminary treatment rather than primary treatment.	Noted. Text amended.

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Page Ref in Draft Final Report	Comments	Responses
Director of Environmental Protection Ref: In EP 1/G/42 Annex 1 (EPD 4) Date: 26 July 1991		
Page 7.11 Para 7.5.2 Sub-para 4	If public sewerage is considered necessary to serve the ultimate development, it should be provided in the various stages of development.	Noted.
Page 7.11 Para 7.5.2 Sub-para 6	Existing septic tank overflows should not be allowed to be connected to the proposed box culvert. Rectification works, where necessary, should be carried out.	Noted. Text amended to; ".... be connected to the proposed sewer from the CWTF in Tsing Yi Road".
Page 7.11 Section 7.6	It should be noted that bypass outfalls and overflows from STWs should only be allowed to discharge under emergency situations and adequate measures including equipment etc., should have been provided to minimize the occurrence of emergency situation. The various options addressed in Para 7.6.4 would have serious impact on water quality.	The options stated in para 7.6.4 have been discussed and agreed with EPD (Water Policy Group). As stated in Section 9.4 "Tidal flow modelling suggested that reasonable dispersion would be expected from a short outfall" and as such, we do not consider there will be serious impact on water quality.

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Page Ref In Draft Final Report	**Comments**	**Responses**
Director of Environmental Protection Ref: EPI/G/42 Annex 1 (EPD5) Date: 26 July 1991		
Table 9.7.1	6 monitoring stations about 100m from active dredging and reclamation areas.	The requirement for 100m distance specification has been included in the more detailed description of monitoring requirements given in Para 9.4.7.
Para 9.7.1 Sub-para 3 Line 3	The requirements limits and the related construction activities being taken.	Noted.
Table 9.7.1	Add "1m from surface, 1m from bottom and mid-depth" after "3 depths".	Table 9.7.1 is a summary only; these specific depth requirements are included in the more detailed description of monitoring requirements given in Para 9.4.7.
Table 9.7.2	Please clarify tackle value and action value.	As indicated in the footnote to Table 9.7.2, the trigger value is 4 mgl^{-1} DO for surface samples and 2 mgl^{-1} DO for bottom samples. Action values for any of the impact monitoring stations, within 100m of the dredging area, are defined as 30% greater (or lesser for DO) than a range of values measured on the same day at the same depths at several control stations further away, out of the impact zone. If the dredging is causing increased turbidity, the values at the impact monitoring station would be expected to be noticeably higher than the values measured at the control stations. In this case, the contractor would be deemed responsible for the observed impact and instructed to review his working methods. If, however, there is generally increased turbidity within the Western Harbour due to external factors such as heavy rainfall or seasonal discharges from the Pearl River, then it would be expected that turbidity would be high at both the impact monitoring stations and the control stations. In this case, the contractor would not be deemed responsible because the high levels observed at all stations indicate a general natural impact rather than a site-specific impact caused by dredging. The trigger values for DO, which are based on the absolute limits specified for, inter alia, protection of marine life under the WPCO, act as an alarm signal. If these are not met, the monitoring data should be reviewed carefully to establish whether this could be the result of dredging activities, or whether it is a general phenomenon affecting the area.

		In the case where examination of the data suggests that it is the result of dredging activities, ie the values at the impact monitoring stations exceed by 30% those at the control monitoring stations, then the contractor would be required to rectify immediately unacceptable working practices. If this situation, in which both the trigger and action values are exceeded, persists for 2 days or more the contractor would be required to modify his method statement and implement the necessary changes to his working methods.
Para 9.6.4 Sub-para 2 Last Line	The leasee should ensure that deterioration of water quality caused by the dredging and reclamation activities is kept to a minimum. The leasee should also undertake all necessary measures to ensure compliance with these requirements.	Noted.

Table 1 Summary of Container Berth Commissioning Dates

	Brief Note 1	Programme A Note 2	Recommended Lease Note 3	Revised Trigger Pt. Note 4	Increased Procedures Note 5
Grant Signing	-	July 1992	July 1992	-	Jan 1993
First Berth	Nov 1994	June 1995	Dec 1995	July 1995	June 1996
Second Berth	May 1995	May 1996	Nov 1996	Jan 1996	May 1997
Third Berth	Nov 1995	Oct 1996	April 1997	July 1996	Oct 1997
Fourth Berth	May 1996	July 1997	Jan 1998	Jan 1997	July 1998

Note 1: Refer SETY Study Brief

Note 2: Refer DFR Figure 12.2

Note 3: Refer DFR Section 12.9

Note 4: Based on Marine Department advice on 25 January 1991

Note 5: Based on Dates recommended for Development Lease (Refer DFR Section 12.9) adjusted to allow 1 year statutory procedures in line with DBL/BLD and DLO/KT advice June/July 1991.