Hong Kong Government
Territory Development Department
Urban Area Development Office

Central and Wan Chai Reclamation Development

Central Reclamation, Phase 1
Focussed Environmental Impact Assessment Study

Final Report
Executive Summary
Supplementary Document

Maunsell Consultants Asia Ltd
in association with
Balfours International (Asia)
MVA Asia Ltd · Urbis Travers Morgan Ltd
CES Consultants in Environmental Sciences (Asia) Ltd

(14) in EP 2/1H4/67 Annex(I)

Hong Kong Government
Territory Development Department
Urban Area Development Office

Central and Wan Chai Reclamation Development

Central Reclamation, Phase 1
Focussed Environmental Impact Assessment Study

Final Report
Executive Summary
Supplementary Document

May 1993

Maunsell Consultants Asia Ltd

in association with

Balfours International Asia Consulting Engineers Ltd

CES Consultants in Environmental Services (Asia) Ltd

Hydralics and Water Research (Asia) Ltd

PREFACE

The Focussed EIA Study was carried out on behalf of the Project Manager, Urban Area Development Office, Territory Development Department by CES Consultants in Environmental Sciences (Asia) Ltd. The objective of EIA was to ensure that environmental mitigation measures specified in the contract documents for the Central Reclamation Phase 1 are adequate to maintain acceptable environmental quality, particularly water quality, during the process of reclamation. The functional output of the EIA took the form of recommendations on additional mitigation measures, where necessary, for inclusion in the works contract.

The Focussed EIA Study enabled water quality modelling plus a review of air, noise, waste and construction matters to be carried out. Pollution reduction measures were identified and recommended by the Study to ameliorate the effects of the new reclamation and its embayments, although the effective extent of pollution reduction will need to be quantified by subsequent investigation and monitoring. Certain amendments to the construction specification were found necessary and were incorporated into the contract. As a result, this study has enabled construction impacts of the reclamation to be minimised. The Final Report of the Study was issued on 7th October 1992.

In the Final Report, a maximum sound power level from construction plant of 132 dB(A) was calculated for the two worst case months (May and June 1995). The maximum noise level at noise sensitive (NSR 2) was predicted to reach 85 dB(A) which exceeded the day-time requirement by 10 dB(A). This calculation did not, however, take into account that the noise would be arising from contracts in two separate areas. Upon further review, EPD requested an additional assessment to evaluate in more detail the noise impact at NSR 2 (United Building) within the critical months by considering the construction schedule and any mitigation required to satisfy the day-time construction noise limit of 75 dB(A). This assessment was carried in November 1992 and took into account the different site areas available to each contract. The "Addendum on Noise Assessment" was issued on 27th November 1992.

Further discussion on some minor points continued with EPD, who subsequently requested that a Supplementary Document to the Final Report be produced to incorporate the Addendum on Noise Assessment, further comments and responses, and Post-Final Report correspondence. A sticker was also requested for the present copies of the Final Report, advising readers that it was to be read in conjunction with the Final Report. The Supplementary Document was issued on 31st March 1993.

In order to comply with Planning, Environment and Lands Branch's General Circular No. 2/92, Urban Area Development Office instructed the production of additional copies of a report combining the Final Report, Executive Summary and the Supplementary Document in order to facilitate public inspection. The three documents are in the following order:

Executive Summary
Final Report
Supplementary Document to the Final Report

Hong Kong Government
Territory Development Department
Urban Area Development Office

Central and Wan Chai Reclamation Development

Central Reclamation, Phase 1
Focussed Environmental Impact Assessment Study

Executive Summary

September 1992

Maunsell Consultants Asia Ltd

in association with

Balfours International Asia Consulting Engineers Ltd

CES Consultants in Environmental Sciences (Asia) Ltd

Hydraulics and Water Research (Asia) Ltd

Executive Summary

1 Introduction and Objectives

This focussed EIA was carried out on behalf of the Project Manager, Urban Area Development Office, Territory Development Department by CES Consultants in Environmental Sciences (Asia) Ltd. The objective of the EIA was to ensure that environmental mitigation measures specified in the contract documents for the Central Reclamation Phase I are adequate to maintain acceptable environmental quality, particularly water quality, during the process of reclamation. The functional output of the EIA takes the form of recommendations on additional mitigation measures, where necessary, for inclusion in works contract conditions as tender addenda.

Construction of the Central Reclamation Phase I will involve the formation of a temporary embayment between the Star Ferry and Macau Ferry Terminals (Figure 1). The embayment will exist for a period of approximately three years before the being infilled to form the reclamation itself (Figure 2). There are a number of storm sewer outfalls discharging significant pollution loads into and immediately outside the embayment; these discharges are in the process of investigation and rectification under the Central Western and Wan Chai West Sewerage Master Plan (SMP), but collection and disposal measures defined by the SMP will not be fully implemented until after the Central Reclamation embayment has been infilled. A number of cooling water intakes and outlets will also be affected.

There is therefore concern that discharges of sewage and cooling water may cause adverse water quality impacts in three main areas associated with construction of Phase I of the reclamation; east of the eastern reclamation bund around Star Ferry terminal and Queens Pier; in the embayed area between the two reclamation bunds; and between the western reclamation bund and the Macau Ferry terminal. The areas to the east and west of the reclamation will still be of concern after its completion. While a number of measures to improve water quality and a water quality monitoring programme have already been included in the Contract, it was considered necessary to carry out a study to predict the impacts of the storm sewer and cooling water discharges on water quality by mathematical modelling, to estimate potential water quality impacts from dredging, and to identify what mitigation measures would be necessary to reduce these to acceptable levels. Impacts of construction dust and noise, and the implications of the presence of contaminated marine mud have also been evaluated. The following sections summarise the impacts, mitigation measures and monitoring proposals relevant to each environmental medium considered.

2 Water Quality

2.1 Summary of Impacts

Cooling Water Discharges - While the embayment is in place, cooling water will be drawn in from inside the embayment and discharged outside it, to the east and west. The reclamation bunds have the effect of reducing the tidal flows slightly to the east and west of the bunds, thus the warm water discharged after being used for cooling purposes will tend to collect in the corners formed near the Star Ferry and Macau Ferry terminals. As it is warmer and hence less dense than the seawater, it will tend to float on the surface and remain in a plume near the sea walls, outside the embayment. The temperature increases resulting from this, however, are generally low, exceeding 2°C above the existing seawater temperature only within an area of about 250 m x 50 m in the wet season under neap tide conditions. Completion of the reclamation showed similar results, except that a new large cooling water outfall located on the new sea wall would result in plumes exceeding 2°C above ambient up to 125 m from the outfall.

Stormwater Discharges - The reclamation bunds are to be constructed from the seaward side towards the shore and the embayment will not be fully formed and closed off until the bunds connect with existing seawall. Of the four major stormwater outfalls which presently discharge into the potential embayed area, two (B and F on Figure 1) will be diverted outside the embayment to reduce the pollution loading into the trapped body of water, although there will be a short period of time between completing the bunds and diverting these outfalls. Since for the majority of the time that the embayment is present, the outfalls will discharge outside it, this scenario was used for modelling purposes.

Pollution loads in the stormwater culverts, resulting from overflows and expedient connections made from the foul sewer system to the stormwater system, were estimated on the basis of field measurements made in 1990 as part of the Central Western and Wan Chai Sewerage Master Plan. In some culverts, no evidence of sewage contamination had been observed in the field survey, but an estimate was made of potential pollution loads based on catchment populations; this gave a worst case estimate of polluting loads from the storm sewers. A number of improvements to the drainage system have been made or are in the process of being made by DSD, but as the efficacy of these in terms of pollution reduction could not be established, they were not taken account in the modelling. This also gave a conservative approach.

The results of the mathematical modelling suggested that water quality would not be significantly affected within the embayed area or to the west, but that conditions would deteriorate somewhat to the east of the eastern reclamation bund near Star Ferry. Mitigation measures were considered in relation to the two stormwater catchments affecting this area, catchments F and J1, comprising rectification of expedient connections and relaying sections of hydraulically inadequate sewers. No field data were available on the effectiveness of such measures in reducing pollution loads, thus assumptions had to be made on the potential load reductions in order to simulate water quality conditions following implementation of such mitigation measures, under both the partial and full reclamation scenarios.

The model results suggested that dissolved oxygen concentrations, which are predicted to be below the proposed Water Quality Objective (WQO) of 60% saturation without the reclamation, would be reduced near the Star Ferry by about 2% saturation in the wet season, but would be unaffected elsewhere or during the dry season. Small increases in biochemical oxygen demand could be adequately mitigated. Nutrient concentrations were predicted to increase near Star Ferry as a result of the works, but this effect could be mitigated such that concentrations of ammonia and nitrate would be well within the WQOs. Bacterial counts are predicted to be already over the WQO limit in the absence of the reclamation, but would increase within the embayment and near Star Ferry following construction of the bunds. The mitigation measures reduced this effect near Star Ferry but gave no improvement in the embayment.

While the assumptions made on the pollution loads in the storm sewers and the load reductions associated with the mitigation measures meant that the mathematical modelling results were only indicative, they suggested that the main water quality impacts resulting from the reclamation would occur around the Star Ferry area, and that substantial reductions in the amount of foul sewage entering the storm water drains in catchments F and J1 would be required in order to minimise these effects.

Dredging Works - An evaluation of potential pollution loads arising from dredging was carried out. Approximately 400,000 m^3 of marine mud will be dredged in the area of the reclamation bunds over a 1.7 month period in late 1992. A further 600,000 m^3 of mud will be removed from inside the embayment over a 2.5 month period in mid-1994. The same rate of dredging, i.e. 8,000 m^3/d, will be used in both periods. Worst case estimates of pollution loads arising from dredging were 280 tonnes per day of suspended solids, 5 tonnes per day of chemical oxygen demand and 0.5 tonnes per day of total kjeldahl nitrogen. The initial dredging will be carried out in open water prior to the reclamation bunds being formed and although some sediment plumes may be generated, adverse effects on dissolved oxygen levels would not be expected to occur as there should be adequate exchange with the main tidal flow in the harbour. Dredging within the embayment, however, could be expected to significantly increase the pollutant loads to the embayment (when combined with that from the stormwater discharges) for a 2.5 month period.

Controls over the type and operation of dredgers, together with a performance specification in terms of suspended solids concentrations are included in the Contract. It was recommended that a performance specification for dissolved oxygen levels is also included. In consideration of the potential cumulative impacts in the embayment, it was recommended that a number of drainage improvements to be carried out by DSD within catchments draining into the embayment should be implemented immediately.

Floating Refuse - The tidal flow modelling showed that current speeds will reduce locally following construction of the reclamation bunds, which will tend to cause floating refuse to accumulate in slack corners. A requirement has been included in the Contract for a Water Witch refuse collection vessel to operate seven days per week within and around the reclamation site, to pick up and dispose of floating refuse. No amendments to the Contract Specification were considered necessary.

2.2 Mitigation

In view of the potential cumulative impacts on water quality, summarised in Table 1, a number of mitigation measures were recommended regarding the sewerage and drainage infrastructure. These have been categorised on the basis of the conclusions of the assessment as either essential or desirable. The measures are described below and are itemised with cost estimates in Table 2. Their locations are shown schematically in Figure 3.

Essential Measures

(i) Immediate implementation (and monitoring where appropriate) of all measures being or to be completed by DSD (Improvement measures 1 to 4 inclusive).

(ii) Removal of all known cross connections (Improvement measures 6, 10 and 11). One of these items is a provisional item under contract UA11/91.

(iii) Realignment of Culvert B by the future airport station contractor (Improvement measure 5).

(iv) Upgrading the capacity of the existing foul sewers in catchments F and J1 subject to their effectiveness being confirmed by subsequent investigation (Improvement measures 7 and 12 to 18 inclusive). One of the items in catchment F is a provisional item under contract UA11/91. Following positive confirmation of the effectiveness of the measure proposed in catchment J1 (Improvement No.7) the timing of the works should be determined after consideration of both the considerable traffic impact and the programme for larger scale strategic sewerage improvements in the area.

Desirable Measures

(v) Upgrading the capacity of the existing foul sewers in catchments C and D subject to their effectiveness being confirmed by subsequent investigation (Improvement measures 8 and 9). These works are provisional items under contract UA11/91.

It is recommended that investigation of the potential effectiveness of the upgrading works mentioned in (iv) and (v) above is included in the scope of the extension study which is shortly to be let by EPD under the Central, Western and Wan Chai West Sewerage Master Plan Study. It is understood that at present the study is only intended to cover catchments C and D, but investigation of catchments F and J1 would be beneficial in relation to the mitigation measures recommended in this Study. Design of any mitigation measures agreed by Government will need to commence by early November 1992 to ensure that construction is finished prior to the completion of the bunds.

2.3 Monitoring and Audit

As a result of the assessment, a number of changes were recommended to the monitoring requirements specified in the Central Reclamation Contract Documentation. These included minor changes to equipment specifications and calibration frequencies, together with the following;

- an additional water quality monitoring station to be included in the vicinity of Star Ferry because of the predicted impacts in that area

- compliance monitoring frequency to be increased from two to three days per week

- inclusion of alarm (3 mg/l) and action (2 mg/l) levels for dissolved oxygen in the water quality action plan; reduction of the alarm level for suspended solids from 100 mg/l to 70 mg/l; and expression of the alarm and action limits as absolute values rather than as excess over baseline values

- two additional water quality monitoring stations to be included in the vicinity of the Cap D'Aguilar Site of Special Scientific Interest to monitor water quality more closely during fill extraction at the Po Toi marine borrow area.

3 Air Quality

Assessment of air quality impacts from construction has shown that dust levels should remain within acceptable limits at sensitive receivers, with the exception of Exchange Square and the General Post Office where dust levels could exceed acceptable limits for a few hours per year. As these buildings are air-conditioned, this is unlikely to cause a significant nuisance. A series of dust suppression measures has been included in the Contract Specification and a monitoring programme specified. It was recommended, however, that the monitoring frequency specified in the Contract is increased from once every six weeks to once every six days.

4 Noise

The majority of sensitive receivers along Connaught Road Central which overlook the reclamation are air conditioned premises, such as the Mandarin Hotel. Noise from construction activities during the daytime will be likely to have less impact on these buildings than on those used for residential purposes. The construction noise assessment showed that the worst impact would occur in the months of May/June 1995 and the most affected residential building will be the United Building at Jubilee Street. For the majority of the time, the United Building will be screened from plant working on the reclamation site by the Hang Seng Bank Building. However, when plant is working within direct line of sight of the receiver, mitigation measures may need to be applied to achieve the daytime construction noise limit of 75dB(A) specified in the Contract. Mitigation measures such as the use of quiet equipment and acoustic screening are specified in the Contract clauses on noise control. Noise levels at the sensitive receivers will be monitored by the Engineer and mitigation measures applied whenever levels approach the daytime noise level of 75dB(A), where this arises from the construction works. Night work, if required, will have to comply strictly with the requirements of the Noise Control Ordinance.

5 Solid Waste

Approximately half the 1 Mm^3 volume of marine mud which has to be removed is classified as contaminated and will require controlled disposal in a pit south of Sha Chau designated for dumping of contaminated mud. Contaminated mud in the reclamation area will be dredged using a sealed grab as recommended in EPD's Contaminated Spoil Management Study, and any sediment dispersion should be largely contained within the reclamation bunds. Operational restrictions have been placed on other dredging methods which may be used for uncontaminated mud, for example, overflowing and lean mixture overboard systems for trailer hopper dredgers are not permitted. Provision is made in the Contract for a performance specification for suspended solids to protect sensitive cooling water intakes. This will be achieved by measures chosen by the contractor, which are likely to be one or more of slower dredging, more careful removal of mud, or silt screens. No amendments to the Contract Specification were considered necessary.

6 Conclusions

The Focussed EIA Study has enabled water quality modelling plus a review of air, noise, waste and construction matters to be carried out. Pollution reduction measures have been identified and recommended by the Study to ameliorate the effects of the new reclamation and its embayments, although the effective extent of pollution reduction will need to be quantified by subsequent investigation and monitoring. Certain amendments to the construction specification have also been found necessary and have been accepted by tenderers for the project. As a result, this study has enabled construction impacts of the reclamation to be minimised.

Table 1 Summary of potential water quality impacts

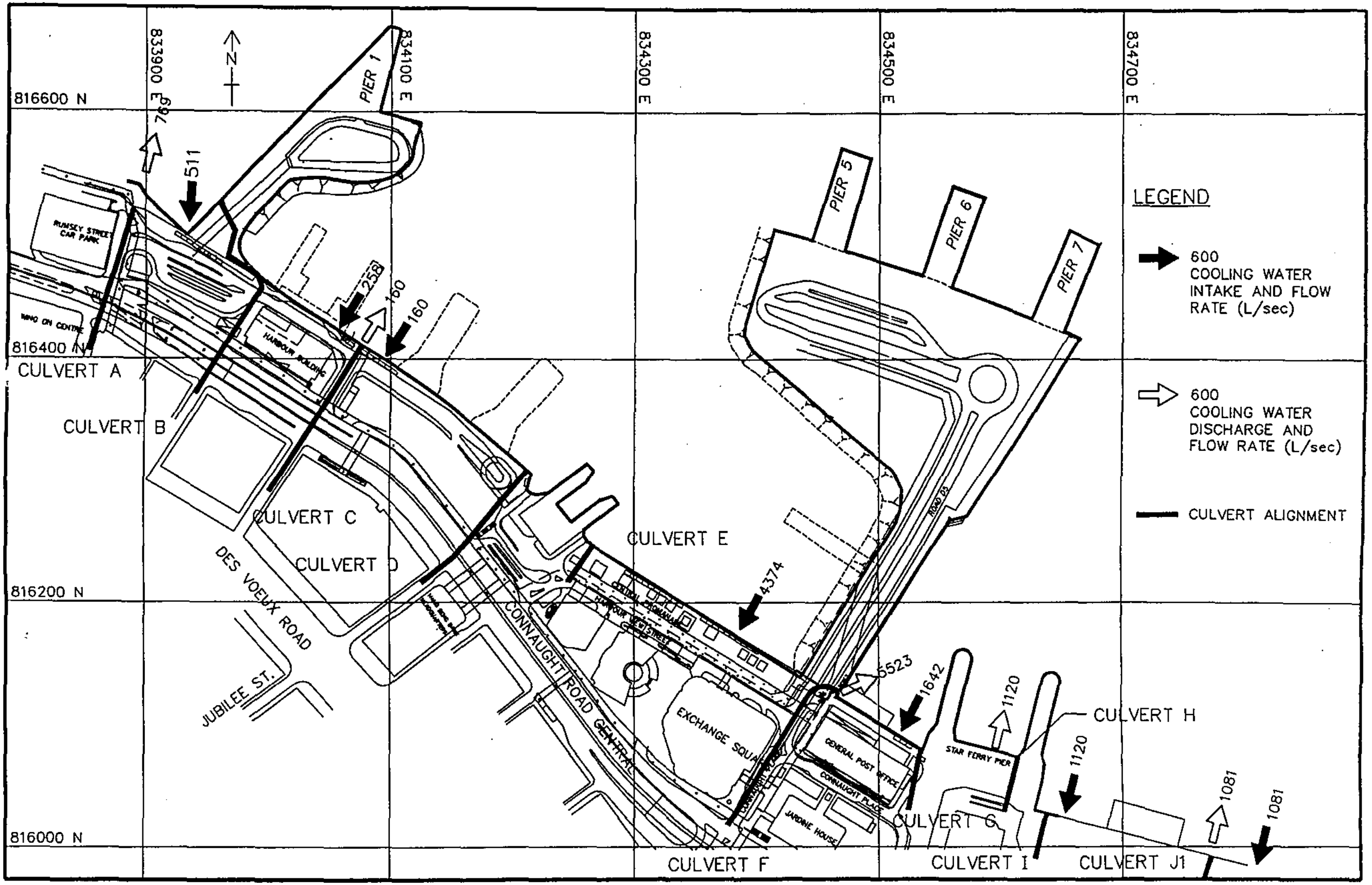
	Predicted Impacts		
	Stormwater discharge	Dredging works	Floating refuse
west of western reclamation bund, near Macau Ferry Terminal	insignificant	short term increases in suspended solids when dredging inshore	visible if present
within embayment between reclamation bunds	increase in *E. coli*	increase in suspended solids, possible decrease in DO	screened from public view
east of eastern reclamation, near Star Ferry Terminal	slight decrease in DO, increase in nutrients and *E. coli*	short term increases in suspended solids when dredging inshore	visible if present

Table 2 Recommended Mitigation Measures

Description	Improvement No.	Stormwater Catchment	Cost[1] HK$
Essential works			
Lower Electrodes[2]	1	A,B,C,D, part F	-
Desilting trunk sewer[2]	2	A,B,C,D, part F	-
Sewer Upgrading[2]	3	D	-
Repair of pipe[2]	4	D	-
Realignment of culvert B[3]	5	B	1,300,000
Expedient Connection[2]	6	B	-
Expedient Connection	10	F	15,000
Expedient Connection	11	F	15,000
Sewer Upgrading[4]	12	F	1,400,000
Sewer Upgrading	13	F	100,000
Sewer Upgrading	14	F	800,000
Sewer Upgrading	15	F	800,000
Sewer Upgrading	16	F	150,000
Sewer Upgrading	17	F	760,000
Sewer Upgrading	18	F	290,000
Sewer Upgrading	7	J1	5,000,000
Desirable Works			
Sewer Upgrading[4]	8	D	600,000
Sewer Upgrading[4]	9	C	1,900,000
Cost of essential improvements (excl. DSD works)			$10,630,000
Cost of desirable improvements (excl. DSD works)			$2,500,000
Total cost of all improvements (excl. DSD works)			$13,130,000

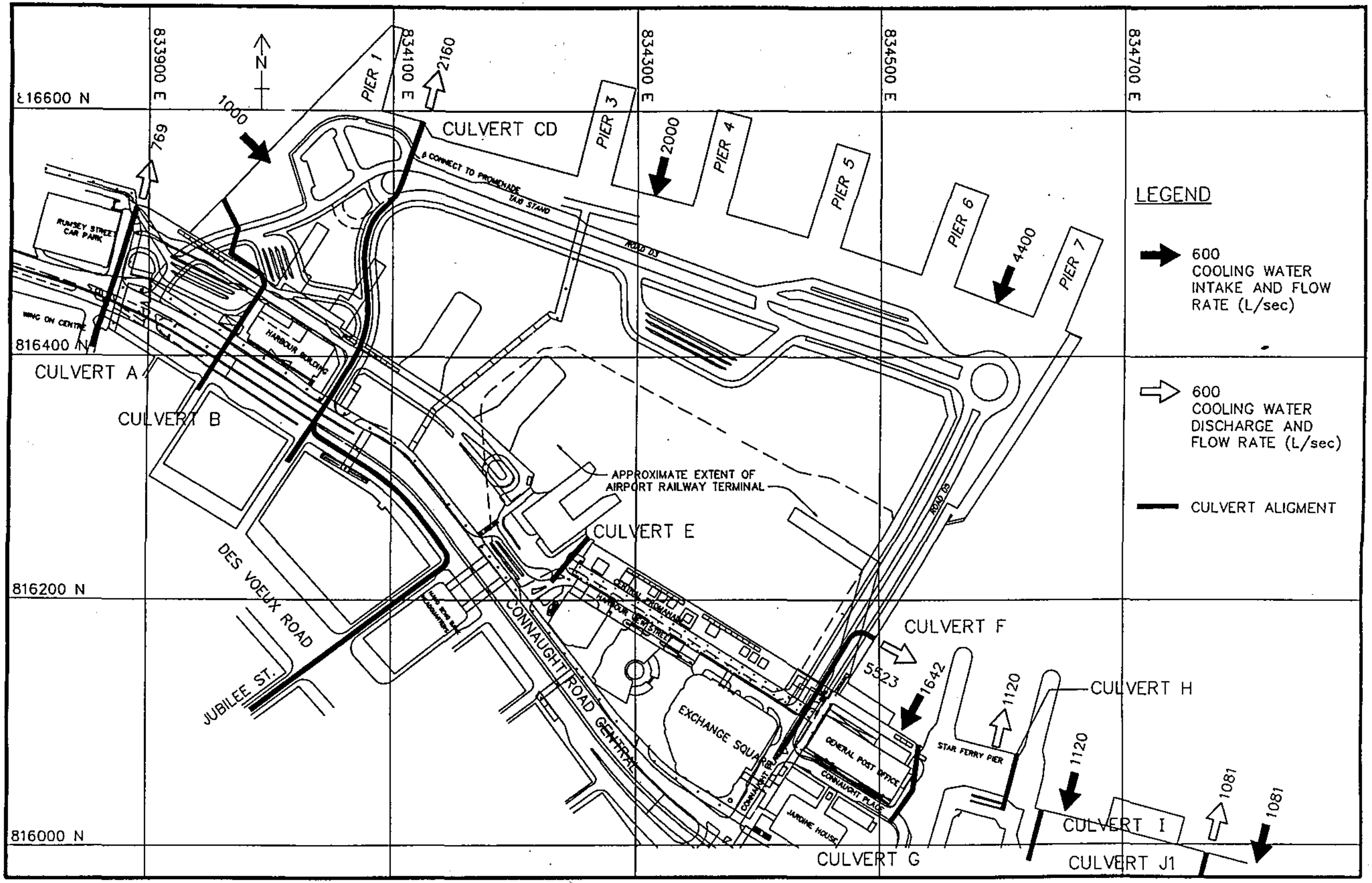
Notes:

1 - 1992 prices including preliminaries, contingencies and Projected Inflation Allowance. Costs of the works by DSD are not known by the Consultants.
2 - DSD works which are either about to commence or are on-going.
3 - To be carried out by the Station contractor
4 - Provisional item under contract UA11/91.



COOLING WATER INTAKE AND DISCHARGE LOCATIONS – STAGE ONE

Figure 1



COOLING WATER INTAKE AND DISCHARGE LOCATIONS – FINAL ARRANGEMENT

Figure 2

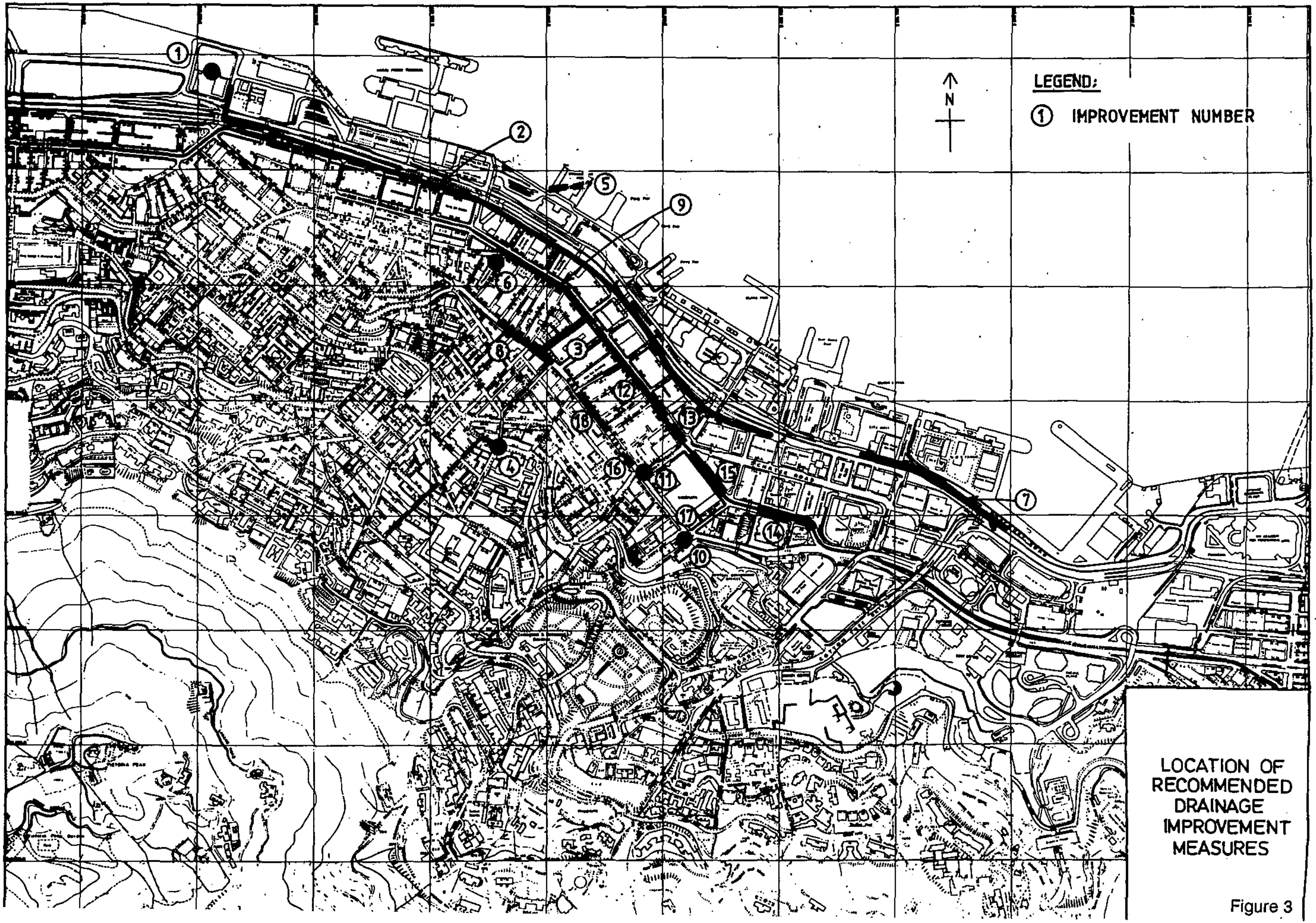

LEGEND:
① IMPROVEMENT NUMBER
N
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
LOCATION OF RECOMMENDED DRAINAGE IMPROVEMENT MEASURES

Figure 3

Hong Kong Government
Territory Development Department
Urban Area Development Office

Central and Wan Chai Reclamation Development

Central Reclamation, Phase 1
Focussed Environmental Impact Assessment Study

Final Report

September 1992

Maunsell Consultants Asia Ltd

in association with

Balfours International Asia Consulting Engineers Ltd

CES Consultants in Environmental Sciences (Asia) Ltd

Hydraulics and Water Research (Asia) Ltd

Contents

Chapter 1 Introduction

Chapter 2 Principal Features of the Project

Chapter 3 Impact Assessment

Chapter 4 Conclusions and Recommendations

Figures

Appendix 1 Study Brief

Appendix 2 Setting Up and Validation of 3D WAHMO Model

Appendix 3 Contract Specification Provisions

Appendix 4 Comments and Responses

Central Reclamation Phase I Focussed EIA
Contents

			Page No
1	**Introduction**		1-1
1.1	Objectives		1-1
1.2	Background		1-1
1.3	Scope		1-1
2	**Principal Features of the Project**		2-1
2.1	Reclamation		2-1
	2.1.1	Project Description	2-1
	2.1.2	Project Phasing	2-1
	2.1.3	Construction Activities	2-1
2.2	Drainage		2-4
	2.2.1	Sewerage	2-4
	2.2.2	Cooling Water Intakes	2-5
	2.2.3	Potential Improvements	2-6
	2.2.4	Other Improvement Measures Considered	2-8
3	**Impact Assessment**		3-1
3.1	Water Quality		3-1
	3.1.1	Assessment Criteria	3-1
	3.1.2	Existing Environment	3-1
	3.1.3	Assessment Methodology	3-3
	3.1.4	Impacts	3-5
	3.1.5	Mitigation Measures	3-13
	3.1.6	Monitoring and Audit	3-15
3.2	Marine Mud		3-16
	3.2.1	Assessment Criteria	3-16
	3.2.2	Existing Environment	3-17
	3.2.3	Assessment Methodology	3-17
	3.2.4	Impacts	3-17
	3.2.5	Mitigation Measures	3-19
	3.2.6	Monitoring and Audit	3-19
3.3	Air Quality		3-19
	3.3.1	Assessment Criteria	3-19
	3.3.2	Existing Environment	3-19
	3.3.3	Assessment Methodology	3-19
	3.3.4	Impacts	3-21
	3.3.5	Mitigation Measures	3-21
	3.3.6	Monitoring and Audit	3-22
3.4	Noise		3-22
	3.4.1	Assessment Criteria	3-22
	3.4.2	Existing Environment	3-23
	3.4.3	Assessment Methodology	3-26
	3.4.4	Impacts	3-26
	3.4.5	Mitigation Measures	3-28
	3.4.6	Monitoring and Audit	3-28

4	**Conclusions and Recommendations**	4-1
4.1	Conclusions	4-1
4.2	Recommendations	4-2

Appendix 1 **Study Brief**
Appendix 2 **Setting Up and Validation of 3D WAHMO Model**
Appendix 3 **Contract Specification Provisions**
Appendix 4 **Comments and Responses**

List of Tables **Page No**

Table 2.1	Pollutant Loads Measured in Stormwater Discharges in 1990	2-6
Table 2.2	Potential Improvement Measures to Mitigate Water Quality Impacts during Construction of Central Reclamation Phase 1	2-10
Table 3.1	Proposed Water Quality Objectives for Victoria Harbour Water Control Zone	3-1
Table 3.2	Summary Statistics of 1990 Water Quality of Victoria Harbour (EPD, 1991)	3-2
Table 3.3	Stormwater Pollutant Loads Simulated	3-4
Table 3.4	Summary of Predicted Worst Case Water Quality Conditions	3-10
Table 3.5	Predicted Pollutant Loading from Dredging	3-12
Table 3.6	Potential Pollutant Loading from Dredging and Stormwater Discharges	3-12
Table 3.7	Summary of Water Quality Impacts	3-13
Table 3.8	Recommended Mitigation Measures	3-15
Table 3.9	Classification of Sediments by Metal Content (mg/kg dry weight)	3-16
Table 3.10	Mean and Range of Heavy Metal Concentrations in Marine Mud Samples Close to the Phase 1 Reclamation area (mg/kg dry weight) (Contaminated Spoil Management Study - Final Report, 10/1991, EPD)	3-17
Table 3.11	Results of Marine Mud Analysis for Central Reclamation Phase 1	3-18
Table 3.12	Hong Kong Air Quality Objectives	3-19
Table 3.13	Dust Emission Factors	3-20
Table 3.14	Worst Case 1-hour Average TSP Concentrations at Sensitive Receivers	3-21
Table 3.15	Construction Noise Criteria for Activity Other Than Percussive Piling	3-22
Table 3.16	Construction Noise Criteria for Percussive Piling Activity	3-23
Table 3.17	Sound Power Levels [dB(A)] for Central Reclamation Phase 1 Engineering Works Plant Schedule No.1	3-24
Table 3.18	Sound Power Levels [dB(A)] for Hong Kong Station and Tunnel Contract Plant Schedule No.2	3-25
Table 3.19	Correction Factors to Obtain the Predicted Noise Level from the Total Sound Power Level at Given Distances 301 to 425 m	3-26
Table 3.20	Maximum Noise Levels at NSRs from Powered Mechanical Equipment	3-27
Table 3.21	Maximum Noise Levels at NSRs from Percussive Piling	3-28

List of Figures

Figure 1.1	Intermediate Construction Stage
Figure 2.1	Central and Wan Chai Reclamation
Figure 2.2	Central Reclamation, Phase 1
Figure 2.3	Works Carried Out under Railway Contract
Figure 2.4	Central and Tamar Development - Stage 1
Figure 2.5	Central and Tamar Development - Stage 2
Figure 2.6	Cooling Water Pumping Station
Figure 2.7	Advance Rail Tunnel (Sheet 1 of 2)
Figure 2.8	Advance Rail Tunnel (Sheet 2 of 2)
Figure 2.9	Cooling Water Intake and Discharge Locations - Construction Arrangement
Figure 2.10	Cooling Water Intake and Discharge Locations - Final Arrangement

Figure 2.11 Drainage Improvements Nos.1-4 Being Carried Out by DSD
Figure 2.12 Drainage Improvement No.5 - Realignment of Culvert B to Merge with Culvert CD
Figure 2.13 Drainage Improvements No.6 - Plug Expedient Connection on Des Voeux Road and Wing Wo Street
Figure 2.14 Drainage Improvements No.7 - Upgrading and Relaying Sewer in Harcourt Road Between Murray Road and Tamar Street
Figure 2.15 Drainage Improvement No.8 - Upgrading Existing Foul Sewer in Queens Road Central Between Cochrane Street and Peel Street
Figure 2.16 Drainage Improvement No.9 - Upgrading Existing Foul Sewer in Des Voeux Road Central Between Wing Wo Street and Jubilee Street
Figure 2.17 Drainage Improvement No.10 - Plug Expedient Connection on Junction of Queens Road Central and Ice House Street
Figure 2.18 Drainage Improvement No.11 - Plug Expedient Connection on Junction of Queens Road Central and Pedder Street
Figure 2.19 Drainage Improvement No.12 - Upgrading and Relaying Existing Foul Sewer in Des Voeux Road Central Between Theatre Lane and Pottinger Street
Figure 2.20 Drainage Improvement No.13 - Upgrading and Relaying Existing Sewer in Des Voeux Road Central Between Pedder Street and Theatre Lane
Figure 2.21 Drainage Improvement No.14 - Upgrading and Relaying Existing Sewer in Des Voeux Road Central Between Bank Street and Ice House Street
Figure 2.22 Drainage Improvement No.15 - Upgrading and Relaying Existing Sewer in Des Voeux Road Central Between Chater Road and Ice House Street
Figure 2.23 Drainage Improvement No.16 - Upgrading and Relaying Existing Sewer in Queens Road Central Between D'Aguilar Street and Wyndham Street
Figure 2.24 Drainage Improvement No.17 - Upgrading and Relaying Existing Sewer in Queens Road Central Between Duddell Street and Ice House Street
Figure 2.25 Drainage Improvement No.18 - Upgrading and Relaying Existing Sewer in Queens Road Central Between Li Yuen Street West and Douglas Lane

Figure 3.1 Location of Positions for Temperature Plots
Figure 3.2 Temperature Variations at Fixed Positions, Wet Season Neap Tide Existing Conditions
Figure 3.3 Temperature Variations at Fixed Positions, Dry Season Neap Tide Existing Conditions
Figure 3.4 Surface Temperature Distributions, Wet Season Neap Tide Existing Conditions
Figure 3.5 Surface Temperature Distributions, Dry Season Neap Tide Existing Conditions
Figure 3.6 Surface Temperature Distributions, Wet Season Neap Tide Partial Reclamation
Figure 3.7 Surface Temperature Distributions, Dry Season Neap Tide Partial Reclamation
Figure 3.8 Surface Temperature Distributions, Wet Season Neap Tide Full Reclamation
Figure 3.9 Surface Temperature Distributions, Dry Season Neap Tide Full Reclamation
Figure 3.10 Location of Model Positions for Plotting Water Quality Results
Figure 3.11 Dry Season Neap Tide : Comparison of Dissolved Oxygen (% saturation) for Partial Reclamation With and Without Mitigation
Figure 3.12 Dry Season Neap Tide : Comparison of Ammoniacal Nitrogen (mg/l) for Partial Reclamation With and Without Mitigation
Figure 3.13 Dry Season Neap Tide : Comparison of Oxidised Nitrogen (mg/l) for Partial Reclamation With and Without Mitigation
Figure 3.14 Dry Season Neap Tide : Comparison of *E. coli* (/100ml) for Partial Reclamation With and Without Mitigation
Figure 3.15 Dry Season Neap Tide : Comparison of BOD Concentrations (mg/l) for Partial Reclamation With and Without Mitigation
Figure 3.16 Wet Season Neap Tide : Comparison of Dissolved Oxygen (% saturation) for Partial Reclamation With and Without Mitigation
Figure 3.17 Wet Season Neap Tide : Comparison of Ammoniacal Nitrogen (mg/l) for Partial Reclamation With and Without Mitigation
Figure 3.18 Wet Season Neap Tide : Comparison of Oxidised Nitrogen (mg/l) for Partial Reclamation With and Without Mitigation
Figure 3.19 Wet Season Neap Tide : Comparison of *E. coli* (/100ml) for Partial Reclamation With and Without Mitigation
Figure 3.20 Wet Season Neap Tide : Comparison of BOD Concentrations (mg/l) for Partial Reclamation With and Without Mitigation

Figure 3.21 Dry Season Neap Tide : Comparison of Dissolved Oxygen (% saturation) for Full Reclamation With Mitigation

Figure 3.22 Dry Season Neap Tide : Comparison of Ammoniacal Nitrogen (mg/l) for Full Reclamation With Mitigation

Figure 3.23 Dry Season Neap Tide : Comparison of Oxidised Nitrogen (mg/l) for Full Reclamation With Mitigation

Figure 3.24 Dry Season Neap Tide : Comparison of *E. coli* (/100ml) for Full Reclamation With Mitigation

Figure 3.25 Dry Season Neap Tide : Comparison of BOD Concentrations (mg/l) for Full Reclamation With Mitigation

Figure 3.26 Wet Season Neap Tide : Comparison of Dissolved Oxygen (% saturation) for Full Reclamation With Mitigation

Figure 3.27 Wet Season Neap Tide : Comparison of Ammoniacal Nitrogen (mg/l) for Full Reclamation With Mitigation

Figure 3.28 Wet Season Neap Tide : Comparison of Oxidised Nitrogen (mg/l) for Full Reclamation With Mitigation

Figure 3.29 Wet Season Neap Tide : Comparison of *E. coli* (/100ml) for Full Reclamation With Mitigation

Figure 3.30 Wet Season Neap Tide : Comparison of BOD Concentrations (mg/l) for Full Reclamation With Mitigation

Figure 3.31 Tide Averaged Distribution of Dissolved Oxygen (% sat), Dry Season Existing Conditions

Figure 3.32 Tide Averaged Distribution of Dissolved Oxygen (% sat), Dry Season Partial Reclamation

Figure 3.33 Tide Averaged Distribution of Dissolved Oxygen (% sat), Dry Season Partial Reclamation plus Mitigation

Figure 3.34 Tide Averaged Distribution of Dissolved Oxygen (% sat), Dry Season Full Reclamation plus Mitigation

Figure 3.35 Tide Averaged Distribution of Dissolved Oxygen (% sat), Wet Season Existing Conditions

Figure 3.36 Tide Averaged Distribution of Dissolved Oxygen (% sat), Wet Season Partial Reclamation

Figure 3.37 Tide Averaged Distribution of Dissolved Oxygen (% sat), Wet Season Partial Reclamation plus Mitigation

Figure 3.38 Tide Averaged Distribution of Dissolved Oxygen (% sat), Wet Season Full Reclamation plus Mitigation

Figure 3.39 Tide Averaged Distribution of Ammoniacal Nitrogen (mgN/l), Dry Season Existing Conditions

Figure 3.40 Tide Averaged Distribution of Ammoniacal Nitrogen (mgN/l), Dry Season Partial Reclamation

Figure 3.41 Tide Averaged Distribution of Ammoniacal Nitrogen (mgN/l), Dry Season Partial Reclamation plus Mitigation

Figure 3.42 Tide Averaged Distribution of Ammoniacal Nitrogen (mgN/l), Dry Season Full Reclamation plus Mitigation

Figure 3.43 Tide Averaged Distribution of Ammoniacal Nitrogen (mgN/l), Wet Season Existing Conditions

Figure 3.44 Tide Averaged Distribution of Ammoniacal Nitrogen (mgN/l), Wet Season Partial Reclamation

Figure 3.45 Tide Averaged Distribution of Ammoniacal Nitrogen (mgN/l), Wet Season Partial Reclamation plus Mitigation

Figure 3.46 Tide Averaged Distribution of Ammoniacal Nitrogen (mgN/l), Wet Season Full Reclamation plus Mitigation

Figure 3.47 Tide Averaged Distribution of Oxidised Nitrogen (mgN/l), Dry Season Existing Conditions

Figure 3.48 Tide Averaged Distribution of Oxidised Nitrogen (mgN/l), Dry Season Partial Reclamation

Figure 3.49 Tide Averaged Distribution of Oxidised Nitrogen (mgN/l), Dry Season Partial Reclamation plus Mitigation

Figure 3.50 Tide Averaged Distribution of Oxidised Nitrogen (mgN/l), Dry Season Full Reclamation plus Mitigation

Figure 3.51 Tide Averaged Distribution of Oxidised Nitrogen (mgN/l), Wet Season Existing Conditions

Figure 3.52 Tide Averaged Distribution of Oxidised Nitrogen (mgN/l), Wet Season Partial Reclamation

Figure 3.53 Tide Averaged Distribution of Oxidised Nitrogen (mgN/l), Wet Season Partial Reclamation plus Mitigation

Figure 3.54	Tide Averaged Distribution of Oxidised Nitrogen (mgN/l), Wet Season Full Reclamation plus Mitigation
Figure 3.55	Tide Averaged Distribution of *E coli* (no./100ml), Dry Season Existing Conditions
Figure 3.56	Tide Averaged Distribution of *E coli* (no./100ml), Dry Season Partial Reclamation
Figure 3.57	Tide Averaged Distribution of *E coli* (no./100ml), Dry Season Partial Reclamation plus Mitigation
Figure 3.58	Tide Averaged Distribution of *E coli* (no./100ml), Dry Season Full Reclamation plus Mitigation
Figure 3.59	Tide Averaged Distribution of *E coli* (no./100ml), Wet Season Existing Conditions
Figure 3.60	Tide Averaged Distribution of *E coli* (no./100ml), Wet Season Partial Reclamation
Figure 3.61	Tide Averaged Distribution of *E coli* (no./100ml), Wet Season Partial Reclamation plus Mitigation
Figure 3.62	Tide Averaged Distribution of *E coli* (no./100ml), Wet Season Full Reclamation plus Mitigation
Figure 3.63	Tide Averaged Distribution of BOD (mg/l), Dry Season Existing Conditions
Figure 3.64	Tide Averaged Distribution of BOD (mg/l), Dry Season Partial Reclamation
Figure 3.65	Tide Averaged Distribution of BOD (mg/l), Dry Season Partial Reclamation plus Mitigation
Figure 3.66	Tide Averaged Distribution of BOD (mg/l), Dry Season Full Reclamation plus Mitigation
Figure 3.67	Tide Averaged Distribution of BOD (mg/l), Wet Season Existing Conditions
Figure 3.68	Tide Averaged Distribution of BOD (mg/l), Wet Season Partial Reclamation
Figure 3.69	Tide Averaged Distribution of BOD (mg/l), Wet Season Partial Reclamation plus Mitigation
Figure 3.70	Tide Averaged Distribution of BOD (mg/l), Wet Season Full Reclamation plus Mitigation
Figure 3.71	Location of Water Quality Monitoring Stations
Figure 3.72	Location of Vibrocore Stations and Contours of the Base of Contaminated Marine Mud
Figure 3.73	Location of Sensitive Receivers

1. Introduction

1.1 Objectives

1.2 Background

1.3 Scope

1 Introduction

1.1 Objectives

This focussed EIA has been carried out on behalf of the Project Manager, Urban Area Development Office, Territory Development Department by CES Consultants in Environmental Sciences (Asia) Ltd. The objective of the EIA is to ensure that environmental mitigation measures specified in the contract documents for the Central Reclamation Phase I are adequate to maintain acceptable environmental quality, particularly water quality, during and after the process of reclamation. The functional output of the EIA takes the form of recommendations on additional mitigation measures, where necessary, for inclusion in works contract conditions as tender addenda.

1.2 Background

Construction of the Central Reclamation Phase I will involve the formation of a temporary embayment between the Star Ferry and Macau Ferry Terminals (Figure 1.1). The embayment will exist for a period of approximately three years before the being infilled to form the reclamation itself. There are a number of storm sewer outfalls discharging significant pollution loads into and immediately outside the embayment; these discharges are in the process of investigation and rectification under the Central Western and Wan Chai West Sewerage Master Plan (SMP), but collection and disposal measures defined by the SMP will not be fully implemented until after the Central Reclamation embayment has been infilled.

There is therefore concern that discharges of sewage and other pollutants may cause significant water pollution in three main areas associated with Phase I of the reclamation, as follows;

- east of the eastern reclamation bund around Star Ferry terminal and Queens Pier;
- in the embayed area between the two reclamation bunds;
- between the western reclamation bund and the Macau Ferry terminal.

While a number of measures to improve water quality and a water quality monitoring programme have already been included in the Contract, which went out to tender on 8 June 1992, it was considered necessary to carry out a study to predict the impacts of the storm sewer and cooling water discharges on water quality by mathematical modelling, to estimate potential water quality impacts from dredging, and to identify what mitigation measures would be necessary to reduce these to acceptable levels. Impacts of construction dust and noise, and the implications of the presence of contaminated marine mud have also been evaluated.

1.3 Scope

The scope of the focussed EIA is defined as;

- Identifying the sensitive receivers and quantifying the potential water, noise and air pollution arising from the construction of the reclamation including dredging, placement of fill and other construction activities, and recommending mitigation measures to minimise adverse effects;
- Recommending how adverse effects on water movement and hence water quality of the neighbouring waters arising from the completed reclamation may be mitigated including measures to reduce pollutant discharges to the affected waters, and modifications to the scale, phasing and configuration of reclamation; and
- Outlining a programme by which the environmental impacts of the works can be monitored and audited to ensure compliance with environmental limits.

A copy of the focussed EIA Study Brief is included as Appendix 1.

2. Principal Features of the Project

2.1 Reclamation

2.2 Drainage

2 Principal Features of the Project

2.1 Reclamation

2.1.1 Project Description

The Central and Wan Chai Reclamation Development consists of approximately 108 ha of new reclamation and 60 ha of water basin and existing land to be redeveloped. The reclamation has three distinct development cells separated by parks, as shown on Figure 2.1.

Central Reclamation, Phase 1 shown on Figure 2.2, is required to accommodate the Hong Kong station of the Airport Railway and provide land for the expansion of the Central Business District. The new reclamation also provides much needed public open space within Central. It consists of 20 ha of new reclamation and some existing land which is to be redeveloped. There are five ferry piers, a Government pier and fifteen reprovisioned cooling water pumping stations. Nine additional pumping stations shells are provided for use of future developments, including those above the Airport Railway station. Other features of the reclamation include a waterfront promenade and an extensive covered walkway system.

Some of the Central Reclamation, Phase 1 works will be built under the railway contract to simplify construction interfaces. This includes the construction of the Trunk Road Viaduct, Jubilee Street Underpass, elevated walkways and surface roads over and around the station, as indicated on Figure 2.3.

2.1.2 Project Phasing

The Hong Kong station of the Airport Railway is to be opened in July 1997. Construction of Central Reclamation, Phase 1 is programmed to commence in early October 1992 with completion in October 1996. There will be an overlap of approximately two years between the Central Reclamation, Phase 1 contract and the railway contract. Reclamation of the existing Tamar basin is scheduled to commence when the existing HMS Tamar naval facilities have been relocated to Stonecutters Island in mid 1993. This reclamation is shown on Figure 2.4

The second phase of reclamation will consist of the section of land joining Central Reclamation, Phase 1 to the Tamar area, as shown on Figure 2.5. This reclamation is required to accommodate the Airport Railway overrun tunnel extension. To allow the overrun tunnel to open in mid 2002, as required by MTRC, the construction of this section will have to commence in the second half of 1997. There is currently no programme for the remainder of the reclamation.

Central reclamation, Phase 1 is essentially carried out in two constructions stages. During the first stage, two bunds are constructed to the new seawall along the eastern and western boundaries of the reclamation, as shown on Figure 1.1.

The ferry piers, access roads, cooling water pumping stations and some culvert extensions will be constructed during this stage. Once these facilities are fully operational, the existing piers and pumping stations are abandoned and the second stage of reclamation commences. The existing ferry piers will be demolished and the precast piles extracted or cut off at seabed level.

2.1.3 Construction Activities

The principal construction activities in the Central reclamation, Phase 1 contract are listed below:

a) Seawalls and Reclamation

A conventional 'Port Works' design is used throughout the reclamation for permanent seawalls. This comprises of a rockfill foundation to -4.65 mPD with precast concrete blocks above. There are a large number of special precast blocks to accommodate cooling water intakes and storm water discharges. An area in Sui Sai Wan with sea access is provided for the precasting of the seawall blocks. A sloping seawall design is used for the temporary seawalls inside the embayment.

The fill material is generally marine sand from East Po Toi with a silt content ranging from 0% to 15%. Approximately 0.9 million m^3 and 1.2 million m^3 will be placed during the first and second stages of reclamation respectively. 0.4 and 0.6 million m^3 of rock will also be placed during the first and second stages of reclamation. The estimated quantity of marine mud is 1.0 million m^3 and approximately half of this is contaminated. The contaminated mud will be dumped south of Sha Chau, while the non-contaminated mud will be disposed at Cheung Chau or Ninepins.

The seawall construction and land formation will essentially be marine based activities.

b) Cooling Water Pumping Stations

The existing cooling water pumping stations will be reprovisioned at P1, south of the Custom and Excise berth, and P4, between Piers 6 and 7, as shown on Figure 2.2. Pumping station shells are provided at P2 and P3 between piers 4 and 5 to cater for future commercial developments. An additional pumping station MP1 will be built between Piers 3 and 4 to provide cooling water for the Airport Railway station. The pumping stations will be located underground to facilitate an uninterupted waterfront pedestrian promenade running the complete length of the reclamation, as indicated on Figure 2.6.

The pumping stations are designed as precast reinforced concrete units. It is envisaged that the units will be precast on a semi-submersible barge moored off site. The units will then be floated into position and ballasted down onto the top of the rubble mound of the seawall. Suitable fill material and then be placed around the units.

The construction of the cooling water pumping stations is also eseentially a marine based activity.

c) Government and Ferry Piers

One Government pier and five ferry piers will be constructed under this contract. The pier decks are supported on grade 50 driven tubular steel piles with the top section filled with reinforced concrete to five metres below seabed level. Precast concrete planks have been detailed for all pier decks for ease of construction. These will be manufactured in the precast yard at Sui Sai Wan. The upper section of the pier is designed as a cast *in situ* reinforced concrete frame. Curtain walls will be installed at each ferry pier head.

The ferry pier construction and relocation of existing services are very critical activities in the construction programme. It is envisaged that Piers 5, 6 and 7 will be completed by mid 1994, while Piers 3 and 4 will be finished by mid 1996.

Temporary piled dolphins will be required at the Discovery Bay berths in front of Exchange Square and adjacent to Pier 7. Temporary piled dolphins will also be required adjacent to Pier 1 to accommodate the Lamma services pontoon between mid 1994 and mid 1996. Once the temporary pontoons are no longer required, the dolphins will be demolished and piles extracted.

d) Public Pier and Covered Walkways

The new public pier is located along the eastern seawall and replaces the public pier facilities currently on Blake Pier. The public pier will be provided with a steel cladded cover and will be connected to the existing covered walkway system in Central by a steel framed walkway with a polycarbonate roof. A similar structure will be provided along the waterfront between Piers 5 and 7. The pier and walkway covers will be supported on spread foundations. These structure will be completed in mid 1994.

e) Elevated Walkways

The east-west and north-south elevated walkways are designed as reinforced concrete spine beams supported on bored pile foundations. The roof has been specified as a steel frame with tempered glass cladding, which is to be designed by the Contractor.

f) Drainage and Sewerage Systems

The existing storm drains are shown on Figure 1.1. The diversion and extension works are discussed in Section 2.2. The existing storm drainage system will also be upgraded along Jubilee Street under this contract.

A public latrine supported on spread footings will be located adjacent to the new public pier. A small temporary pumping station will be required during the first stage of the reclamation to transport sewage from Piers 5, 6 and 7 and the public latrine to the existing sewerage network. Once the sewerage network in completed the sewage will discharge into the trunk sewer running under Connaught Road at the western edge of the reclamation. The trunk sewer flows into the existing sewage screening plant at western. The existing sewers along Jubilee Street will be upgraded under a separate contract, which is programmed for completion in December 1992. The sewerage network is discussed in more detail in Section 2.2.

g) Immersed Tube Unit

The advance immersed tube unit is located at the western seawall just south of Pier 1. The unit must be installed under the Central Reclamation, Phase 1 contract to minimise future disruption to Pier 1, the Customs and Excise berth and adjacent roads and services.

The unit is approximately 74 m long by 7 m high. The width varies from 11 m to 15.5 m. It is envisaged that the unit will be partially precast on a semi-submersibe barge and the construction sequence will be similar to that for the cooling water pumping stations.

h) Advance Rail Tunnel

The advance rail tunnel is located under road D5 at the eastern edge of the station. A large number of services, including cooling water pipes and high voltage cables for the reprovisioned pumping stations and ferry piers will be laid under road D5. In order to avoid major disruption to these services and the ferry pier access road during construction of the railway tunnels, some advance work is carried out under this contract.

The advance work consists of the construction of the diaphragm walls and top slab of the overrun tunnel, as shown on Figure 2.7 and Figure 2.8. Construction of the remainder of the tunnel can then take place under the railway contract without disturbing the important services and access road above. A smaller size of rockfill has been specified in this area for the seawall foundation to facilitate the construction of the diaphgram walls.

i) Advance Road Tunnel

The advance road tunnel is located north of the overrun tunnel under road D5. This work is again required to avoid disruption to the large number of services under road D5 when the east-week trunk road is eventually built. Government have indicated that funds will not be available for the construction of the remainder of the trunk road until after 2001.

This advance work also consists of the construction of the diaphragm walls and the top slab only. Excavation under the top slab can then take place at some time in the future without disturbing the services and road above.

j) Urban Council Facilities

The following affected Urban Council facilities will be reporvisioned under the Central Reclamation, Phase 1 contract:

- Blake Pier Rooftop Garden
- Central Promenade Garden
- Blake Pier Rooftop Cafe
- Blake Pier Public Toilet

- Kiosks on Central Promenade

The reprovisioned facilities will provide an increase in public open space of approximately 35%. This excludes the substantial area of public open space at podium level to be provided by the developer of the MTRC site.

k) Works Carried Out Under Railway Contract

Some of the Central Reclamation, Phase 1 works will be built under the railway contract to simplify the construction interfaces. The main structural elements of these works are listed below:

- Trunk Road Viaduct

  The viaduct is designed as a prestressed cast *in situ* spine beam with approximately 30 m spans. This structure will eventually form part of the east-west trunk road. The eastbound carriageway only will be constructed to provide access to Central Reclamation, Phase 1 for traffic from the west. As the structure is a continuation of the existing Rumsey Street flyover, the appearance will be similar.

- Jubilee Street Underpass

  A two lane vehicle underpass at Jubilee Street is required to give direct access from the reclamation to the westbound carriageway of Connaught Road Central. Diaphragm walls and top down construction techniques will be employed.

- Elevated Walkways

  Approximately 120 m of the existing elevated walkway along Connaught Road is to be reconstructed to accommodate the Jubilee Street underpass. The new footbridge will adopt the same structural form and arrangement as the existing one, which is of precast spine beam construction with bored pile foundations. A 150 m long temporary steel footbridge is also required to link the north-south elevated walkway with the existing Connaught Road system. The structure is designed as a series of 15 m long street trusses supported on steel columns on spread footings.

- Airport Railway Station and Tunnels

  It is likely that the Airport Railway station and tunnels will be constructed using diaphragm walls and cut and cover construction techniques. It is envisaged that the station and development above will be supported on bored piles.

2.2 Drainage

2.2.1 Sewerage

There are ten stormwater catchments which will be affected by the Phase 1 reclamation works. These catchments (labelled A to I inclusive and J1) presently drain the Central, Mid Level and Peak areas. The catchments vary considerably in size, from approximately 0.1 ha to 144 ha, as well as in topography. Most of the outfall inverts lie within the tidal range of the harbour at about 0.3 mPD. The location of the outfalls for these catchments are shown on Figure 1.1.

The SMP for this area identified areas where cross-connections between the foul sewer and storm system were known to exist. It is believed that these cross-connections represent the m· jor source of the pollution loading in the storm catchment. The SMP estimated that 50% of the pollution generated in Central was entering the storm drains. It was further concluded that the majority of this polluted flow was from expedient connections, with the remaining pollution load attributed to the direct discharge of effluents from industrial or commercial activities, such as street markets and restaurants, into the stormwater system via road gullies. The details of these expedient connections are generally unknown: those connections for which details are available indicate that they are either diversions or high level overflows. An additional major source of pollution is from illegal connections within buildings and private sewers. The occurrence of various types of cross connections from the foul to the storm sewer system is indicated by pollution loadings within each stormwater catchment. Catchments C, D, F and J1 were observed in the SMP survey to have significant pollution loads as indicated in Table 2.1. Catchments A, E, G, H and I were inspected during the survey but were not found to contain significant foul or dry weather flow at that time.

Under the Central Reclamation Phase 1 works there will be two stages of construction, as discussed in Section 2.1.2. The location of the catchment outfalls for Stage 1 are given in Figure 2.9. Catchments B and F will be diverted to discharge outside the embayed area. Catchment A, B will thus discharge to the west of the reclamation, catchment C, D into the embayed area between the bunds and catchments F and J1 to the east of the reclamation.

At the completion of the second stage of construction, catchments C and D will outfall at the new seawall. Catchments A, B, F and J1 will still outfall in the same location as before under Stage 1. Figure 2.10 details the location of the outfalls.

Potential improvement measures to these catchments to reduce the pollution loadings are discussed in Section 2.2.3 below. Some mitigation measures are, however, already being implemented independently of the Central Reclamation works. Drainage Services Department (DSD) will commence in September 1992 to upgrade the sewer in Jubilee Street between Queens Road Central and Connaught Road Central within catchment D. This will relieve surcharging in Des Voeux Road Central by intercepting flows in Des Voeux Road and transferring them via Jubilee Street to the trunk sewer in Connaught Road Central. The new sewer will also be available to collect flows from major redevelopment proposals currently under consideration. The high level overflow on the junction of Des Voeux Road and Jubilee Street will also be removed at this time.

In November 1990 the SMP fabric survey found excessive amounts of silt deposited in the Connaught Road Trunk sewer. This silt reduced the hydraulic capacity and raised the hydraulic grade line. It was believed that overflows then occurred into the stormwater system from expedient connections. Since then DSD have desilted the trunk sewer on a regular basis and this may have reduced the amount of foul sewage entering the storm system and hence Victoria Harbour.

The SMP study identified a major expedient connection in catchment J1. This has since been temporarily blocked by DSD and the situation is being monitored closely. The Hillside Escalator works currently in progress in Cochrane St have recently uncovered a 225 mm diameter broken sewer pipe discharging to a storm drain on the corner of Hollywood Road. The Hillside Escalator Contractor has been instructed to reconnect this pipe into the foul sewer system and these works will be completed shortly.

The SMP also found that a potentially effective way to reduce pollution was to lower the start electrodes operating the screw pumps at the Central Screening Plant. A lower start level will lower the hydraulic grade line in the trunk sewer, increase the velocities and therefore increase the amount of silt being flushed through the pipes. This improvement measure could remove pollution loads from storm catchments A, B, C, D and a part of F. DSD have advised that this measure will be implemented at the end of September.

These measures are shown in Figure 2.11.

2.2.2 Cooling Water Intakes

Under the Phase 1 works fifteen cooling water pumping stations will be reprovisioned on the new seawall. A further thirteen stations are in close proximity to the works and may have the quality of the intake water affected. In total, twenty-eight pump stations were therefore considered within this study. Each pumping station draws water from Victoria Harbour and pumps it through an inlet pipeline to the building. Used water is discharged through an outlet pipeline either to the existing storm drainage system or direct to Victoria Harbour.

Figure 2.9 shows the location of the inlet and discharge locations for the Stage 1 construction works. Under this scheme all the cooling water which previously discharged directly into the harbour has been temporarily diverted to the east or west, outside the embayed area. Cooling water which discharges into the storm system remains unchanged. The total intake flow is 9146 l/s and the total discharge is 8653 l/s. The total discharge is less than the intake flow as some water is used for flushing purposes and the remainder is lost to evaporation.

For the Stage 2 works, shown in Figure 2.10, fifteen intakes have been relocated and all the discharge points are into the storm culverts as a permanent arrangement. The total intake flow is 11243 l/s and the total discharge is 10653 l/s. This figure has increased from those in Stage 1 due to some new stations being commissioned to service the airport railway station. It was assumed, for the purposes of this study, that Government would approve these additional discharges into the storm culverts.

Note that Figures 2.9 and 2.10 do not show each individual intake and discharge point. Where several points were close together they have been merged into a single point for the purposes of this study.

Table 2.1 Pollutant Loads Measured in Stormwater Discharges in 1990

Outfall	pollutant loads (kg/d)					
	SS	BOD	COD	NH_3-N	TKN	*E. coli* load (count/s)
A[i]	--	--	--	--	--	--
B[2]	630	300	480	50	120	1.8×10^9
C[2]	2240	920	1370	50	100	2.5×10^9
D[2]	2280	1790	2590	70	230	8.2×10^{10}
E[1]	--	--	--	--	--	--
F[2]	880	600	1610	60	150	9.7×10^{10}
G[1]	--	--	--	--	--	--
H[1]	--	--	--		--	--
I[1]	--	--	--	--	--	--
J1[2]	980	2500	3750	290	410	3.1×10^{10}

Source : Central Western and Wan Chai West SMP Study (1991)

1 no significant foul or dry weather flow observed during sewer survey June - August 1990
2 measured as a mean of duplicate spot samples taken during sewer survey June - August 1990

2.2.3 Potential Improvement Measures

There are a number of additional improvement measures which could be implemented to reduce the amount of pollution entering the harbour during and after the construction works.

Most of these measures are specific to a stormwater catchment whilst some will affect several catchments. If fully implemented these improvement will improve the water quality but will not completely eliminate the pollution problem. To identify all the sources of pollution in the storm system would require an extensive inspection of pipes in catchments A to J1 inclusive which is a difficult, expensive and time-consuming task.

These measures are based on the findings of this study, the Central, Western and Wan Chai West SMP, record drawings and operations records from DSD. The effectiveness of these measures is difficult to quantify at this stage and the detailed design will have to assess how effective these measures will be in reducing the pollution loads. It is possible that some measures will be found to be impractical after detailed design and review by Government. The estimated costs are in mid 1992 Hong Kong dollars and include an allowance for preliminaries, contractual contingency and a projected inflation allowance. These cost estimates will require refinement during the design and detailing and so at this stage must be considered as indicative only.

a) Stormwater Catchment B

Culvert B will be extended under the Central Reclamation works and will outfall on the western seawall under Stage 1. Discharge from this catchment will not affect water quality in the embayed areas but the location of the outfall on the western seawall could affect local water quality near the Macau Ferry Terminal. Relocation of the outfall further northwards along the seawall would be expected to improve dispersion of the discharge. However, the outfall location is controlled by the seawater pumping station and Custom and Excise building immediately north of outfall, which cannot be relocated.

It is feasible, however, to divert the pipe into culvert CD, under the final reclamation works, to outfall along the new seawall between piers 1 and 2. This would require the abandonment of 78 m of pipe constructed under Stage 1 of the reclamation, the construction of 85 m of new pipe in the Stage 2 works (in this case to be constructed by the Airport Railway Station Contractor), and a slight enlargement of culvert CD. This improvement measure is estimated to cost $0.1 million under the reclamation contract and $1.2 million under the Station contract. The pollution load will remain unchanged but discharge into the main tidal flow off the nothern seawall is considered preferable to discharging into the relatively slack water area to the west of the reclamation. The scheme is shown in Figure 2.12 (Improvement No.5).

An overflow was noted on a recent survey between the foul and stormwater system on the corner of Des Voeux Road and Wing Wo Street. Plugging both ends of this connection would ensure no sewage can enter the storm system. Figure 2.13 (Improvement No.6) details this connection. DSD have advised that they will be closing this connection shortly.

b) Catchment CD

The culvert CD will outfall into the embayed area during Stage 1 and extend to the northern seawall after the Stage 2 works.

The existing sewer in Queens Road Central between Cochrane Street and Peel Street is hydraulically inadequate and needs relaying. This sewer was recommended by the SMP study for upgrading. A new sewer will perform better, minimize silting and reduce the level of surcharging in adjacent pipes. This will reduce the pollution loading entering the storm system through unknown expedient connections. A similar situation occurs with the sewer along Des Voeux Road Central between Wing Wo Street and Jubilee Street. The Hillside Escalator scheme will alter the distribution of flows in this area and it is likely that additional works may be necessary along Wing Lok Street. Figures 2.15 and 2.16 (Improvements No.8 and 9) detail these proposals.

The cost of relaying both these pipelines is estimated at $2.5M. This improvement measure can only be implemented after detailed design including C.C.T.V, manhole inspections and a traffic assessment. The construction works would take about 5 months to complete.

c) Catchment F

Catchment F will be extended to outfall on the eastern seawall of the reclamation under Stage 1 of the works. There are two known expedient connections into this stormwater catchment from the sewer system.

One expedient connection is on the junction of Queen's Road Central and Ice House Street. The connection is known to be a high level overflow into the stormwater system. Permanently blocking off this connection may cause hydraulic problems upstream and further improvement works in Ice House Street may be necessary. It is recommended that it is blocked on a trial basis and if problems occur, then upgrading the sewer between Queen's Road Central and Connaught may be necessary. Another is an overflow (through a broken sewer pipe) into the stormwater system on the junction of Queen's Road Central and Pedder Street. The size of the pipe is 225 mm diameter. Plugging both ends of these connections will ensure that no pollution loading can enter the storm system. The estimated cost of these works is $30,000 excluding the upgrading works. The details of these connections are shown in Figures 2.17 and 2.18 (Improvements No.10 and 11). Details and costs of the Ice House Street upgrading works are shown in Figure 2.24 (Improvement No.17).

The existing sewer along Des Voeux Road Central between Theatre Lane and Pottinger Street is hydraulically inadequate. The relaying of a 900 mm diameter pipe will reduce the pollution loading entering the storm system and is shown in Figure 2.19 (Improvement No.12).

Additional improvements can also be made should the above works prove to be insufficient. These works cannot be as precisely defined at this time due to a lack of record information. These works are in Des Voeux Road Central and Queen's Road Central. The Des Voeux Road Central works include the relaying of a 225 mm pipe between Pedder Street and Theatre Lane (Figure 2.20, (Improvement, No.13); a 300 mm pipe between Bank Street and Ice House Street (Figure 2.21, Improvement, No.14); and a 300/450 mm pipe between Ice House Street and Pedder Street (Figure 2.22, Improvement No.15). Improvements to the foul sewer in Queens Road Central include the relaying of a 225 mm pipe between D'Aguilar Street and Wyndham Street (Figure 2.23, Improvement No.16); a pipe between Duddell Street and Connaught Road (Figure 2.24, Improvement No.17); and a 225 mm pipe between Li Yuen Street West and Douglas Lane (Figure 2.25, Improvement No.18).

The cost of these works is estimated at $4.3M. These improvement measures can only be implemented after detailed design including manhole inspections and a traffic assessment. The construction works would take about 12 months to complete.

d) Catchment J1

Catchment J1 will not be affected by the works but the outfall will discharge into the embayed area to the east of the eastern reclamation bund.

Approximately 570 m of 450/600 mm diameter pipe along Harcourt Road/Connaught Road Central have negative gradients and are frequently blocked. The replacement of this section of pipe will reduce the incidence of blockage and ensure that the hydraulic capacity is adequate. Figure 2.14, Improvement No.7) details the proposal. This measure was recommended by the SMP and will be used as the basis of detailed design.

The cost of the works is estimated at $5.0M and would take about 3 months to complete. Highways Department presently has a restriction for openings imposed on this section of road until February 1995, which would delay the start date for the works, unless the restriction can be lifted.

A summary of the improvement measures is given in Table 2.2.

2.2.4 Other Improvement Measures Considered

a) Interception of Dry Weather Flows

Other improvement measures have been considered. Principally this would be to intercept the dry weather flow in the culverts and either divert it into the existing foul sewer pipes or a submarine outfall. If practical to implement they would remove virtually all the pollution loading in the vicinity of Central Reclamation during dry weather.

To intercept these flows, however, is difficult. All the outfalls are below tide level with an average level of 0.3 mPD. The tidal range in this area is from 0.5 to 2.3 mPD. This means that every outfall is subjected to tidal water at all times. To divert the dry weather flow successfully would require weirs in the culverts at 2.3 mPD to separate the tidal water from the foul (dry weather) flow in the culvert. The addition of weirs will seriously affect the hydraulic capacity of the culverts and increase the potential for flooding in Central. This measure is not recommended.

A submarine outfall is also an option but to operate successfully would need a hydraulic head of 1 to 2 m. This has the same effect as a weir and would increase the potential for flooding in Central. This measure is not therefore recommended.

Interception of the foul flows above the tidal areas is possible, but the existing interceptor sewers have insufficient capacity to cater for the additional flow and new interceptors cannot be constructed since the existing trunk sewer is too shallow to accept the new sewer. This measure is not considered feasible.

b) Extension of Stormwater Outfalls

Submarine outfalls are also an option but to operate successfully would need a hydraulic head of 1 to 2 m. This has the same effect as a weir and would increase the potential for flooding in Central. Furthermore, the outfall extensions would be ultimately abortive, as they would require diversion in the next phase of reclamation. This measure is therefore not recommended.

c) Extension of Culvert F to New Seawall Line

Extending culvert F to discharge away from the vinicity of Star Ferry would reduce any potential water quality problems due to reduced tidal movement. However, there are several problems in any extension to culvert F. Firstly any extension will only be temporary until the next phase of the reclamation is completed. This is because the ARL overrun tunnel would clash with the culvert and the work would therefore be abortive. Secondly any extension will cause a greater headloss in the culvert which increases the potential for flooding in the existing areas of Central. The surface water drainage systems investigation report (R1) has concluded that extensions to culvert F can only be completed after extensive upgrading works have been completed in Central. The cost of these upgrading works was estimated at $20M. The high cost of the upgrading works even before any culvert extension is considered, and its temporary nature, means that this option is impractical and is not recommended.

d) Flow Channels Through Bunds in Stage 1

The possibility of leaving a gap at the inner ends of the Stage 1 bunds was reviewed, with the objective of enhancing water circulation. While no modelling was carried out of such a scenario, the gap envisaged to provide for sufficiently improved water circulation was assumed to be in the order of 50-100 m wide by 10 m deep.

Incorporation of such gaps would;

(i) require vehicular bridges to provide access to piers
(ii) require pipe bridges to carry temporary services and cooling water pipes in an extra construction element
(iii) require considerably increased expenditure
(iv) result in an overall programme delay to the time at which station works would commence of perhaps 6-9 months.
(v) would not permit the separation of cooling water warm discharges from the intakes, with consequent warming of intake water and objections from owners.

This proposal was considered in some detail during the design stage and rejected for the reasons above.

e) Disinfection of Dry Weather Flow

Disinfection of the dry weather flow component of the stormwater discharges to reduce *E. coli* levels and to a lesser extent oxygen demand was considered but was rejected on the basis of inadequate land area for contact tanks and disinfection storage and dosing facilities, and high operating costs.

Table 2.2 Potential Improvement Measures to Mitigate Water Quality Impacts during Construction of Central Reclamation Phase 1

Measure	Storm catchment affected	Implementation/ duration	Cost[2] (HK$)
* lower electrodes at Central screening plant	A, B, C, D, part F	by DSD[1]	
* desilt the trunk sewer	A, B, C, D, part F	by DSD[1]	--
* upgrade capacity of Jubilee St sewer	D	by DSD[1]	--
* remove known cross-connections/ overflows	B D F	by DSD[1] by DSD[1] immediate (trial basis)	-- -- 30,000
* realign culvert B	B	2 months under station contract	1,300,000
* upgrade capacity of existing foul sewer	C,D	5 months after detailed design	2,500,000
	F	12 months after detailed design	4,300,000
	J1	3 months after February 1995	5,000,000

Source : Central, Western and Wan Chai West SMP Study (1991)

1 - DSD works are already in progress or will start shortly.

2 - 1992 prices including preliminaries, contingencies and Projected Inflation Allowance. Costs of the works by DSD are not known by the Consultants.

3. Impact Assessment

3.1 Water Quality

3.2 Marine Mud

3.3 Air Quality

3.4 Noise

3 Impact Assessment

3.1 Water Quality

3.1.1 Assessment Criteria

The study area falls within the Victoria Harbour Water Control Zone which has not yet been gazetted. This zone has proposed water quality objectives (WQOs) specified for beneficial uses 3 (marine life); 6 (domestic/industrial); 7 (navigation/shipping) and 8 (aesthetic). There is also a general limit for inorganic nitrogen within Victoria Harbour which is specified on the basis of controlling algal growth in quiescent areas. The numerical WQOs relevant to the present study are shown in Table 3.1. In addition, a general objective designed to promote the aesthetic quality of the harbour waters is specified. This states that there should be no objectionable odours or discolouration of the water and that tarry residues, floating wood, articles of glass, plastic, rubber or any other substance should be absent. Mineral oil should not be visible on the water surface, nor surfactants producing lasting foams and no recognisable sewage-derived debris should be present.

A revised set of WQOs is currently being drafted by EPD but these are not available for assessment purposes at this stage. The original WQOs proposed in the Sewage Strategy Study (1989) have therefore been presented.

Table 3.1 Proposed Water Quality Objectives for Victoria Harbour Water Control Zone

Beneficial Use	Dissolved Oxygen	Ammonia-N	Inorganic-N	*E. coli*	Temperature
3	>60%[1]	0.021 mg/l[2]			2°C[3]
6	>30%[1]			20,000/100 ml[4]	
General			<0.5 mg/l[5]		

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. Temperature limit refers to permitted increase above ambient
4. *E. coli* limit refers to 90% of samples taken over a year.
5. Inorganic-N limit is a depth and annual average.

Victoria Harbour is not expected to be fully gazetted until 1997 at which time regulation made under the Water Pollution Control Ordinance (Cap 358, 1980) will come into effect. For most of the duration of the Central Reclamation Phase I construction period (1992-1998), therefore, the WQOs will be non-statutory. They do however provide a guideline against which to compare the water quality conditions during the construction phase, as predicted by modelling.

In addition to these criteria, impacts are also assessed by comparison of model output for the reclamation scenario with a baseline case with no development.

3.1.2 Existing Environment

Summary statistics for water quality in Victoria Harbour during 1990 are shown in Table 3.2. These data are for stations in the main flow channel of the harbour rather than near the reclamation area, but given an indication of the local water quality. The data suggest reasonable quality although dissolved oxygen levels exhibit a wide range, from values below the WQO to values of over 100% saturation, suggesting vigorous algal activity. BOD values are generally below 3 mgl^{-1} and as such are acceptable. Average nutrient and chlorophyll levels are below the guideline values indicative of eutrophication.

Table 3.2 Summary Statistics of 1990 Water Quality of Victoria Harbour (EPD, 1991)

Determinand		Harbour East and Central	Harbour West
Temperature (°C)	Surface	22.906 (16.010 -28.923)	22.965 (15.900 - 28.875)
	Bottom	22.409 (15.630 - 28.695)	22.571 (15.810 - 28.436)
Salinity (ppt)	Surface	30.868 (26.407 - 32.890)	30.198 (22.312 - 32.440)
	Bottom	31.566 (28.380 - 33.695)	31.192 (27.279 - 32.623)
DO (% satn.)	Surface	72.412 (25.000 - 145.960)	80.183 (28.696 - 145.960)
	Bottom	61.405 34.047 - 96.580)	69.188 (42.952 - 116.172)
pH		8.258 (7.687 - 8.763)	8.279 (7.740 - 8.831)
Secchi Disc (m)		2.091 (0.800 - 6.000)	2.050 (0.500 - 5.000)
Turbidity (NTU)		5.105 (1.633 - 18.167)	5.596 (1.500 - 17.500)
SS (mg/l)		5.200 (0.833 - 20.000)	6.362 (0.833 - 28.333)
BOD_5 (mg/l)		1.134 (0.140 - 3.310)	0.836 (0.175 - 1.997)
Inorganic N (mg/l)		0.282 (0.136 - 0.620)	0.282 (0.063 - 0.557)
Total N (mg/l)		0.862 (0.395 - 1.505)	0.864 (0.415 - 2.690)
PO_4-P (mg/l)		0.040 (0.002 - 0.107)	0.034 (0.002 - 0.076)
TP (mg/l)		0.089 (0.027 - 0.240)	0.075 (0.027 - 0.133)
Chlorophyll - a (μg/l)		3.267 (0.200 - 31.333)	3.206 (0.233 - 15.333)
E. coli (no./100 ml)		3374 (27 - 44000)	692 (27 - 18000)

Note :
1. Except as specified, data presented are depth average data.
2. Data presented are annual means except for *E. coli* data which are annual geometric means.
3. Data enclosed in brackets indicate the ranges.

3.1.3 Assessment Methodology

a) Models

In order to examine the impact the reclamation works would have on water quality, a three-dimensional model of tidal flows and cooling water discharges was set up on a fine 25m grid and used to simulate the detailed local wet and dry season neap tide conditions. (Setting up and validation of this model is described in Appendix 2. The model covered an area 1.6km square from the Macau Ferry terminal on the west to HMS Tamar on the east and extended northwards to include the tip of the Kowloon Peninsula. The three-dimensional model was used to simulate the tidal flows and resulting increase in water temperature caused by the cooling water discharges, which are 5°C above ambient.

A 25m grid was used in order to resolve the local, horizontal variations in water temperature, salinity and tidal flows and the three-dimensional model was used because the hot water discharges would be buoyant and would, to some extent, modify local surface water movements. The model is made up of three separate, interactive modules which simulate tidal flows, salt movement and thermal balance. The water density is a function of both the salinity and water temperature and, during the tidal cycle, as salinities and water temperatures change at each point in the model area, the water density required in the simulation of water movements is recalculated throughout the tidal cycle.

The results from this model were then processed to provide the necessary hydraulic input to the WAHMO two-dimensional two-layer model of water quality. It was considered that neap tides would experience poorer water quality than spring tides because of the reduced tidal flushing; the model was therefore used to simulate four possible scenarios for wet and dry season neap tides as described below.

b) Model Simulations

Four scenarios were modelled as follows;

1) Existing Conditions

Tidal flows were based on boundary conditions taken from a previous WAHMO model simulation with the 1987 coastline while water quality boundary conditions were taken from a previous WAHMO simulation of 1996 conditions. Stormwater pollutant loads local to the Central Reclamation were based on observations and measurements made under the Central Western and Wan Chai West SMP Study in 1990, as described in Section 2.2.1 and Table 2. While certain catchments (A, E, G, H and I) were observed in the SMP survey to have little foul or dry weather flow, for the purposes of a worst case analysis, an estimate was made of potential polluting loads in these catchments. This was based on catchment population and an assumption that 70% of the pollution load generated was discharged via the storm sewers, as was observed in the worst case catchments in the SMP survey. Catchment E was omitted as it drains only a small area of hard paving. The loads simulated are given in Table 3.3.

2) Partial Reclamation

Tidal flows were modelled with the reclamation bunds in place and culverts B and F and cooling water discharges from Harbour Building, Wing On Centre, St George Building, Exchange Square, Landmark, Jardine House and General Post Office diverted outside the embayment (see Figure 2.9). Water quality boundary conditions were taken from the simulation of 1996 conditions in the WAHMO 250m model, which also included the large PADS reclamations of West Kowloon, Container Terminals 8 and 9 and the full Central and Wan Chai Reclamation. Stormwater pollutant loads modelled were increased by 10% compared with the simulation carried out for existing conditions ((1) above) to account for nominal population increase. No load reductions were assumed for ongoing DSD works. The loads simulated are given in Table 3.3.

Table 3.3 Stormwater Pollutant Loads Simulated

Pollution Loads for Existing Conditions Scenario (1)

Outfall	BOD (kg/d)	NH_3-N (kg/d)	Org-N (kg/d)	*E. coli* (count/s)
A[1]	480	13	17	3.6×10^9
B[2]	300	50	70	1.8×10^9
C[2]	920	50	50	2.5×10^9
D[2]	1790	70	160	8.2×10^{10}
F[2]	600	60	90	9.7×10^{10}
G[1]	80	2.2	2.8	7.0×10^8
H & I[1]	460	18	22	4.0×10^9
J1[2]	2500	290	120	3.1×10^{10}

Pollution Loads[3] for Partial Reclamation Scenario (2)

Outfall	BOD (kg/d)	NH_3-N (kg/d)	Org-N (kg/d)	*E. coli* (count/s)
A[1]	528	14	18	4.0×10^9
B[2]	330	550	77	2.0×10^9
C[2]	1012	55	55	2.7×10^9
D[2]	1969	77	176	9.0×10^{10}
F[2]	660	66	99	1.1×10^{11}
G[1]	88	2.4	3.1	7.7×10^8
H & I[1]	506	19	24	4.4×10^9
J1[2]	2750	319	132	3.4×10^{10}

Pollution Loads[4] for Partial/Full Reclamation Scenario with Mitigation Measures (3,4)

Outfall	BOD (kg/d)	NH_3-N (kg/d)	Org-N (kg/d)	*E. coli* (count/s)
A[1]	528	14	18	4.0×10^9
B[2]	330	550	77	2.0×10^9
C[2]	1012	55	55	2.7×10^9
D[2]	1969	77	176	9.0×10^{10}
F[2]	330	33	49	5.3×10^{10}
G[1]	88	2.4	3.1	7.7×10^8
H & I[1]	506	19	24	4.4×10^9
J1[2]	1100	127	52	1.4×10^{10}

Notes:

1 Loads were estimated from catchment land-use/population, assuming as a worst case that 70% of total load is discharged via storm sewers.

2 Loads were determined from field measurements made during the SMP survey in 1990.

3 Loads increased by 10% for nominal population increase.

4 Loads in outfall F and J1 reduced by 50% and 60% respectively.

3) Partial Reclamation with Mitigation Measures

The simulation described in (2) was repeated but with reduced effluent loads to reflect the effect of potential mitigation measures. Examination of the results from simulation (2) showed that the main area of concern with regard to water quality was the area to the east of the eastern reclamation bund. A number of mitigation measures were therefore identified for catchments F and J1 (which discharge into this area) for inclusion in simulation 3. These comprised rectification of cross connections at Queens Road Central/Ice House Street (Improvement No.10, Figure 2.17) and Queens Road Central/Pedder Street (Improvement No.11, Figure 2.18), and relaying sections of sewer along Des Voeux Road Central (Improvement No.12, Figure 2.19) in catchment F. In catchment J1, the measures included the recent temporary rectification by DSD of a major 450mm diameter cross-connection at Murray Road/Connaught Road Central, and relaying sections of sewer along Harcourt Road/Connaught Road Central (Improvement No.7, Figure 2.14).

For the purposes of modelling, a percentage load reduction was assumed to result from these mitigation measures of 50% in catchment F and 60% in catchment J1. These values were based on estimates given in the Central Western and Wan Chai West SMP, but are subjective and would only be able to be confirmed by sampling during the forthcoming SMP extension study in the area. The assumed loads simulated are given in Table 3.3.

4) Full Reclamation with Mitigation Measures

Tidal flows were modelled with the full Phase 1 reclamation completed and culverts C and D and fifteen cooling water intakes relocated on the new seawall (see Figure 2.10). Culvert F was relocated approximately 80m further north along the eastern seawall of the reclamation, as shown in Figure 2.10. All other intakes and outfalls were as for scenario (2). The same mitigation measures were assumed as for (3); the pollutant loads simulated are given in Table 3.3.

3.1.4 Impacts

a) Tidal Flow and Thermal Effects

Simulation of the existing tidal flows and cooling water discharges showed that because the warmer water being discharged is buoyant, it tends to spread as a relatively thin surface layer with little mixing over the depth for most of the tide in both the wet and dry seasons (Figures 3.2 and 3.3). The simulations showed (Figures 3.4 and 3.5) that the warm water plumes remained close to the seawalls during the main run of the tides and, only at slack water periods, did the 0.2°C contour extend up to 500m offshore. The initial warm water discharges were specified as having a temperature of 5°C above background and, following the initial discharge where the immediate surface receiving waters had temperatures of approximately 4°C above background, it was found that the area which experienced temperatures of 2°C or higher was confined to within 50m of the main outfall area at Blake Pier.

Following the introduction of the Stage 1 reclamations bunds, the main hot water discharges will be directed outside the embayment to the east of the reclamation near the Star Ferry Pier. The model was again used to predict the resultant tidal flows and temperature distributions. In both wet and dry seasons on neap tides, the temperature in the embayed area was at background values over most of the area except for a small patch around the remaining cooling water discharge point, where temperatures were predicted to increase to between 0.2°C and 0.5°C. This area, however, remained within 175m of the outfall site (Figure 3.6). The main discharge of cooling water becomes confined in the corner created by the eastern reclamation bund and the existing seawall near the Star Ferry Pier. Because the reclamations reduce tidal flows in the immediate vicinity of the discharge point, especially in the wet season, the cooling water is not dispersed as quickly as at present (Figure 3.6). In the wet season, the surface layer (top 2.5 m of the water column) reaches 2°C or more above ambient in an area extending approximately 250m along the seawall and up to 50m wide. In the dry season, the area of surface waters affected by temperatures of 2°C or more above ambient is slightly smaller than in the wet season (Figure 3.7).

The full reclamation was then inserted in the model data set. Apart from reclaiming the embayed area, this final layout had a new cooling water discharge located at the western end of the northern face of the reclamation. The model of tidal flows, salt transport and thermal discharges was re-run to simulate this new configuration. The simulated increases in water temperatures for both wet and dry season tidal flows were similar to those for the Stage 1 reclamation for the area to the east in the vicinity of the Star Ferry terminal. On the wet season neap tide, the main difference between the Stage 1 and full reclamation layouts is caused by the new outfall at the western end of the northern face of the reclamation where the new 2000 l/s outfall produces a plume with temperatures 1°C above ambient at up to 125 m from the outfall (Figure 3.8). Again the plume from the outfall closest to the eastern side of the reclamation is generally confined to the eastern side with a similar structure to that predicted for Stage 1 (Figure 3.6). On the flood tide, however, the plume extends round the front of the reclamation at a temperature of 0.2-0.5°C to join the plume from the new outfall (Figure 3.8). On the dry season neap tide, as with the Stage 1 layout, the plumes are more widely dispersed than those of the wet neap tide.

The main difference in the simulated temperatures between the Stage 1 and full reclamations occurs at the front of the reclamation at high water slack where the plume extends further to the west because of the new outfall (Figure 3.9) and temperature increases due to the new outfall can be seen. Apart from this, the plume is similar to that for Stage 1 (Figure 3.7). For both wet and dry season conditions, as a result of the new outfall, water temperature offshore of the reclamations are higher than those for the Stage 1 layout as a result of the new outfall but water temperature increases in this area, however, are predicted to remain less than 0.6°C.

b) Water Quality Effects

Results from the WAHMO water quality model for the partial reclamation are presented as time histories at 6 stations (Figure 3.10) of the variation of dissolved oxygen (DO), ammoniacal nitrogen, oxidised nitrogen, *E. coli* and biological oxygen demand (BOD) over the tidal cycles (Figures 3.11-3.20). Results for the full reclamation are presented as time history plots at the same fixed stations except B, which disappears due to the reclamation, in Figures 21-30. Plan contour plots of the model's surface layer (ca. top 7 m of the water column) for each parameter for both the partial and full reclamation layouts are shown in Figures 31-70.

At the three stations offshore, D, E and F, the introduction of the reclamation bunds in general makes negligible difference to the tidal variations in the parameters simulated. These stations are influenced mainly by the larger scale water movements and quality in the neighbouring waters of Victoria Harbour on the east and the Western Harbour on the west. The relatively small magnitude and the exact location of the local effluent discharges has little influence on these offshore sites and the impact of the proposed works on water quality offshore is very small.

At station A, inshore to the west of the reclamation, the proposed works have little impact on the existing water quality. This is probably because this area is not subject to any significant local pollutant loadings and the water quality is determined principally by the large scale water quality in the surrounding waters which will not be affected by the works.

At the inshore sites, B and C, however, the effect of the reclamations with the provisioned outfalls and the effect of the reducing the local pollution loadings can be seen. Within the embayed area, following diversion of the major storm sewer discharge at F, the water body is no longer subject to a local effluent source. Because the reclamations greatly reduce the tidal flows within the embayed area compared to existing conditions, the tidal variations in the various parameters of interest are smaller because this area is no longer exposed to the poorer water quality in Victoria Harbour to the east or the better water quality to the west.

<u>Dissolved Oxygen</u>

The WAHMO model predicted that DO levels at Station B would improve in the dry season following construction of the reclamation bunds, with an existing minimum DO of 54% saturation increasing to 61% (Figure 3.11). In the wet season, the minimum DO levels with or without the reclamation bunds remained approximately the same but the highest DO levels within the tidal cycle are predicted to reduce from existing values of 59% to 55% saturation (Figure 3.16). Introduction of the mitigation measures has no noticeable impact on the DO levels in the vicinity of Station B.

Following the construction of the reclamation bunds, Station C, which is still more or less subject to the existing variations in water quality over the tidal cycle, will lie in a relatively poorly flushed area and will be subject to the relatively large pollutant loading from the diverted outfall F. As a result, DO concentrations reduce, with peak values during the dry season neap tide falling from 63% to 59% and with minimum values dropping from 51% to 48% saturation. Similarly, in the wet season, peak DO levels fall from 61% to 56% saturation while minimum values reduce from 43% to 41% saturation. The introduction of the mitigation measures which reduce the local pollution loading has no noticeable impact on DO levels in either the wet or dry seasons.

At Station D further offshore in the wet season, the construction of the reclamation bunds appears to reduce DO levels for a short part of the tide. It is not clear why this occurs. However, DO levels are predicted to reduce by on average 2% saturation for approximately 3 hours during the tide. Again, the mitigation measures have no noticeable impact on DO concentrations.

Completion of the reclamation makes no noticeable difference to the DO concentrations in either the wet or dry seasons at Station A (Figures 3.21 and 3.26), to the west of the reclamations, compared to the partial reclamation case. The loadings in the vicinity of Station A do not change following completion of the reclamation and so this result is not unexpected. Station B lay within the embayed area and, following the completion of the reclamations, this position was reclaimed. At Station C, in the corner between the Star Ferry and the reclamation, as at Station A, local loadings remain unchanged and completion of the reclamation has no noticeable impact on DO concentrations.

At Stations D, E and F, in the main flow channel between Kowloon and the Central reclamation, small changes in DO levels can be seen from the time history plots. These differences are probably the result of locating some outfalls on the northern face of the reclamation closer to the main flow channel than before and possible also due to some small changes in the tidal flows. However, the differences in DO concentrations between the base case without any reclamations and the partially and fully completed reclamations is small on both wet and dry season neap tides.

Ammoniacal Nitrogen

Following construction of the reclamation bunds, in the dry season, peak concentrations of ammoniacal nitrogen reduce at Station B while minimum concentrations during the tidal cycle increase (Figure 3.12). Concentrations still lie within the range 0.11-0.14 mg/l which is within the range for existing conditions and below the proposed water quality objective. In the wet season, however, concentrations of ammoniacal nitrogen increase as a result of the remaining discharges into the embayment and the probable reduced flushing of this area in the wet season. For existing conditions, over the wet season neap tidal cycle, concentrations of ammoniacal nitrogen are predicted to vary from 0.08 mg/l to 0.13 mg/l; following reclamation, the concentration of ammoniacal nitrogen remains fairly uniform at around 0.14 mg/l for most of the tide (Figure 3.17). The mitigation measures have little noticeable impact on ammoniacal nitrogen concentrations within the embayed area.

At Station C, following construction of the reclamation bunds and the diversion of outfall F, ammoniacal nitrogen concentrations increase by around 0.01mg/l uniformly over the tidal cycle in the dry season. The reduced load following the mitigation measures, however, bring the concentrations back close to the existing values for most of the tidal cycle. In the wet season, a similar behaviour is predicted although, following the mitigation measures, while peak concentrations (0.13mg/l) remain as at present, the minimum concentrations during the tidal cycle still remain slightly (0.01mg/l) above the existing values.

As for DO, compared with the partially completed reclamation layout, the effect of completing the reclamation on ammoniacal nitrogen concentrations, especially in the dry season, is very small at each of the Stations A-F where the model results have been analysed in detail (Figures 3.22 and 3.27).

Oxidised Nitrogen

At Station B within the embayed area in the dry season, the tidal variation in oxidised nitrogen is smaller than for existing conditions and, following reclamation, peak concentrations reduce slightly from their present value of 0.13 mg/l while minimum values remain very similar to those found at present. In the dry season, at Station C, minimum concentrations remain the same as those predicted for existing conditions while peak concentrations increase by less than 0.01 mg/l to a peak of 0.13 mg/l (Figure 3.13). The mitigation measures have little noticeable impact on the concentrations of oxidised nitrogen.

In the wet season, in the embayed area, the ammoniacal nitrogen concentration behaves much the same as in the dry season. At Station C, however, there is little difference between the existing concentrations and those predicted following construction of the reclamation bunds. The mitigation measures have little noticeable impact on wet season concentrations of oxidised nitrogen (Figure 3.18).

From examination of the time history plots of concentrations of oxidised nitrogen at the fixed stations, it can be seen that completion of the reclamation introduces no additional changes in the predicted concentrations of oxidised nitrogen in either the wet or dry seasons compared with the partially completed reclamation (Figures 3.23 and 3.28).

E. coli

In the embayed area in both the wet and dry seasons, *E. coli* concentrations increase over much of the tide following reclamation. It is thought that this is the result of the remaining storm sewer discharges after outfall F has been diverted and the reduced flushing in this area once embayed. Peak counts increase from 63,000/100 ml to 92,000/100 ml in the dry season and from 63,000/100ml to 75,000/100 ml in the wet season. Following the mitigation measures, peak counts in the embayed area remain very similar in both seasons, because the mitigation measures do not affect the discharges into the embayed area.

At Station C, now under the influence of the diverted discharge from outfall F, peak *E. coli* counts in the dry season are predicted to increase from 49,000/100 ml to 83,000/100 ml (Figure 3.14). Following the mitigation measures, however, peak counts only reach 55,000 mg/l at Station C in the dry season. In the wet season, predicted peak existing counts increase from 56,000/100 ml to 76,000/100 ml but, following the mitigation measures, the peak counts drops to 57,000/100 ml (Figure 3.19). It is clear that, at Station C, the mitigation measures are very effective in reducing the *E. coli* concentrations.

As with the other parameters simulated, completion of the reclamation introduces no significant change to the predicted *E. coli* concentrations in either the wet or dry seasons at the stations examined in detail (Figures 3.24 and 3.29).

BOD

In the dry season, in the embayed area at Station B, the peak BOD concentrations predicted during the tidal cycle remain very similar to those predicted for existing conditions (approximately 2.7mg/l) (Figure 3.15). The minimum BOD concentrations following construction of the reclamation bunds, however, remain around 0.2mg/l higher than those predicted for existing conditions (approximately 2mg/l). In the wet season, peak BOD concentrations are significantly higher at 5mg/l for existing conditions with the minimum concentrations during the neap tide falling to approximately 3.6mg/l (Figure 3.20). Following the introduction of the reclamation bunds, however, peak concentrations reduce and minimum concentrations increase; both by approximately 0.1mg/l. Averaged over the tide, there would be little difference in the mean concentration following the construction of the reclamation bunds. As might be expected, the mitigation measures have no significant impact on BOD levels within the embayment.

At Station C in the dry season, following the construction of the reclamation bunds, concentrations of BOD increase almost uniformly over the tide by approximately 0.2 mg/l. Following the mitigation measures, however, the BOD concentrations reduce to values very close to those predicted for existing conditions for most of the tidal cycle. Only for a relatively short period are the minimum concentrations greater than those predicted for existing conditions where the predicted increase is of the order of 0.2-0.3 mg/l. For most of the dry season tidal cycle, the mitigation measures appear effective in maintaining existing BOD concentrations.

In the wet season at Station C, the partial reclamation and discharge pattern increase the BOD concentrations by a smaller margin than in the dry season. Again, introduction of the mitigation measures effectively restores the BOD concentrations to the values predicted for existing conditions.

Again, the simulation of the completed reclamation is predicted to have little, if any, impact on BOD concentrations compared with those predicted for the partially completed reclamation (Figures 3.25 and 3.30) at the stations at which the results have been examined in detail.

Summary

The results of the water quality modelling for both the partial and full reclamation scenarios are summarised in Table 3.4. This shows the predicted worst case conditions under the various scenarios modelled and compares the results with the tentative WQO's for Victoria Harbour. Where differences of >5% occur in comparison to the baseline case of existing conditions, the figures are underlined for emphasis.

DO is predicted to be below the WQO of 60% saturation under existing conditions. Partial or complete reclamation may reduce DO concentration near the Star Ferry by 2% saturation in the wet season but is not predicted to have a significant effect elsewhere or during the dry season.

Ammonia-nitrogen concentrations will remain below the WQO at all times. Increases of 7-8% were predicted near the Star Ferry but this effect appeared to be adequately mitigated by the measures proposed.

Nitrate-nitrogen concentrations are predicted to increase by 31% near the Star Ferry; mitigation would reduce this to a 22-24% increase. Although there is a residual effect, the resultant concentrations (approximately 0.15 mg/l) are well below the WQO (0.5 mg/l).

E. coli counts are predicted to exceed the WQO limit of 20,000 per 100 ml under existing conditions in the absence of any reclamations. Partial reclamation is predicted to increase numbers of *E. coli* to both the east of the reclamation and inside the embayment by 50-70% in the dry season and 15-35% in the wet season. The mitigation measures are effective in reducing this around the Star Ferry area, giving only a 10% increase over baseline in the dry season and no increase in the wet season, but do not materially improve conditions inside the embayment.

BOD concentrations, for which there is no proposed WQO, are predicted to increase slightly around Star Ferry, but the increase of less than 5% is effectively counteracted by the mitigation measures assumed.

Table 3.4 Summary of Predicted Worst Case Water Quality Conditions (surface/bed, if applicable)

Determinand	Station (Location)	Season	Existing Conditions	Reclamation Bunds with No Mitigation	Reclamation Bunds with Mitigation	Completed Reclamation with Mitigation	WQO
DO (% sat)	A (Macau Ferry)	Dry	54.4	54.7	54.6	54.4	>60
		Wet	46.9	47.0	47.0	47.6	
	B (Inside Embayment)	Dry	53.9/53.9	62.1/62.1	62.0/62.0	--	
		Wet	44.8/39.6	44.8/38.1	44.8/38.1	--	
	C (Star Ferry Terminal)	Dry	51.1/51.1	44.8/48.4	48.4/48.4	48.6/48.6	
		Wet	43.0/39.6	41.4/37.6	41.4/37.6	41.7/37.6	
NH_3-N (mg/l)	A (Macau Ferry)	Dry	0.156	0.155	0.155	0.155	0.25-0.5
		Wet	0.116	0.116	0.115	0.114	
	B (Inside Embayment)	Dry	0.151/0.151	0.143/0.143	0.143/0.143	--	
		Wet	0.130/0.135	0.138/0.142	0.137/0.142	--	
	C (Star Ferry Terminal)	Dry	0.156/0.156	0.168/0.168	0.157/0.157	0.159/0.159	
		Wet	0.132/0.138	0.141/0.147	0.133/0.143	0.131/0.134	
NO_3-N (mg/l)	A (Macau Ferry)	Dry	0.117	0.116	0.116	0.116	0.5
		Wet	0.125	0.124	0.124	0.125	
	B (Inside Embayment)	Dry	0.125/0.125	0.116/0.116	0.116/0.116	--	
		Wet	0.126/0.130	0.122/0.122	0.122/0.122	--	
	C (Star Ferry Terminal)	Dry	0.128/0.128	0.168/0.168	0.157/0.157	0.159/0.159	
		Wet	0.127/0.134	0.129/0.134	0.129/0.134	0.131/0.134	
E. coli (per 100ml)	A (Macau Ferry)	Dry	46243	35646	32618	37834	20,000
		Wet	47046	34334	33775	35308	
	B (Inside Embayment)	Dry	63612/63612	92945/92945	89234/89234	--	
		Wet	65784/52451	75804/54047	73966/53327		
	C (Star Ferry Terminal)	Dry	49719/49719	86277/86277	55545/55545	56117/56117	
		Wet	56645/56962	76255/66558	53899/57543	54263/57575	
BOD (mg/l)	A (Macau Ferry)	Dry	2.79	2.78	2.75	2.76	--
		Wet	5.29	5.25	5.25	5.27	
	B (Inside Embayment	Dry	2.78/2.78	2.75/2.76	2.72/2.72	--	
		Wet	5.07/4.90	4.92/4.77	4.92/4.77	--	
	C (Star Ferry Terminal)	Dry	2.75/2.75	2.88/2.88	2.75/2.75	2.78/2.78	
		Wet	4.97/4.89	4.88/4.87	4.81/4.87	4.85/4.86	

Note: Underlining indicates where predicted values differ from the baseline case of no reclamation by more (or less in the case of DO) than 5%.

c) Dredging

Dredging of marine mud within the embayment could adversely affect the cooling water intakes along the existing sea wall, by increasing the suspended solids content of the intake water. At high levels, suspended solids can block filters and increase the normal wear on pump components. The upper tolerance threshold for solids in cooling water reported by the operators of the various intakes is 140 mg/l. The typical range experienced in mid-channel in the harbour is 1-30 mg/l. Through the suspension of organic rich sediments in the upper marine mud layers, dredging may also cause a reduction in dissolved oxygen levels and increases in nutrient levels. An evaluation of the potential for these effects has therefore been made.

Table 3.5 presents the characteristics of the marine mud to be dredged and the dredged volume, from which the total pollutant loads can be estimated. The results indicate that the dredging operation could, as a worst case estimate, generate 33,260 tonnes of suspended solids, 600 tonnes of COD, 300 tonnes of BOD and 60 tonnes of TKN over the duration of the dredging works.

The first phase of dredging, which will remove approximately 400,000 m^3 of mud, will be carried out over a period of about 50 days at the beginning of the contract in late 1992. Some 8,000 m^3 of mud will be removed per day. The loads associated with this rate of removal are shown in Table 3.6. For comparison, the pollutant loads in the stormwater culverts within the study area are also shown. It can be seen that the suspended solids loads per day are much higher from dredging, as might be expected, but the organic and nutrient loading is lower. This initial dredging of 400,000 m^3 will be carried out prior to formation of the reclamation bunds and will thus occur in open water, not in an embayment. While turbidity levels will increase, significant oxygen depletion would not be anticipated as there should be adequate exchange with the tidal flow.

The second phase of dredging (600,000 m^3) will be carried out in mid-1994, to remove mud from inside the embayment prior to infilling the reclamation. The same rate of dredging will be used, i.e. 8,000 m^3/d. Dredging will thus continue for a period of 75 days, or 2.5 months. Reference to Table 3.6 shows that for a limited period of 2.5 months in mid-1994, the dredging could be expected to double the pollutant loads to the embayment.

The loads predicted from dredging are broad, worst case estimates and are subject to the following factors;

1) sediment quality data are based on a limited number of surface samples - older sediments at depth less are likely to contain organic matter and nutrients;

2) losses will vary depending on the type and operation of the grab; the figure of 5% assumed for losses to suspension is high and represents a conservative factor in the load estimation;

3) COD:BOD ratios would be likely to be higher for marine sediments than sewage; although COD loads are similar from dredging and storm sewage, the BOD would be expected to be less from dredged mud;

4) BOD loads are likely to represent an overestimate since a proportion of sediment will resettle rapidly before the full 5 day BOD can be exerted.

The results suggest, however, that for a short period in mid-1994, the dredging activity will be liable to cause a temporary deterioration water quality conditions in the embayment.

Table 3.5 Predicted Pollutant Loading From Dredging

Volume of dredged material			0.96 Mm^3
Assumed worst case losses to water column on dredging			5%
Marine Mud	-	Specific gravity	2.31
Properties[1]	-	dry weight ratio	0.30
	-	COD ($mgkg^{-1}$ d.s.)	18,000
	-	TKN ($mgkg^{-1}$ d.s.)	1,800
Total mass of marine mud dredged			0.66 tonnes
Mass of dispersed solids			33,260 tonnes
COD exerted by dispersed solids			600 tonnes
Assuming BOD : COD ratio = 0.5, BOD exerted			300 tonnes
TKN load			60 tonnes

Notes :
1. average of results obtained by EPD for sediment monitoring station VS6 for 1991

Table 3.6 Potential Pollutant Loading from Dredging and Stormwater Discharges

	Potential Pollutant Loads (t/d)			
Source	SS	COD	TKN	NH_3-N
Dredging	280	5	0.5	0.05
Stormwater Outfalls in Study Area (culverts A-J1)	7	12	1.1	0.5
Stormwater outfalls within embayment (C and D)	5	4	0.3	0.1

In addition to the reclamation area, dredging of marine fill will be carried out at two allocated borrow areas east of Po Toi. The nearest sensitive receiver, approximately 2 km away, is Cap D'Aguilar which is designated as an SSSI. The waters around Cap D'Aguilar are currently under consideration for gazettal as a Marine Reserve under a new Marine Parks Ordinance proposed by the Agriculture and Fisheries Department. This area is of particular conservation value due to its marine life, and is therefore extremely sensitive in terms of water quality. It is understood that little overburden exists at the borrow areas and that sufficient fill is expected to able to be won from areas which are sand only. No backfilling is required. The impacts are therefore expected to be less than dredging in muddy areas, because the larger sand particles will settle more rapidly and have a lesser tendency to form extensive plumes.

d) Floating Refuse

The flow modelling has shown that current speeds in the Star Ferry area will decrease slightly following construction of the eastern reclamation bund. There will therefore be a tendency for floating refuse to collect in this area. Refuse would also be expected to gather in the embayment and to the west of the western reclamation bund near the Macau Ferry terminal. While the embayment will be screened from public view at ground level, refuse accumulation immediately outside the embayment would be undesirable, particularly in view of the exposure of these areas to tourists and visitors to Hong Kong using the sea front walkways and nearby ferry terminals.

3.1.5 Mitigation Measures

a) Identification

In view of a number of uncertainties associated with the modelling, such as assumptions made on the input parameters, and with broad estimates of dredging impacts, the results have to be regarded as indicative only. They do, nevertheless, serve to identify the major potential problem areas.

The areas of most concern with regard to the Phase 1 reclamation works and the predicted impacts on water quality can be broadly summarised as in Table 3.7.

Table 3.7 Summary of Water Quality Impacts

Area	Predicted Impacts		
	Stormwater discharge	Dredging works	Floating refuse
west of western reclamation bund, near Macau Ferry Terminal	insignificant	short term increases in SS when dredging inshore	visible if present
within embayment between reclamation bunds	increase in *E. coli*	increase in SS, possible decrease in DO	screened from public view
east of eastern reclamation, near Star Ferry Terminal	slight decrease in DO, increase in nutrients and *E. coli*	short term increases in SS when dredging inshore	visible if present

The area to the west of the reclamation is not expected to be affected significantly, but in view of the existing non-compliance with the WQO's for DO and *E. coli* in the area, it would be beneficial to implement any practicable mitigation measures. One of these is the realignment of culvert B to discharge via culvert C, D on the northern seawall. This mitigation measure is a long term measure as the ultimate location of culvert B will not change with subsequent phases of the reclamation.

The embayment is predicted to be subject to higher *E. coli* counts as a result of stormwater discharges. While this has limited potential for adverse health effects since the embayment will not be accessible to the public, the exceedance of the WQO for *E. coli* is indicative of unacceptable levels of other potential pathogens and as such is undersirable. The embayment will also be subject to localised deterioration in water quality during mid-1994 when dredging works are carried out. While specific dredging methods and operational restrictions have been specified in the Contract (see Appendix 3 S.Appx 4/7 Clause 4.09 and S.Appx 4/8 Clauses 4.10, 4.11) to reduce the potential for water pollution, some turbidity generation will be inevitable. In view of the potential for cumulative impacts from both stormwater discharges and dredging during this period, reduction in pollution loads from stormwater outfalls is recommended wherever practicable.

The area to the east of the embayment around Star Ferry is expected to deteriorate slightly, with a small decrease in DO and increases in nutrients and *E. coli*. The modelling exercise indicated that significant reductions in pollution load from catchments F and J1 would be needed to give improvement. While one of the measures has recently been implemented by DSD, the remaining measures assumed for the modelling scenario (3) together with any others subsequently identified in these catchments should be implemented as a matter of priority.

The visibility of this area to members of the public using the Star Ferry, and similarly the area west of the reclamation to the public using the Macau Ferry Terminal means that any exacerbation of the existing problem of floating refuse caused by the reclamation is undesirable. The contract specifications require the Contractor to supply a Water Witch or similar craft to operate continuously from 0730 to 1830 seven days a week (Appendix 3, page S.Appx.1/70, Clause 1.113). The Contractor is required to collect all floating debris and rubbish generated or trapped by the works within the works boundaries to the satisfaction of the Engineer and other relevant Government Authorities. The collected refuse will be disposed of to an approved Government landfill site.

b) Implementation

Mitigation measures for the catchments within the study area were discussed in Section 2.2. The pollution load reductions which may be achieved with implementation of these measures are subjective but they will assist in reducing the overall pollution loading once implemented. In evaluating sensitivity, the modelling shows that substantial mitigation measures are needed to produce only modest water quality improvements. The level of implementation is therefore difficult to determine. Certainly implementation of those measures which have a major impact on traffic and pedestrian movements should be considered carefully, however, measures such as plugging/repairing expedient connections are inexpensive, relatively quick to complete, involve little disruption, and should therefore have priority.

A detailed assessment of the stormwater system in catchments C and D is likely to be made by EPD later this year. This study will determine the areas where cross connections have occurred, remedial measures which can be made and the reduction in pollution loading which will result.

Several of the improvement measures discussed in this report have been included as provisional items in the Central Reclamation Contract (UA11/91) where information was available. These measures will need detailed design before they can be instructed by the Engineer but do give Government flexibility on which items to proceed with.

The detail all of these mitigation measures is constrained by the programme of construction of the reclamation. These works need to be implemented prior to the completion of the bunds. This means that design must start by November 1992 if this is to be achieved.

Taking these factors into account, and on the basis of the assessment in Section 3.1.5 (a) of the requirements for mitigation, a number of mitigation measures are recommended in respect of sewerage and drainage infrastructure. These have been categorised on the basis of the conclusions of the assessment as either essential or desirable. The measures are described below and itemised with cost estimates in Table 3.8.

Essential Measures

(i) Immediate implementation (and monitoring where appropriate) of all measures being or to be completed by DSD (Improvement measures 1 to 4 inclusive, Figure 2.11).

(ii) Removal of all known cross connections/overflows (Improvement measures 6, 10 and 11, Figures 2.13, 2.17 and 2.18).

(iii) Realignment of Culvert B by the future airport station contractor (Improvement measure 5, Figure 2.12).

(iv) Upgrading the capacity of the existing foul sewers in catchments F and J1 subject to their effectiveness being confirmed by the SMP extension study (Improvement measures 7 and 12 to 18 inclusive, Figures 2.14 and 2.19 to 2.25). One of the items in catchment F is a provisional item under contract UA11/91. Following positive confirmation of the effectiveness of the measure proposed in catchment J1 (Improvement No.7, Figure 2.14) the timing of the works should be determined after consideration of both the considerable traffic impact and the programme for larger scale strategic sewerage improvements in the area.

Desirable Measures

(v) Upgrading the capacity of the existing foul sewers in catchments C and D subject to their effectiveness being confirmed by the SMP extension study (Improvement measures 8 and 9, Figures 2.15 and 2.16). These works are provisional items under contract UA11/91.

It is recommended that all the upgrading works mentioned in (iv) and (v) above are included in the scope of the SMP extension study. Design of the agreed mitigation measures will need to commence by early November 1992 to ensure that construction is completed prior to the completion of the bunds.

Table 3.8 Recommended Mitigation Measures

Description	Improvement No. Figure No.	Stormwater Catchment	Cost[1] HK$
Essential works			
Lower Electrodes[2]	1/2.11	A,B,C,D, part F	-
Desilting trunk sewer[2]	2/2.11	A,B,C,D, part F	-
Sewer Upgrading[2]	3/2.11	D	-
Repair of pipe[2]	4/2.11	D	-
Realignment of culvert B[3]	5/2.12	B	1,300,000
Expedient Connection[2]	6/2.13	B	-
Expedient Connection	10/2.17	F	15,000
Expedient Connection	11/2.18	F	15,000
Sewer Upgrading[4]	12/2.19	F	1,400,000
Sewer Upgrading	13/2.20	F	100,000
Sewer Upgrading	14/2.21	F	800,000
Sewer Upgrading	15/2.22	F	800,000
Sewer Upgrading	16/2.23	F	150,000
Sewer Upgrading	17/2.24	F	760,000
Sewer Upgrading	18/2.25	F	290,000
Sewer Upgrading	7/2.14	J1	5,000,000
Desirable Works			
Sewer Upgrading[4]	8/2.15	D	600,000
Sewer Upgrading[4]	9/2.16	C	1,900,000
Cost of essential improvements (excl. DSD works)			$10,630,000
Cost of desirable improvements (excl. DSD works)			$2,500,000
Total cost of all improvements (excl. DSD works)			$13,130,000

Notes:

1 - 1992 prices including preliminaries, contingencies and Projected Inflation Allowance. Costs of the works by DSD are not known by the Consultants.
2 - DSD works which are either about to commence or are on-going.
3 - To be carried out by the Station contractor
4 - Provisional item under contract UA11/91.

3.1.6 Monitoring and Audit

Water quality monitoring programmes are specified in the contract documentation for both the reclamation area and the marine borrow area.

The locations of the monitoring stations specified for the reclamation area are shown in Figure 3.71. Four points are located close to the existing seawall near the main seawater intake points. A further seven stations are located around the site boundary and to the east and west of the reclamation area. In view of the predicted impacts the east of the eastern reclamation bund, it is recommended tnat station 9 is relocated to grid reference 816217N, 834600E and that an additional water quality monitoring station is included at grid reference 816217N, 834765E.

An action plan is included in the contract documentation (Appendix 3, Page S.Appx 4/6, Clause 4.08) detailing the trigger and action values for suspended solids at the sensitive receivers, and remedial measures and increased monitoring frequencies to be implemented on exceedance. This action plan has been approved by the operators of the cooling water intakes likely to be affected by the works.

In view of the potential for cumulative impacts of stormwater discharges and sediment suspension during the dredging works, however, it is recommended that the alarm level for suspended solids is reduced from 100 mg/l to 70 mg/l and that the alarm and action levels are expressed as absolute values rather than as excess over baseline values. It is also recommended that alarm and action levels for DO are included in the Contract Specifications. The DO limits should be based on the 80%ile and 95%ile values of depth-averaged DO as routinely measured in Victoria Harbour by EPD as part of their long term monitoring programme. Based on 1991 data, these percentile values approximate to an alarm limit of 3 mg/l and action limit of 2 mg/l DO. These limit values of depth-averaged data should be included in the action plan for water quality monitoring given in Appendix 3, S.Appx 4/6, Clause 4.08 (b), Figure 1. The Engineer will have discretion in applying the alarm limits at stations 1, 2 and 3 (Figure 3.71) within close proximity (i.e. <100m distance) to an active dredger.

A separate water quality monitoring programme is included in the contract documentation for the marine borrow areas (Appendix 3, page S.Appx.26/7). This requires measurement of dissolved oxygen and turbidity levels at six locations, five in the vicinity of the borrow area and one near Cap D'Aguilar. In view of the sensitivity of Cap D'Aguilar, it is recommended that two additional monitoring locations are specified, giving three stations sited approximately 500 m to the east, south and west of Kan Pei Chau respectively.

3.2 Marine Mud

3.2.1 Assessment Criteria

Relevant criteria for assessing marine mud quality and associated disposal options were contained within the Draft Works Branch Technical Circular No/92, Marine Disposal of Dredged Muds. However, this circular has recently been issued in final form (September 1992) without any numerical limits specified, thus there are no statutory limits at present for the classification of contaminated muds. The limits given in the Draft Works Branch Technical Circular have been adopted as guidelines for the purposes of this assessment.

The Works Branch Technical Circular outlines the procedures necessary for marine mud disposal and methods of sampling, testing and classification to determine appropriate disposal methods and sites. Marine muds are classified by their heavy metal content, and the exceedance of the specified limit for only one metal within a sample is necessary for the mud to be placed in a particular class. The classification levels are shown in Table 3.9.

Table 3.9 Classification of Sediments by Metal Content (mg/kg dry weight)

	Cd	Cr	Cu	Hg	Ni	Pb	Zn
Background	0.05	7	7	0.07	10	19	40
Class A	0.40	25	20	0.20	20	35	75
Class B	1.00	50	55	0.80	35	65	150
Class C	1.50	80	65	1.00	40	75	100

Class A muds are described as uncontaminated and no special methods are required for disposal. Class B muds are moderately contaminated and special care is required during dredging and transportation. Those muds of Class C are highly contaminated, requiring special removal methods and specially designated dump sites. These dump sites are assigned by EPD and a special licence is required.

3.2.2 Existing Environment

Marine mud quality data available from the Contaminated Spoil Management Study (EPD, 1991) show elevated metal concentrations in the vicinity of the reclamation area (Table 3.10). While mercury and zinc values are high, mean values for copper and lead exceed the Class C threshold by a factor of five. Existing data thus indicate that some of the mud to be dredged as part of the construction works is likely to be highly contaminated.

Table 3.10 Mean and Range of Heavy Metal Concentrations in Marine Mud Samples Close to the Phase 1 Reclamation area (mgkg^{-1} dry weight) (Contaminated Spoil Management Study - Final Report, 10/1991, EPD)

	Cd	Cr	Cu	Hg	Ni	Pb	Zn
Stations 33, 37, 39	1.11 (0.43-1.6)	65 (17-85)	290 (15-524)	1.1 (0.2-2)	28 (20-32)	379 (32-180)	202 (67-262)
Classification	B	B	C	C	A	C	C

3.2.3 Assessment Methodology

Approximately 1 Mm^3 of marine sediment will be removed as part of the reclamation works. A sampling and analysis programme was carried out on the reclamation site to ascertain the contamination status of the muds.

A total of 19 stations were chosen as survey points in the Phase 1 area (Figure 3.72). The distribution of stations was based on recommendations in the Works Branch Technical Circular on the density of sampling points required, and on information from the Central, Western and Wan Chai SMP Study regarding the position of stormwater outfalls in the area. The positions of the sampling stations and sampling methodology were approved by EPD prior to commencement of the sampling programme.

The sampling was undertaken in March and April 1992. The samples were taken by vibrocoring using an inert PVC liner for sample collection. Samples of mud were taken from the surface and at 2 m intervals along the length of the core for the entire depth of the marine mud layer.

Analysis of mud samples was undertaken in accordance with the methodology in the Works Branch Technical Circular, using acid digestion followed by flame atomic absorption spectrophotometry for copper, cadmium, chromium, lead, nickel and zinc. The cold vapour generation method was used for mercury.

3.2.4 Impacts

The mud samples were categorised into Classes A, B, and C according to the their heavy metal content (Table 3.11). Based on the requirement that the mud is classed as contaminated if the concentration of any one of the seven metals falls into Class B or C, the results indicate extensive contamination over the study area. The base of the contaminated mud layer (Class B or greater) is shown on Figure 3.23. Dredging profiles prepared on this basis give a total of 545,000 m^3 of contaminated mud and 416,000 m^3 of non-contaminated mud.

Potential adverse impacts on marine biota could be caused by disturbance of these contaminated sediments, thus specific dredging methods are required.

Table 3.11 Results of Marine Mud Analysis for Central Reclamation Phase 1

Hole No.	Sample Depth	Metal Concentration (mg/kg, dry wt)						
		Chromium	Copper	Lead	Zinc	Cadmium	Nickel	Mercury
V1	0-0.5m	46.1	55.1	35.4	38.0	<0.05	9.9	0.5
V1	2-2.5m	45.4	13.1	32.0	74.2	<0.05	7.5	0.2
V1	4-4.5m	41.7	12.4	35.1	66.8	<0.05	12.4	0.2
V1	6-6.5m	30.2	10.3	37.5	53.5	<0.05	12.0	0.2
V2	0-0.5m	62.5	313.2	93.7	299.7	<0.05	13.4	2.2
V2	2-2.5m	73.3	113.6	120.0	370.6	<0.05	13.4	5.9
V3	0-0.5m	68.9	369.7	211.9	913.2	0.52	18.1	2.07
V3	2-2.5m	56.1	102.3	140.5	393.9	0.49	14.5	3.08
V4	0-0.5m	119.4	368.3	86.0	331.8	0.10	16.9	3.0
V4	2-2.5m	93.1	134.5	112.5	303.6	<0.05	18.9	5.4
V4	4-4.5m	40.6	72.1	125.2	260.5	<0.05	6.5	5.7
V4	6-6.5m	32.3	22.8	23.4	65.0	<0.05	12.9	0.2
V5	0-0.5m	105.7	125.3	123.9	389.3	0.40	21.8	3.6
V5	2-2.5m	87.4	160.9	101.3	309.7	<0.05	16.3	2.2
V5	4-4.5m	61.6	248.3	157.1	341.0	<0.05	10.1	2.3
V5	6-6.5m	52.4	111.1	154.6	359.1	0.10	10.4	5.4
V7	0-0.5m	26.3	14.1	42.0	56.0	<0.05	9.4	0.6
V7	2-2.5m	37.5	11.1	26.4	67.9	<0.05	12.4	0.8
V7	4-4.5m	32.4	11.7	23.2	62.6	<0.05	14.5	1.0
V8	0-0.5m	24.7	16.3	53.4	56.3	<0.05	9.4	1.91
V8	2-2.5m	33.3	11.1	19.3	56.9	<0.05	16.2	1.31
V8	4-4.5m	39.4	13.6	239.0	68.4	<0.05	18.2	0.62
V8	6-6.5m	26.4	9.8	16.6	49.3	<0.05	4.7	0.45
V9	0-0.5m	24.0	12.6	92.5	53.0	<0.05	6.5	0.6
V9	2-2.5m	44.0	11.9	30.4	68.4	<0.05	11.9	1.8
V9	4-4.5m	25.0	7.8	22.4	44.4	<0.05	3.8	0.5
V10	2.4-2.9m	10.7	33.8	111.3	47.1	<0.05	1.2	0.66
V11	0-0.5m	34.3	61.5	34.2	78.3	<0.05	15.6	0.49
V11	2-2.5m	43.7	14.4	27.8	74.6	<0.05	13.7	0.48
V12	0-0.5m	55.4	323.7	78.5	267.4	0.30	22.4	2.0
V12	2-2.5m	63.7	13.5	18.3	51.8	<0.05	16.4	0.4
V13	0-0.5m	40.8	312.1	103.0	341.2	0.35	12.4	2.55
V14	0-0.5m	111.2	466.5	109.2	406.2	1.00	27.4	2.4
V14	2-2.5m	87.0	138.3	121.2	110.3	0.20	21.4	3.4
V15	0-0.5m	10.6	27.6	12.3	35.5	<0.05	6.4	1.8
V16	0-0.5m	93.8	285.0	98.5	328.2	0.50	16.4	2.3
V16	2-2.5m	106.6	208.7	201.1	283.6	0.45	21.4	4.5
V16	4-4.5m	77.9	120.6	116.0	213.3	0.40	18.9	4.0
V17	0-0.5m	22.8	12.8	21.2	49.9	<0.05	3.7	0.14
V17	2-2.5m	19.2	7.2	11.4	34.4	<0.05	1.2	0.02
V18	0-0.5m	111.8	500.1	89.8	351.2	0.42	24.2	1.81
V18	2-2.5m	65.2	143.8	115.4	315.8	0.10	16.7	2.77
V18	4-4.5m	25.7	11.1	11.2	50.7	<0.05	9.6	0.30
V19	0-0.5m	26.5	16.6	20.7	58.2	<0.05	17.3	0.11
V19	2-2.5m	36.0	12.5	21.6	62.6	<0.05	19.6	0.17
V19	4-4.5m	34.6	12.9	23.0	65.7	<0.05	13.0	0.15

3.2.5 Mitigation Measures

To minimise impacts during dredging, use of a closed grab has been specified in the contract documentation (Appendix 3, page S.Appx.4/8, Clause 4.11 (i)). Use of medium or large closed grab dredgers in an enclosed site, such as the reclamation embayment, is considered an acceptable dredging method for Class C (highly contaminated) muds by EPD. Additional clauses are included in the contract to control turbidity generation during transport and disposal methods (Appendix 3, page S.Appx.4.8, Clauses 4.11 (ii)-(iv)).

The contaminated mud will be disposed of in a pit south of Sha Chau, specially designated by Government for the purpose.

3.2.6 Monitoring and Audit

No monitoring during disposal of contaminated mud is required of the Contractor, as this function will be fulfilled by the West Kowloon Project Area Environmental Project Office.

3.3 Air Quality

3.3.1 Assessment Criteria

The Air Pollution Control Ordinance (Cap. 311, 1983) provides powers for controlling air pollutants from a variety of stationary and mobile sources, including fugitive dust emissions from construction sites, and encompasses a number of Air Quality Objectives (AQO) which stipulate concentrations for a range of pollutants. Of AQOs there, only those for Total Suspended and Respirable Particulates (TSP/RSP) are relevant to this study as assessment criteria. These are listed in Table 3.12.

Table 3.12 Hong Kong Air Quality Objectives

Parameter	Maximum Average Concentration $\mu g/m^3$			
	1-Hour	8-Hour	24-Hour*	Annual
TSP	500**		260	80
RSP			180	55

* 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 $\mu g/m^3$ 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.

3.3.2 Existing Environment

The reclamation will be formed between the years 1992 and 1996. Estimation of background dust levels in the future is not possible, however an indication of the existing conditions is available from the monitoring programme undertaken by EPD.

The closest EPD Air Quality Monitoring Station is the Central/Western monitoring station. Results for 1990 show that there were no exceedances of the annual average statutory AQOs for TSP and RSP.

3.3.3 Assessment Methodology

The greatest potential air quality impact during the formation of the reclamation will result from dust emissions. Vehicle and plant exhaust emissions are not considered to constitute a significant source of air pollutants.

Possible dust sources are:

- o demolition of the existing ferry piers;
- o site preparation;
- o excavations;
- o wind erosion of the site;
- o material transfer to and from trucks;
- o vehicle/plant movements on unpaved roads and over the site.

Dust levels arising from construction work may be estimated using USEPA Compilation of Air Pollutant Emission Factors (AP-42). In order to make predictions of air quality impacts, the following information is required; site area, nature of activity, quantities of stockpiled materials, vehicle movements to and from the site, vehicle speed over the site, silt content of excavated material and rainfall data. The basic emission categories area: dust from vehicles movements on unpaved roads, dust from material movement and dust from the erosion of the site. The ISCST dispersion model was used for the modelling to assess the effects of dust emissions.

For the purposes of this assessment worst-case 1-hour average TSP concentrations were calculated.

Meteorological conditions of wind speed 2m/s and 5.4m/s, stability category D and a mixing layer height of 500m were adopted for the analysis. Selection of the two wind speeds represents conditions of low dust generation (ie. no site erosion) but low dispersion, and high dust generation with greater dispersion as a result of higher wind speed. Because of the large site area and the nature of the material, it was considered that overall site erosion at higher wind speeds may be a significant source of dust. The 5.4 m/s wind speed represents the cut-off speed above which site erosion occurs. For the purposes of modelling, it was assumed that the high wind speeds would coincide with a dry period. This would represent a worst case condition for dust generation.

The dust emissions were calculated using the methodology as given in AP-42. It was assumed that the second stage of construction represented the worse case, with the greatest level of activity occurring in 1995. Dust emission factors are given in Table 3.13.

Table 3.13 Dust Emission Factors

Activity	Emission (kg/day)	
	Wind 2 m/s	Wind 5.4 m/s
Diaphragm Wall Formation	7	11
Tunnel Excavation	106	132
Site Erosion	0	1049
Delivery of concrete	43	43
Total	155	1235

Quantification of dust impacts from pier demolition was not undertaken because a suitable assessment methodology does not appear to be available. However, due to the nature of the area, the demolition will have to be carefully controlled for safety reasons. There is likely to be shrouding of the demolition area, which will have the benefit of significantly controlling dust emissions. This activity may come under the Building (Demolition Works) Regulations, which include prevention of dust nuisance.

3.3.4 Impacts

A number of representative points were taken at the buildings in the area (Figure 3.73). These are mainly office and commercial buildings. There are no residential blocks which will be directly affected by dust from the reclamation. The results of the dispersion modelling at these locations are given in Table 3.14.

Table 3.14 Worst Case 1-hour Average TSP Concentrations at Sensitive Receivers

Receiver	TSP Concentration ($\mu g/m^3$)	
	Wind 2 m/s	Wind 5.4 m/s
1	100	403
2	108	430
3	115	459
4	117	461
5	110	437
6	98	411
7	97	407
8	93	399
9	86	377
10	83	362
11	79	347
12	80	332
13	82	324
14	155	620
15	142	570

The higher wind speed condition represents a worse case impact on receivers. The concentrations are below the 1-hour guideline limit of 500 $\mu g/m^3$ for TSP at receivers south of Connaught Road, but modelling indicates that ground level dust concentrations may reach 620 μgm^{-3} under worst case conditions at the Post Office and 570 μgm^{-3} at Exchange Square. However, meteorological statistics show that the conditions leading to these levels occur for only a few hours per year. The probability of these conditions coinciding with periods of maximum activity would be very low.

Exchange Square and the General Post Office are unlikely to be adversely by dust, these being air conditioned buildings.

3.3.5 Mitigation Measures

In view of these potentially high levels of dust arising from the reclamation, will be necessary to adopt mitigation measures wherever practical.

A number of dust suppression measures are specified in the contract documentation (Appendix 3, page S.Appx.5/2, Clause 4) including enclosure of stockpiles, water spraying, hard paving of site loads and vehicle speed restriction (15 km/hr). Given that the major dust source is site erosion, watering through sprinklers or from tankers should be employed over the whole site during dry periods. Additional conditions are specified for the use of batching or crushing plant.

3.3.6 Monitoring and Audit

The contract documentation specifies TSP monitoring at two locations (Appendix 3, page S.Appx.5/5, Clause 5). The frequency for compliance monitoring is given as once every six weeks at one or both locations. This frequency is not considered adequate to indicate if there are dust problems. The recommendation would be to monitor once every six days at both locations.

Actions to be taken when monitored dust levels exceed baseline levels established by the Engineer are specified in Appendix 3, page S.Appx.5/5, Clause 6.

3.4 Noise

3.4.1 Assessment Criteria

The Noise Control Ordinance (NCO) provides the statutory framework for noise control and defines statutory limits which will apply to the construction of the Central Reclamation. Three technical memoranda (TM) are published under the NCO which define the technical means for the assessment of noise. Only those relating to construction noise are relevant to this study.

The NCO divides construction noise into activities involving powered mechanical equipment excluding percussive piling, and percussive piling activity. The criteria for the assessment of noise from construction are therefore similarly divided.

a) Activity other than Percussive Piling

Under the TM on 'Noise from Construction Work other than Percussive Piling' noise from activity excluding piling is not restricted during the period 0700-1900 hours (except Public Holidays). However, the Government White Paper 'Pollution in Hong Kong - A Time to Act' has signalled a desire to improve the noise environment in Hong Kong whenever reasonably practical. To this end, EPD has suggested a daytime general construction noise limit of 75 dB(A). While this limit has no statutory significance with respect to Construction Noise Permits, it has been included in a number of contract specifications together with the requirement that appropriate noise mitigation measures be considered once this limit is exceeded.

Between 1900 and 0700 hours and all day on Sundays and public holidays, activity is prohibited unless a permit is obtained. A permit will be granted provided that the Acceptable Noise Level (ANL) for the noise sensitive receiver can be complied with. Basic Noise Levels (BNL) are assigned depending upon the Area Sensitivity Rating (ASR). For the Central Reclamation, NSRs are likely to be assigned an ASR of either B or C; the corresponding BNLs for evening and night time periods are given in Table 3.15.

Table 3.15 Construction Noise Criteria for Activity Other Than Percussive Piling

Basic Noise Level				
$L_{Aeq\ (5\ mins)}$	$L_{Aeq\ (5\ mins)}$			
Daytime (all ASRs)	Evening and Daytime on General Holidays		Night	
	ASR 'B'	ASR 'C'	ASR 'B'	ASR 'C'
75*	65	70	50	55

* Non-statutory

b) Percussive Piling

Under a separate TM on 'Noise from Percussive Piling', piling is prohibited between 1900 and 0700 hours and on Sundays and Public Holidays, unless permission is granted by the Governor in Council. Between 0700 and 1900 hours, piling is allowed under permit, subject to ANL limits. If the noise level is expected to exceed these limits, restricted hours of operation are included in the permit. Table 3.16 summarises the ANLs to be complied with.

Table 3.16 Construction Noise Criteria for Percussive Piling Activity

Noise Sensitive Receiver	Acceptable Noise Levels ($L_{Aeq\ 5\ mins}$)*	
	Day 0700 - 1900	Night 1900 - 0700 and General Holidays
without windows or other openings	100	Prohibited
with central A/C	90	Prohibited
with windows or other openings (but without central A/C)	85	Prohibited

* 10 dB(A) shall be deducted from the above when the NSRs are hospitals, schools or law courts or other NSRs which are considered by the Authority to be particularly sensitive to noise.

3.4.2 Existing Environment

The existing environment is dominated by traffic noise from Connaught Road Central. An estimate of noise from this source was made using traffic figures taken from the Annual Traffic Census 1990, Transport Department. Traffic counts on Connaught Road Central were used and seven percent of this daily traffic flow was taken to represent a peak hour flow. The percentage of heavy goods vehicles was calculated from the vehicle classification data for Core Station 1001. Calculations were carried out using the UK Department of Transport 'Calculation of Road Traffic Noise', 1988 (CRTN).

Vehicles per day 1990	=	84,010
7% (peak hour flow)	=	5,880
Basic noise level	=	79.8dB(A)
Correction for speed and % HGVs (15.8)	=	+3.5dB(A) @ 80 km/h, +0.5 @ 40 km/h
Facade effect	=	+2.5
Corrected Noise Level	=	82.8 - 85.8 dB(A)

This assumes a distance of 4 m or less to the sensitive receivers. There are sensitive receivers on Connaught Road and an addition correction foı distance is not considered necessary.

The existing traffic noise levels at lower floor levels on Connaught Road Central are estimated to be between 83 and 86 dB(A) [$L_{(A10\text{-peak hour})}$] at the facades of the buildings. At higher floors, noise levels will reduce because of distance attenuation.

An empirical relationship between L_{10} and L_{eq}, i.e. $L_{10} \approx L_{eq} + 3$ dB(A), is given in the publication "Road Traffic Noise" (Alexandre, A. *et al*, 1975). This equation holds for vehicle flows of more than or equal to about 100 vehicles per hour and thus it can be applied to the condition of Connaught Road Central. Therefore, the L_{eq} of the traffic noise levels on this road can be estimated approximately as 80-83 dB(A).

Table 3.17 Sound Power Levels [dB(A)] for Central Reclamation Phase 1 Engineering Works Plant Schedule No. 1

	1992			1993												1994												1995												1996											
Equipment	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
Material Handling																																																			
Mobile Crane	115	115	115	115	115	115	115	115	121	121	121	121	121	121	118	118	118	118	118	118	115	115	115	115	115	115	115	115	115	115	115	118	118	118	118	118	118	118	118	118	118	118	115	115	115	115	115	115	115		
Track Crane										118	118	118	118	118	118	118	118	118	118	118	115	115	115	115	115	115	115	115	115	115	115	118	118	118	118	118	118	118	118	118	118	118	115	115	115	115	115	115	115		
Concreting																																																			
Ready-mix Truck		113	116	116	116	116	116	116	116	116	116	116	116	116	116	116	116	116	116	116	116	116	116	116	116	116	116	116	116	116	116	116	116	116	116	116	116	116	116	113	113	113	113	113	113	113	113	113	113		
Concrete Pump		113	113	113	113	113	113	113	113	113	113	113	113	113	113	113	113	113	113	113	113	113	113	113	113	113	113	113	113	113	113	113	113	113	113	113	113	113	113	113	113	113									
Excavation and Filling																																																			
Dump Truck										127	127	127	127																	127	127	127	127																		
Dozer										121	121	121	121																																						
Backhoe	112	112	112												118	118	118	118	118	118																						118	118	118	118	115	115	115	115		
Lorry	115	115	115	115	115	115	115	115	118	118	118	118	118	118	118	118	118	118	118	118	118	115	115	115	115	115	115	115	115	115	115	115	118	118	118	118	118	118	118	118	118	118	118	118	118	115	115	115	115		
Marine																																																			
Tug Boat	110	113	113	113	113	113	113	113	113	113	113	110									110	113	113	113	113	113	113	113	113	113	113	113	113	110																	
Barge	110	113	113	113	113	113	113	113	113	113	113	110									110	113	113	113	113	113	113	113	113	113	113	113	113	110																	
Grab Dredger	118	119	119	119																	118	119	119	119	119																										
Lighter	107	107	107	107	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	107	107	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	104	104	104	104			
Piling																																																			
Bored Piling Oscillator									118	118	118	118	118	118																				118	118	118	118	118	118												
Bentonite Filtering Plant									105	105	105	105	105	105																																					
Diaphragm Wall Extractor									96	96	96	96	96	96																																					
Auxillary																																																			
Compressor	112	112	115	115	116	116	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115	112	112	112	112		
Generators	111	115	114	114	115	115	114	114	114	114	114	114	114	114	114	114	114	114	114	114	114	114	114	114	114	114	114	114	114	114	114	114	114	114	114	114	114	114	114	114	114	114	114	114	114	111	111	111	111		
Hydraulic Impact Breaker			114	114	114	114															117	117	117	117																							110	110	110		
Total Sound Power Level	123	125	126	126	125	125	124	124	127	131	131	130	130	127	126	126	126	126	126	126	126	126	126	126	126	125	125	125	125	129	129	129	129	126	126	126	126	126	126	125	125	126	125	125	125	123	123	123	123		

Table 3.18 Sound Power Levels [dB(A)] for Hong Kong Station and Tunnel Contract Plant Schedule No. 2

	1994			1995											
Equipment	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
Material Handling															
Tower Crane															
Mobile Crane	115	115	115	118	118	118	118	118	118	118	118	118	118	118	118
Track Crane															
Concreting															
Ready-mix Truck		114	117	117	117	117	117	117	117	117	117	117	117	117	117
Concrete Pump		109	109	114	114	114	114	114	114	114	114	114	114	114	114
Excavation and Filling															
Dump Truck	120	120	120	123	123	123	123	123	123	123	123	123	123	123	123
Dozer		118	118	120	120	120	120	120	120	120	120	120	120	120	120
Backhoe	112	115	115	115	115	115	115	115	115	115	115	115	115	115	115
Lorry	115	115	115	117	117	117	117	117	117	117	117	117	117	117	117
Marine															
Tug Boat	113	113	113	113	113	113	113	113	113	113	113	113	113	113	113
Barge	107	107	107	107	107	107	107	107	107	107	107	107	107	107	107
Grab Dredger	115	115	115	115	115	115	115	115	115						
Piling															
Bored Piling Oscillator	118	121	121	121	121	121	121	121	121	121	121	121	121	121	121
Bentonite Filtering Plant	108	112	112	112	112	112	112	112	112	112	112	112	112	112	112
Diaphragm Wall Extractor	93	97	97	97	97	97	97	97	97	97	97	97	97	97	97
Auxillary															
Compressor	112	115	115	116	116	116	116	116	116	116	116	116	116	116	116
Generators	111	114	114	115	115	115	115	115	115	115	115	115	115	115	115
Hydraulic Impact Breaker	110	113	113	113											
Total Sound Power Level	125	127	128	129	129	129	129	129	129	129	129	129	129	129	129

	1996											
Equipment	1	2	3	4	5	6	7	8	9	10	11	12
Material Handling												
Tower Crane	100	100	100	100	100	100	100	100	100	100	100	100
Mobile Crane	118	118	118	118	118	115	115	115	115	115	115	115
Track Crane	117	117	117	117	117	117	112	112	112	112		
Concreting												
Ready-mix Truck	117	117	117	117	117	117	117	117	117	117	117	117
Concrete Pump	114	114	114	114	114	114	114	114	114	114	114	114
Excavation and Filling												
Dump Truck	117	117	117	117	117	117	117	117	117	117	117	117
Dozer	115	115	115	115	115	115	115	115	115	115	115	115
Backhoe	115	115	115	115	115	115	115	115	115	115	115	115
Lorry	117	117	117	117	117	117	117	117	117	117	117	117
Marine												
Tug Boat												
Barge												
Grab Dredger												
Piling												
Bored Piling Oscillator												
Bentonite Filtering Plant												
Diaphragm Wall Extractor												
Auxillary												
Compressor	116	116	116	116	116	116	116	116	116	116	116	116
Generators	115	115	115	115	115	115	115	115	115	115	115	115
Hydraulic Impact Breaker												
Total Sound Power Level	126	126	126	126	126	126	125	125	125	125	125	125

	1997											
Equipment	1	2	3	4	5	6	7	8	9	10	11	12
Material Handling												
Tower Crane	100	100	100	100	100	100	100	100	100	100	100	100
Mobile Crane	115	115	115	115	115	115	112	112	112	112	112	112
Track Crane												
Concreting												
Ready-mix Truck	117	117	117	117	117	117	116	116	116	116	116	116
Concrete Pump	114	114	114	114	114	114	112	112	112	112	112	112
Excavation and Filling												
Dump Truck	117	117	117	117	117	117						
Dozer	115	115	115	115	115	115						
Backhoe	115	115	115	115	115	115	112	112	112	112	112	112
Lorry	117	117	117	117	117	117	115	115	115	115	115	115
Marine												
Tug Boat												
Barge												
Grab Dredger												
Piling												
Bored Piling Oscillator												
Bentonite Filtering Plant												
Diaphragm Wall Extractor												
Auxillary												
Compressor	116	116	116	116	116	116	114	114	114	114	114	114
Generators	115	115	115	115	115	115	113	113	113	113	113	113
Hydraulic Impact Breaker												
Total Sound Power Level	125	125	125	125	125	125	122	122	122	122	122	122

	1998											
Equipment	1	2	3	4	5	6	7	8	9	10	11	12
Material Handling												
Tower Crane	100	100	100	100	100	100	100	100	100	100	100	100
Mobile Crane	112	112	112	112	112	112	112	112	112	112	112	112
Track Crane												
Concreting												
Ready-mix Truck	116	116	116	116	116	116	116	116	116	116	116	116
Concrete Pump	112	112	112	112	112	112	112	112	112	112	112	112
Excavation and Filling												
Dump Truck												
Dozer												
Backhoe	112	112	112	112	112	112	112	112	112	112	112	112
Lorry	115	115	115	115	115	115	115	115	115	115	115	115
Marine												
Tug Boat												
Barge												
Grab Dredger												
Piling												
Bored Piling Oscillator												
Bentonite Filtering Plant												
Diaphragm Wall Extractor												
Auxillary												
Compressor	114	114	114	114	114	114	114	114	114	114	114	114
Generators	113	113	113	113	113	113	113	113	113	113	113	113
Hydraulic Impact Breaker												
Total Sound Power Level	122	122	122	122	122	122	122	122	122	122	122	122

3.4.3 Assessment Methodology

The construction of the Phase 1 reclamation is in 2 phases:

1) Formation of areas to the east and west for reprovision of the existing ferry piers.
2) Formation of whole area.

The reclamation engineering works are scheduled from October 1992 until October 1996, and the Hong Kong station and tunnel works will be undertaken from November 1994 until mid-1997.

Noise will be generated from the powered mechanical equipment (PME) used on site, and from percussive piling operations. Plant schedules and sound power levels of the equipment are given in Tables 3.17 and 3.18. Formation of new ferry pier foundations will be undertaken using four tubular steel percussive piling rigs. The assumption is that these will be diesel hammer rigs, these being the most common form of piling rig in Hong Kong.

The assessment followed the procedures given in the TM on Noise from Construction Work other than Percussive Piling and TM on Noise from Percussive Piling.

Attenuation for distances over 300 m is not provided in the TMs. For assessing noise emanating from PME, the distance attenuation was therefore calculated using the following formula:

Distance attenuation in dB(A) - 20 log D + 8

where D is the distance in metres.

All the PME was assumed be located at the notional source position, selected in accordance with the procedures in the TMs.

For assessing noise emanating from percussive piling, the distance correction factors are presented in Table 3.19.

Table 3.19 Correction Factors to Obtain the Predicted Noise Level from the Total Sound Power Level of Percussive Piling at Given Distances 301 to 425 m

Distance (m)	Correction (dB(A))
301 to 317	63
318 to 351	64
352 to 387	65
388 to 427	66

3.4.4 Impact

The buildings to the south of the proposed reclamation are predominantly offices and commercial centres. Eight noise sensitive buildings were identified, as follows;

1) (118-120) Connaught Road Central - Korea Centre
2) 17-19 Jubilee Street - United Building (residential)
3) 18-19 Connaught Road Central, Grand Building (place of worship)
4) Mandarin Hotel
5) City Hall
6) Victoria Hotel
7) Harbour Building
8) Exchange Square

The definition of NSR is different in the two TMs and therefore not all the NSRs are common to the two assessments carried out for powered mechanical equipment and percussive piling.

The locations of the noise sensitive receivers are shown in Figure 3.73.

Powered Mechanical Equipment

NSR1 to NSR6 were taken into consideration in the assessment of noise from PME. All the NSRs except NSRs 3 and 5 are in an urban area and are directly affected by the traffic noise of a major road (Connaught Road Central). The NSRs have been classified as ASR 'C'. The BNL will therefore be 70 dB(A) (evening, Sundays and Public Holidays) and 55 dB(A) at night. NSR5 is in an urban area and is not affected by traffic noise from Connaught Road Central; it is thus classified as an ASR 'B'. The BNL will therefore be 65 dB(A) in the evenings, on Sundays and Public Holidays and 50 dB(A) at night. NSR 3 is in an urban area but is partially shielded from traffic noise on Connaught Road Central; it could be classified as an ASR 'B' or 'C'.

A maximum sound power level of 132 dB(A) was calculated for the worst case months of May and June 1995. The notional noise source position was taken to be 50 m from the site boundary in a line from the site centre to the NSRs. Maximum calculated noise levels at the NSRs are shown in Table 3.17.

Table 3.20 Maximum Noise Levels at the NSRs from Powered Mechanical Equipment

Receiver	SPL, dB(A)	Distance, m	Distance Attenuation, dB(A)	Noise Level, dB(A) *
NSR1	132	390	60	75
NSR2	132	130	50	85
NSR3	132	234	55	80
NSR4	132	300	57	78
NSR5	132	330	58	77
NSR6	132	250	56	79

* Includes 3 dB(A) facade correction

The maximum noise level at NSR1 (Korea Centre) is estimated to be 75 dB(A) which should not cause undue nuisance.

The greatest noise impact is predicted to occur at NSR2 (United Building), where maximum noise levels may reach 85 dB(A). However, this is likely to be an overestimate because of the level of shielding provided by the Southland Building and the Hang Seng Bank. This will considerably reduce the angle of view over the construction site, and thus reduce the noise impact from the reclamation. The reduction by shielding cannot be quantified, however, because it depends on the mobilisation and distribution of plant over the site, which cannot be accurately predicted at this stage.

NSRs 3 (place of worship), 4 (Mandarin Hotel), 5 (City Hall) and 6 (Victoria Hotel) may all be exposed to maximum noise levels which exceed the 75 dB(A) daytime limit. NSR5, City Hall, is fitted with high quality glazing and central air conditioning which will attenuate received noise levels inside the building to some extent. NSRs 4 and 6 would also be expected to be protected by building design as hotels also usually have high quality glazing and central air conditioning systems, while the windows at the Mandarin Hotel are set back behind solid balcony structures. Although potentially exposed to construction noise, the noise environment at NSRs 4 and 6 in particular will be dominated by traffic noise from Connaught Road Central.

Percussive Piling

The ANLs for the receivers subject to piling noise will be 85 dB(A) for NSR1 and 2, and 90 dB(A) for NSR4, 5, 6, 7 and 8. For the purposes of piling assessment, office blocks are also considered sensitive. The majority of buildings on Connaught Road Central will have an ANL of 90 dB(A).

Percussive piling will be used for formation of the foundation of the relocated ferry piers. On the basis that four rigs will be used, the maximum sound power level will be 138 dB(A). The piling operation will be a minimum distance from the piling locations to the NSRs are shown in Table 3.21.

Table 3.21 Maximum Noise Levels at the NSRs from Percussive Piling

Receiver	Sound Power Level, dB(A)	Minimum Distance, m	Distance Attenuation, dB(A)	Noise Level, dB(A)*
NSR1	138	280	62	79
NSR2	138	280	62	79
NSR4	138	300	63	78
NSR5	138	400	66	75
NSR6	138	370	65	76
NSR7	138	200	59	82
NSR8	138	340	64	77

* Includes 3 dB(A) facade correction

The minimum distance attenuation is not less than 59 dB(A). Hence, the maximum noise level at the NSRs from piling rigs would be 82 dB(A), with 3 dB(A) added for the facade effect.

Piling could be undertaken with up to 15 rigs between 0700 and 1900 without time restriction. It should be noted that percussive piling is prohibited between 1900 and 0700 and on general holidays.

3.4.5 Mitigation Measures

Specific measures for noise mitigation are given in the contract documentation (Appendix 3, page S.Appx.5/6, Clause 7). The inclusion of a 75 dB(A) daytime construction noise limit as measured at NSRs is recommended, but with the proviso that the Engineer interpret the monitoring results in the light of potential influencing factors such as road traffic.

3.4.6 Monitoring and Audit

The contract conditions require the Contractor to provide a noise meter for use on site by the Engineer's Representative. There are no provisions for a specific monitoring programme. It is recommended that a programme of regular monitoring is undertaken by the Engineer's Representative involving two 3 consecutive 5-minute L_{eq} measurements per week made at a point on the site boundary in line with the nearest NSR and the location of the nearest construction activity. The monitoring results can then be adjusted to represent noise levels at the NSR by means of standard distance attenuation calculations.

The results should be audited by the Engineer immediately on receipt and if monitoring indicates potential exceedances of statutory limits or the contractual criterion of 75 dB(A), the Contractor should be required to instigate remedial measures including, but not restricted to, those specified in S.Appx.5/6, Clause 7 of the Contract Specification (see Appendix 3 to this report) in order to reduce noise levels.

If monitoring indicates that limits are already exceeded and the exceedance is deemed by the Engineer to be caused by the construction works, the Contractor will be required to inspect his equipment and working methods, draw up revised remedial proposals for approval by the Engineer, and implement such proposals. If serious noise impacts persist, the contract specifications permit the Engineer to direct the Contractor to cease related parts of the Works, until effective remedial measures are implemented.

Chapter 4 Conclusions and Recommendations

4.1 Conclusions

4.2 Recommendations

4 Conclusions and Recommendations

4.1 Conclusions

4.1.1 Results of the water quality impact assessment suggest that conditions in the vicinity of the Star Ferry terminal are likely to deteriorate slightly following construction of the bunds for the Phase 1 reclamation, due to the effects of polluted stormwater discharges. Conditions within the embayment formed between the reclamation bunds will not be significantly affected by stormwater discharges, but in view of the potential for short term cumulative impacts from dredging, it would be beneficial to reduce pollutant loading from the storm sewers as far as possible. Conditions to the west of the reclamation are not predicted to be adversely affected, but again it is considered prudent to adopt a number of measures to reduce loading to this area. Measures for remedial works on the sewerage and drainage infrastructure are defined in Section 4.2.1.

4.1.2 Water quality monitoring programmes are specified in the Contract for both the reclamation area and marine borrow areas east of Po Toi. After consideration of the modelling results, inclusion of an additional monitoring station to the east of the reclamation is recommended. In view of the sensitivity of the Cap D'Aguilar Site of Special Scientific Interest to adverse water quality effects, inclusion of two additional stations to monitor water quality during fill extraction at the Po Toi marine borrow area is also recommended. On the basis of the potential for increased oxygen demand during dredging, it is further recommended that alarm (3 mg/l) and action (2 mg/l) limits for dissolved oxygen are specified in the water quality monitoring plan. The alarm and action levels for suspended solids should be reduced from 100 mg/l excess over baseline to 70 mg/l total and 140 mg/l excess over baseline to 140 mg/l total, respectively.

4.1.3 Tidal flow modelling showed that current speeds will reduce locally following construction of the reclamation bunds, which will tend to cause floating refuse to accumulate in slack corners. A requirement has been included in the Contract for a Water Witch refuse collection vessel to operate seven days per week inside and outside the embayment, within the limits of the works boundary, to pick up and dispose of floating refuse. No amendments to the Contract Specification are considered necessary.

4.1.4 Approximately half the 1 Mm^3 volume of marine mud which has to be removed prior to reclamation is classified as contaminated and will require controlled disposal in a pit south of Sha Chau designated for dumping of contaminated mud. Contaminated mud in the reclamation area will be dredged using a sealed grab as recommended in EPD's Contaminated Spoil Management Study, and any sediment dispersion should be largely contained within the reclamation bunds. Operational restrictions have been placed on other dredging methods which may be used for uncontaminated mud, for example, overflowing and lean mixture overboard systems for trailer hopper dredgers are not permitted. Provision is made in the Contract for protection of sensitive cooling water intakes where water quality monitoring indicates unacceptable limits. No amendments to the Contract Specification are considered necessary.

4.1.5 Assessment of air quality impacts from construction has shown that dust levels should remain within acceptable limits at sensitive receivers, with the exception of Exchange Square and the General Post Office where dust levels could exceed acceptable limits for a few hours per year. As these buildings are air-conditioned, this is unlikely to cause a significant nuisance. A series of dust suppression measures has been included in the Contract Specification and a monitoring programme specified. It is recommended, however, that the monitoring frequency specified in the Contract is increased from once every six weeks to once every six days.

4.1.6 The construction noise assessment showed that in the worst months of May/June 1995, when most plant is operational concurrently, noise levels at sensitive receivers along Connaught Road Central would be between 75-85 dB(A). However, noise from Connaught Road Central itself will be a dominant factor, thus the potential for nuisance from the construction works at certain sensitive receivers will be low. Specific measures for noise mitigation are included in the Contract, together with a non-statutory day time noise limit of 75 dB(A). In view of the likely background noise level dominated by traffic noise, it is recommended that provision for the Engineer to interpret the results of noise monitoring in the light of potential influencing factors, i.e. road traffic, be included in the

Contract Specification.

4.2 Recommendations

4.2.1 It is recommended that a number of remedial works relating to the sewerage and drainage infrastructure are implemented, in order to minimise water quality impacts during and after construction of the Central Reclamation Phase 1. These works, which have been categorised as either essential or desirable, are described below and itemised with costs in Table 4.1.

Essential Measures

(i) Immediate implementation (and monitoring where appropriate) of all drainage improvement measures being or to be completed by DSD (Improvement measures 1 to 4 inclusive shown in Table 4.1).

(ii) Removal of all known cross connections (Improvement measures 6, 10 and 11 in Table 4.1). One of these items is a provisional item under contract UA11/91.

(iii) Realignment of Culvert B to discharge at the northern seawall, to be carried out by the future airport station contractor (Improvement measure 5 in Table 4.1).

(iv) Upgrading the capacity of the existing foul sewers in catchments F and J1 subject to the effectiveness of these measures being confirmed by subsequent investigation (Improvement measures 7 and 12 to 18 inclusive in Table 4.1). One of the items in catchment F is a provisional item under contract UA11/91. Following positive confirmation of the effectiveness of the measure proposed in catchment J1 (Improvement No.7 in Table 4.1), the timing of the works should be determined after consideration of both the considerable traffic impact and the programme for larger scale strategic sewerage improvements in the area.

Desirable Measures

(v) Upgrading the capacity of the existing foul sewers in catchments C and D subject to the effectiveness of these measures being confirmed by subsequent investigation (Improvement measures 8 and 9 in Table 4.1). These works are provisional items under contract UA11/91.

It is recommended that all the upgrading works mentioned in (iv) and (v) above are included in the scope of the extension study which is shortly to be let by EPD under the Central, Western and Wan Chai West Sewerage Master Plan Study. Design of the agreed mitigation measures will need to commence by early November 1992 to ensure that construction is completed prior to the completion of the bunds.

4.2.2 A number of amendments to the Central Reclamation Phase 1 Contract Specification are recommended as a result of the assessment. These are summarised in Table 4.2, and highlighted in the revised Contract Specification contained in Appendix 3 by underlining. These amendments have been agreed by the tenderers.

Table 4.1 Recommended Mitigation Measures

Description	Improvement No.	Stormwater Catchment	Cost[1] HK$
Essential works			
Lower Electrodes[2]	1	A,B,C,D, part F	-
Desilting trunk sewer[2]	2	A,B,C,D, part F	-
Sewer Upgrading[2]	3	D	-
Repair of pipe[2]	4	D	-
Realignment of culvert B[3]	5	B	1,300,000
Expedient Connection[2]	6	B	-
Expedient Connection	10	F	15,000
Expedient Connection	11	F	15,000
Sewer Upgrading[4]	12	F	1,400,000
Sewer Upgrading	13	F	100,000
Sewer Upgrading	14	F	800,000
Sewer Upgrading	15	F	800,000
Sewer Upgrading	16	F	150,000
Sewer Upgrading	17	F	760,000
Sewer Upgrading	18	F	290,000
Sewer Upgrading	7	J1	5,000,000
Desirable Works			
Sewer Upgrading[4]	8	D	600,000
Sewer Upgrading[4]	9	C	1,900,000
Cost of essential improvements (excl. DSD works)			$10,630,000
Cost of desirable improvements (excl. DSD works)			$2,500,000
Total cost of all improvements (excl. DSD works)			$13,130,000

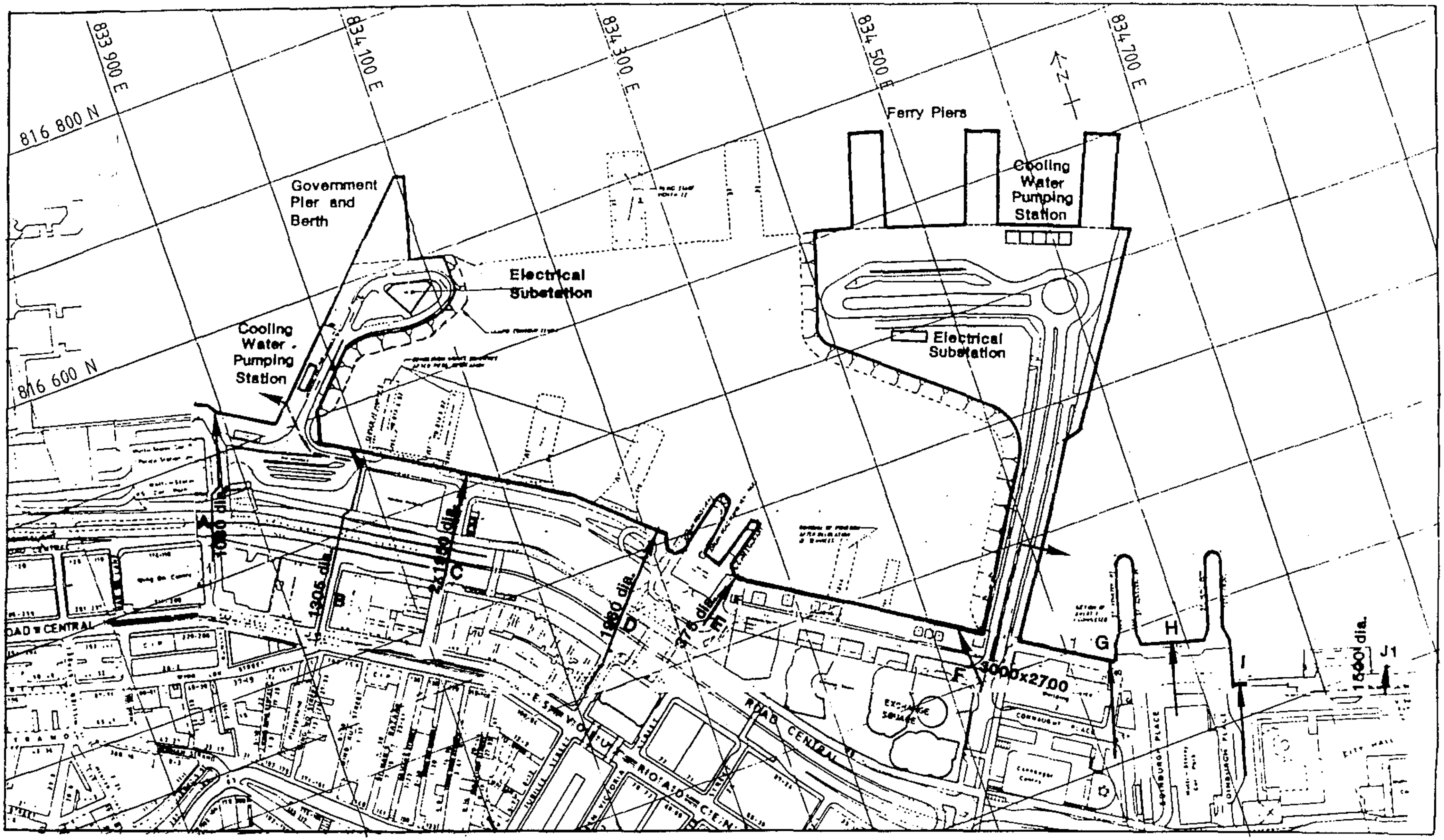
Notes:

1 - 1992 prices including preliminaries, contingencies and Projected Inflation Allowance. Costs of the works by DSD are not known by the Consultants.
2 - DSD works which are either about to commence or are on-going.
3 - To be carried out by the Station contractor
4 - Provisional item under contract UA11/91.

Table 4.2 Recommended Amendments to the Contract Specifications

Contract Specification		Amendment
S.Appendix No.	Clause	
4	4.04 (b) (i)	substitution of 25 m cable length for turbidity sensor rather than 10 m
4	4.04 (b) (i)	inclusion of a statement that turbidity measurements shall be taken as a true representation of levels of suspended solids only before laboratory test results for suspended solids are known
4	4.04 (c)	requirement for equipment recalibration to be increased from every 3 months to every 2 months
4	4.05 (b)	specification of an additional water quality monitoring station to be included near the Star Ferry terminal
4	4.05 (c) (ii)	compliance monitoring frequency to be increased from two days per week to three days per week
4	4.08 (a)	decrease in dissolved oxygen levels to be included as evidence of a deterioration in water quality
4	4.08 (b)	alarm and action limits for depth-averaged dissolved oxygen concentrations of 3 mg/l and 2 mg/l respectively to be included in the action plan for water quality monitoring; alarm level for suspended solids to be reduced from 100 mg/l to 70 mg/l; alarm and action levels for suspended solids to be expressed as absolute values not as excess over baseline; "persistently greater" to be redefined as exceedance on three consecutive days; reference to cooling water intakes to be deleted from action plan;
4	4.10	inclusion of reference to provisions of Clause 4.11 in relation to marine mud disposal
5	5 (6)	construction dust monitoring frequency to be increased from once every six weeks to once every six days
5	7 (2)	clarification of the definition of acceptable noise limits; substitution of Noise Control Ordinance regulations for references to EEC directives regarding noise from hand-held breakers and portable compressors; inclusion of a provision for the Engineer to determine whether construction operations or traffic noise are causing any exceedance of acceptable noise limits
26	2	specification of two additional water quality monitoring stations to be included in the vicinity of Cap D'Aguilar Site of Special Scientific Interest during fill extraction works at Po Toi Borrow Area

Figures

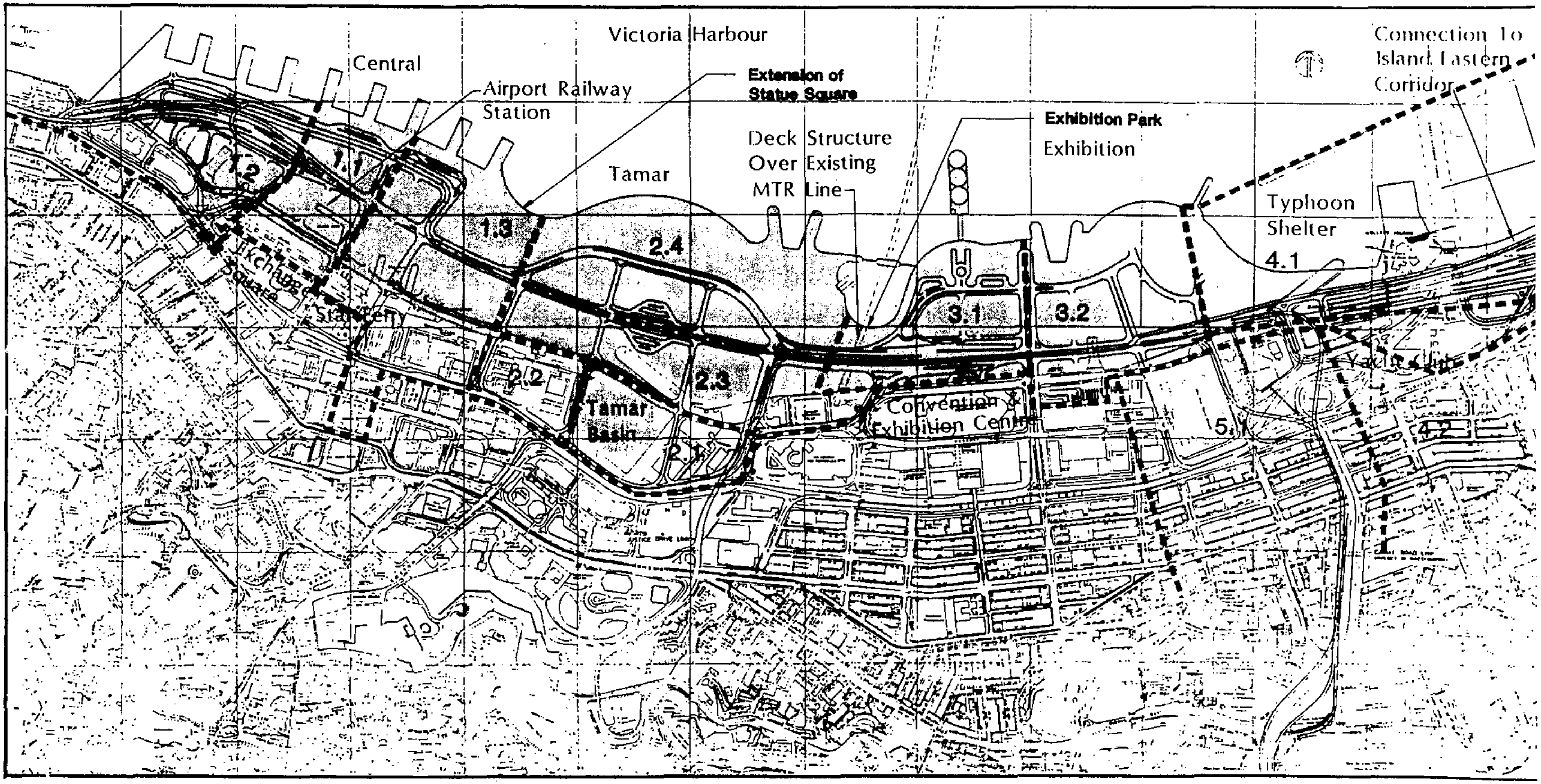


Existing Storm Drains with Size Indicated

Diversion of Existing Storm Drains

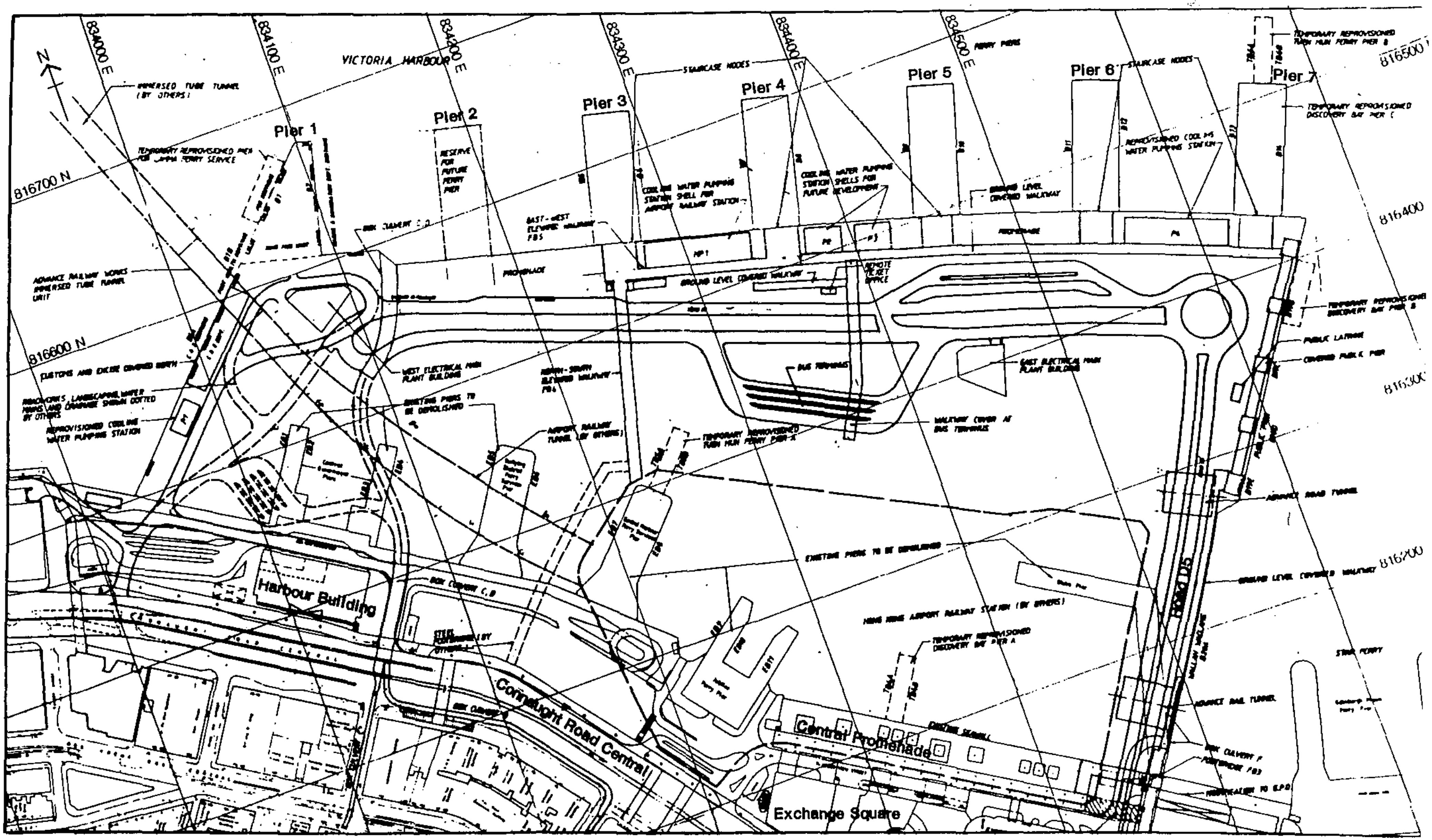
Intermediate Construction Stage

Figure 1.1



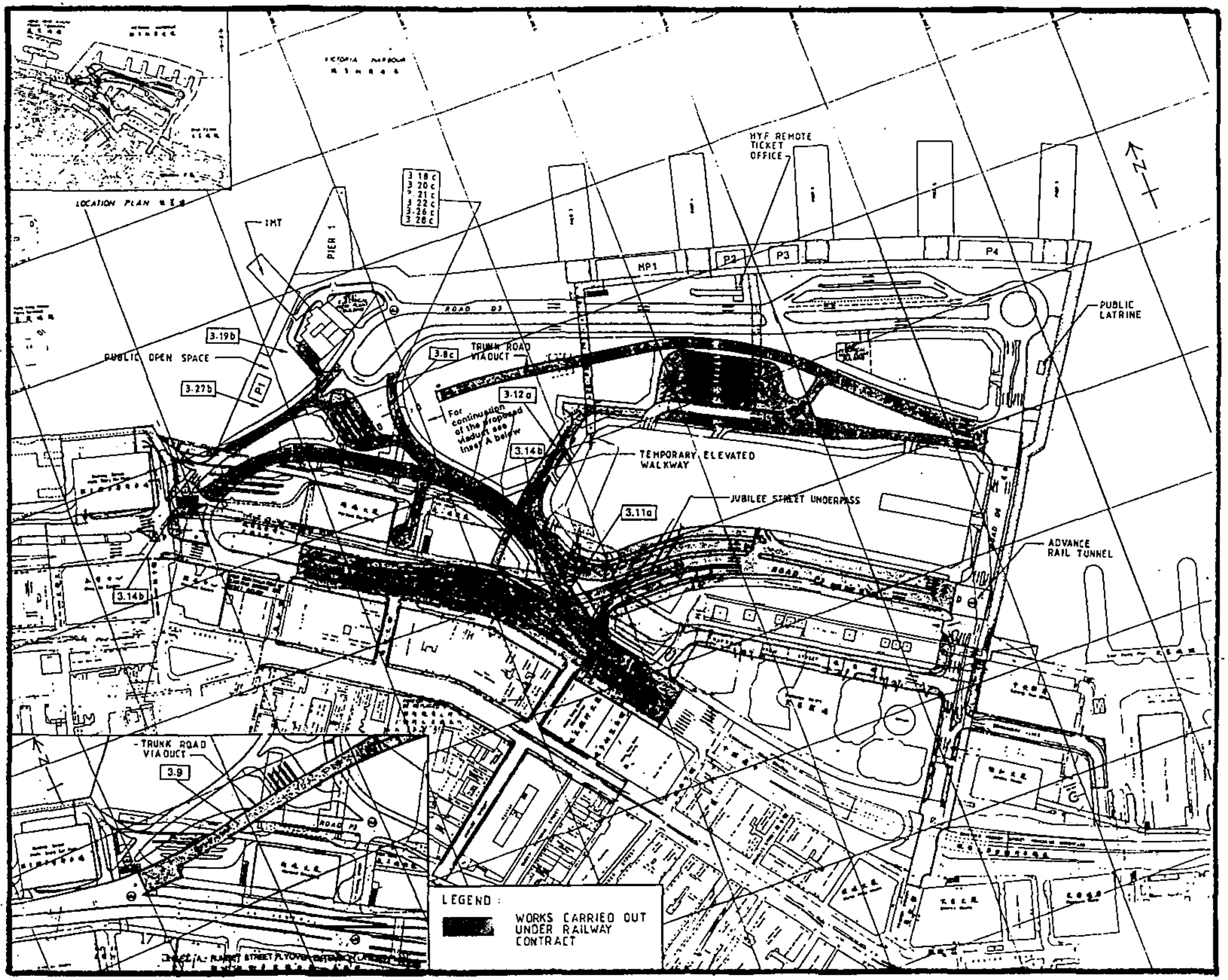
Legend :
- New Reclamation
- Package Boundaries

Central & Wan Chai Reclamation Figure 2.1

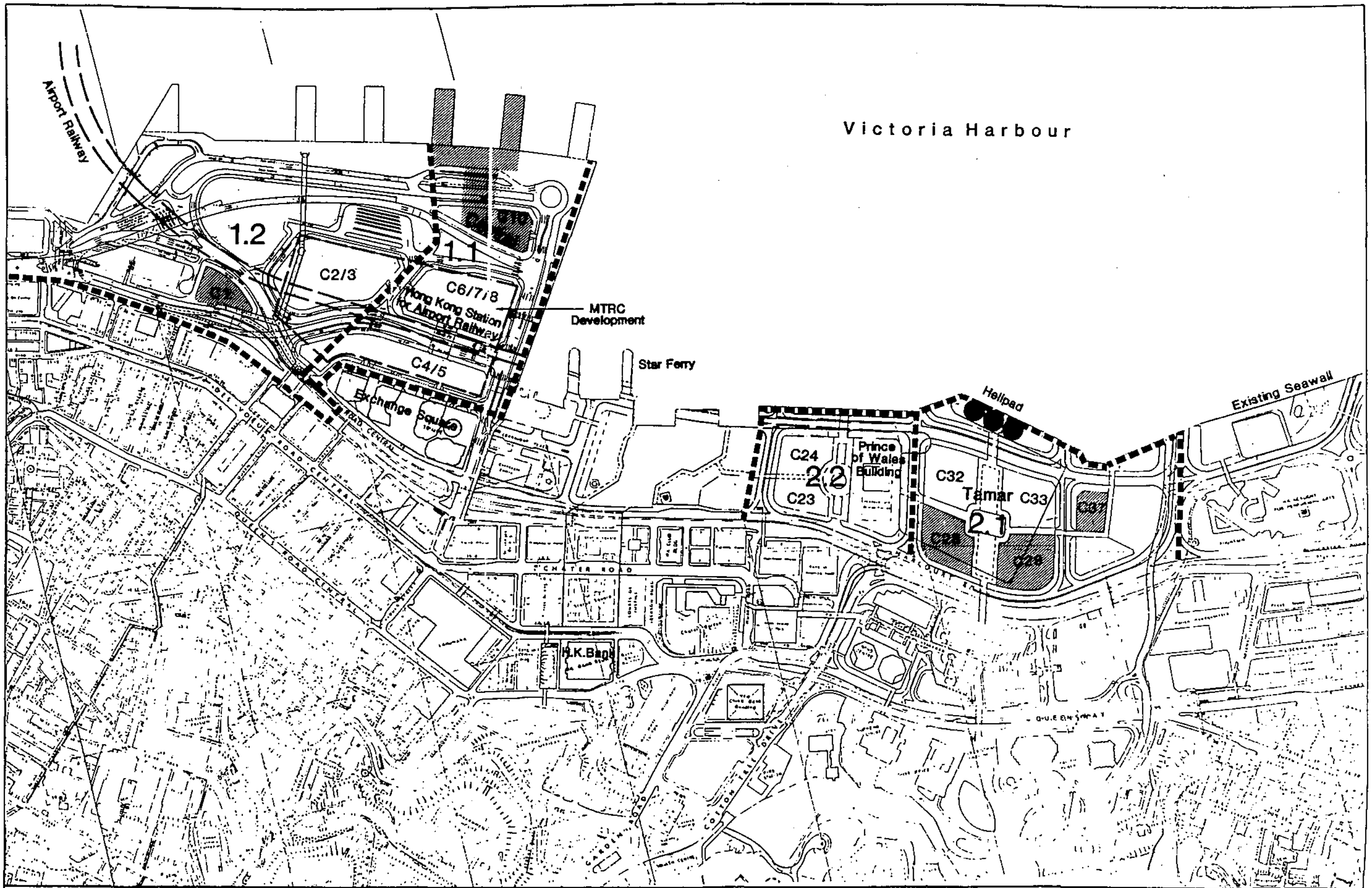


Central Reclamation – Phase 1

Figure 2.



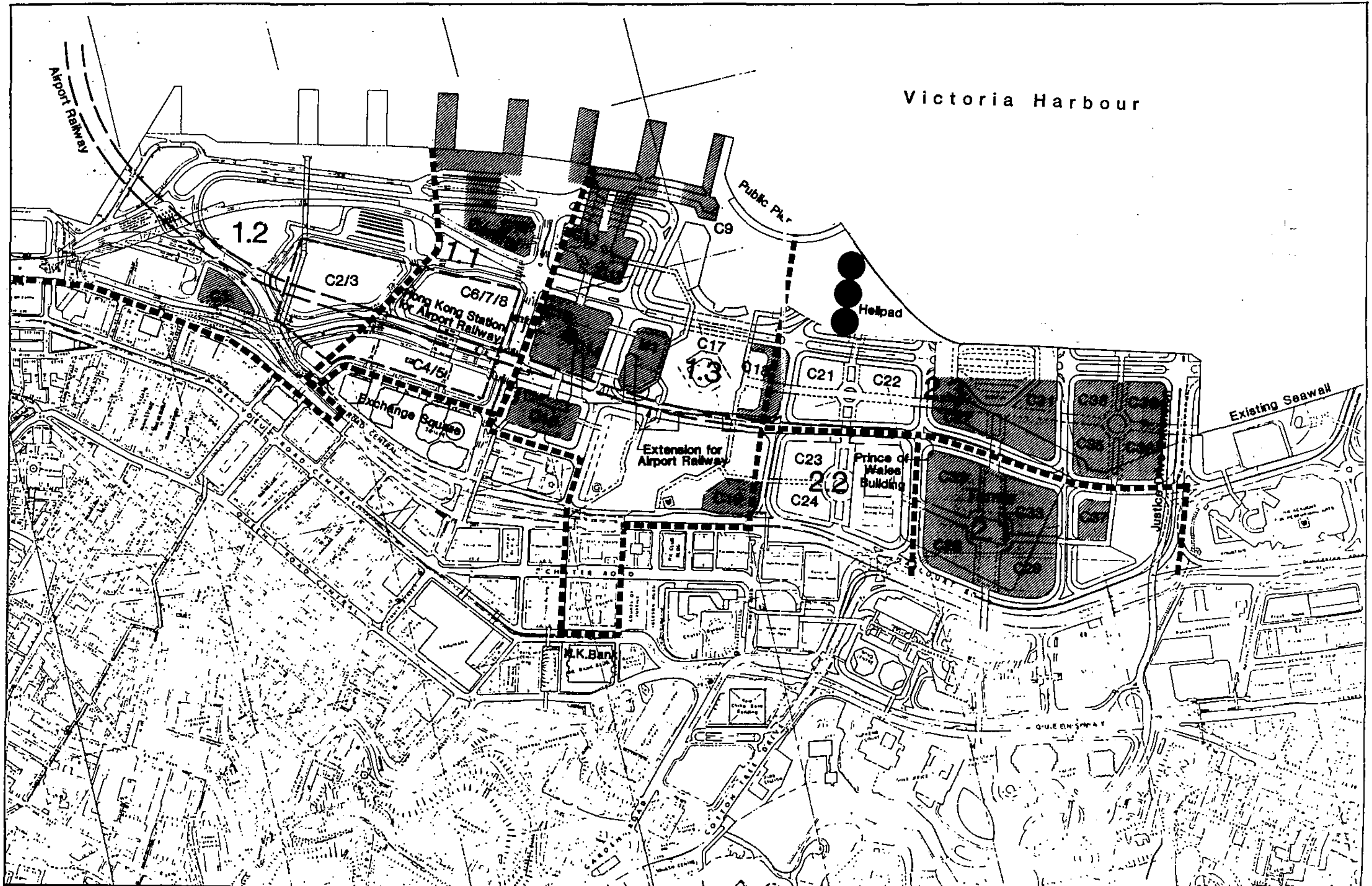
Works Carried Out Under Railway Contract. **Figure 2.3**



Central and Tamar

Development Stage 1

Figure 2.4



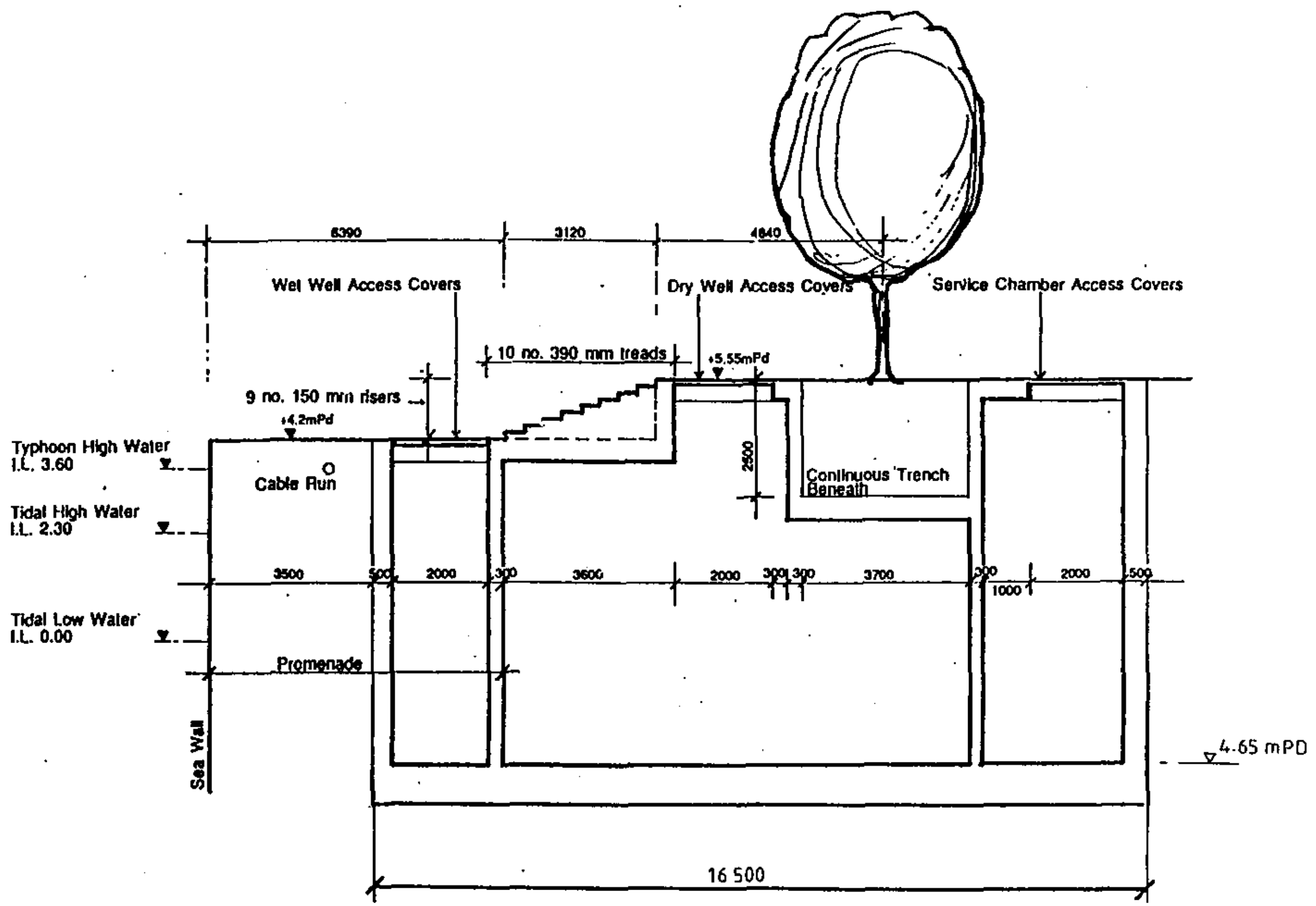
0 50 100 150 200

Legend : Package Boundary

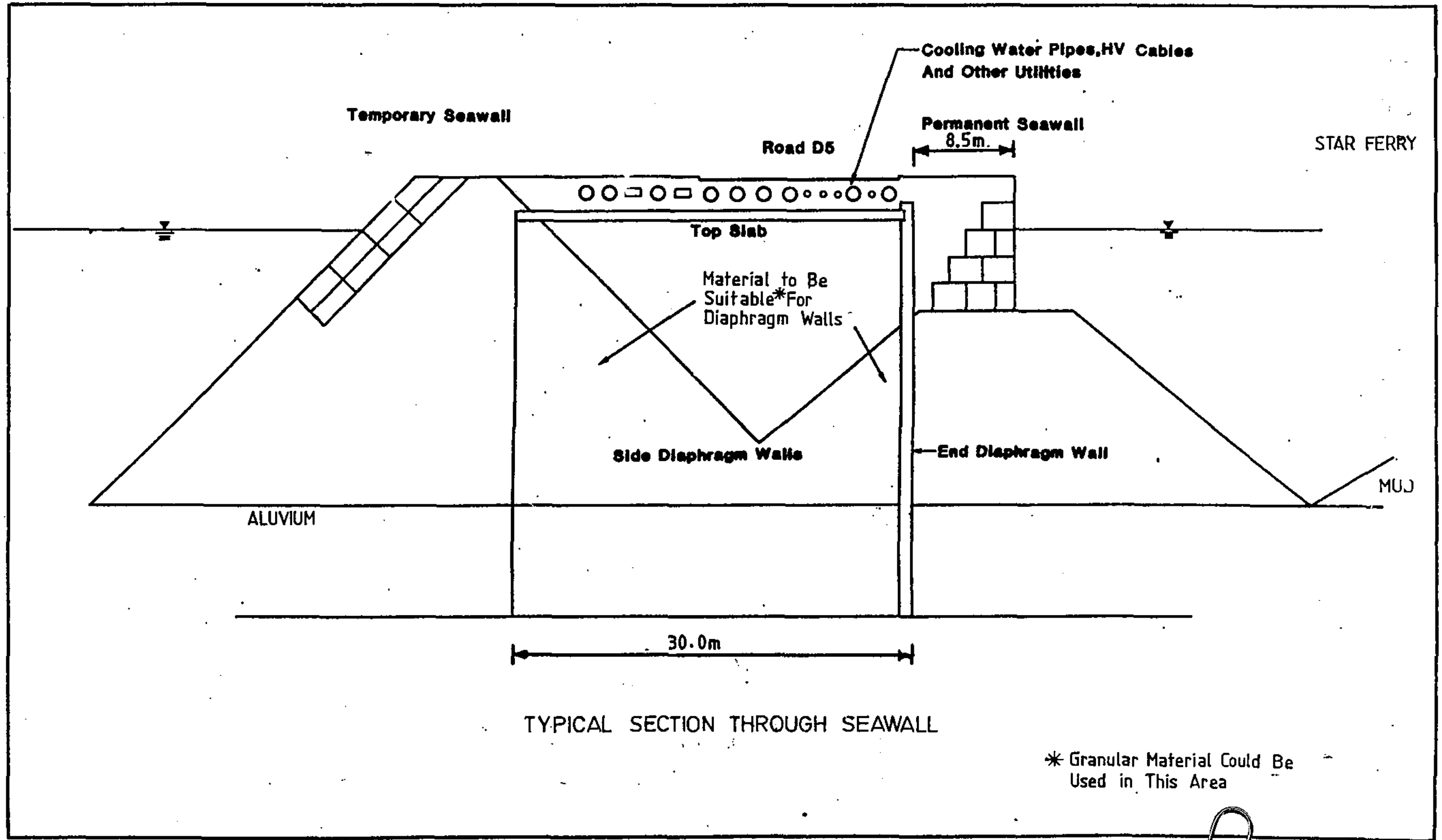
Government Sites

Central and Tamar Development – Stage 2

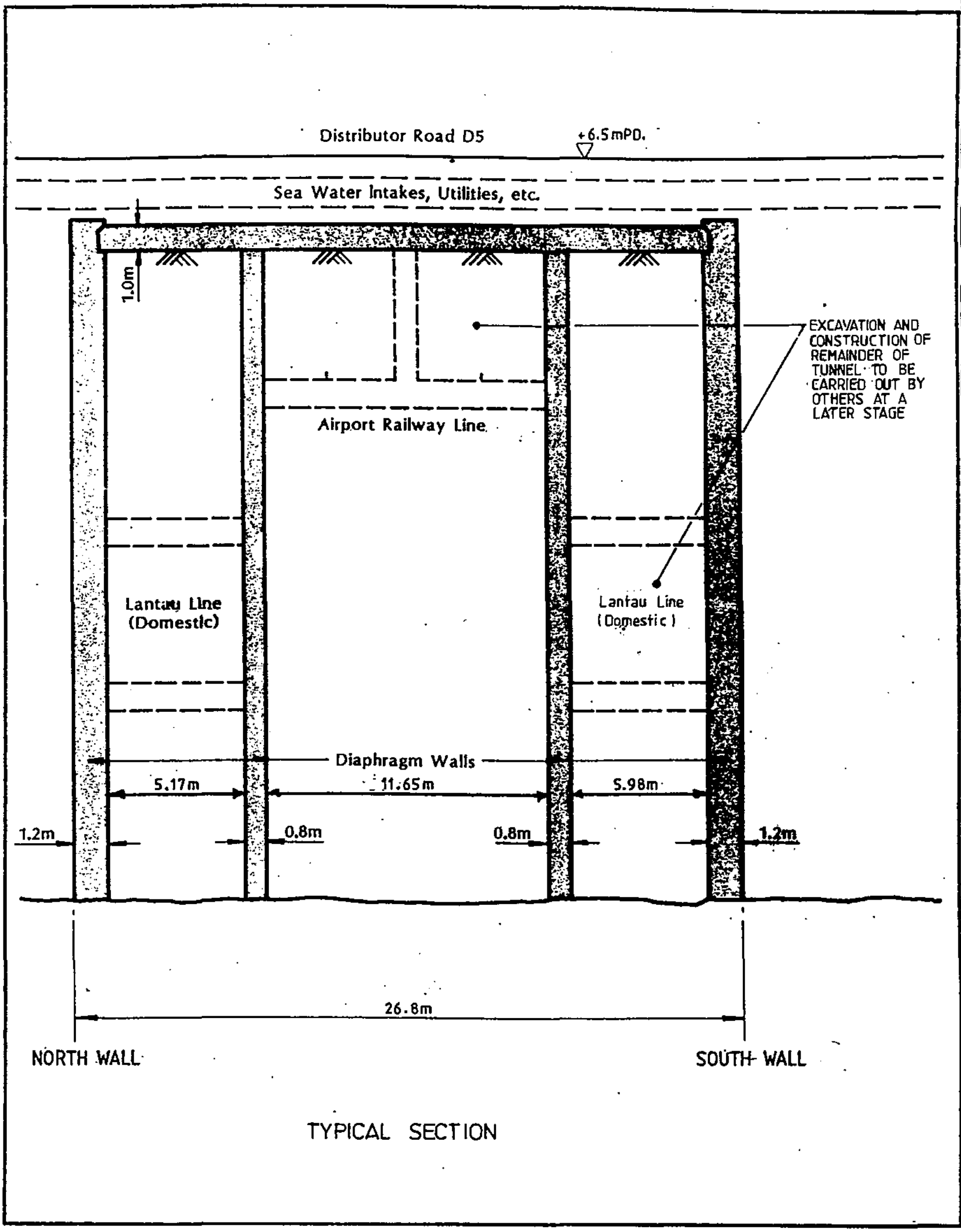
Figure 2.5



TYPICAL SECTION



Advance Rail Tunnel (Sheet 1 of 2) **Figure 2.7**



Advance Rail Tunnel (Sheet 2 of 2) **Figure 2.8**

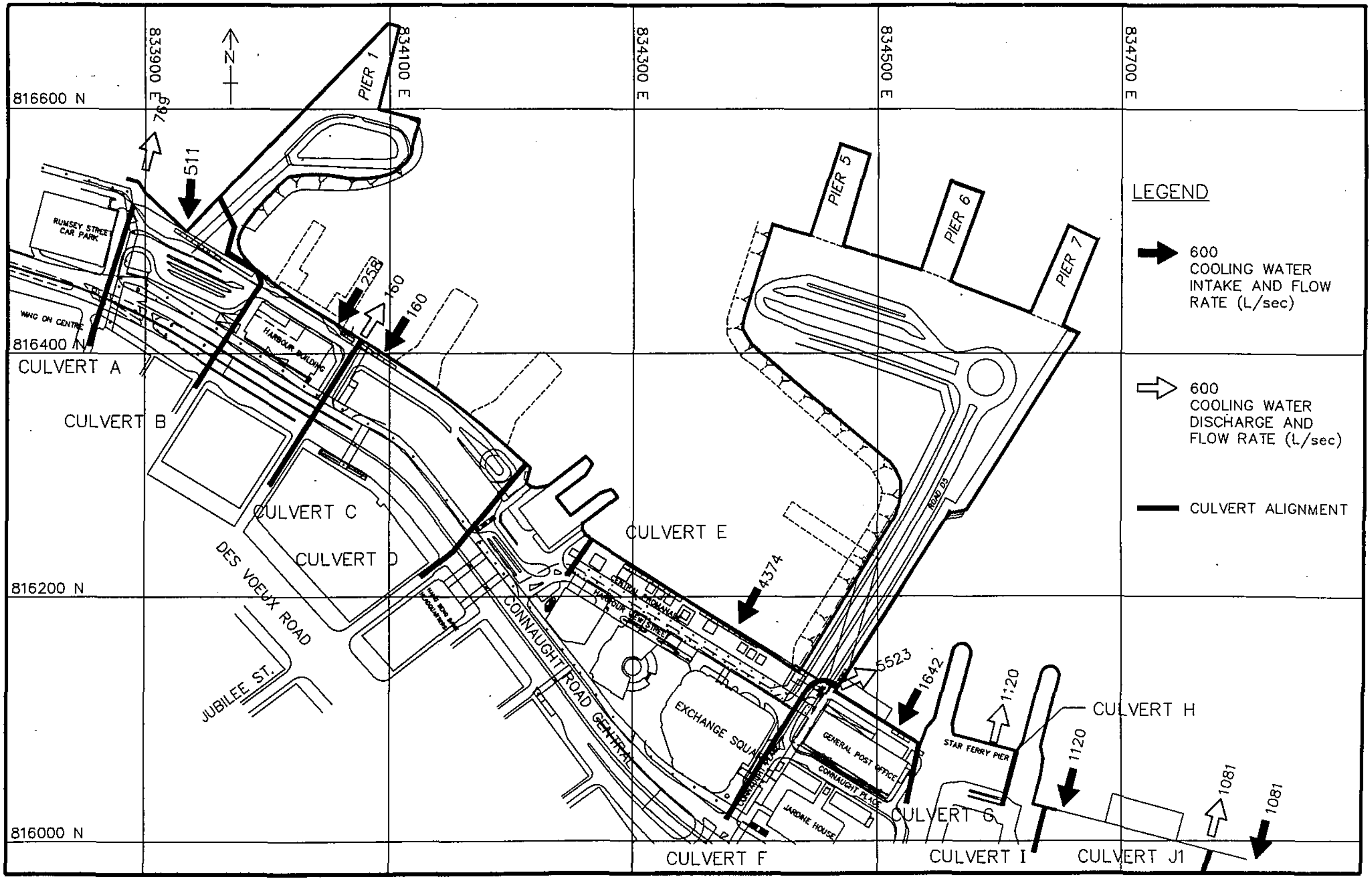
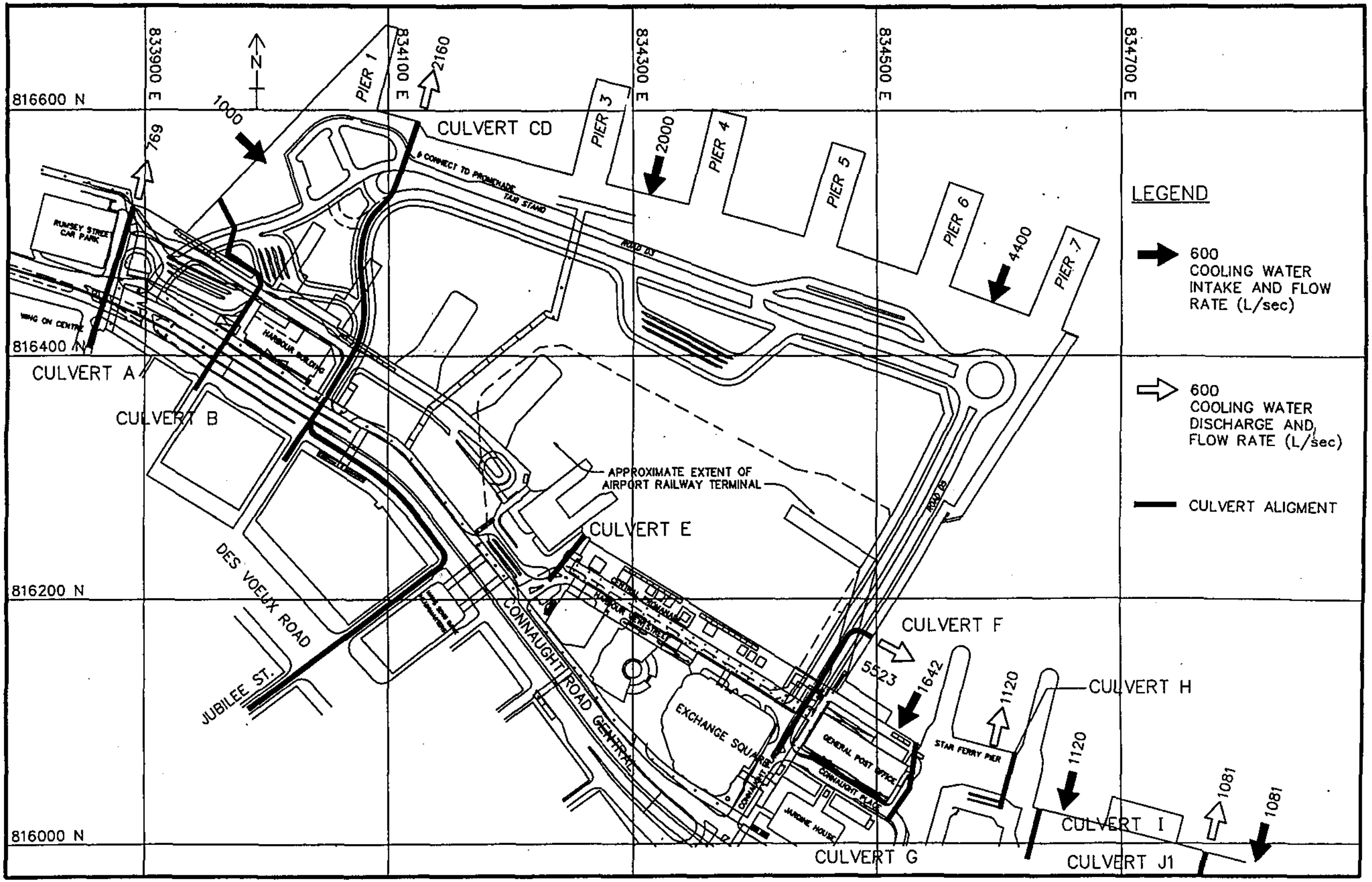
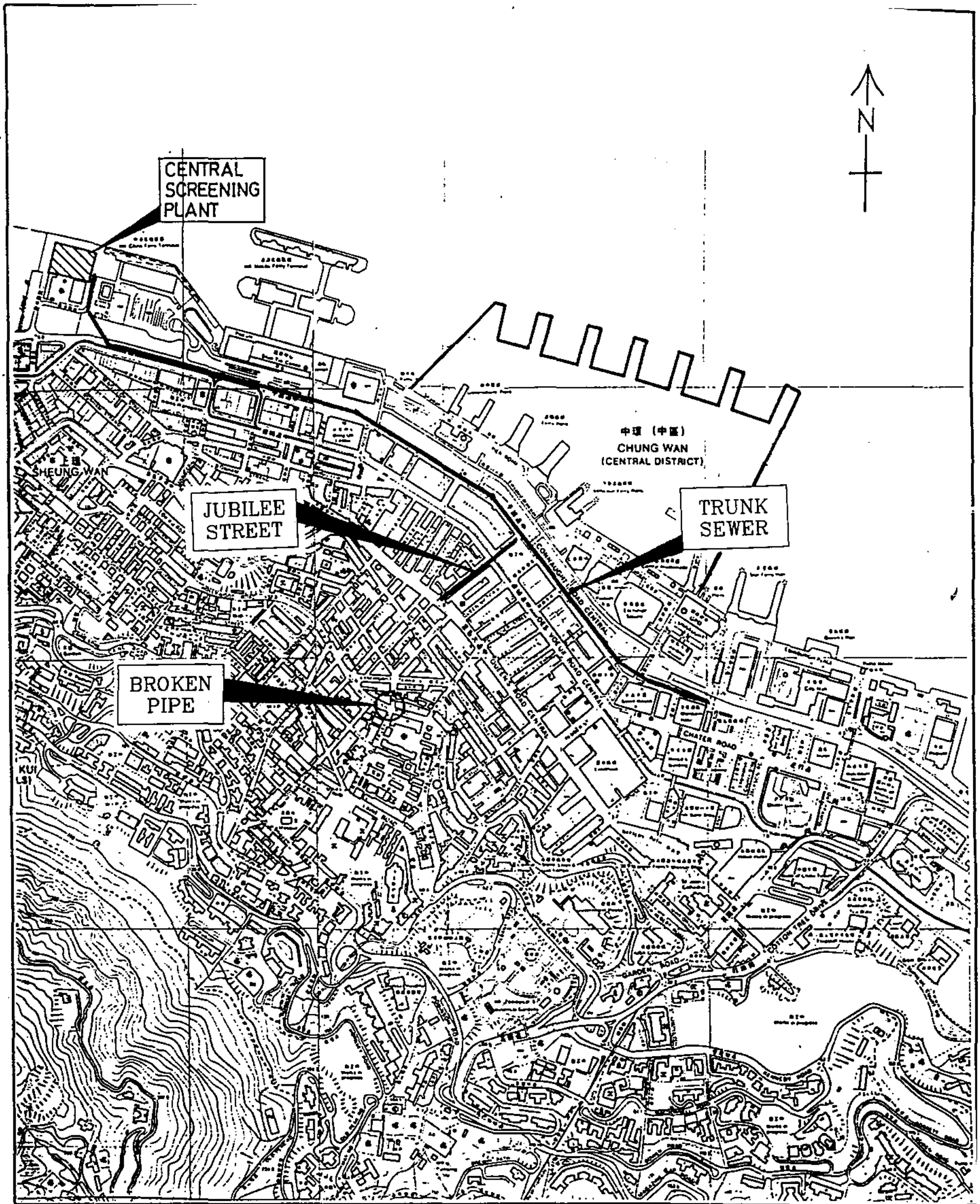


Figure 2.9

COOLING WATER INTAKE AND DISCHARGE LOCATIONS – STAGE ONE



COOLING WATER INTAKE AND DISCHARGE LOCATIONS – FINAL ARRANGEMENT Figure



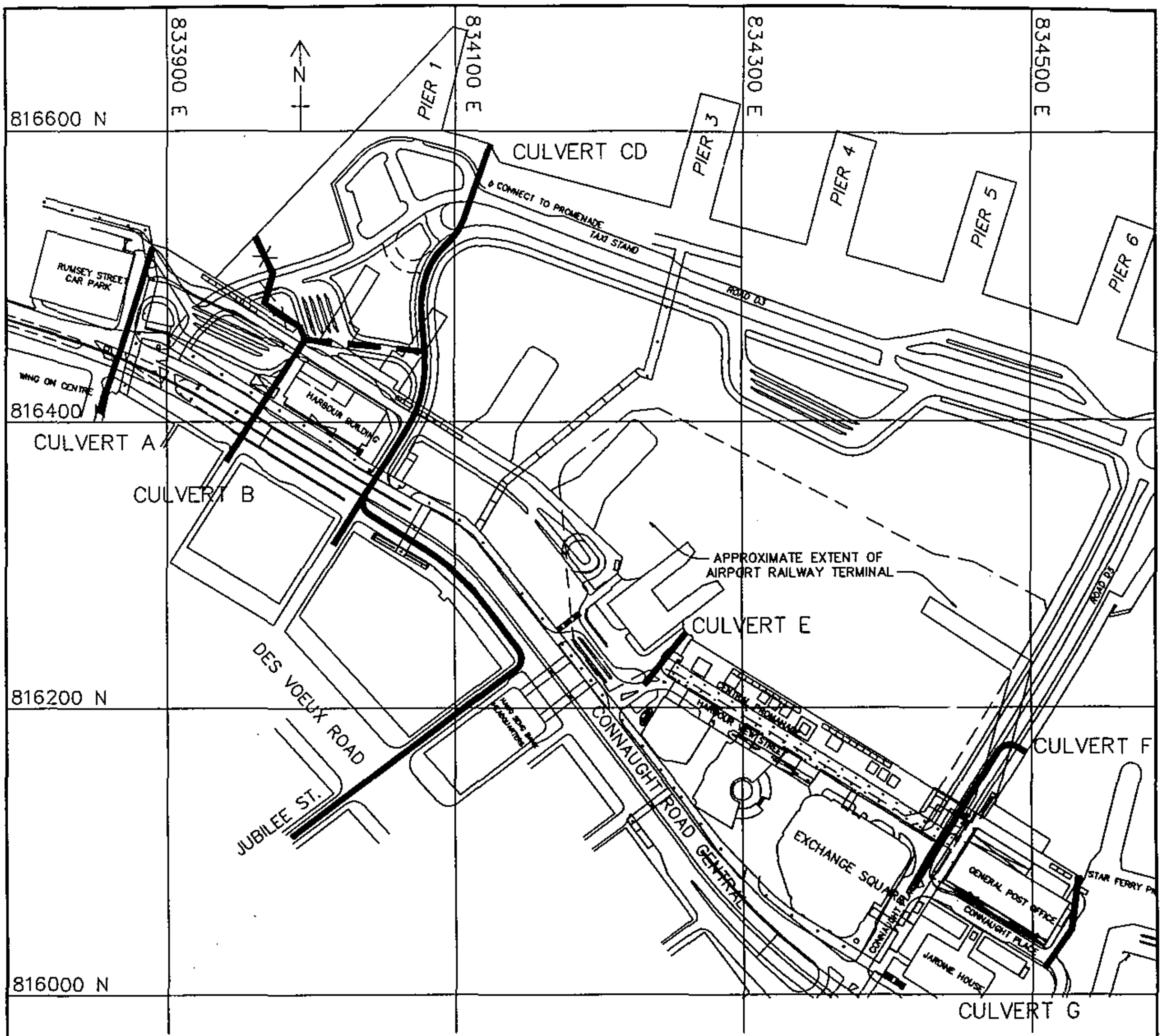
IMPROVEMENT NO. 1
LOWER START ELECTRODES FOR THE SCREW PUMPS AT THE CENTRAL SCREENING PLANT.

IMPROVEMENT NO. 2
DESILTING THE EXISTING TRUNK SEWER FROM THE CENTRAL SCREENING PLANT IN SHEUNG WAN TO ICE HOUSE STREET. THIS SEWER IS LAID UNDER THE WESTERN FIRE SERVICES STREET, CONNAUGHT ROAD WEST AND, CONNAUGHT ROAD CENTRAL.

IMPROVEMENT NO. 3
JUBILEE STREET IMPROVEMENT WORKS.

IMPROVEMENT NO. 4
REPAIR OF BROKEN SEWER PIPE ON THE CORNER OF CONCHRANE STREET AND HOLLYWOOD ROAD.

Figure 2.11



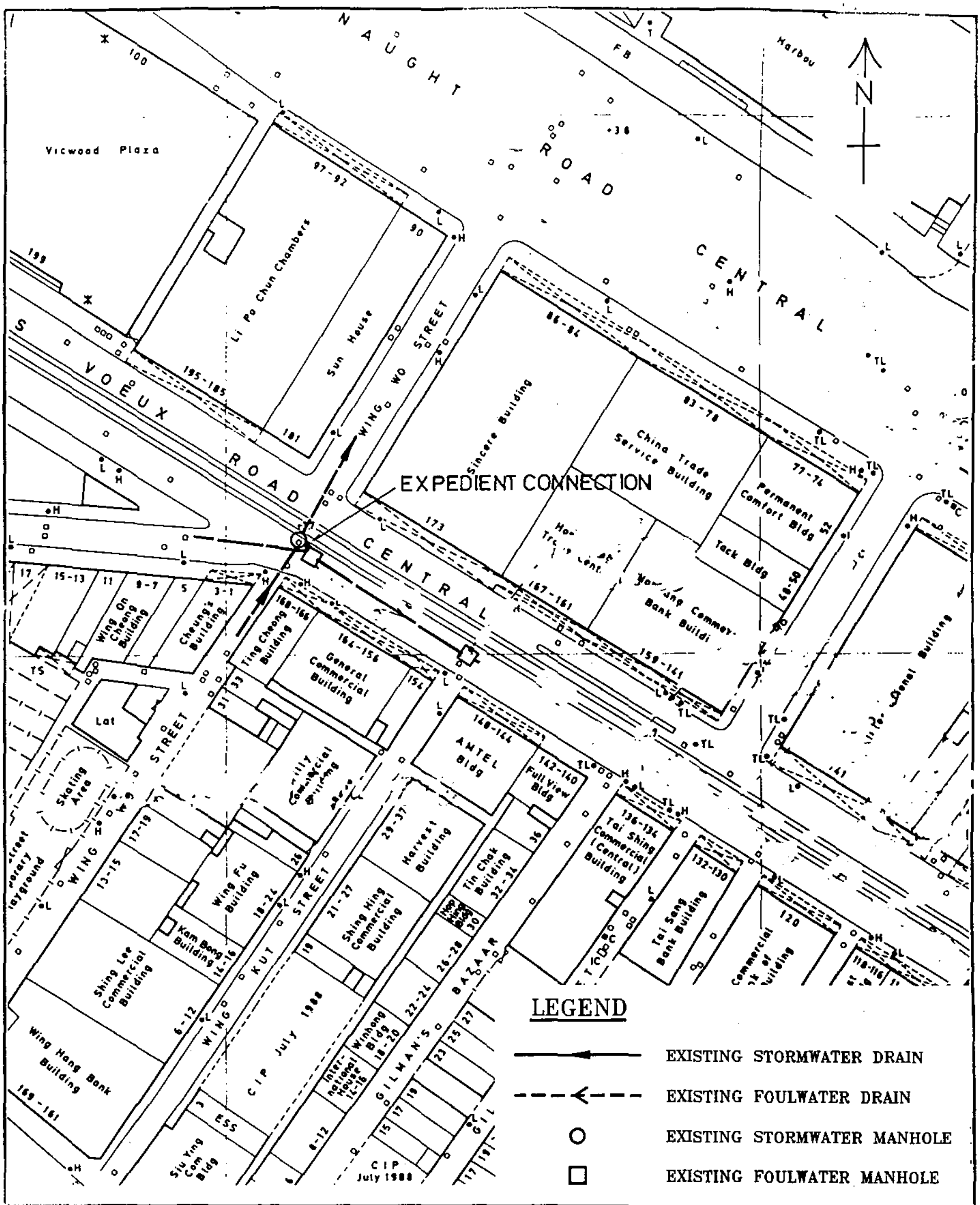
LEGEND

- CULVERT ALIGNMENT
- CULVERT DIVERSION
- CULVERT ABANDONED

IMPROVEMENT NO. 5
REALIGNMENT OF CULVERT B TO MERGE WITH
CULVERT CD

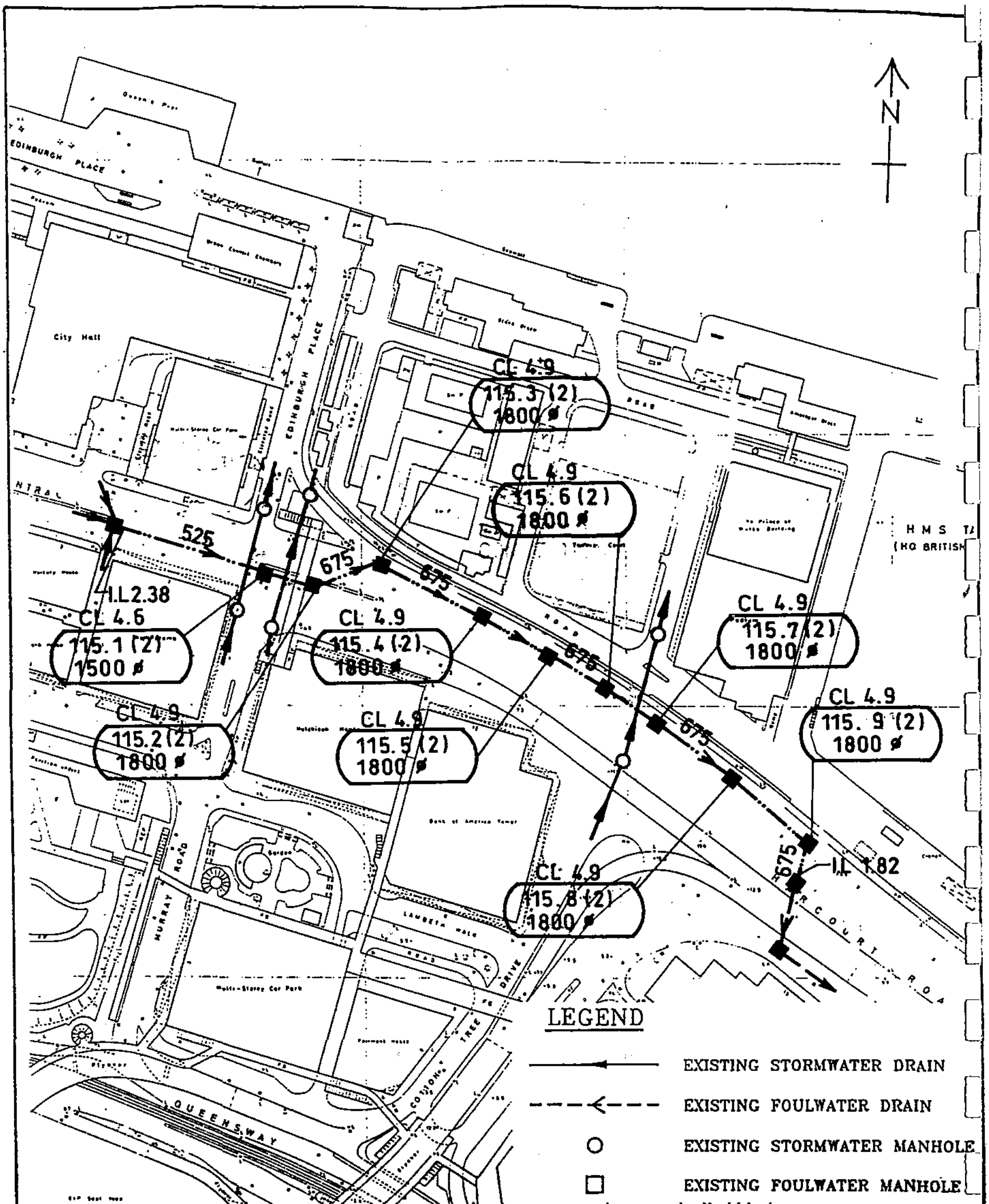
230/EL30/F212/YK.MO/29.9.92

Figure 2.12



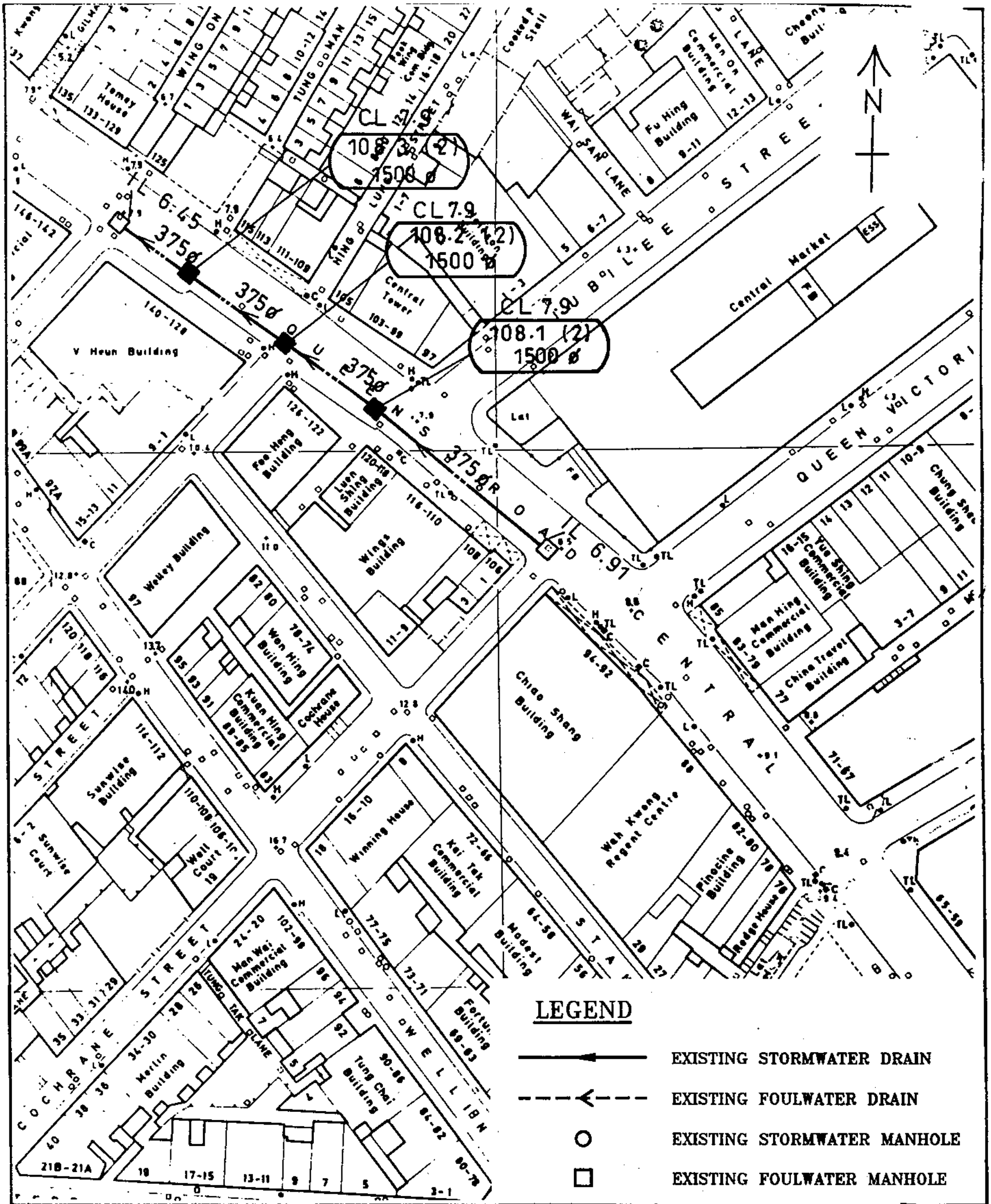
IMPROVEMENT NO. 6
PLUG ENDS OF 300MM DIAMETER EXPEDIENT CONNECTION BETWEEN THE FOUL SEWER AND STORMWATER SYSTEM ON THE CORNER OF DES VOEUX ROAD AND WING WO STREET

Figure 2.13



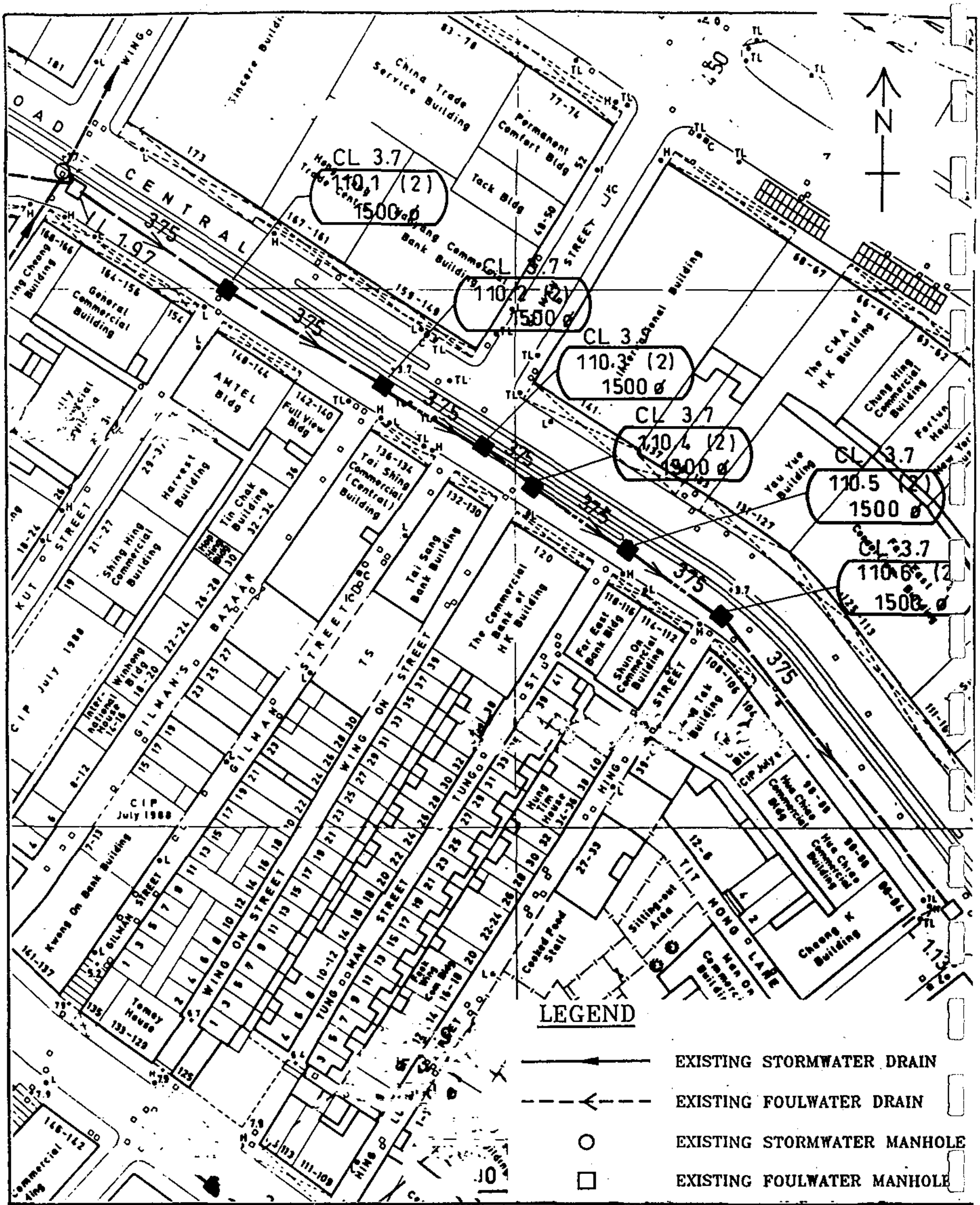
IMPROVEMENT NO. 7
UPGRADING AND RELAYING THE EXISTING 450MM AND 600MM DIAMETER FOUL SEWER IN HARCOURT ROAD BETWEEN CLUB STREET AND RODNEY STREET.

Figure 2.14



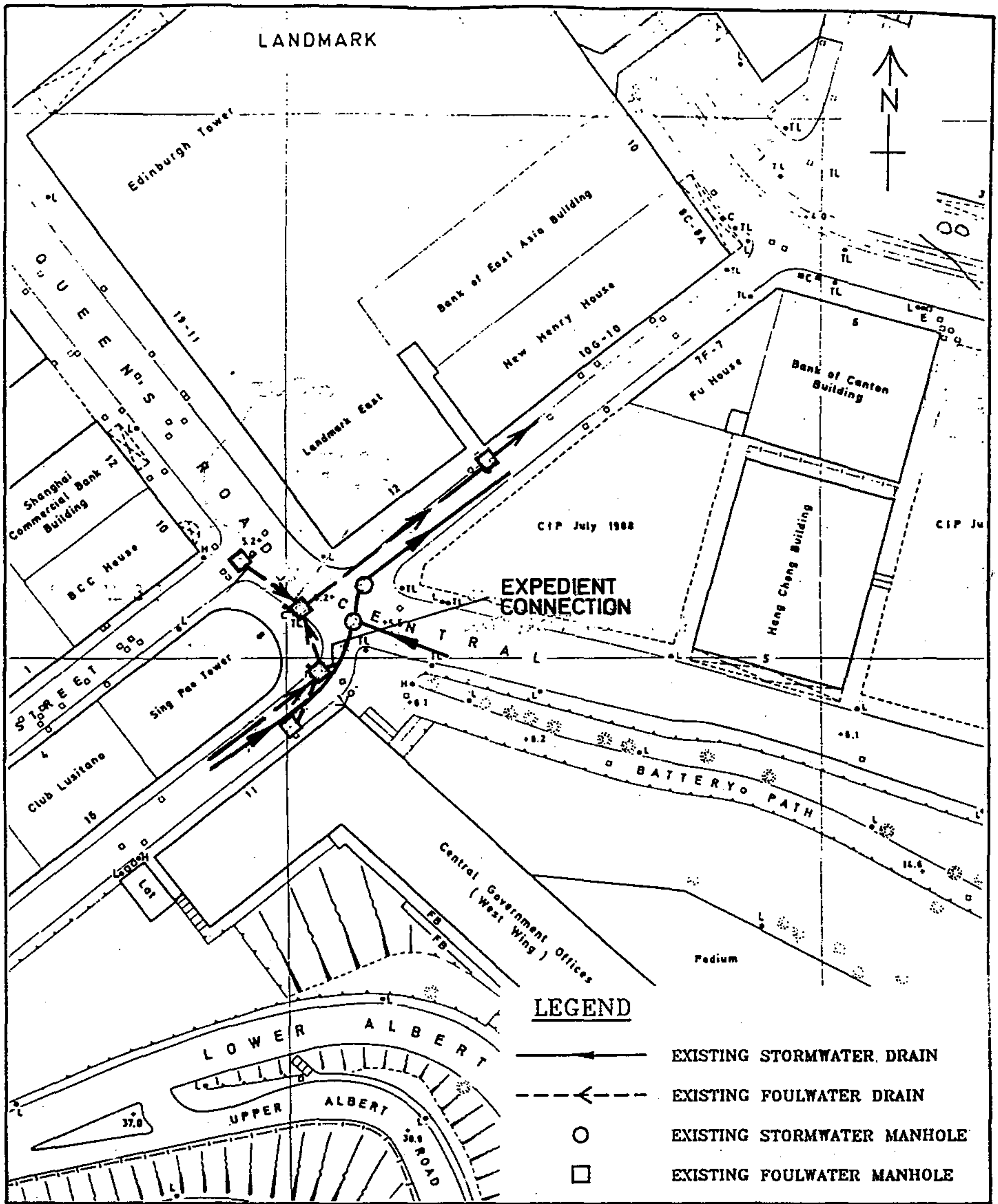
IMPROVEMENT NO. 8
UPGRADING THE EXISTING 225 AND 300MM DIAMETER I OUL SEWER IN QUEEN'S ROAD CENTRAL BETWEEN COCHRANE STREET AND PEEL STREET TO A 375MM DIAMETER PIPE. THE NEW PIPE SHELL BE LAID ON THE SAME ALIGNMENT AS THE EXISTING PIPE. INVERT LEVELS AT THE UPSTREAM AND DOWNSTREAM ENDS OF THE WORKS SHALL MATCH THE EXISTING INVERT LEVELS.

Figure 2.15



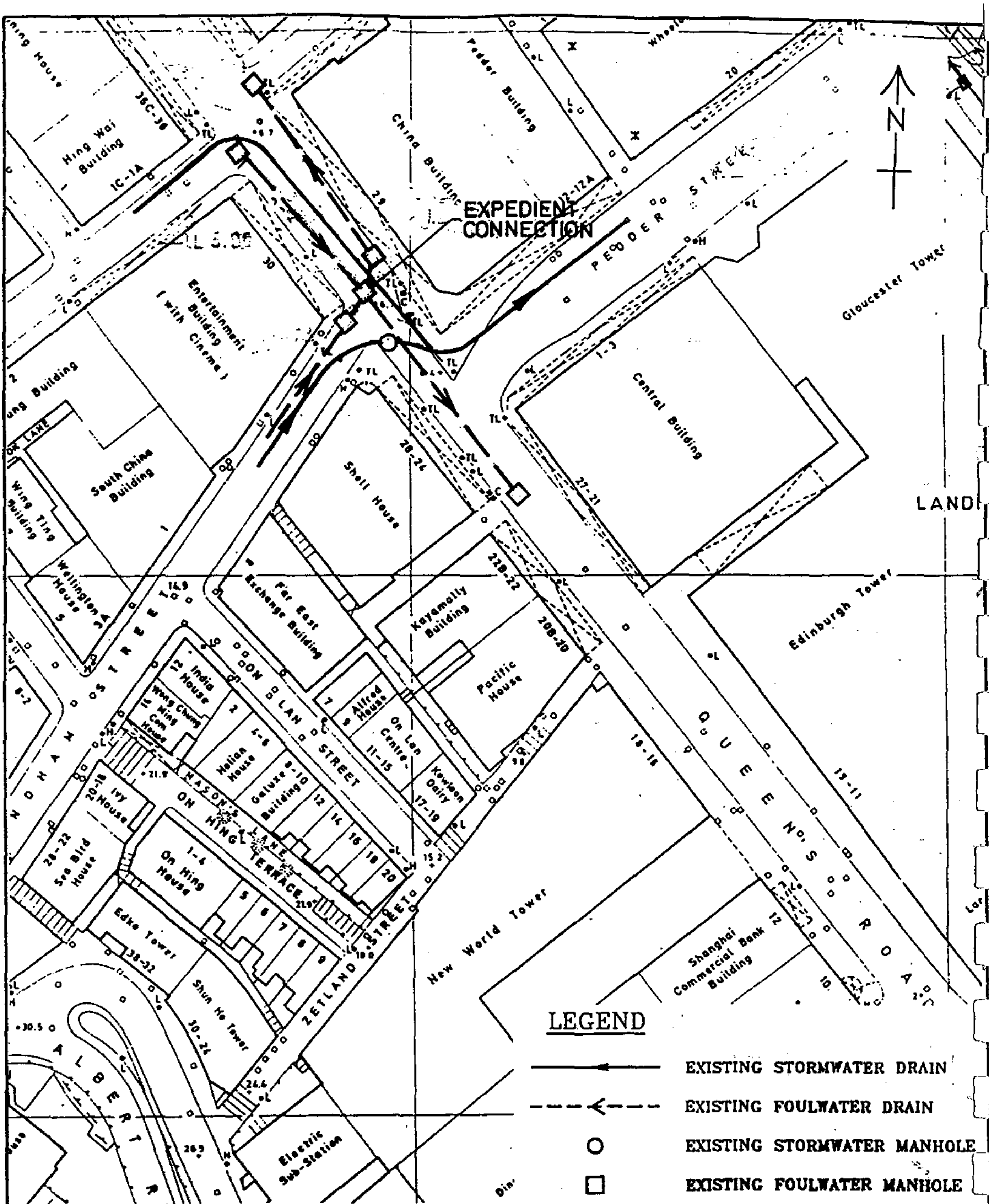
IMPROVEMENT NO. 9
UPGRADING THE EXISTING 225MM DIAMETER FOUL SEWER IN DES VOEUX ROAD CENTRAL BETWEEN WING WO STREET AND JUBILEE STREET. THE HILLSIDE ESCALTOR SCHEME WILL ALTER THE SEWAGE DISTRIBUTION IN THIS AREA AND FURTHER IMPROVEMENT WORKS ALONG WING LOK STREET TO MAN WA LANE MAY BE REQUIRED

Figure 2.16



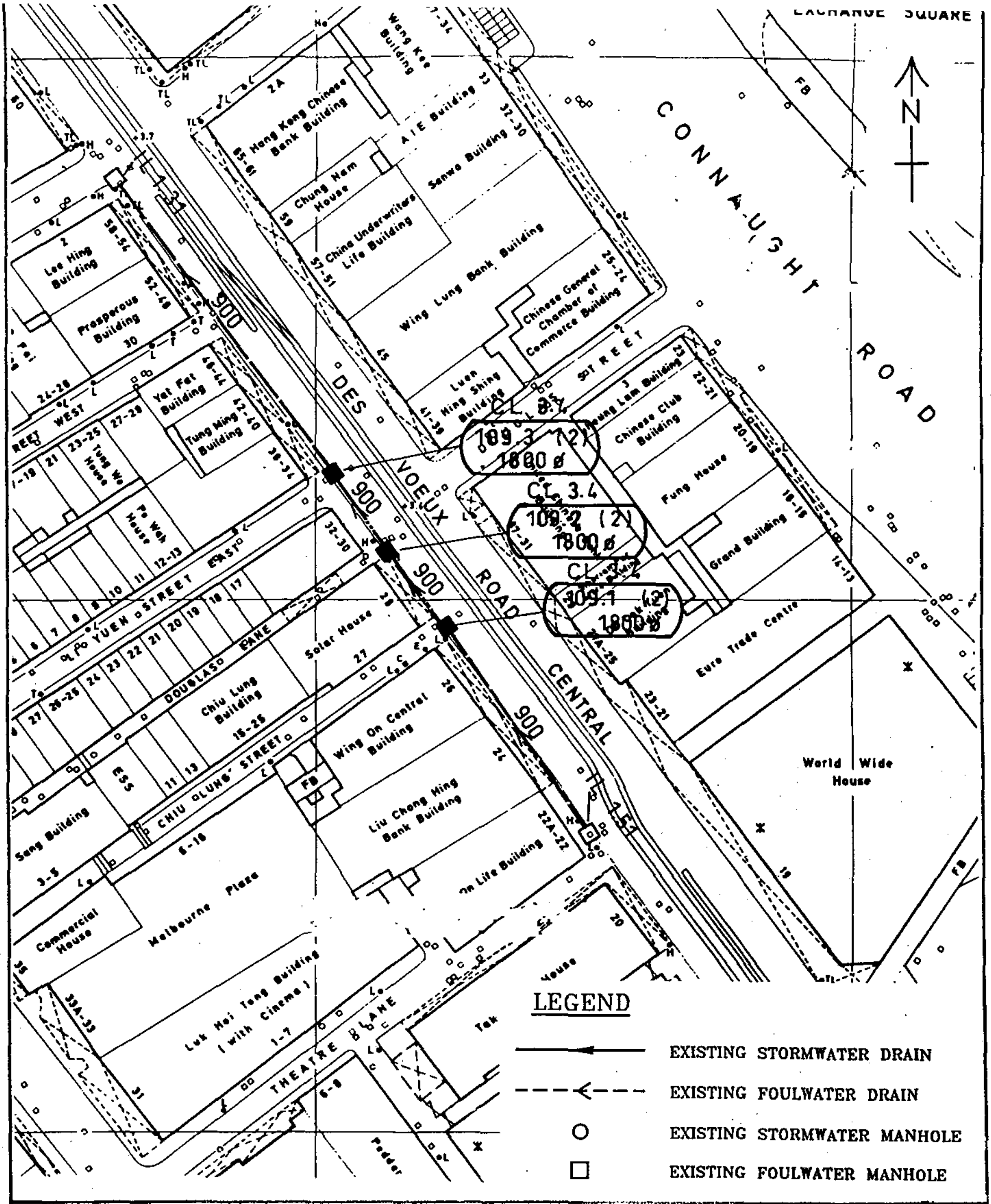
IMPROVEMENT NO. 10
PLUG ENDS OF 225MM DIAMETER EXPEDIENT CONNECTION BETWEEN THE FOUL SEWER AND STORMWATER SYSTEM ON THE JUNCTION OF QUEEN'S ROAD CENTRAL AND ICE HOUSE STREET.

Figure 2.17



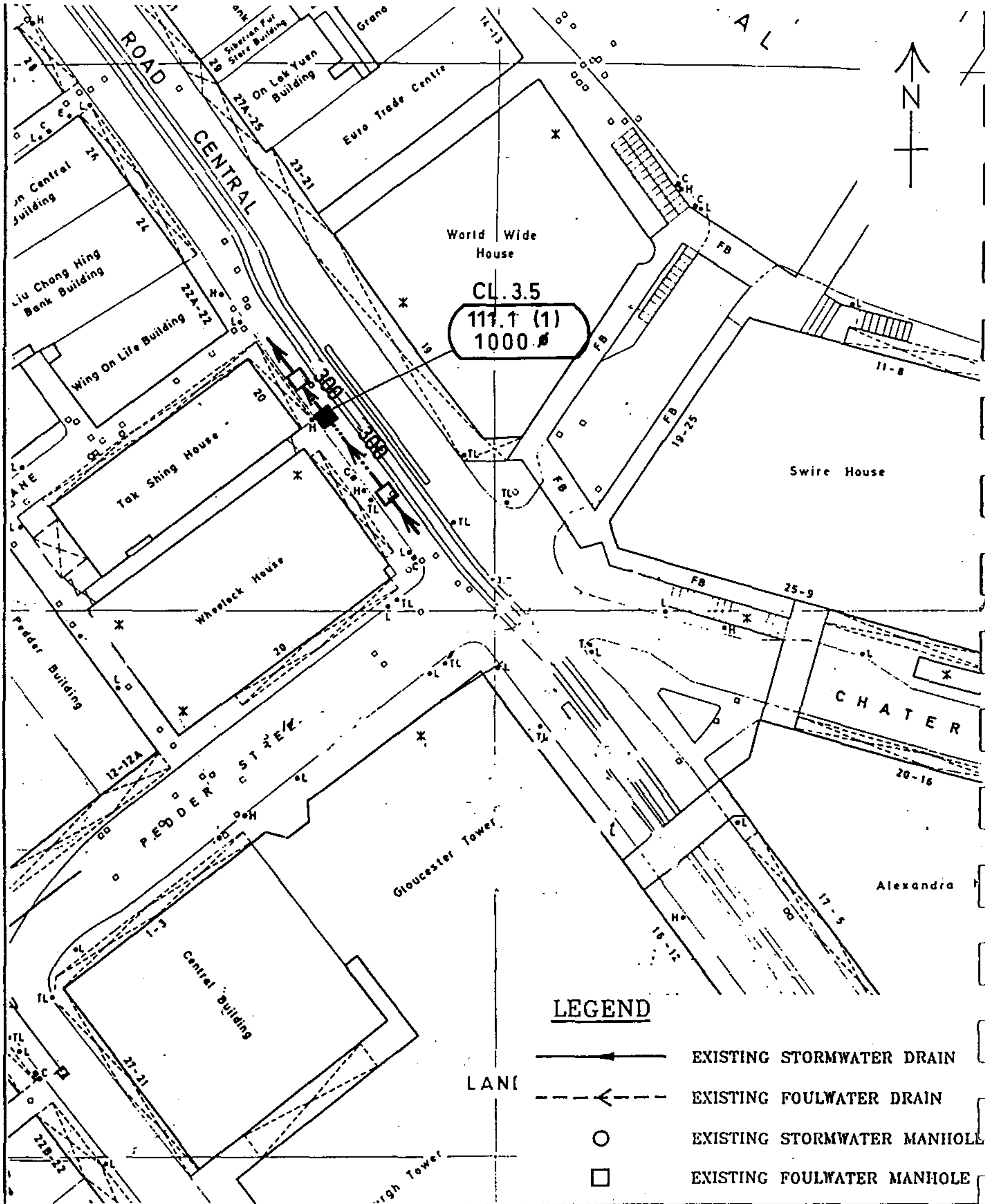
IMPROVEMENT NO. 11
PLUG ENDS OF 225MM DIAMETER EXPEDIENT CONNECTION BETWEEN THE FOUL SEWER AND STORMWATER SYSTEM ON THE JUNCTION OF QUEENS ROAD CENTRAL AND PEDDER STREET.

Figure 2.18



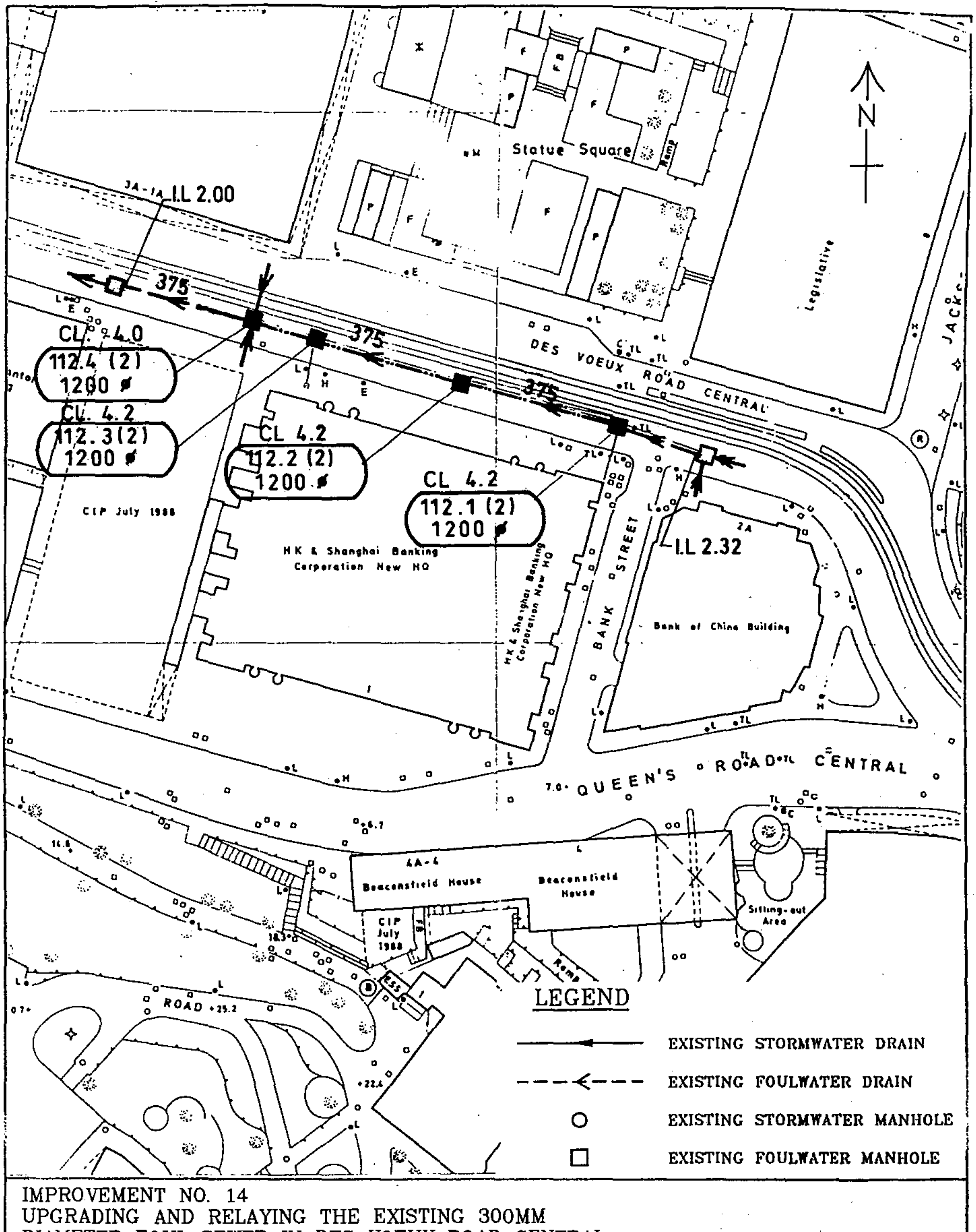
IMPROVEMENT NO. 12
UPGRADING AND RELAYING THE EXISTING 750MM AND 900MM DIAMETER FOUL SEWER IN DES VOEUX ROAD CENTRAL BETWEEN THEATRE LANE AND POTTINGER STREET WITH A 900MM DIAMETER PIPE. THE NEW PIPE SHALL BE LAID ON THE SAME ALIGNMENT AS THE EXISTING PIPE. INVERT LEVELS AT THE UPSTREAM AND DOWNSTREAM ENDS OF THE WORKS SHALL MATCH THE EXISTING INVERT LEVELS.

Figure 2.19



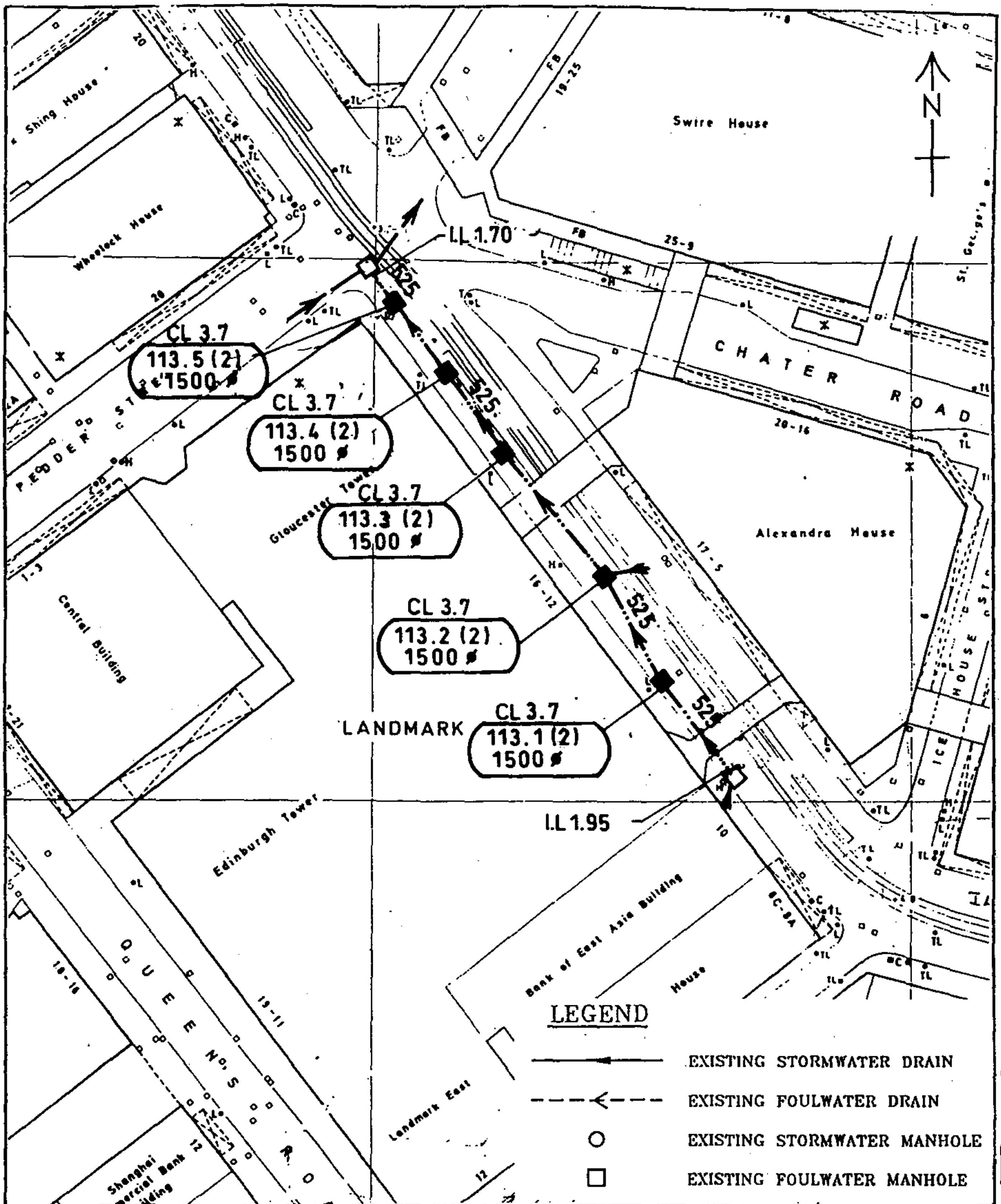
IMPROVEMENT NO. 13
UPGRADING AND RELAYING THE EXISTING 225MM DIAMETER SEWER IN DES VOEUX ROAD CENTRAL BETWEEN PEDDER STREET AND THEATRE LANE WITH A 300MM DIAMETER PIPE. THE NEW PIPE SHALL BE LAID ON THE SAME ALIGNMENT AS THE EXISTING PIPE. INVERT LEVELS AT THE UPSTREAM AND DOWNSTREAM ENDS OF THE WORKS SHALL MATCH THE EXISTING INVERT LEVELS.

Figure 2.20



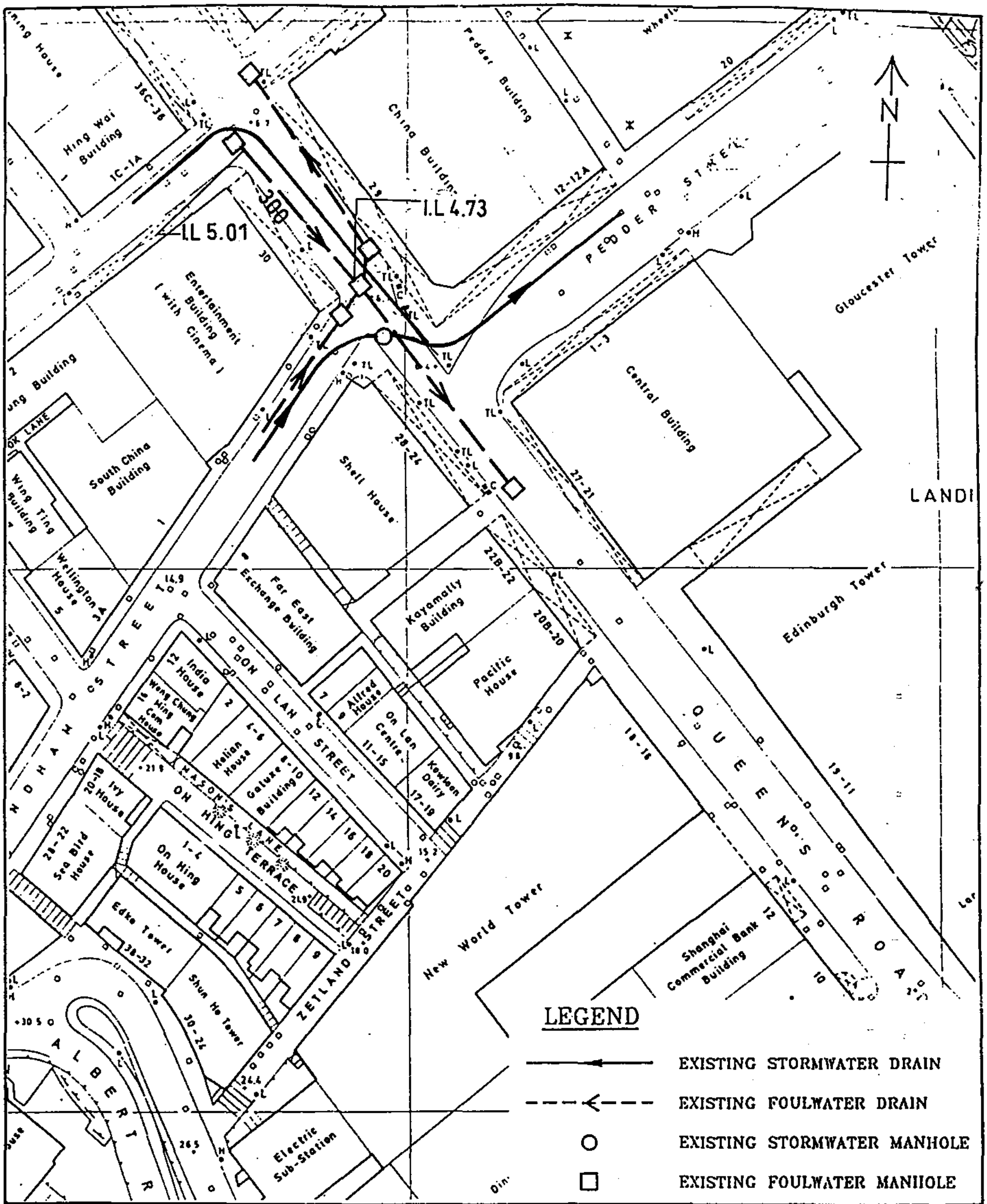
IMPROVEMENT NO. 14
UPGRADING AND RELAYING THE EXISTING 300MM DIAMETER FOUL SEWER IN DES VOEUX ROAD CENTRAL BETWEEN BANK STREET AND ICE HOUSE STREET WITH A 375MM DIAMETER PIPE. THE NEW PIPE SHALL BE LAID ON THE SAME ALIGNMENT AS THE EXISTING PIPE. INVERT LEVELS AT THE UPSTREAM AND DOWNSTREAM ENDS OF THE WORKS SHALL MATCH THE EXISTING INVERT LEVELS.

Figure 2.21



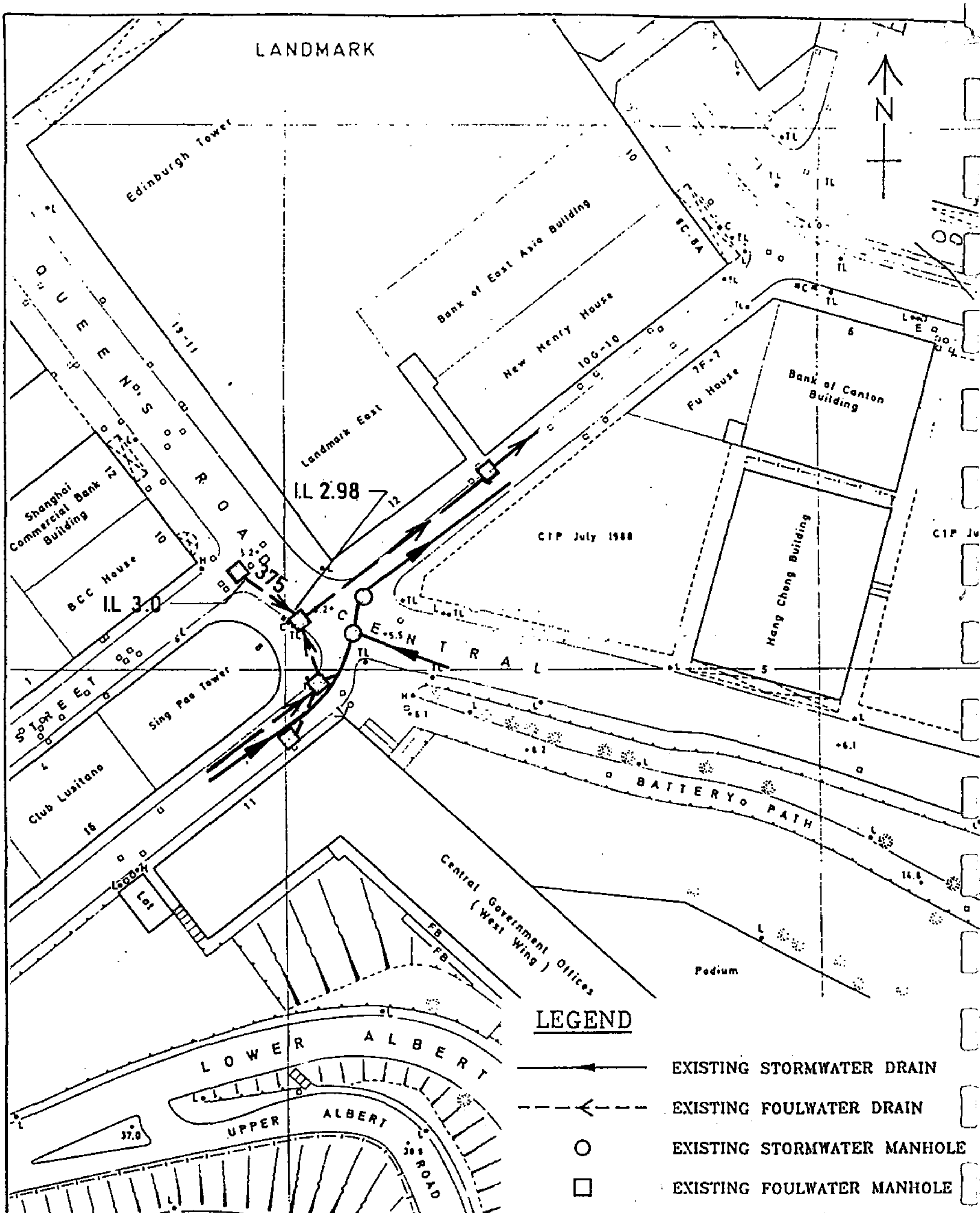
IMPROVEMENT NO. 15
UPGRADING AND RELAYING THE EXISTING 300MM AND 450MM DIAMETER FOUL SEWER IN DES VOEUX ROAD CENTRAL BETWEEN CHATER ROAD AND ICE HOUSE STREET WITH A 525MM DIAMETER PIPE. THE NEW PIPE SHALL BE LAID ON THE SAME ALIGNMENT AS THE EXISTING PIPE. INVERT LEVELS AT THE UPSTREAM AND DOWNSTREAM ENDS OF THE WORKS SHALL MATCH THE EXISTING INVERT LEVELS.

Figure 2.22



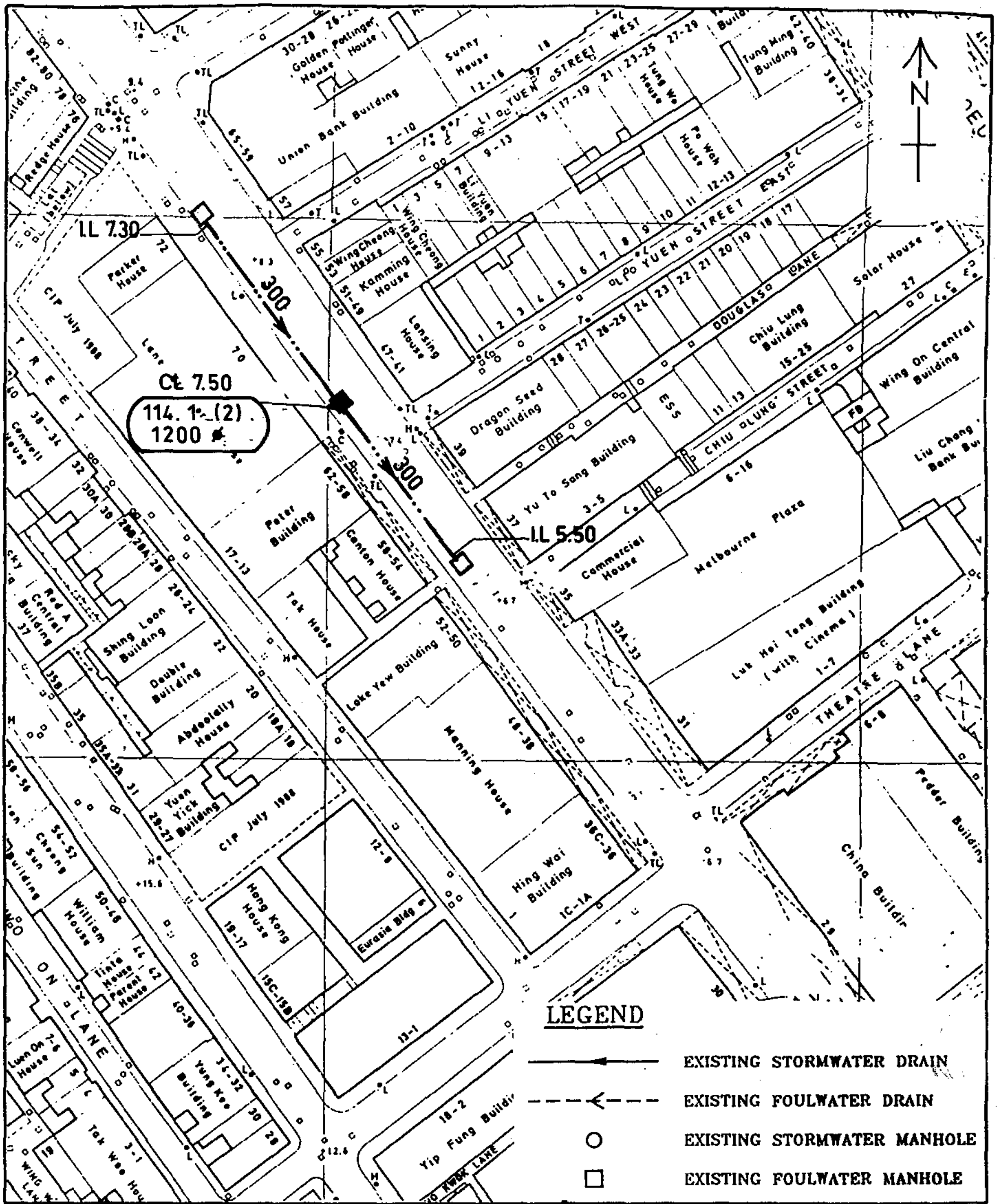
IMPROVEMENT NO. 16
UPGRADING AND RELAYING THE EXISTING 225MM DIAMETER FOUL SEWER IN QUEENS ROAD CENTRAL BETWEEN D'AGULAR STREET AND WYNDHAM STREET WITH A 300MM DIAMETER PIPE. THE NEW PIPE SHALL BE LAID ON THE SAME ALIGNMENT AS THE EXISTING PIPE. INVERT LEVELS AT THE UPSTREAM AND DOWNSTREAM ENDS OF THE WORKS SHALL MATCH THE EXISTING INVERT LEVELS.

Figure 2.23



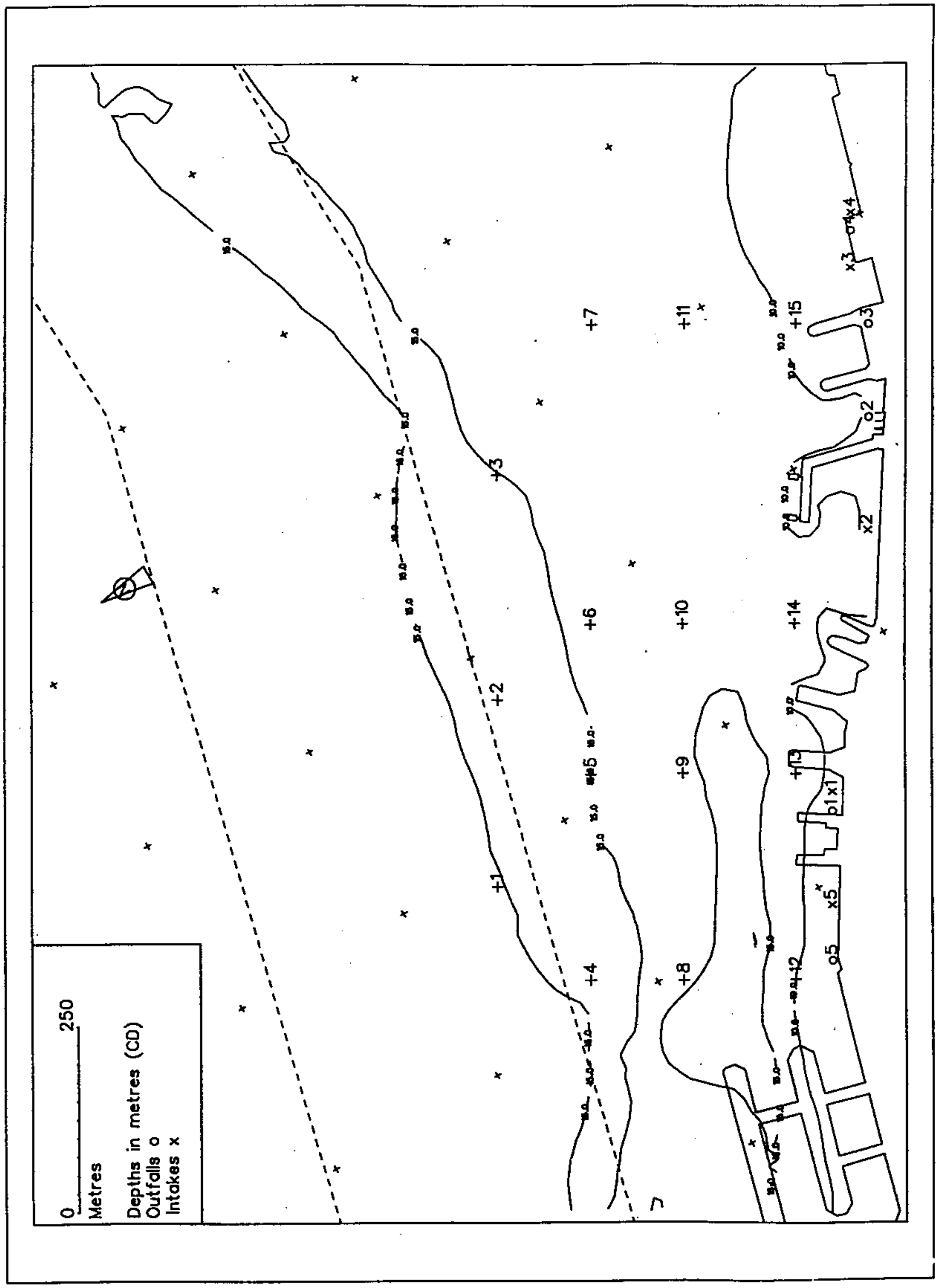
IMPROVEMENT NO. 17
UPGRADING AND RELAYING THE EXISTING 225MM DIAMETER FOUL SEWER IN QUEENS ROAD CENTRAL BETWEEN DUDDELL STREET AND ICE HOUSE STREET WITH A 375MM DIAMETER PIPE. SHOULD IMPROVEMENT NO. 10 CAUSE HYDRAULIC PROBLEMS, THIS UPGRADING MAY NEED TO BE EXTENDED DOWN ICE HOUSE STREET TO CONNAUGHT ROAD.

Figure 2.24

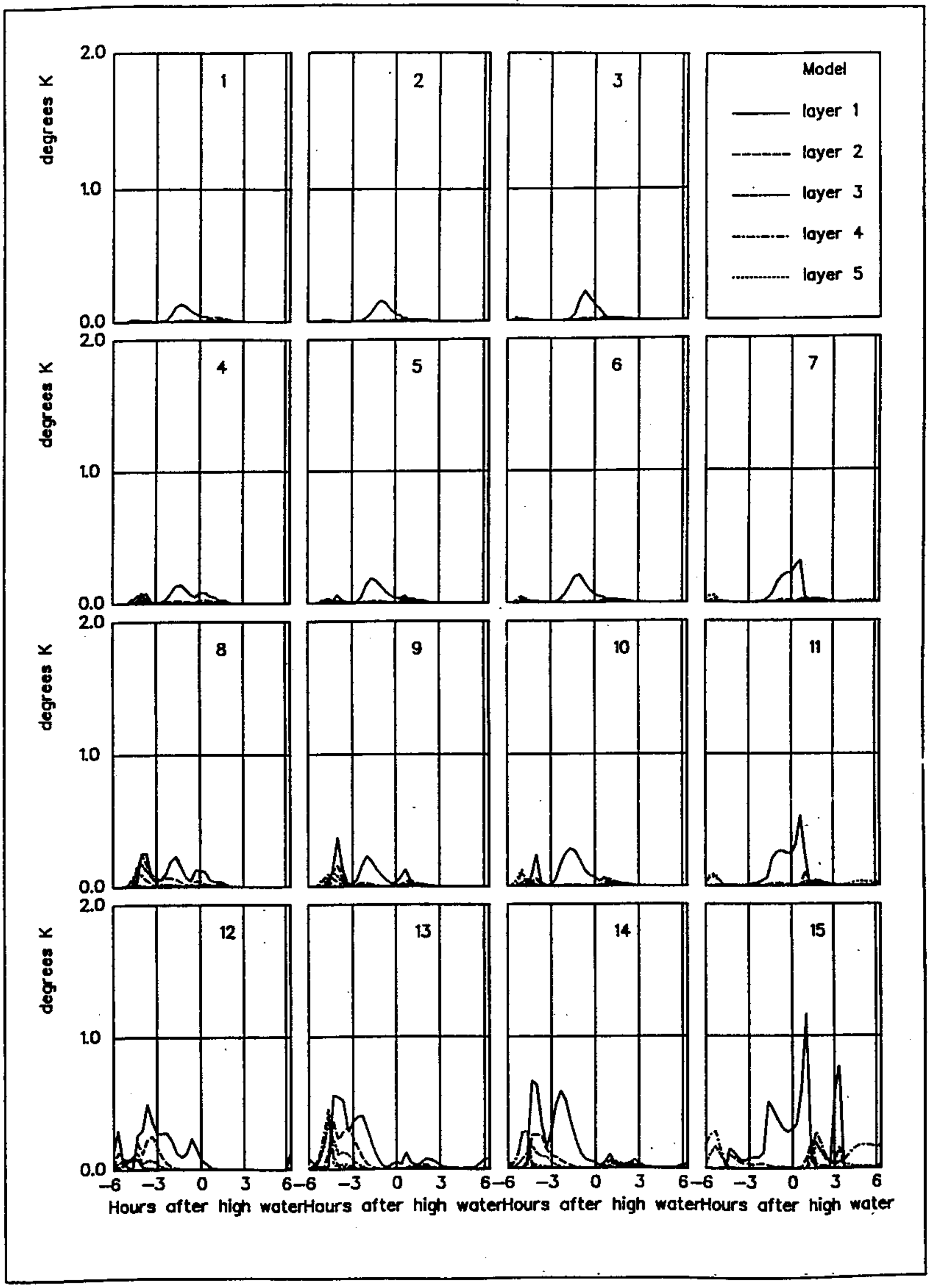


IMPROVEMENT NO. 18
UPGRADING AND RELAYING THE EXISTING 225MM DIAMETER FOUL SEWER IN QUEENS ROAD CENTRAL BETWEEN LI YUEN STREET WEST AND DOUGLAS LANE WITH A 300MM DIAMETER PIPE. THE NEW PIPE SHALL BE LAID ON THE SAME ALIGNMENT AS THE EXISTING PIPE. INVERT LEVELS AT THE UPSTREAM AND DOWNSTREAM ENDS OF THE WORKS SHALL MATCH THE EXISTING INVERT LEVELS

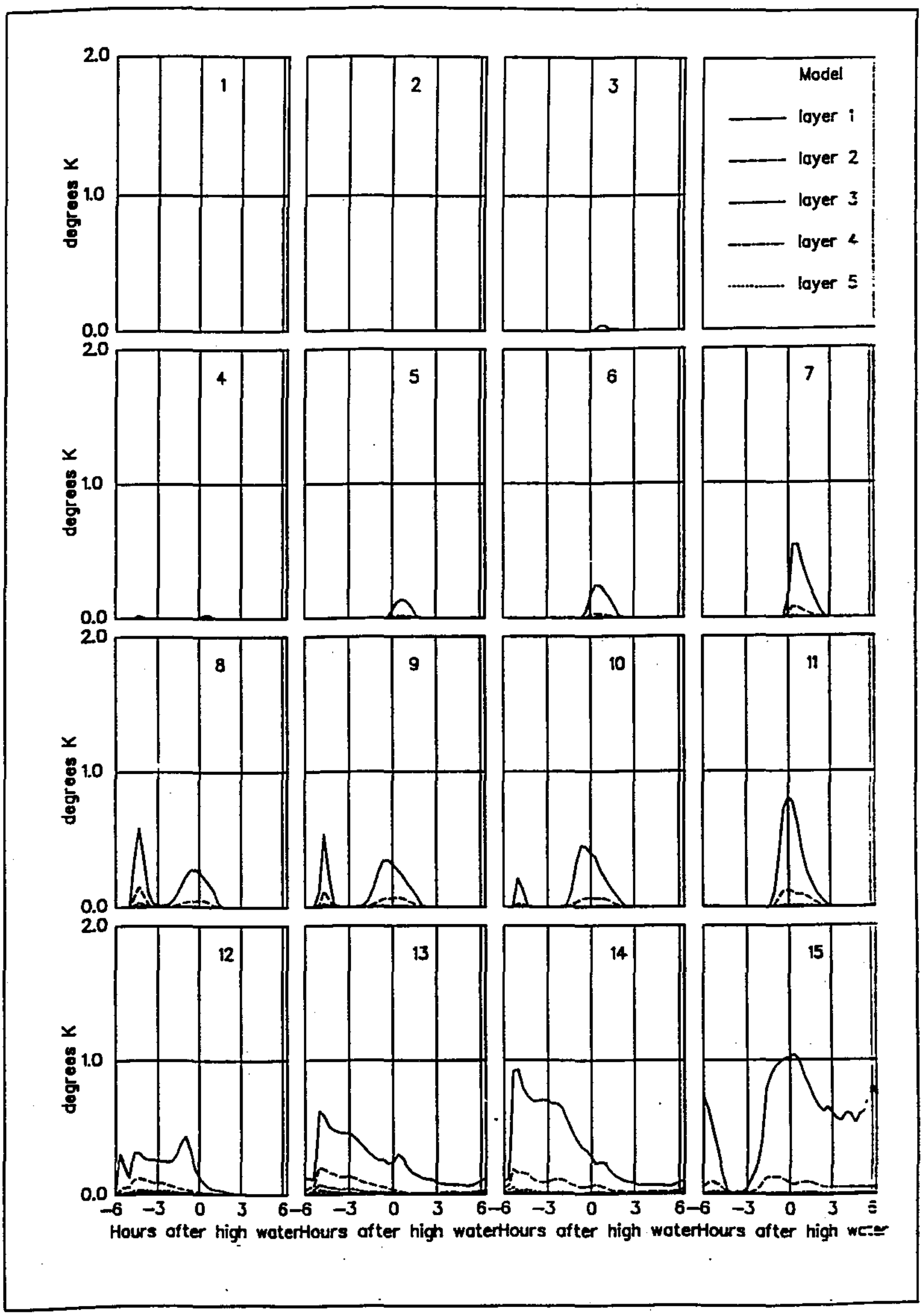
Figure 2.25



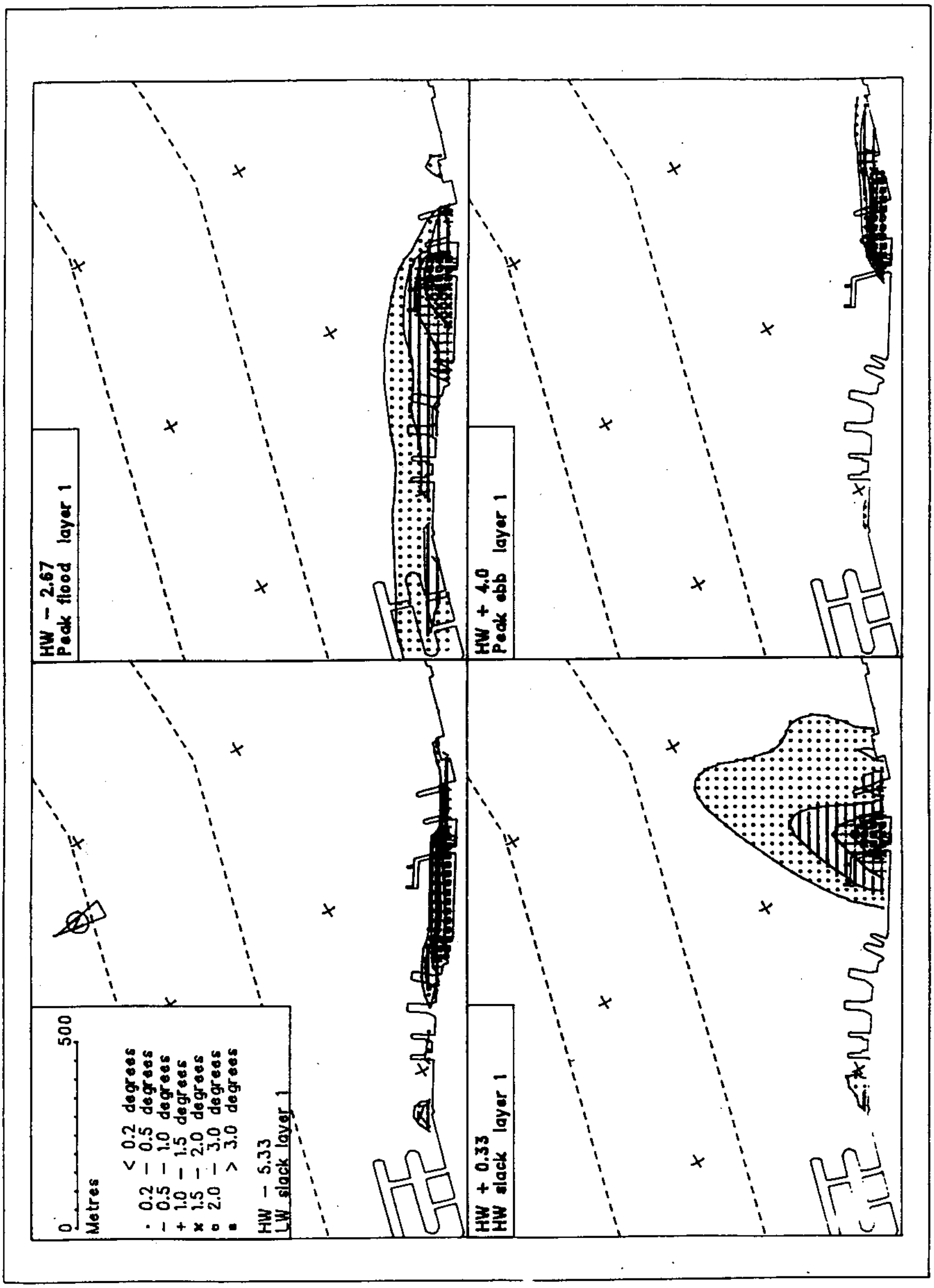
Location of Positions for Temperature Plots Figure 3.1



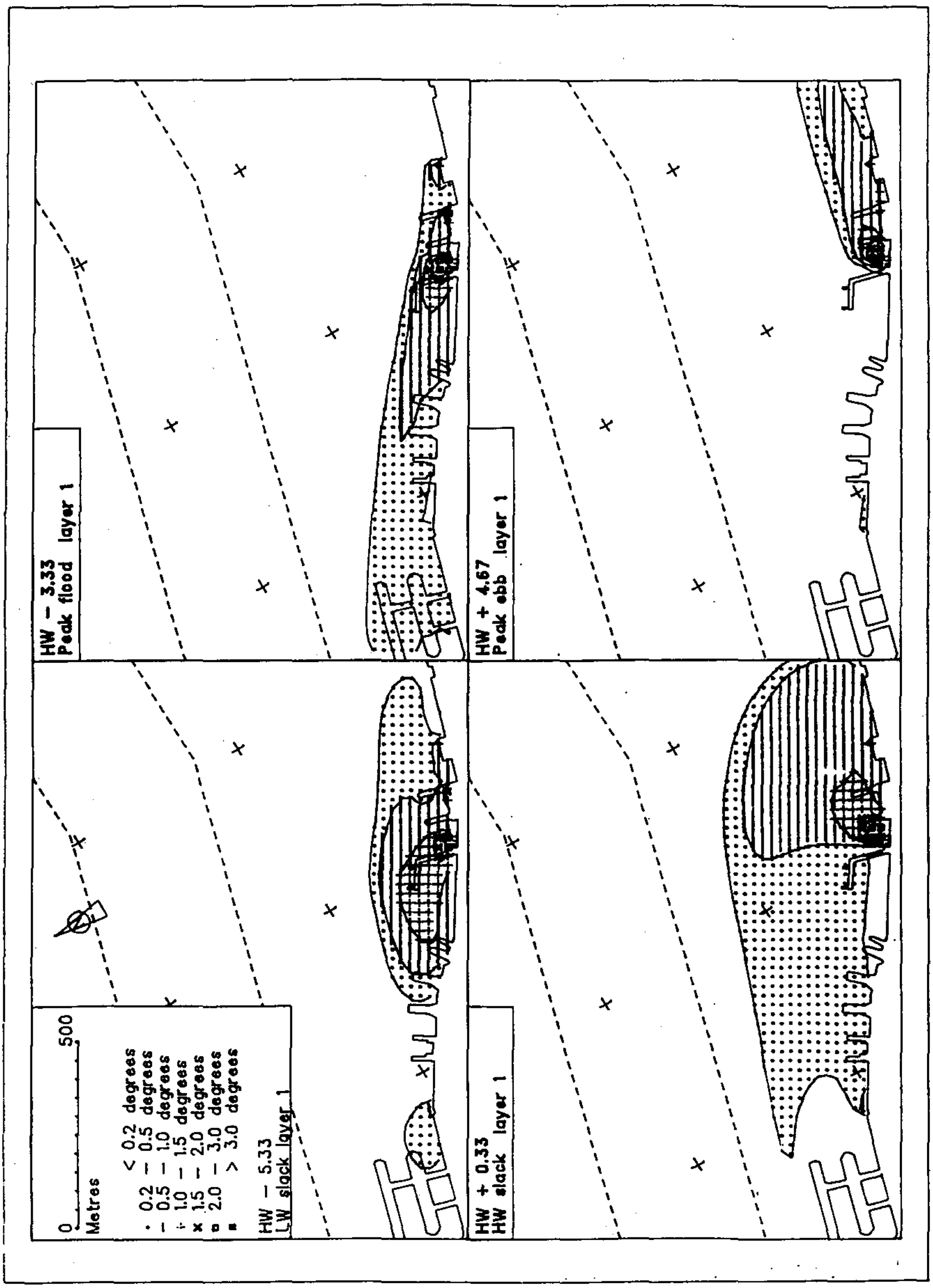
Temperature Variations at Fixed Positions, Wet Season Neap Tide Existing Conditions Figure 3.2



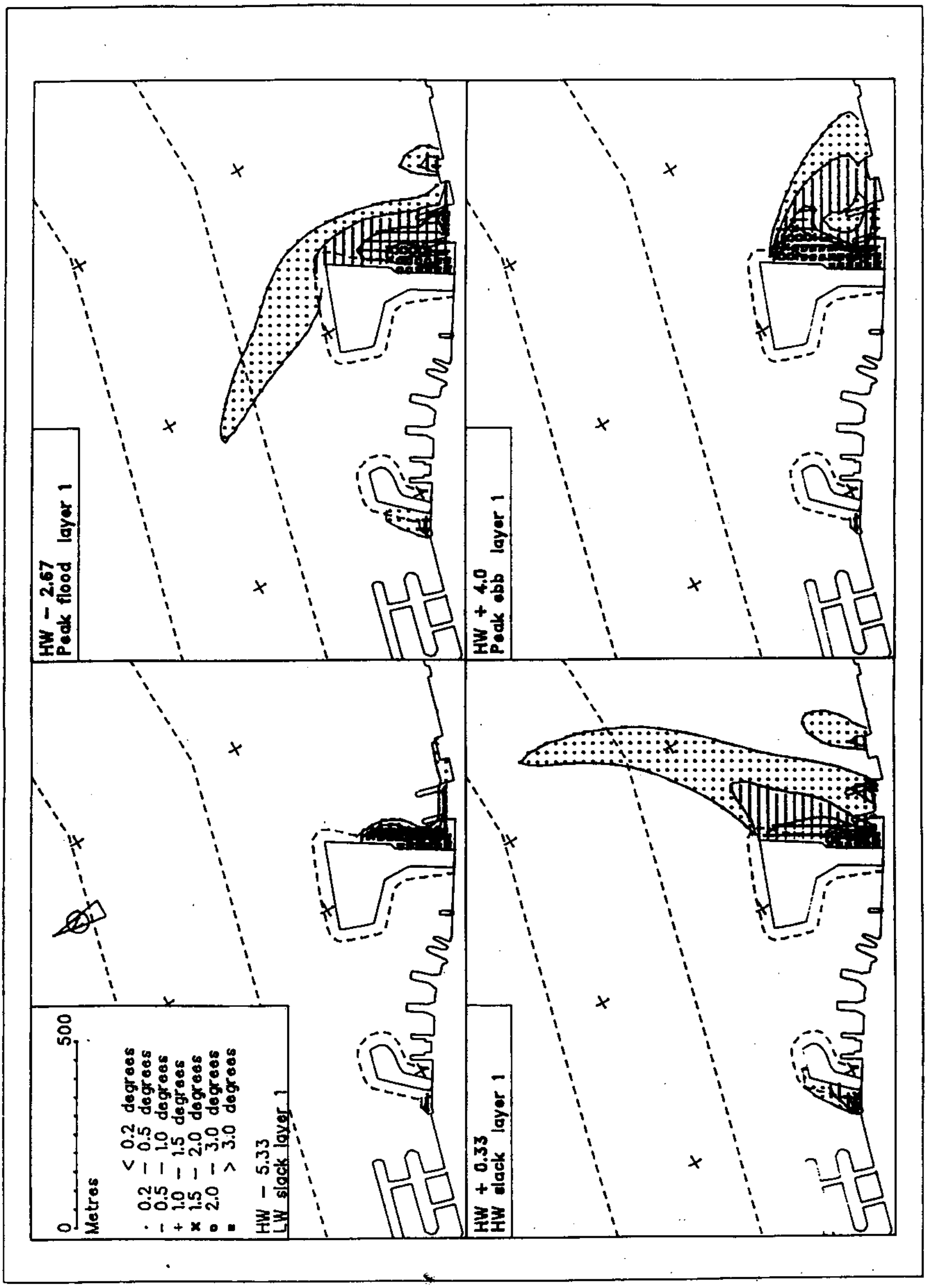
Temperature Variations at Fixed Positions, Dry Season Neap Tide Existing Conditions Figure 3.3



Surface Temperature Distributions, Wet Season Neap Tide Existing Conditions   Figure 3.4

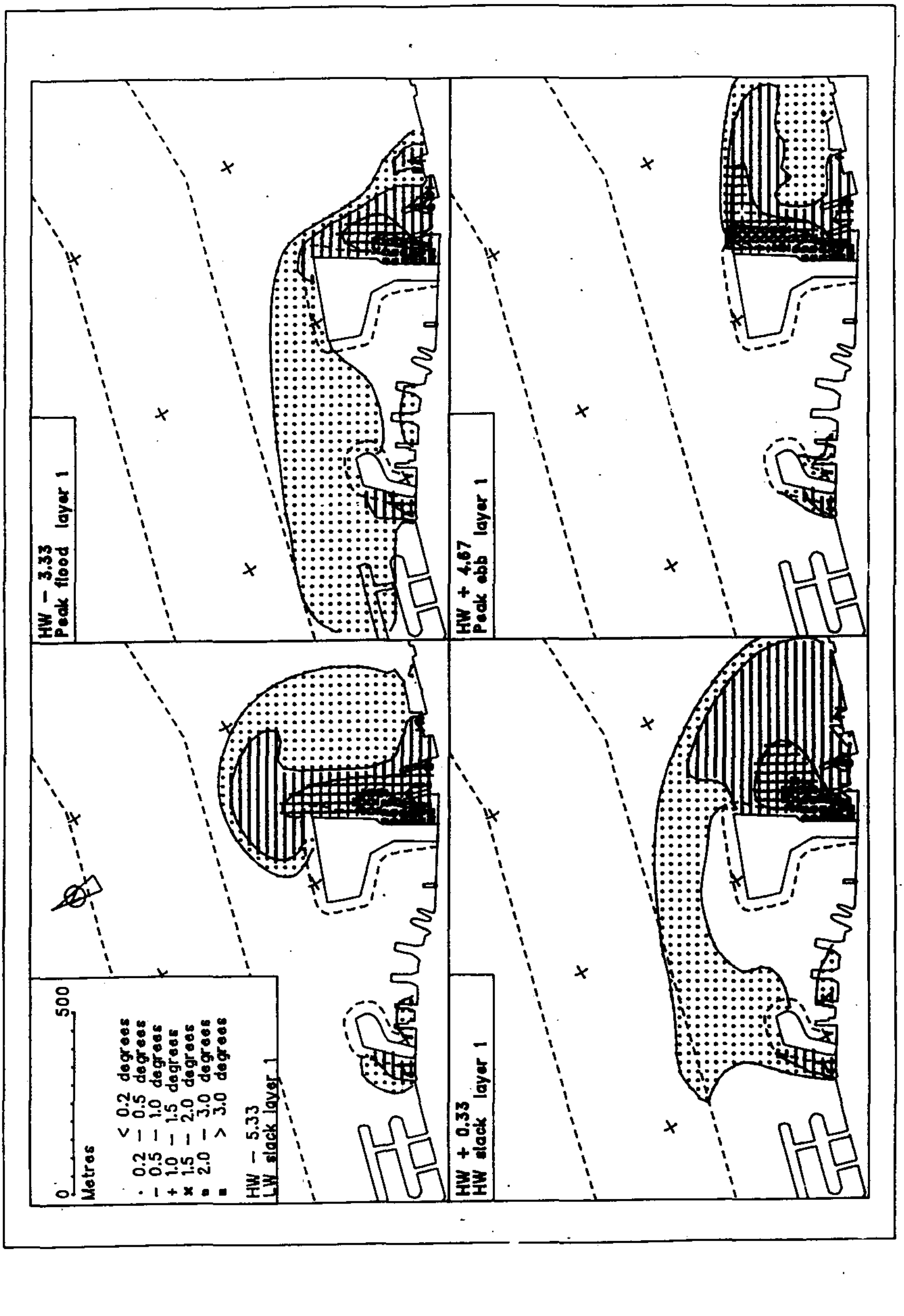


Surface Temperature Distributions, Dry Season Neap Tide Existing Conditions Figure 3.5



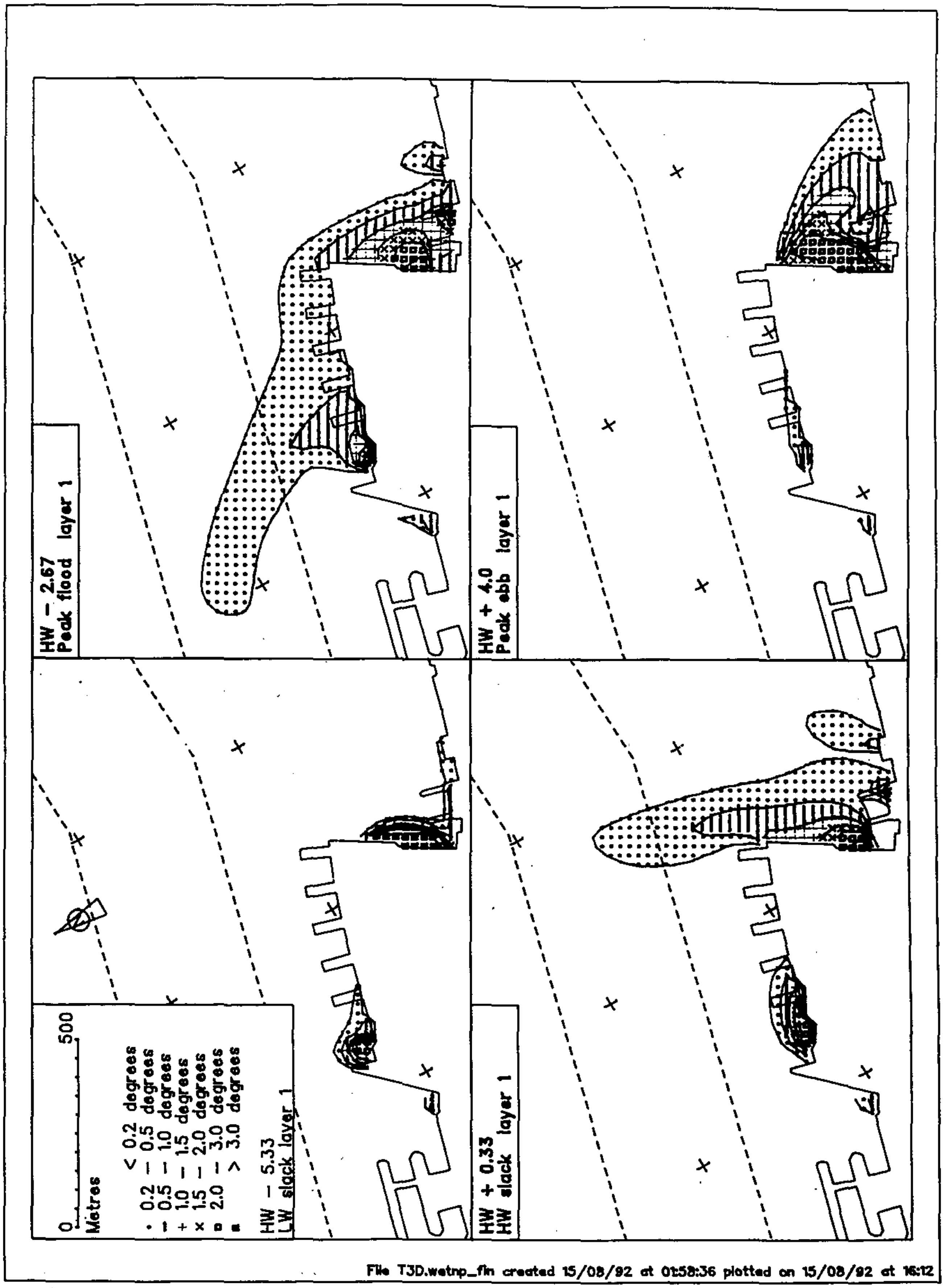
Surface Temperature Distributions, Wet Season Neap Tide PARTIAL RECLAMATION

Fig 3.6



Surface Temperature Distributions, Dry Season Neap Tide . PARTIAL RECLAMATION

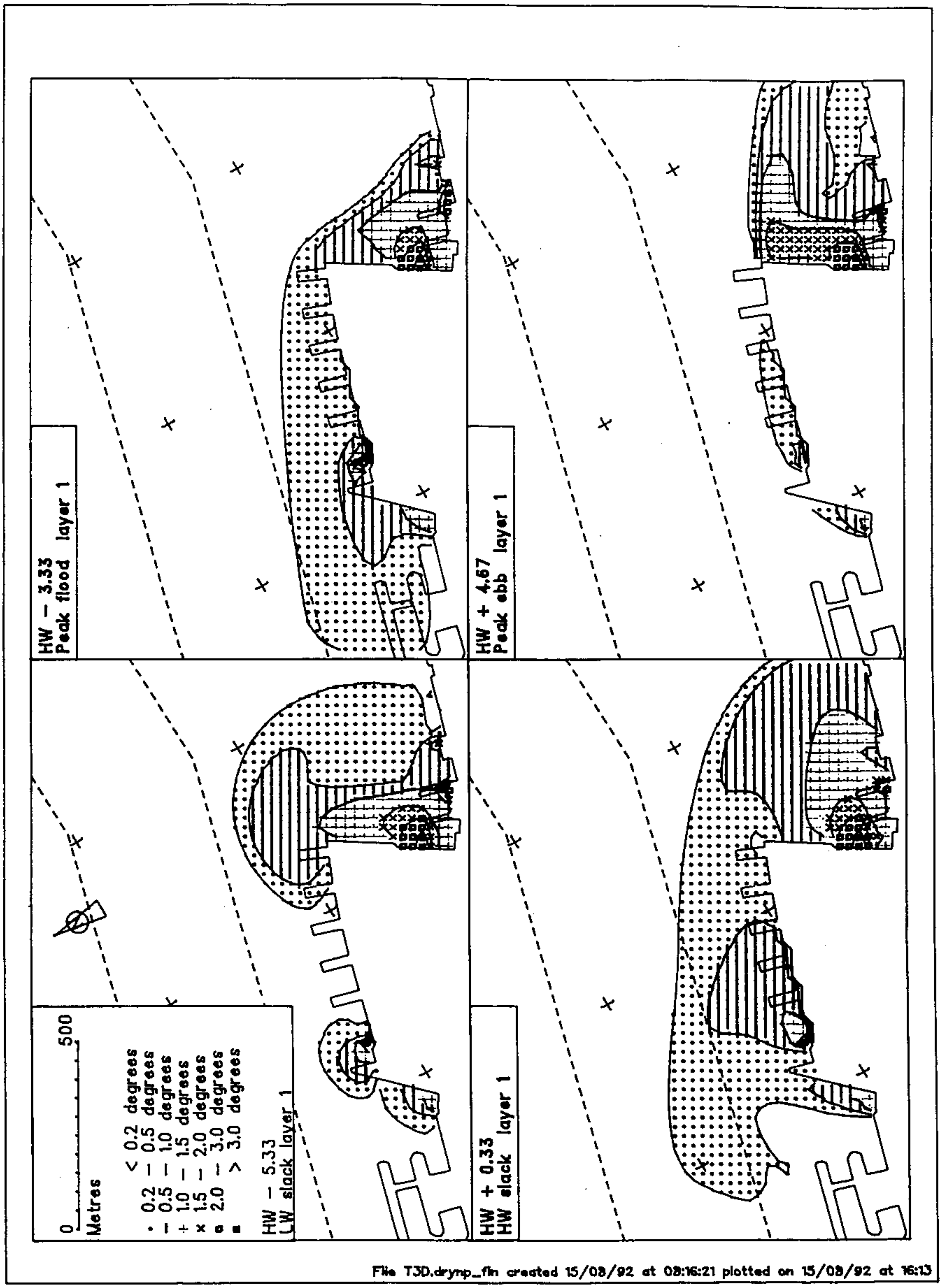
Fig 3.7



Temperature distributions : final Wet neap tide : surface layer

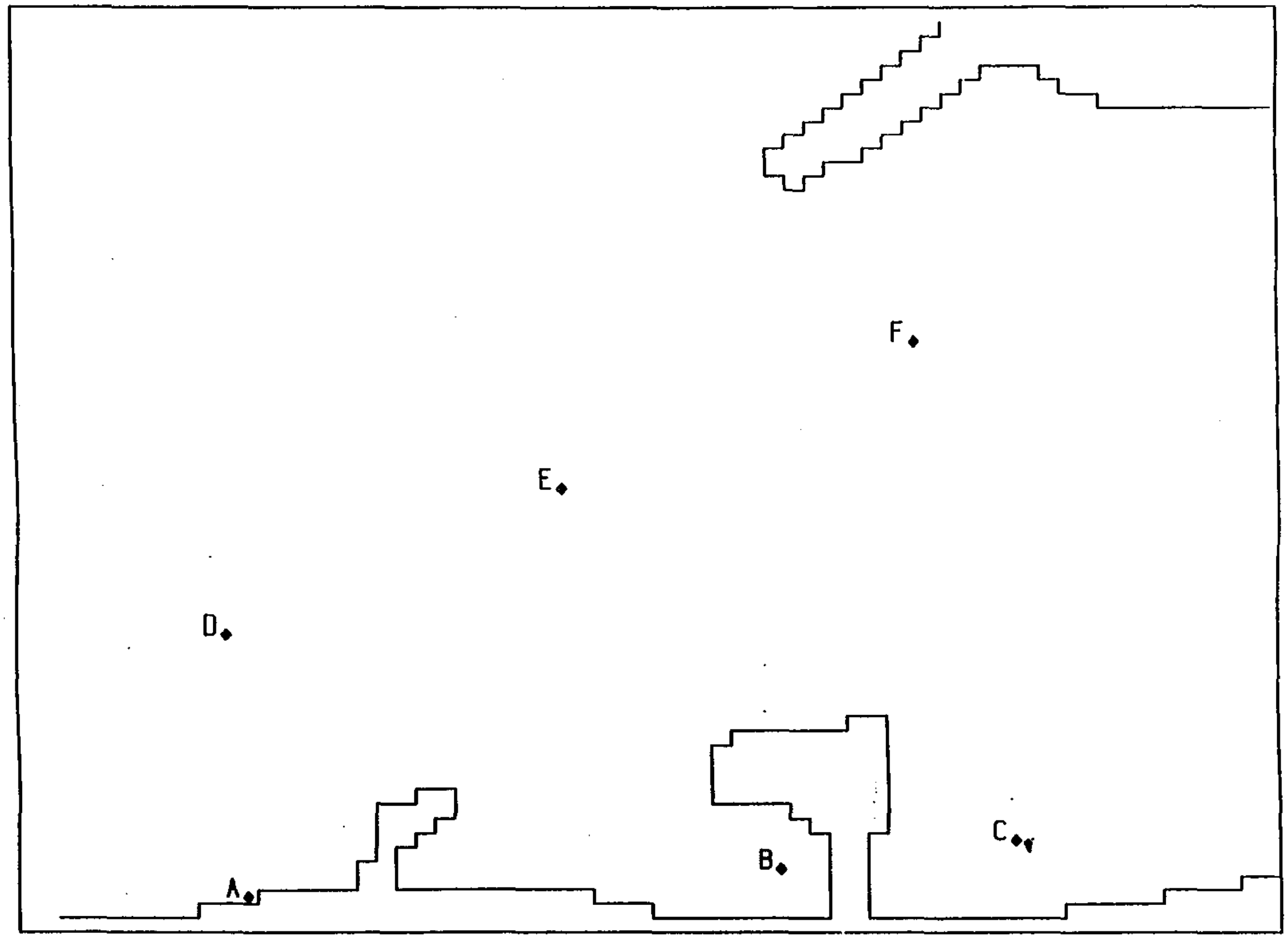
Fig 3.8

FULL RECLAMATION



Temperature distributions : final Fig 3.9
Dry neap tide : surface layer

FULL RECLAMATION

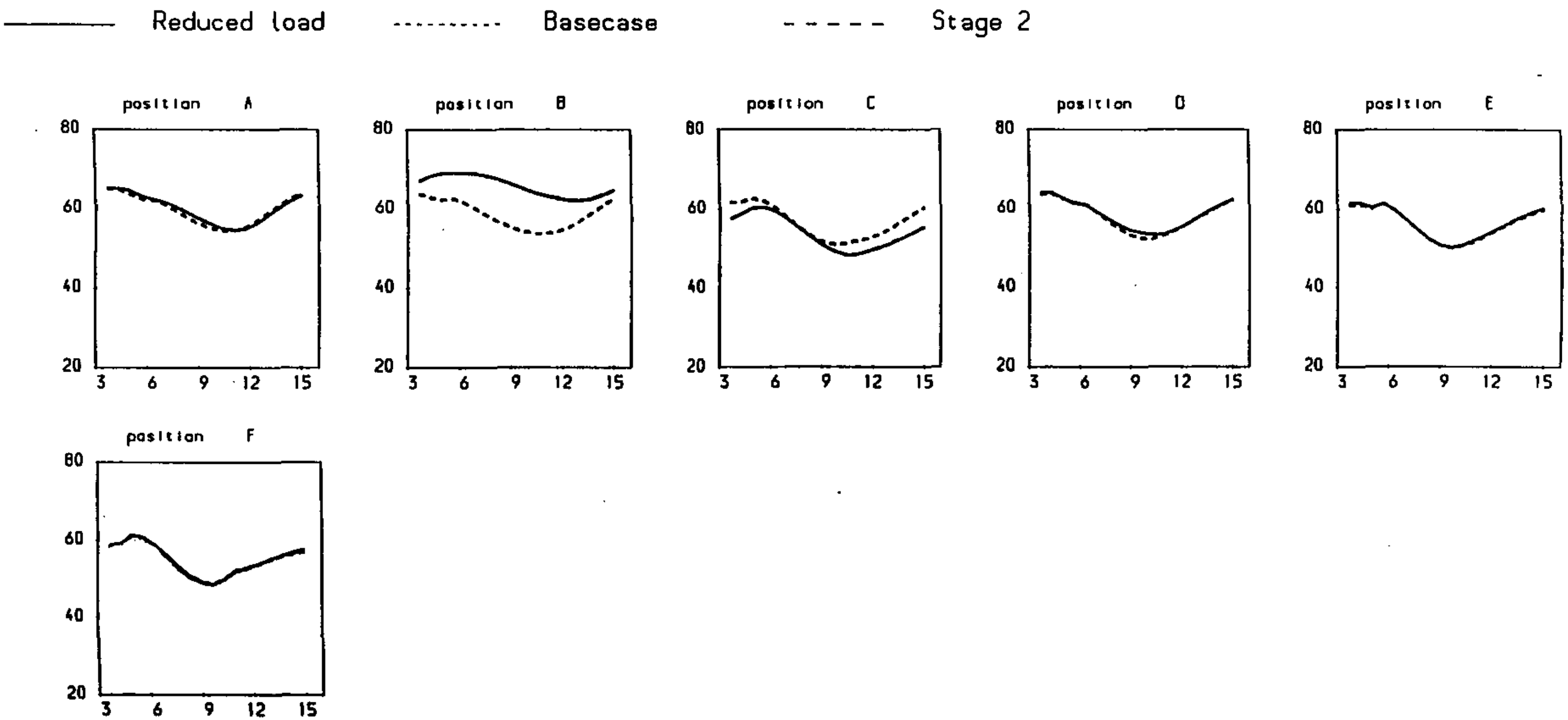


Location of Model Positions for Plotting Water Quality Results   Figure 3.10

Central & Wanchai Reclamation

2-layer model - neap tide

distribution of Dissolved Oxygen (% saturation) against time



PARTIAL RECLAMATION

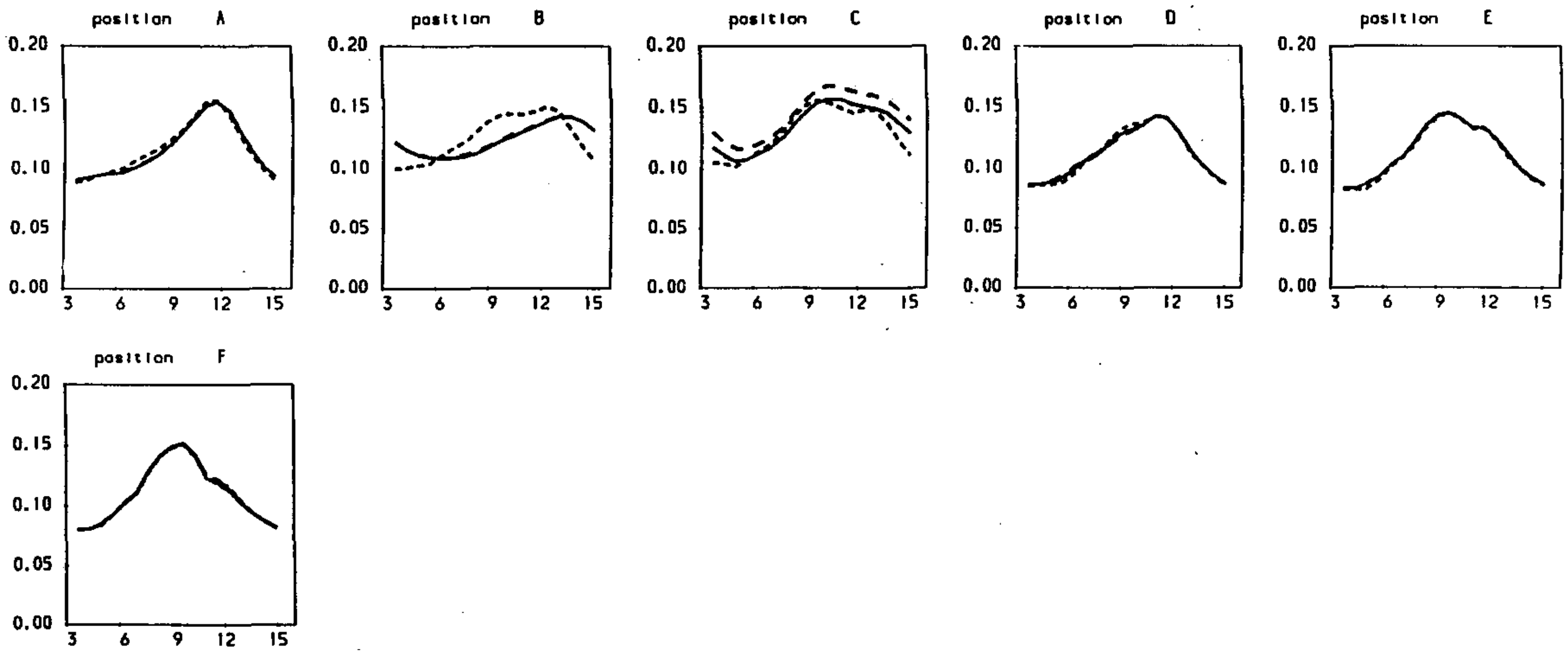
Dry Season Neap Tide : Comparison of Dissolved Oxygen (% saturation) Figure 3.11

Central & Wanchai Reclamation

2-layer model - neap tide

distribution of Ammoniacal Nitrogen (mg N/l) against time

——— Reduced load ---------- Basecase - - - - - Stage 2



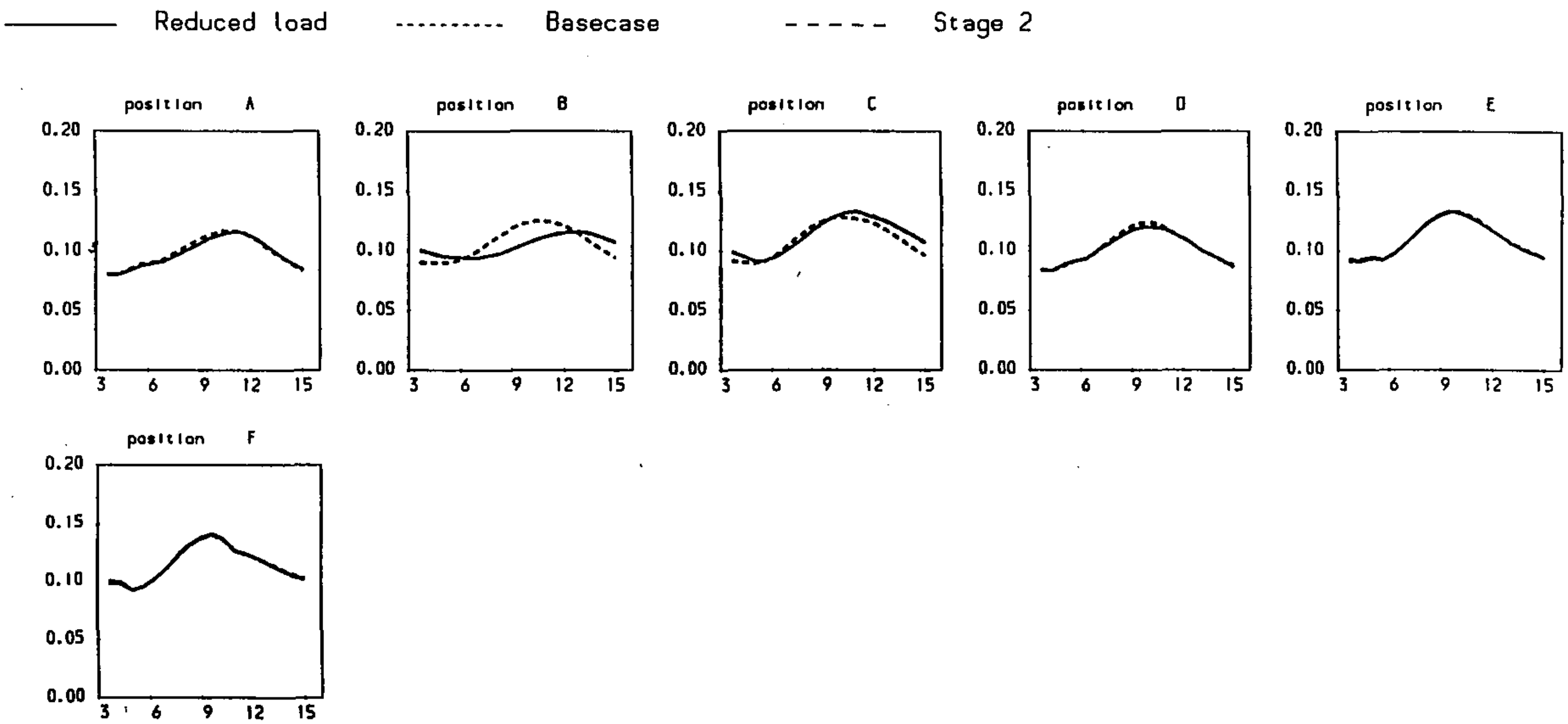
PARTIAL RECLAMATION

Dry Season Neap Tide : Comparison of Ammoniacal Nitrogen (mg/l) Figure 3.1

Central & Wanchai Reclamation

2-layer model - neap tide

distribution of Oxidised Nitrogen (mg N/l) against time



PARTIAL RECLAMATION

Dry Season Neap Tide : Comparison of Oxidised Nitrogen (mg/l) Figure 3.13

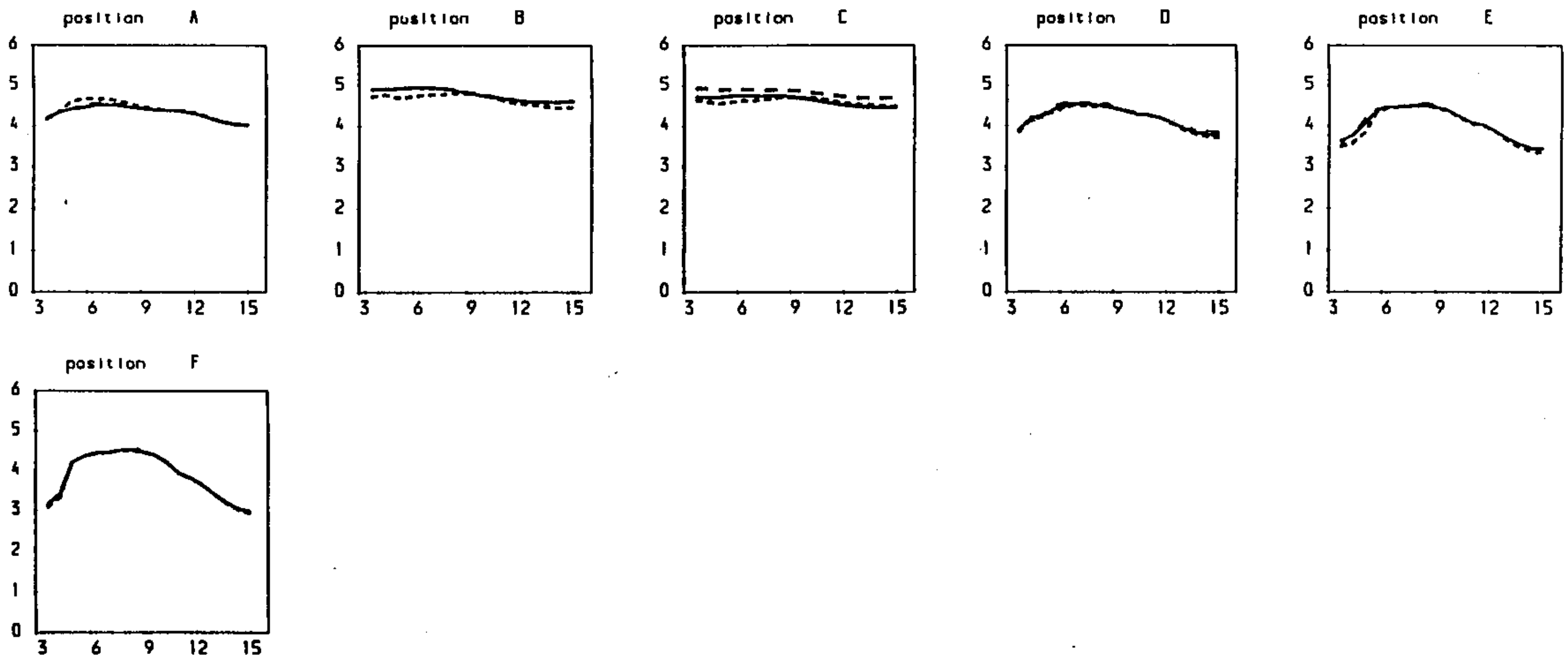
Central & Wanchai Reclamation

2-layer model - neap tide

distribution of E.Coli (no/100ml) against time

note log-scale to base 10 on y-axis

——— Reduced load ---------- Basecase - - - - - Stage 2



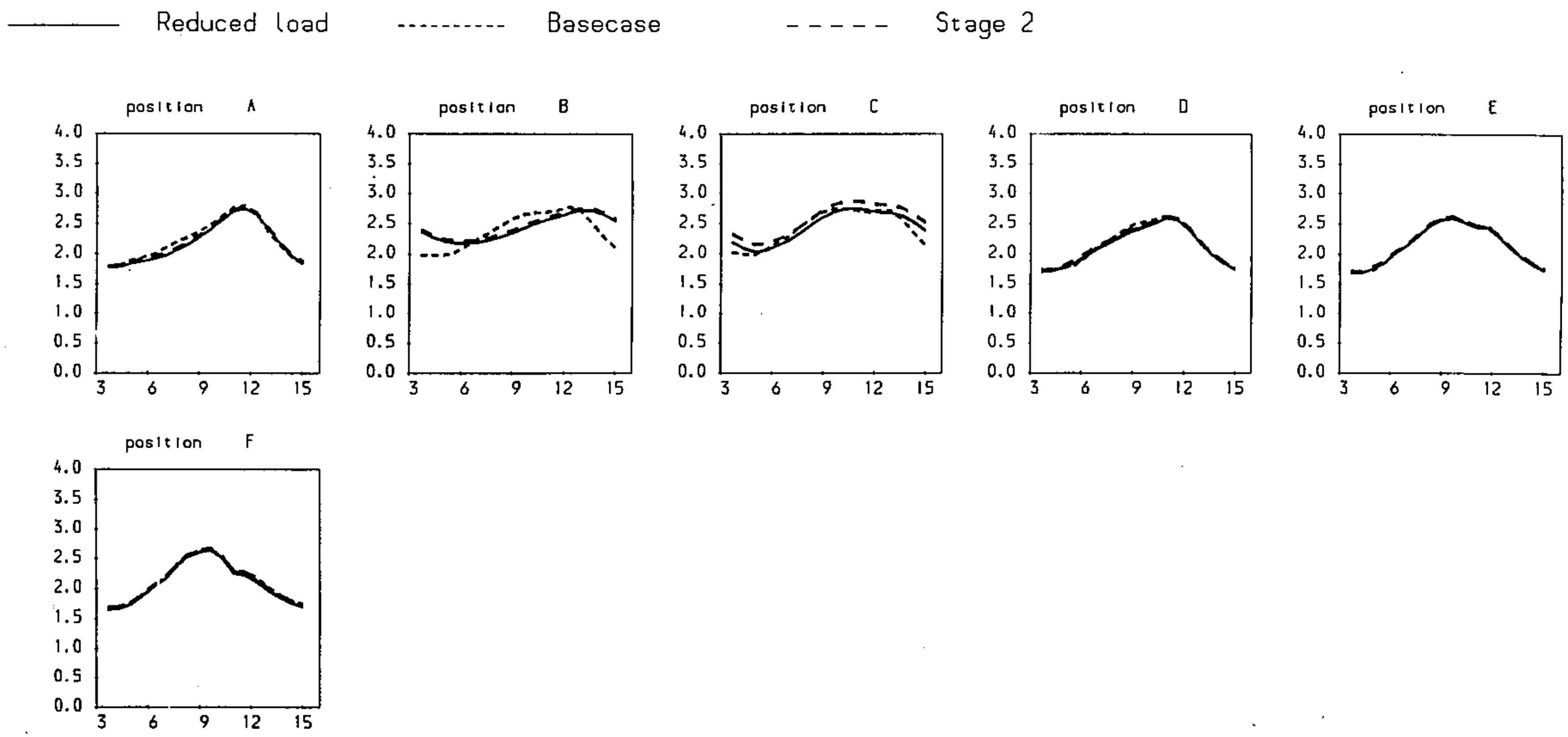
PARTIAL RECLAMATION

Dr[illegible]ason[illegible]ap T[illegible]: Co[illegible]riso[illegible]E.C[illegible]/100[illegible] Figure 3.1[illegible]

Central & Wanchai Reclamation

2-layer model - neap tide

distribution of BOD (mg /l) against time



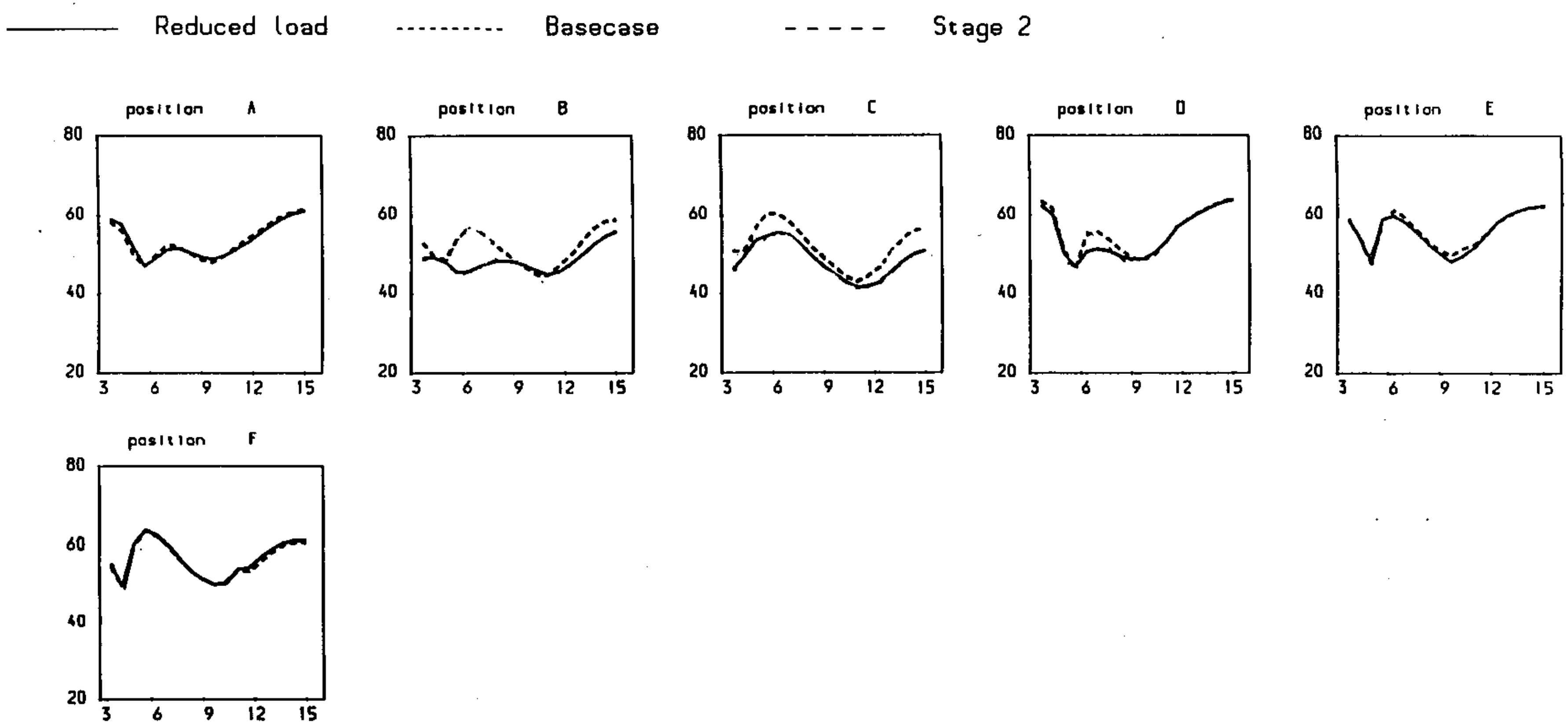
PARTIAL RECLAMATION

Dry Season Neap Tide : Comparison of BOD Concentrations (mg/l) Figure 3.15

Central & Wanchai Reclamation (Wet)

2-layer model - neap tide

distribution of Dissolved Oxygen (% saturation) against time



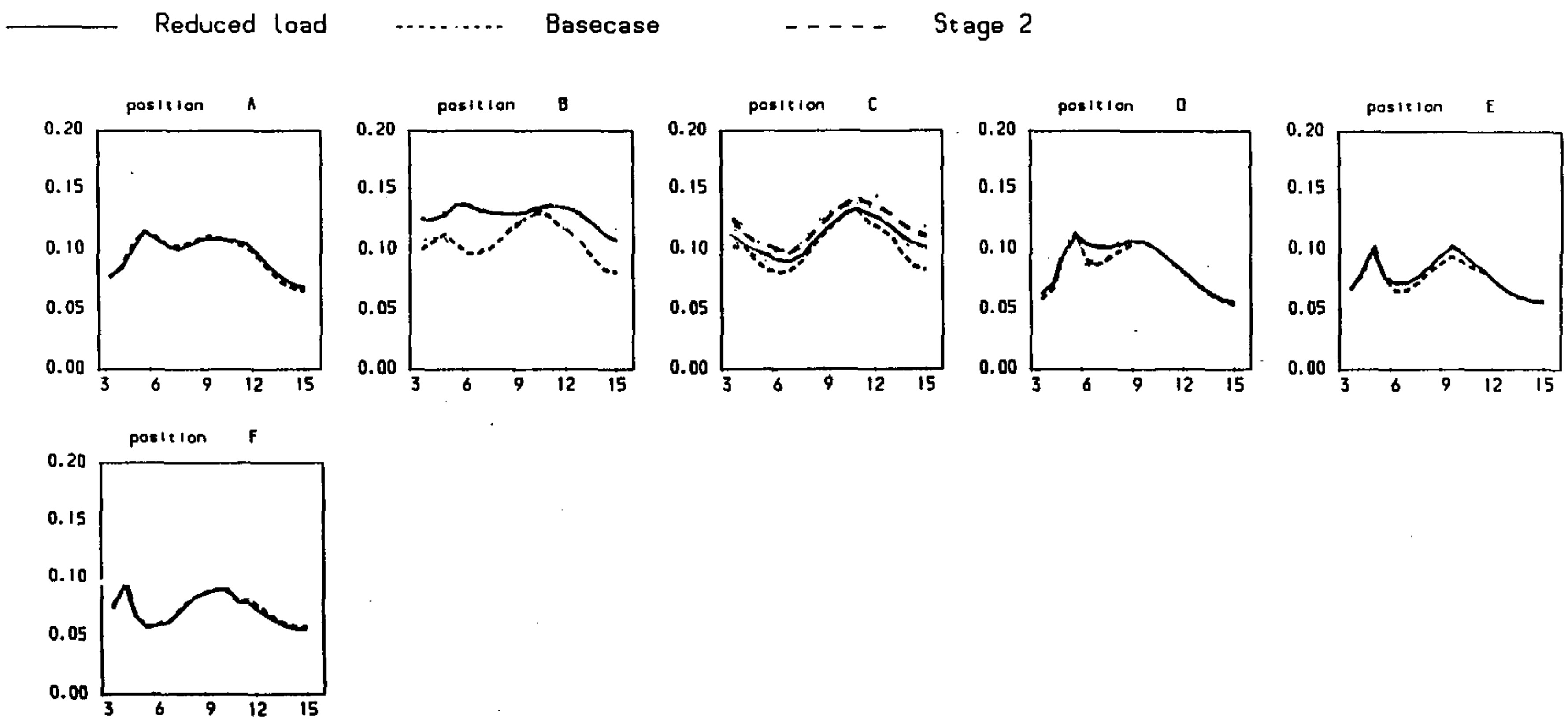
PARTIAL RECLAMATION

Wet [illegible]son [illegible]p Ti[illegible] Co[illegible]ison [illegible] Diss[illegible]d O[illegible]n (%[illegible]urat[illegible] Fi[illegible] 3.1[illegible]

Central & Wanchai Reclamation (Wet)

2-layer model - neap tide

distribution of Ammoniacal Nitrogen (mg N/l) against time



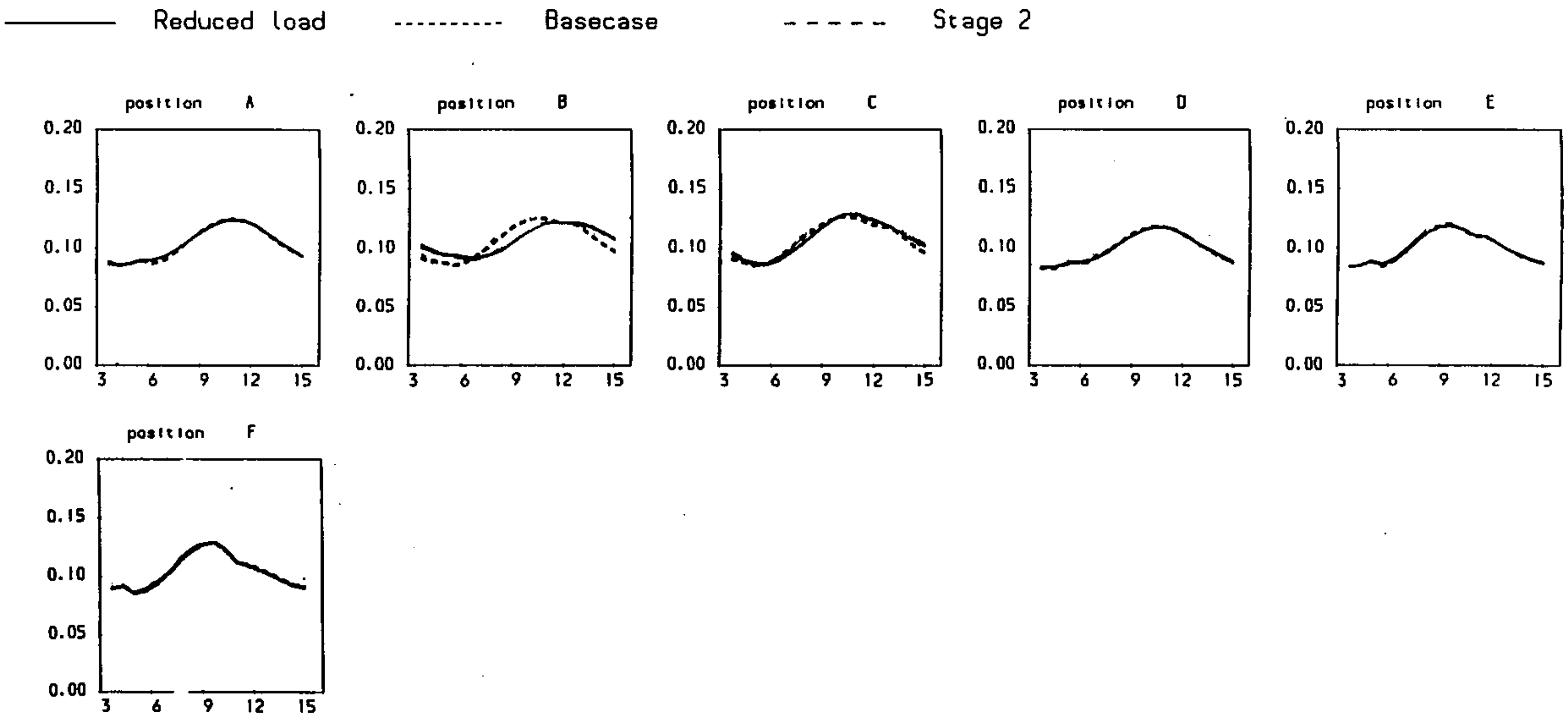
PARTIAL RECLAMATION

Wet Season Neap Tide : Comparison of Ammoniacal Nitrogen (mg/l) Figure 3.17

Central & Wanchai Reclamation (Wet)

2-layer model - neap tide

distribution of Oxidised Nitrogen (mg N/l) against time



PARTIAL RECLAMATION

Wet Season Neap Tide : Comparison of Oxidised Nitrogen (mg/l) Figure 3.1

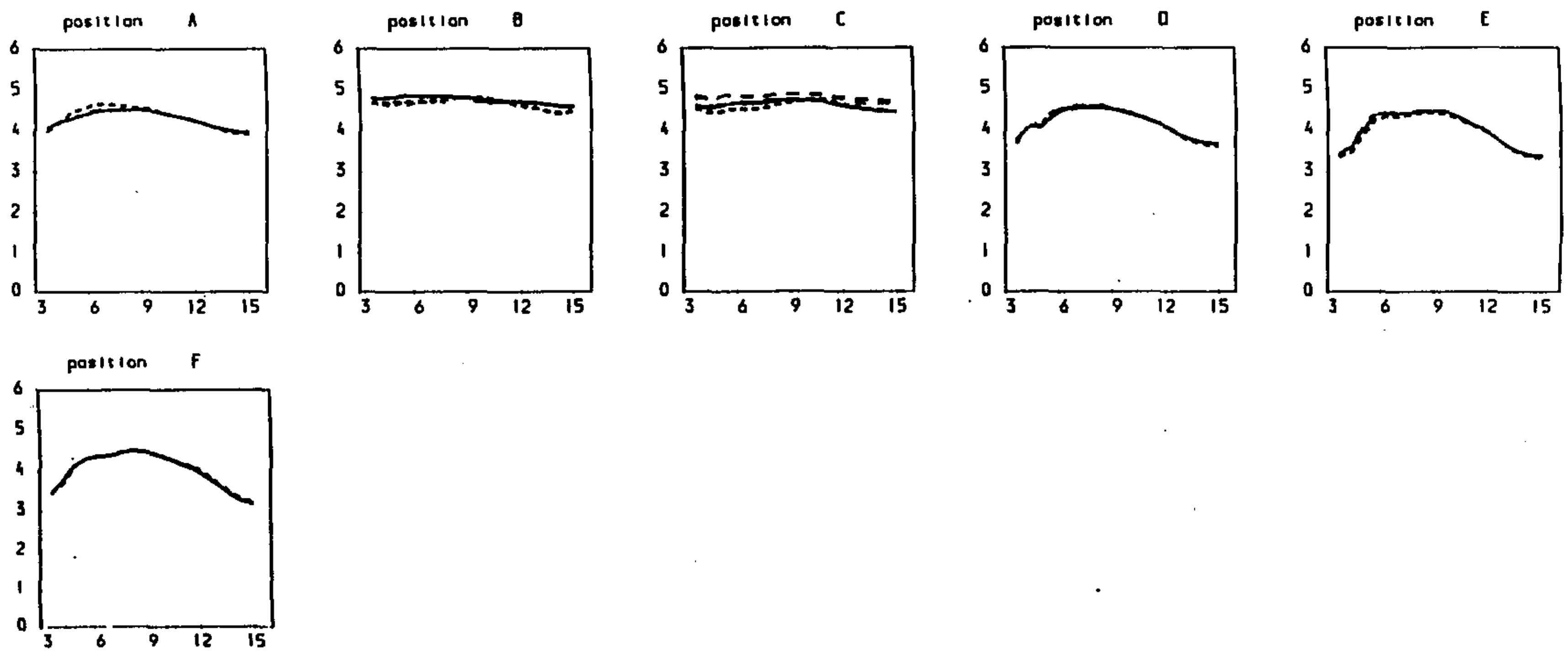
Central & Wanchai Reclamation (Wet)

2-layer model - neap tide

distribution of E.Coli (no/100ml) against time

note log-scale to base 10 on y-axis

——— Reduced load ·········· Basecase - - - - - Stage 2



PARTIAL RECLAMATION

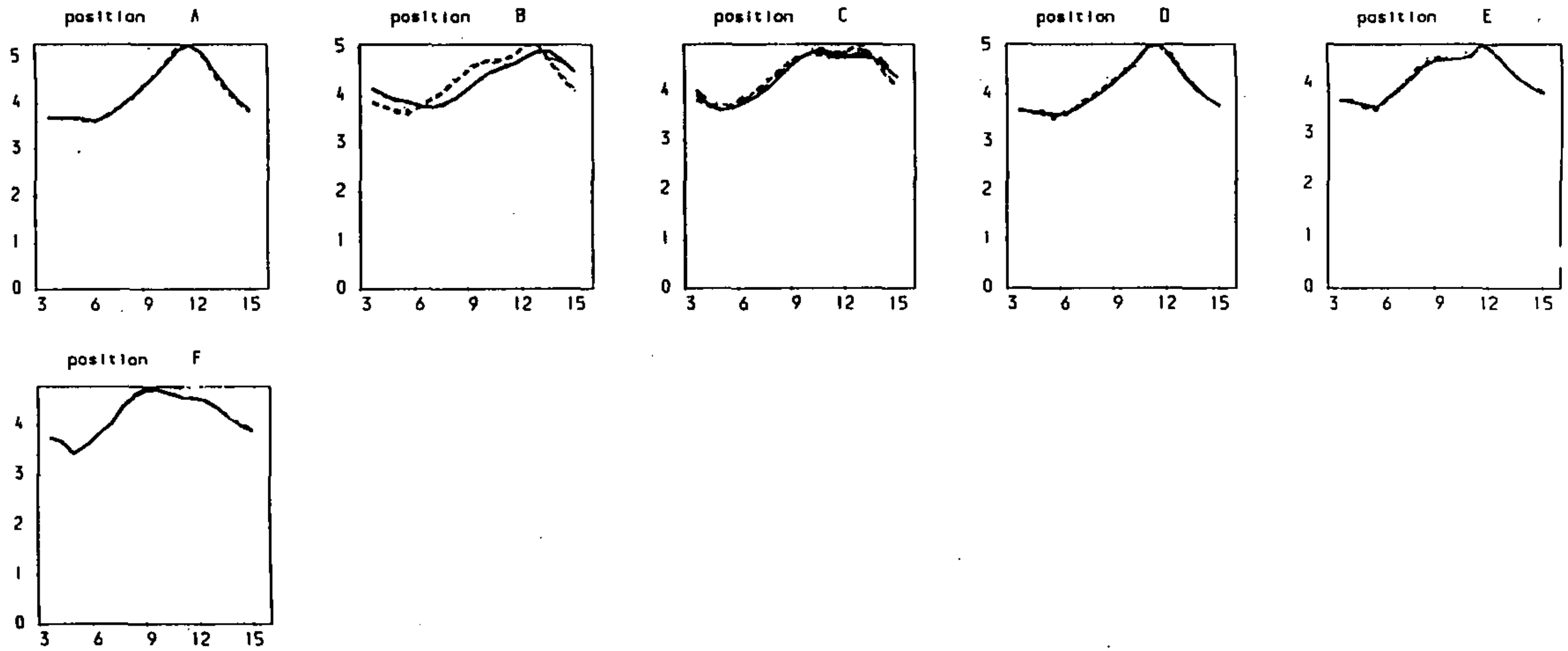
Wet Season Neap Tide : Comparison of E.Coli (/100ml) Figure 3.19

Central & Wanchai Reclamation (Wet)

2-layer model - neap tide

distribution of BOD (mg /l) against time

——— Reduced load ---------- Basecase - - - - - Stage 2



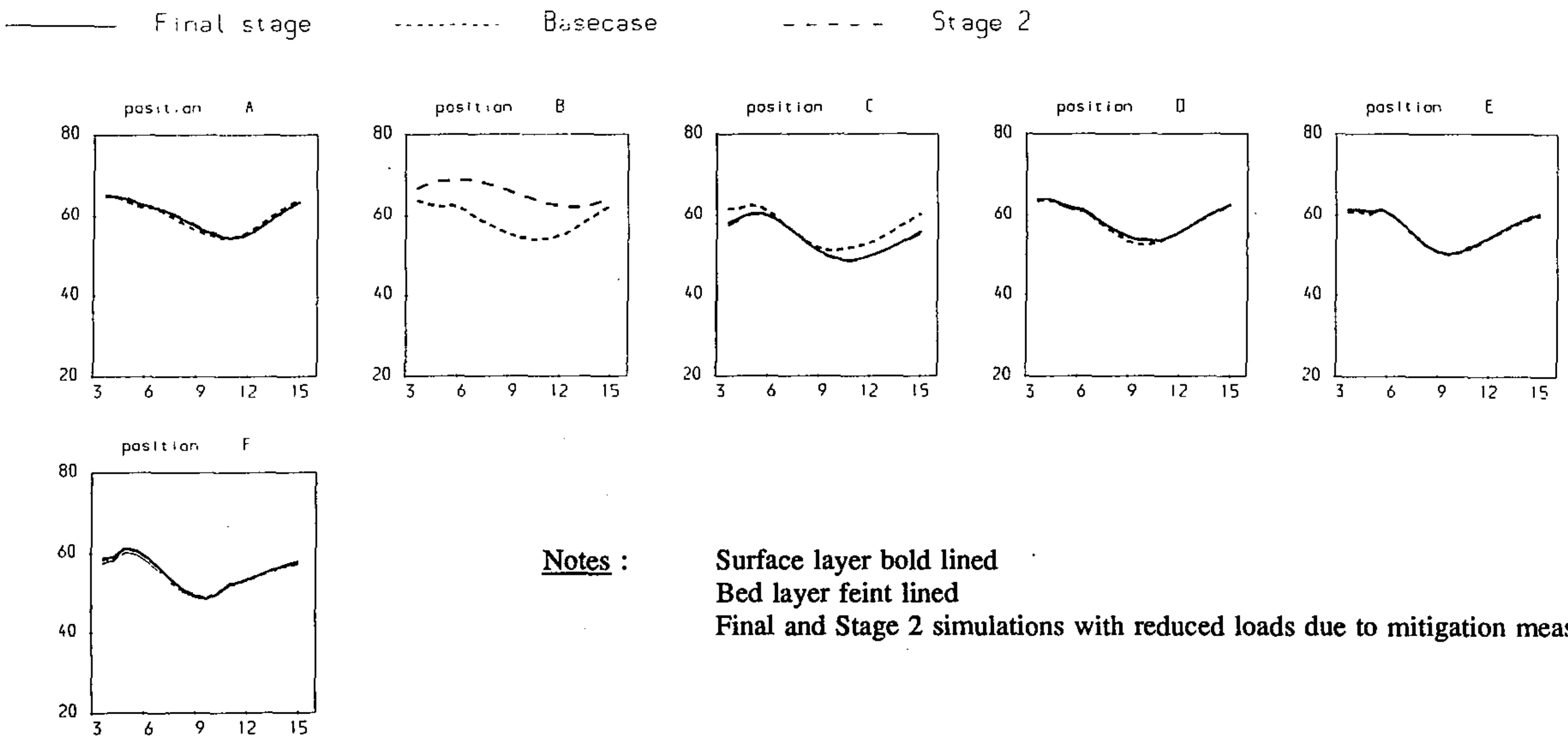
PARTIAL RECLAMATION

Wet Season Neap Tide - Comparison of BOD Concentrations (mg/l) Figure 3.20

Central & Wanchai Reclamation

2-layer model - neap tide

distribution of Dissolved Oxygen (% saturation) against time



Notes : Surface layer bold lined
Bed layer feint lined
Final and Stage 2 simulations with reduced loads due to mitigation measures

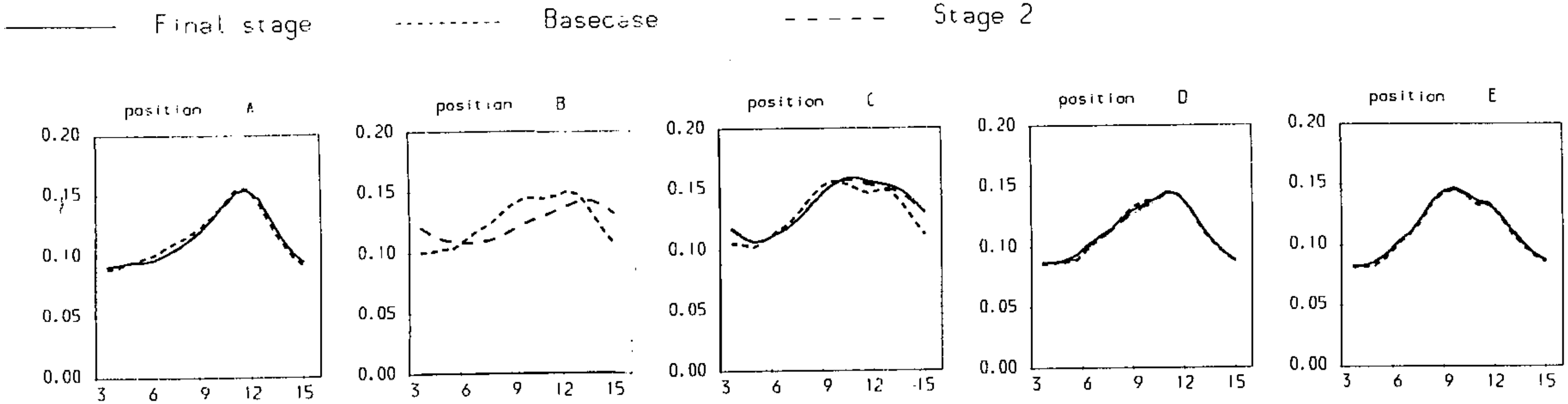
FULL RECLAMATION

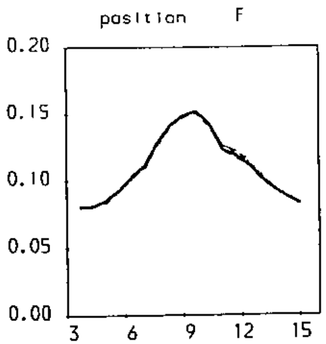
Dry Season Neap Tide : Comparison of Dissolved Oxygen (% saturation) Figure 3.21

Central & Wanchai Reclamation

2-layer model - neap tide

distribution of Ammoniacal Nitrogen (mg N/l) against time





<u>Notes</u> : Surface layer bold lined
Bed layer feint lined
Final and Stage 2 simulations with reduced loads due to mitigation measures

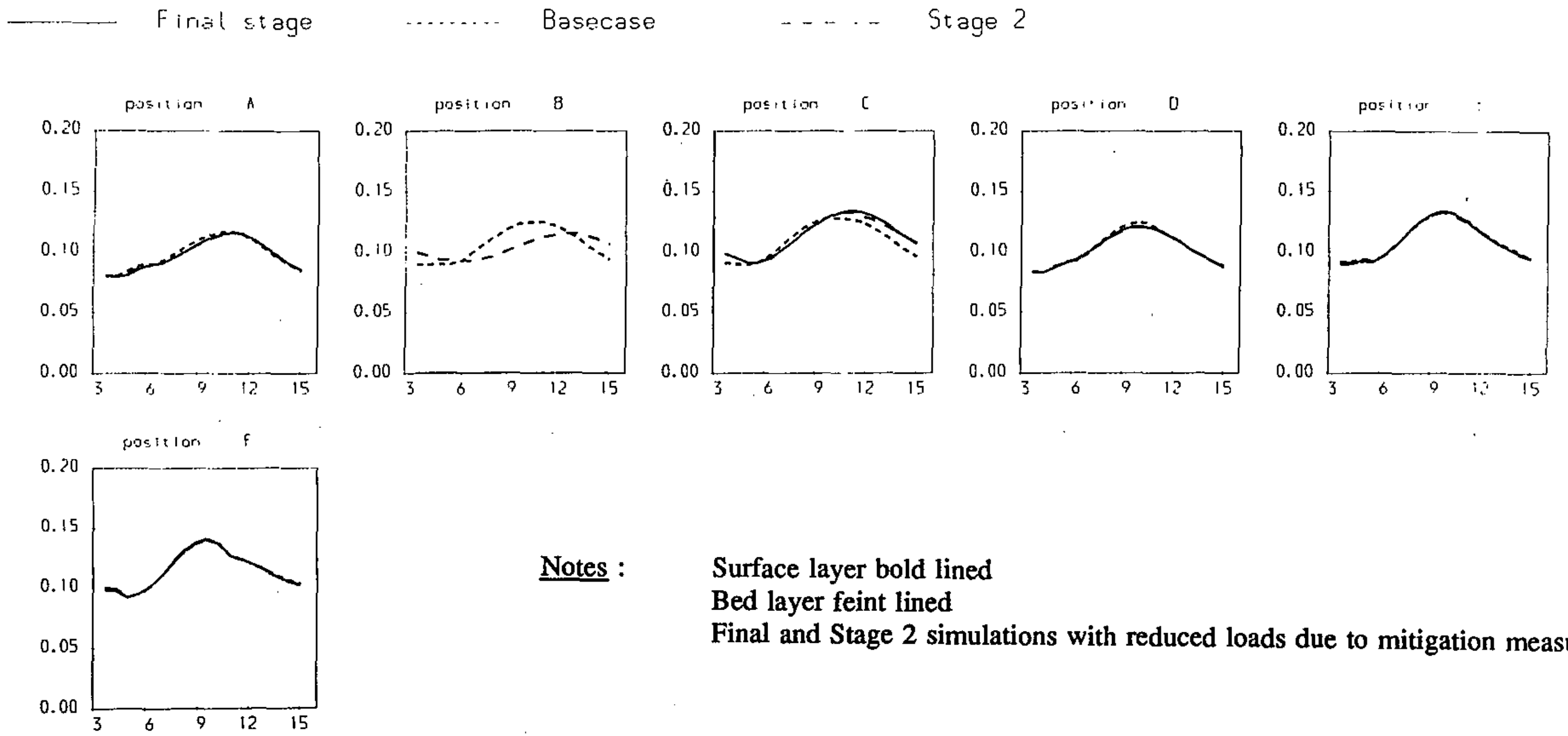
FULL RECLAMATION

Dry Season Neap Tide : Comparison of Ammoniacal Nitrogen (mg/l) Figure 3.22

Central & Wanchai Reclamation

2-layer model - neap tide

distribution of Oxidised Nitrogen (mg N/l) against time



Notes : Surface layer bold lined
Bed layer feint lined
Final and Stage 2 simulations with reduced loads due to mitigation measures

FULL RECLAMATION

Dry Season Neap Tide : Comparison of Oxidised Nitrogen (mg/l) Figure 3.23

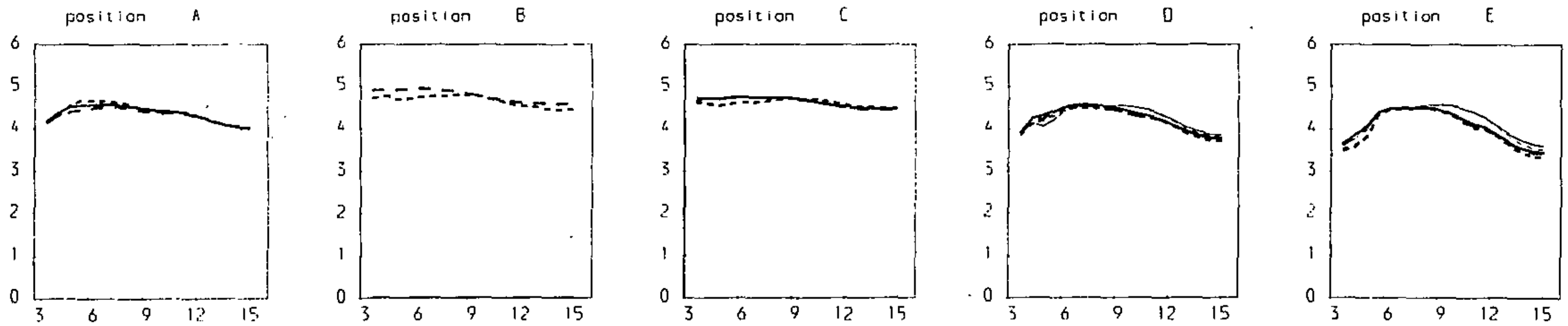
Central & Wanchai Reclamation

2-layer model - neap tide

distribution of E.Coli (no/100ml) against time

note log-scale to base 10 on y-axis

———— Final stage ·········· Basecase - - - - - Stage 2



<u>Notes</u> :

Surface layer bold lined
Bed layer feint lined
Final and Stage 2 simulations with reduced loads due to mitigation measures

FULL RECLAMATION

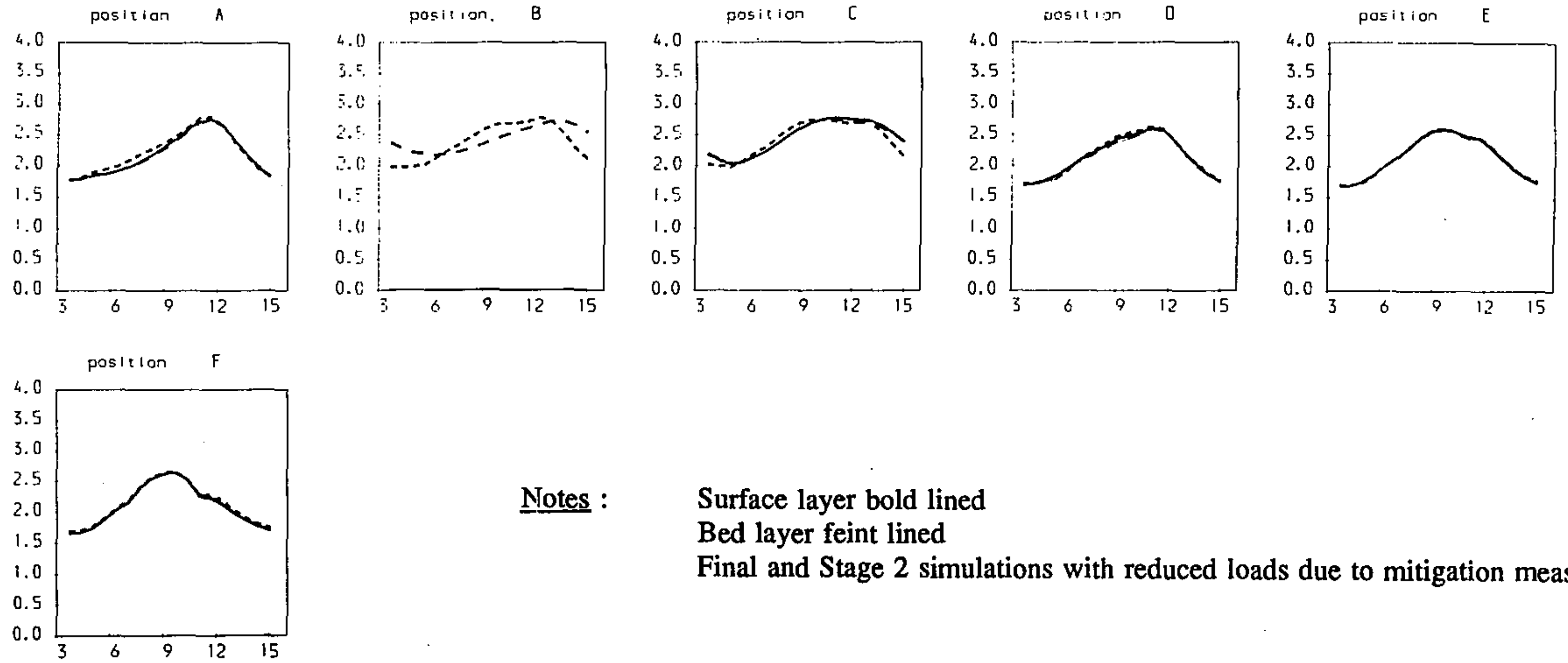
Dry Season Neap Tide : Comparison of E. Coli (No./100ml) Figure 3.24

Central & Wanchai Reclamation

2-layer model - neap tide

distribution of BOD (mg /l) against time

——— Final stage .... Basecase - - - - - Stage 2



<u>Notes</u> : Surface layer bold lined
Bed layer feint lined
Final and Stage 2 simulations with reduced loads due to mitigation measures

FULL RECLAMATION

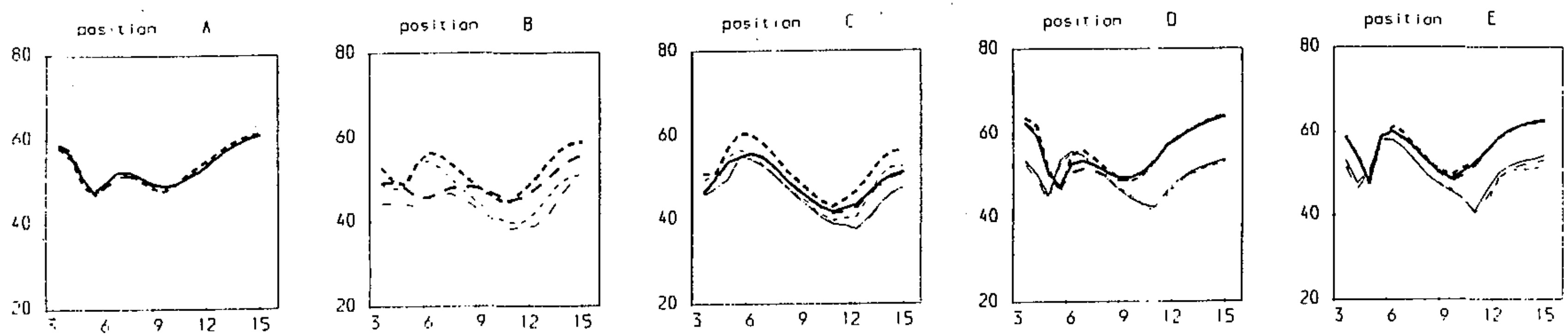
Dry Season Neap Tide : Comparison of BOD (mg/l) Figure 3.25

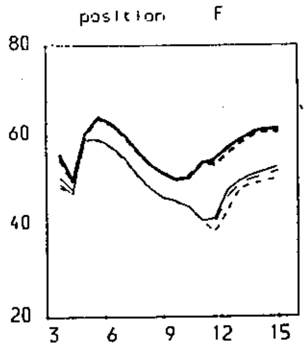
Central & Wanchai Reclamation (Wet)

2-layer model - neap tide

distribution of Dissolved Oxygen (% saturation) against time

——— Final stage ········· Basecase - - - - - Stage 2





<u>Notes</u> : Surface layer bold lined
Bed layer feint lined
Final and Stage 2 simulations with reduced loads due to mitigation measures

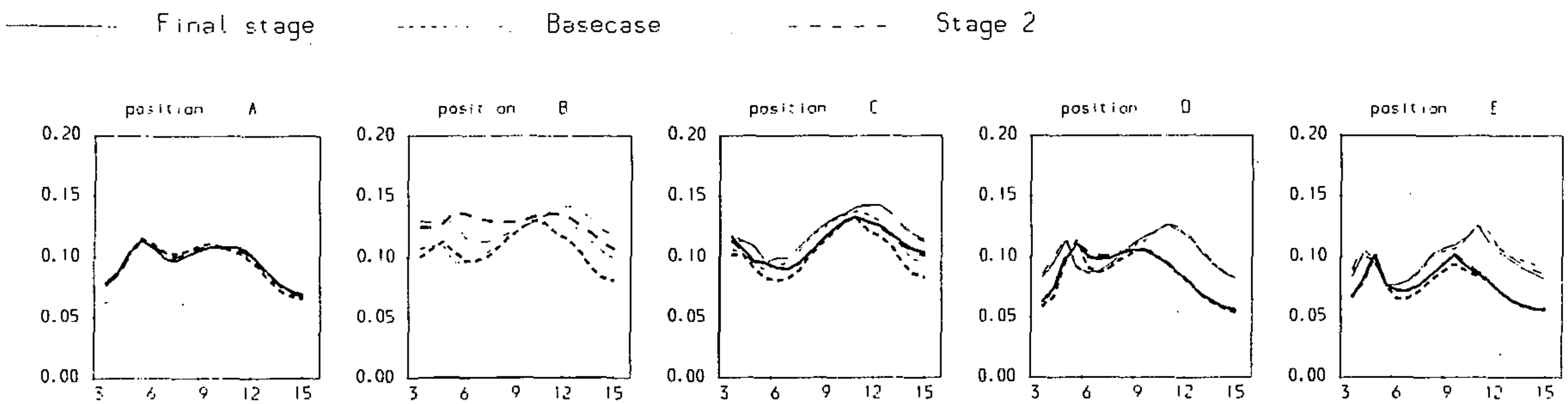
FULL RECLAMATION

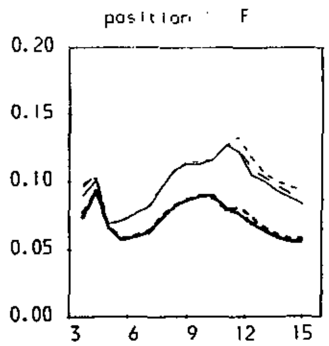
Wet Season Neap Tide : Comparison of Dissolved Oxygen (% saturation) Figure 3.26

Central & Wanchai Reclamation (Wet)

2-layer model - neap tide

distribution of Ammoniacal Nitrogen (mg N/l) against time





<u>Notes</u> :

Surface layer bold lined
Bed layer feint lined
Final and Stage 2 simulations with reduced loads due to mitigation measures

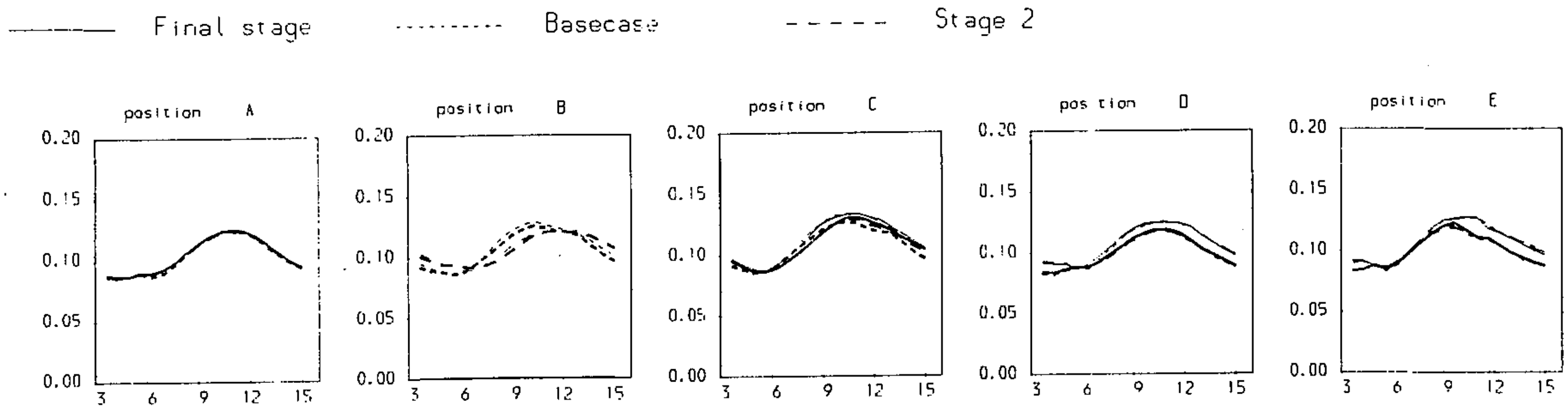
FULL RECLAMATION

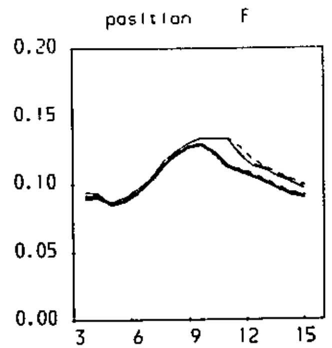
Wet Season Neap Tide : Comparison of Ammoniacal Nitrogen (mg/l) Figure 3.27

Central & Wanchai Reclamation (Wet)

2-layer model - neap tide

distribution of Oxidised Nitrogen (mg N/l) against time





<u>Notes</u> :

Surface layer bold lined
Bed layer feint lined
Final and Stage 2 simulations with reduced loads due to mitigation measures

FULL RECLAMATION

Wet Season Neap Tide : Comparison of Oxidised Nitrogen (mg/l) Figure . 3.28

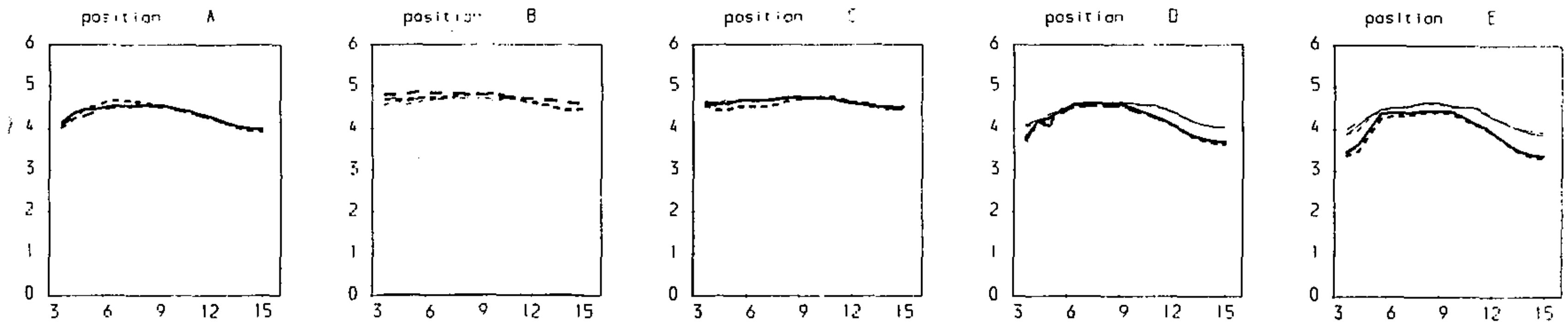
Central & Wanchai Reclamation (Wet)

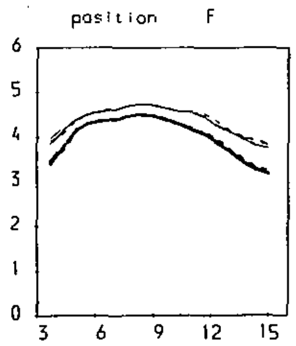
2-layer model - neap tide

distribution of E.Coli (no/100ml) against time

note log-scale to base 10 on y-axis

——— Final stage .... Basecase - - - - - Stage 2





<u>Notes</u> : Surface layer bold lined
Bed layer feint lined
Final and Stage 2 simulations with reduced loads due to mitigation measures

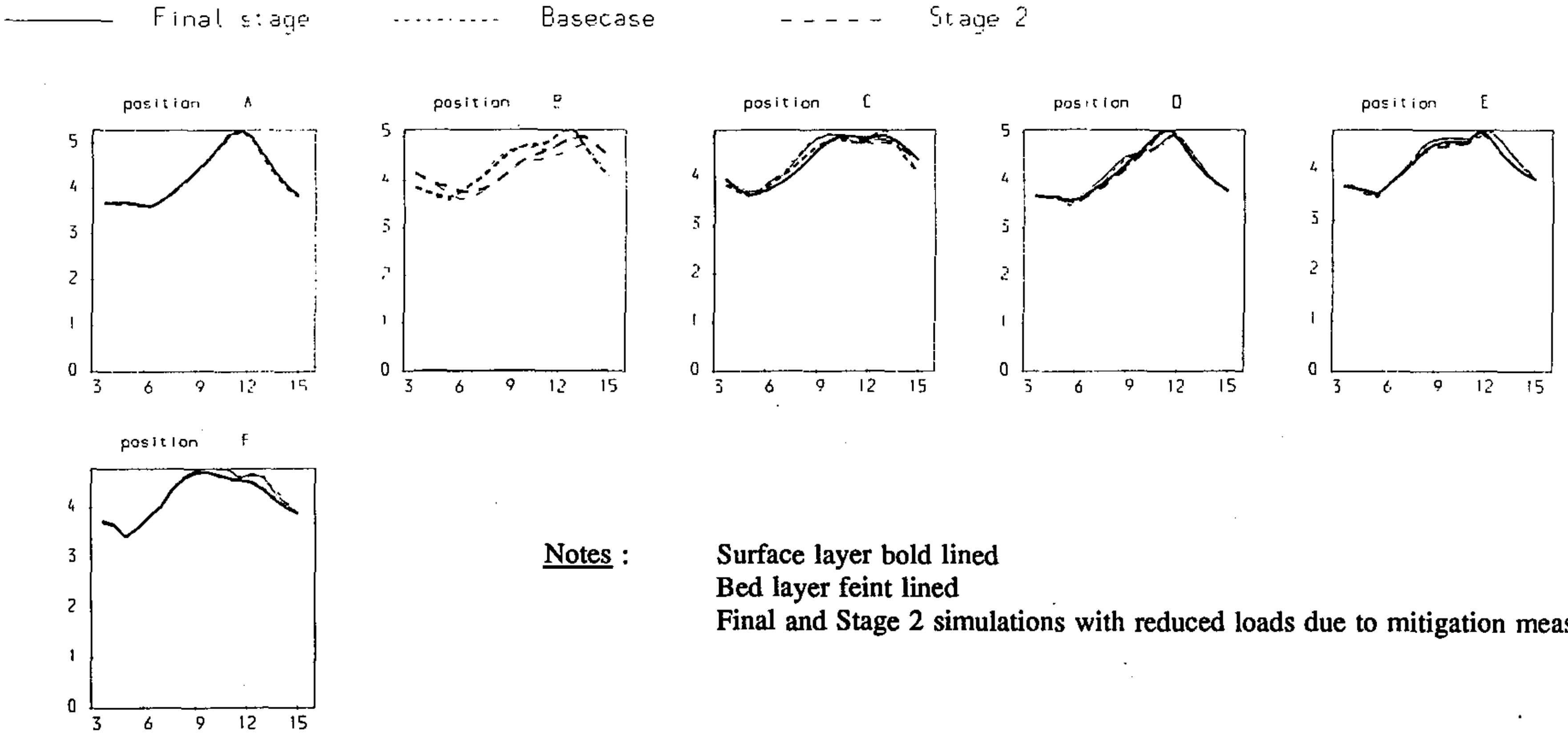
FULL RECLAMATION

Wet Season Neap Tide : Comparison of E. Coli (No./100ml) Figure 3.29

Central & Wanchai Reclamation (Wet)

2-layer model - neap tide

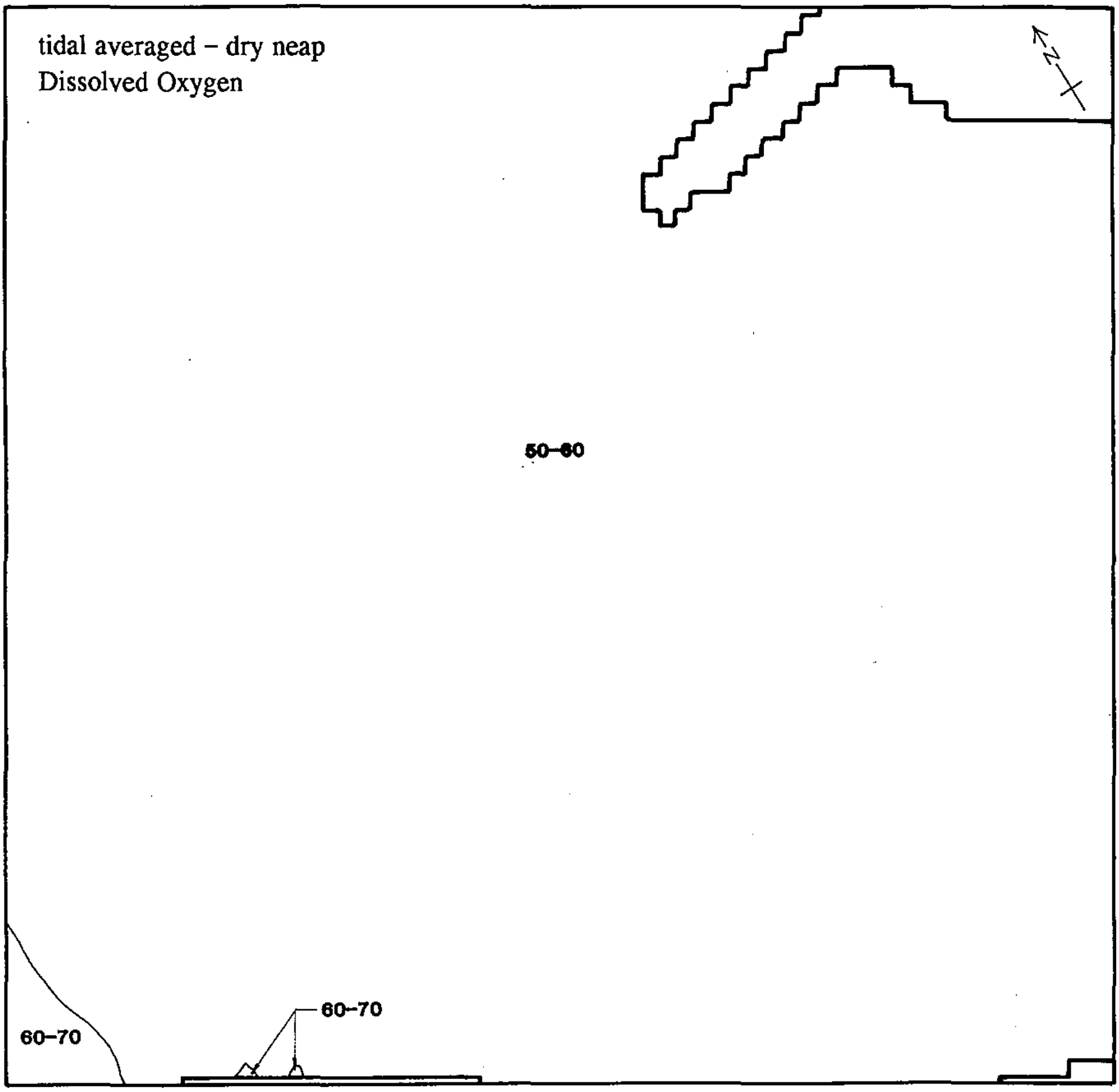
distribution of BOD (mg /l) against time



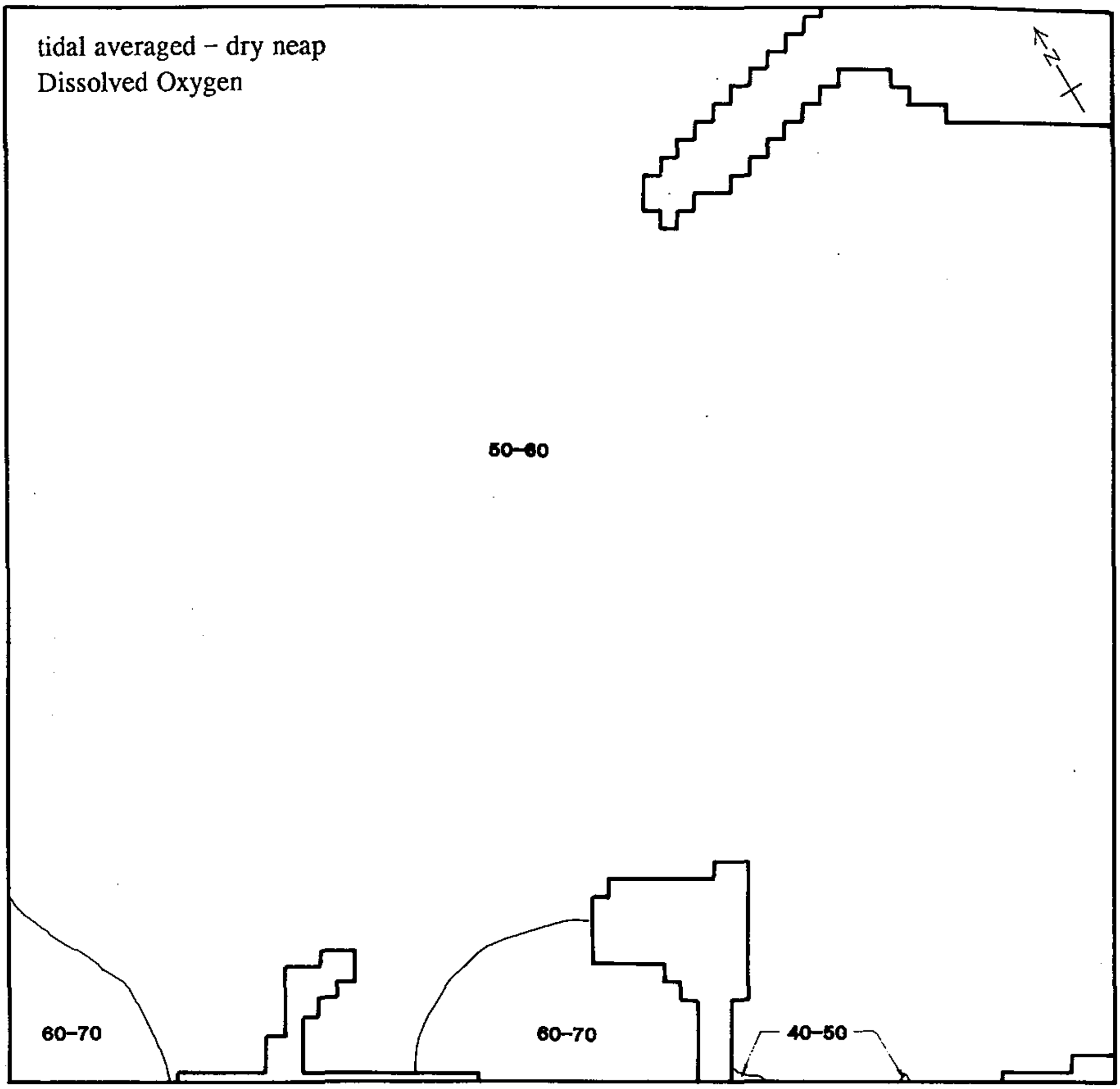
Notes : Surface layer bold lined
Bed layer feint lined
Final and Stage 2 simulations with reduced loads due to mitigation measures

FULL RECLAMATION

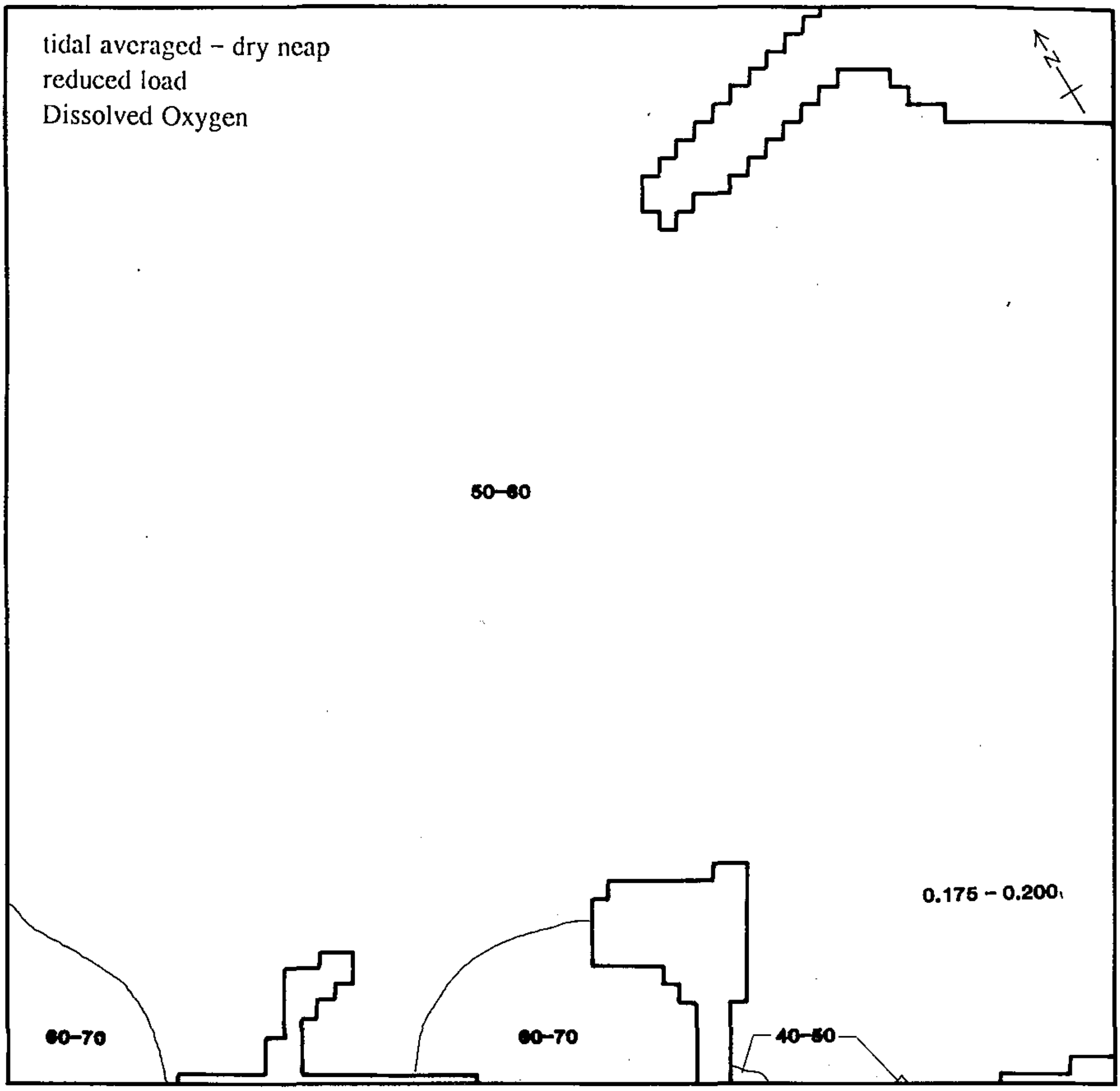
Wet Season Neap Tide : Comparison of BOD (mg/l) Figure . 3.30



Tide Averaged Distribution of Dissolved Oxygen (% sat), Dry Season, Existing Conditions Figure 3.31

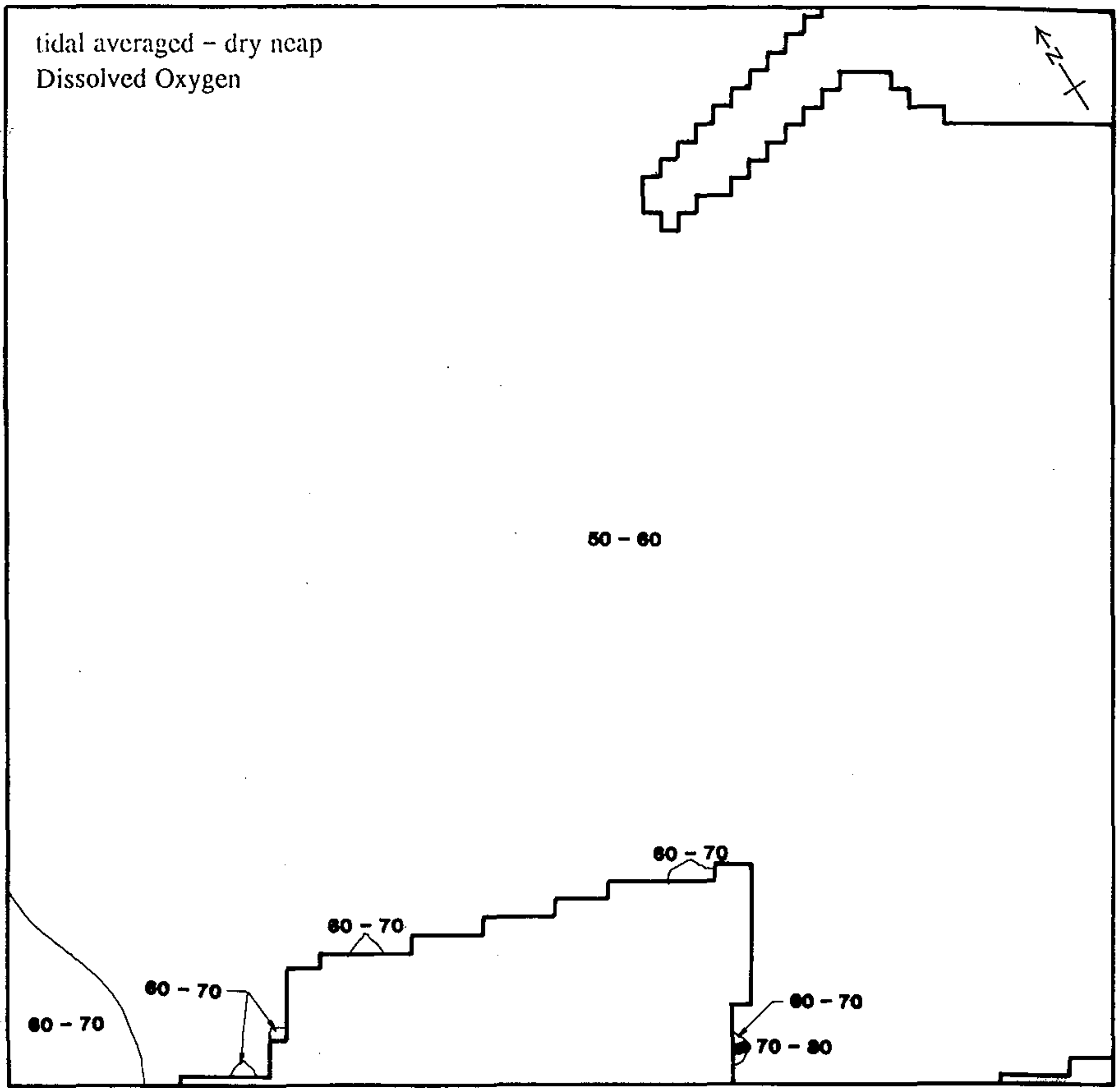


Tide Averaged Distribution of Dissolved Oxygen (% sat), Dry Season, Reclamations Figure 3.32

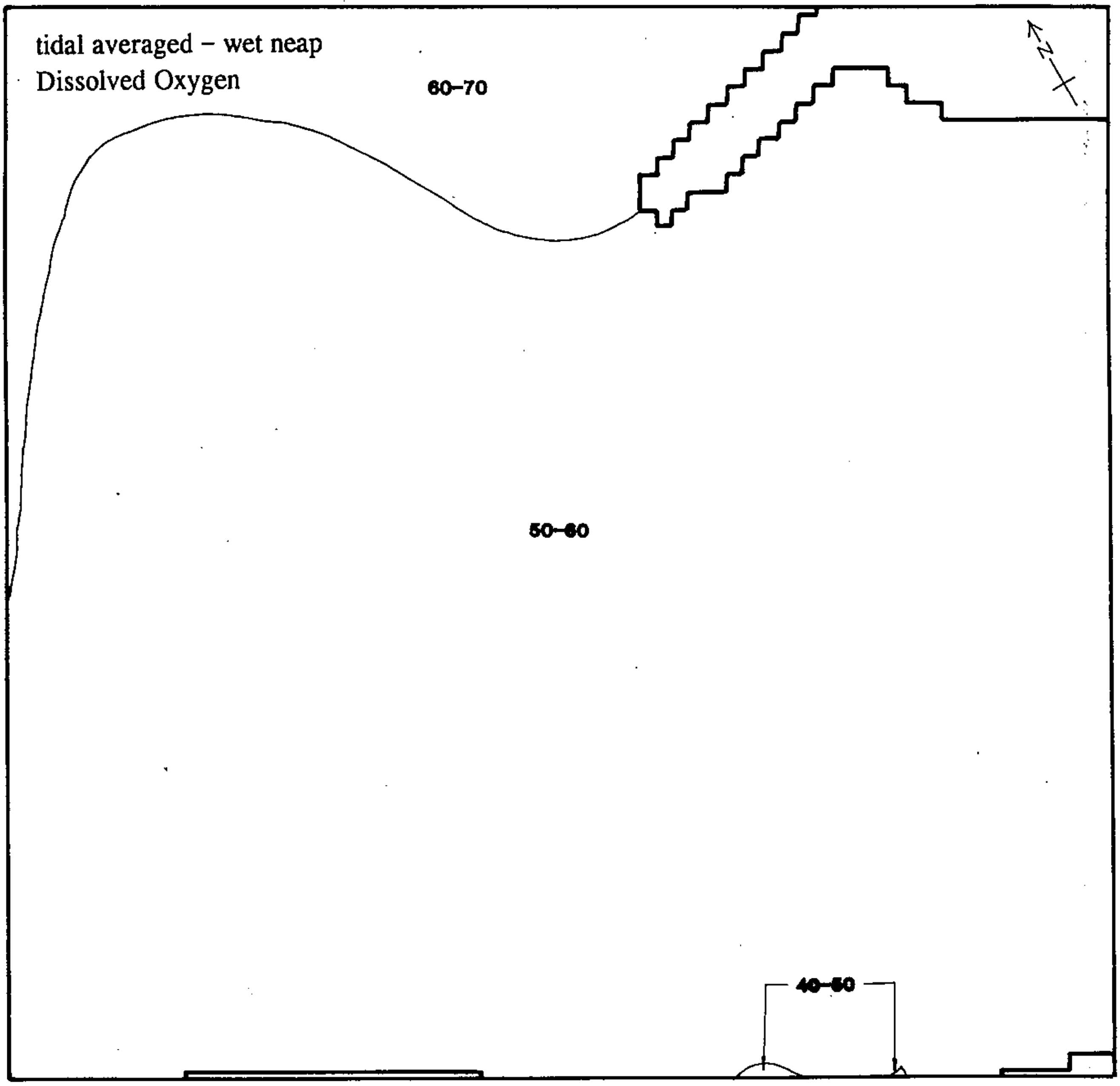


Tide Averaged Distribution of Dissolved Oxygen (% sat), Dry Season, Reclamations Plus Mitigation

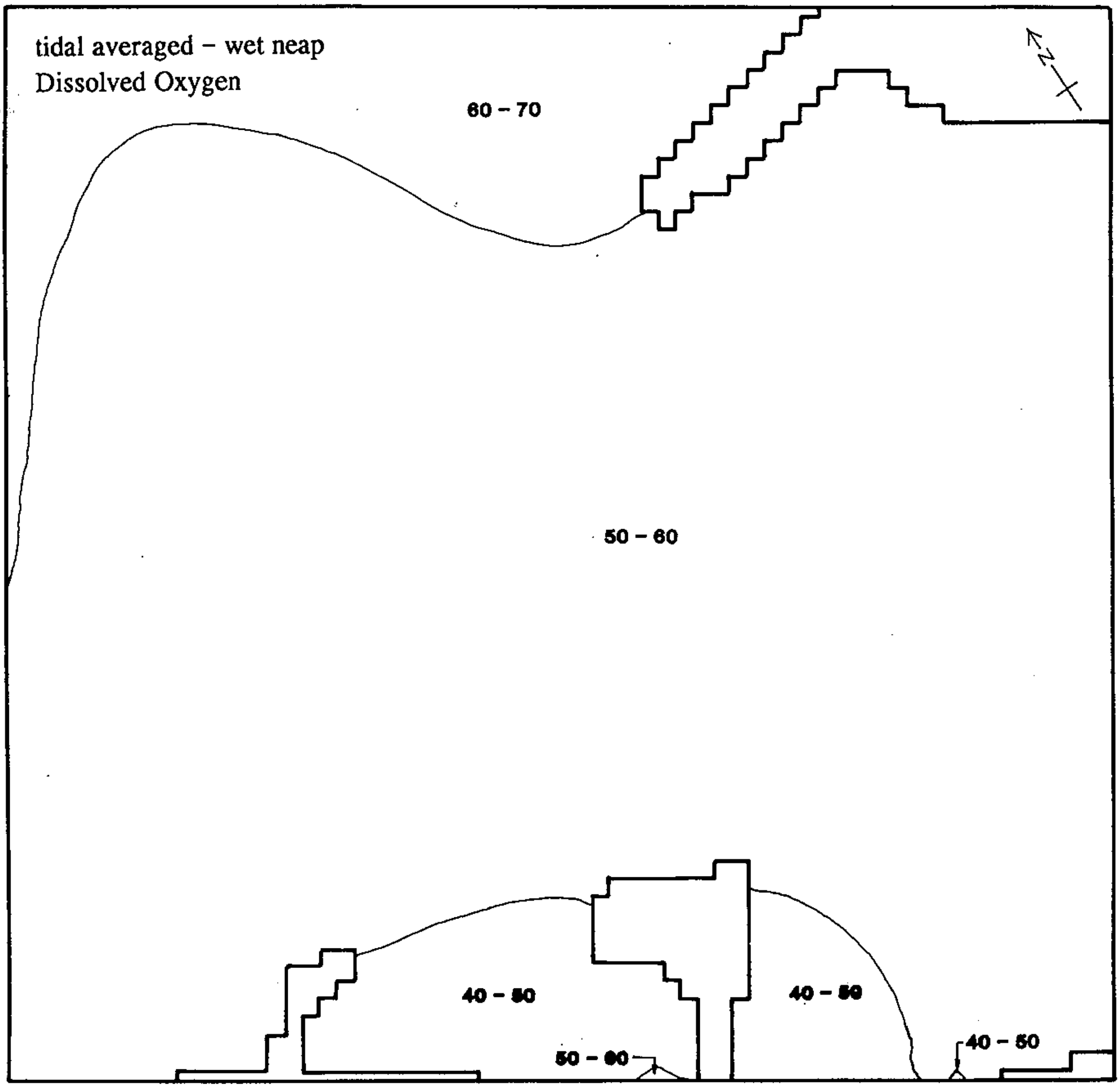
Figure 3.33



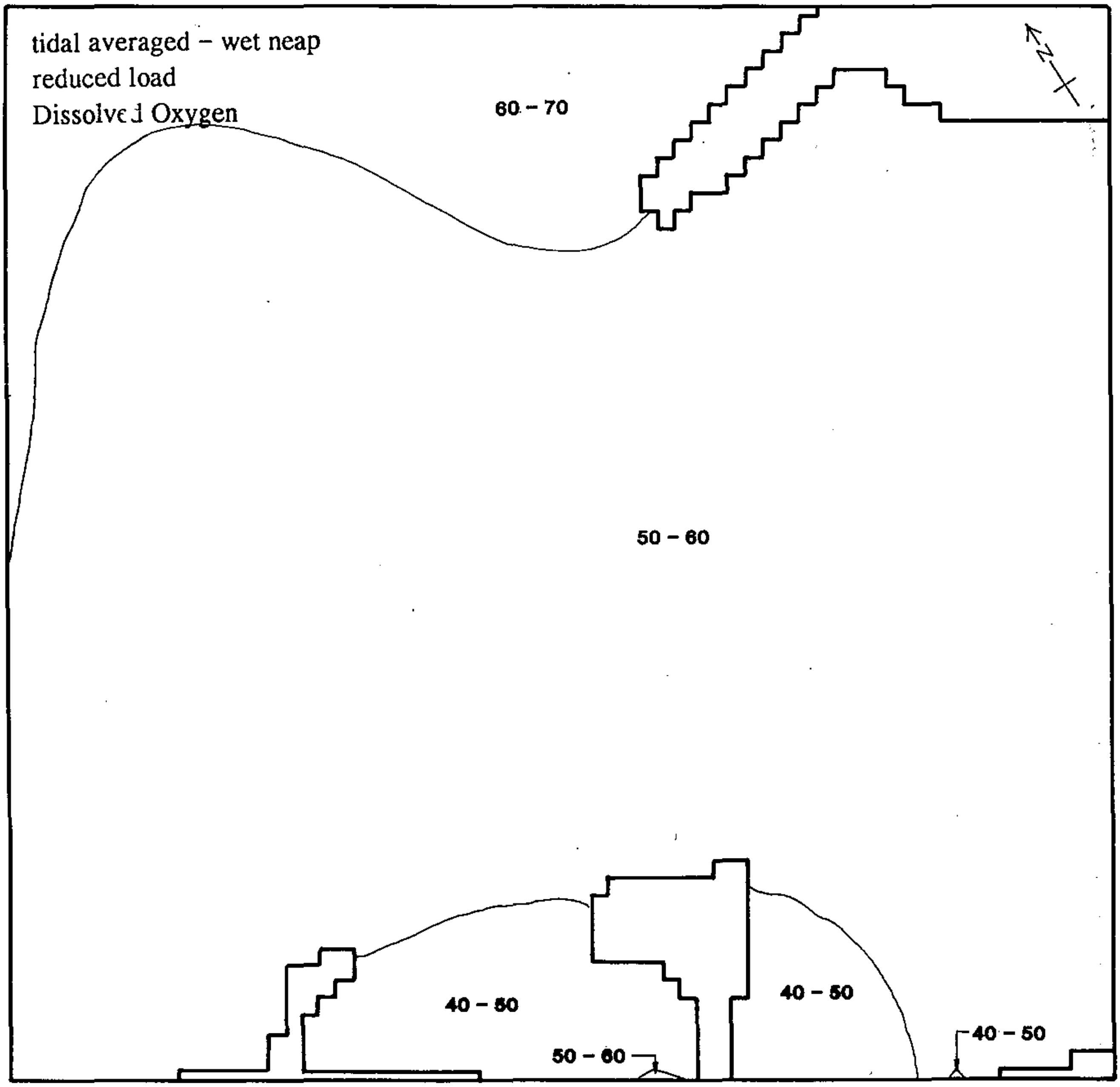
Tide Averaged Dissolved Oxygen (% sat), Dry Season, Full Reclamation Plus Mitigation Figure 3.34



Tide Averaged Distribution of Dissolved Oxygen (% sat), Wet Season, Existing Conditions Figure 3.35

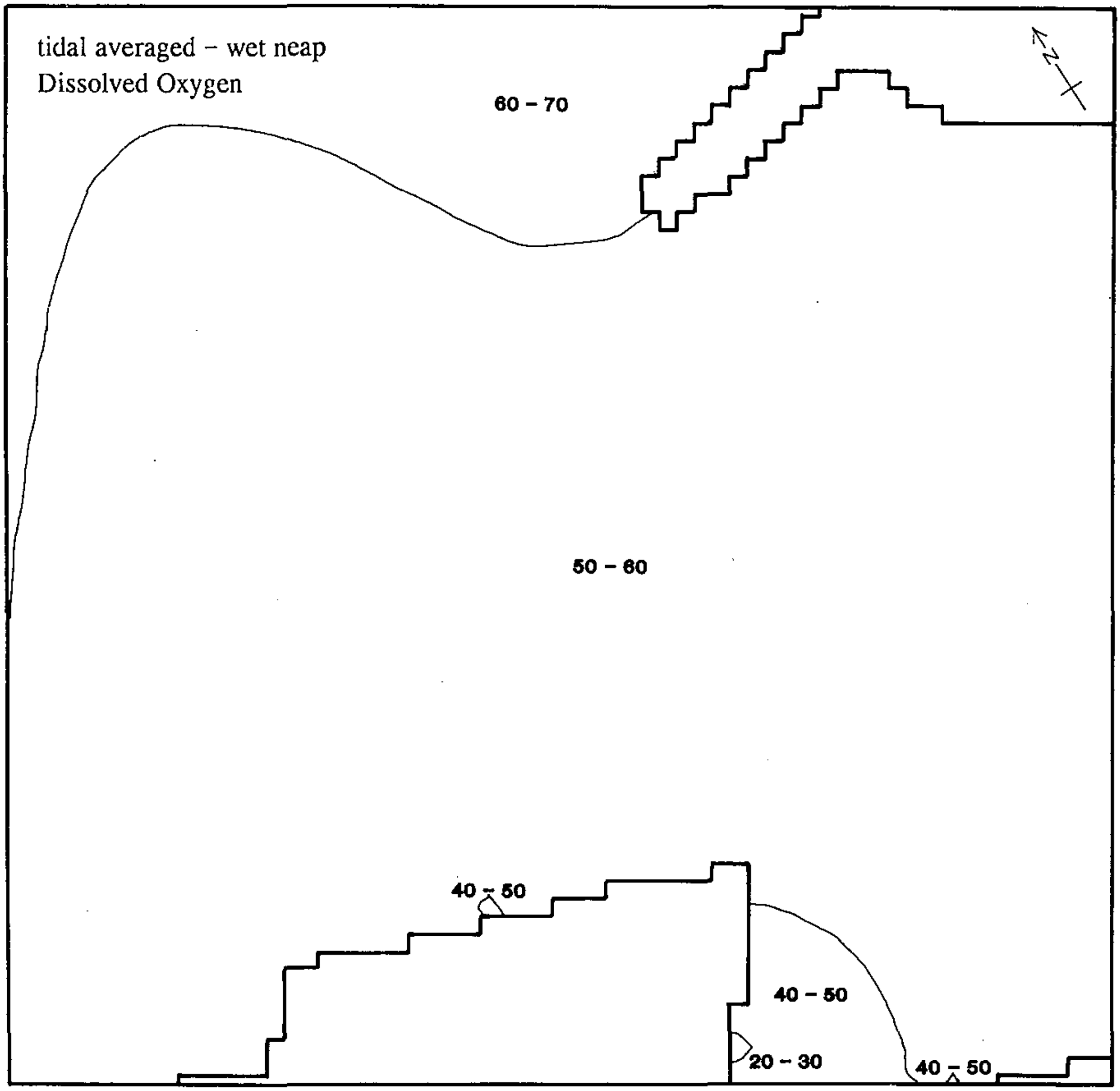


Tide Averaged Distribution of Dissolved Oxygen (% sat), Wet Season, Reclamations Figure 3.36

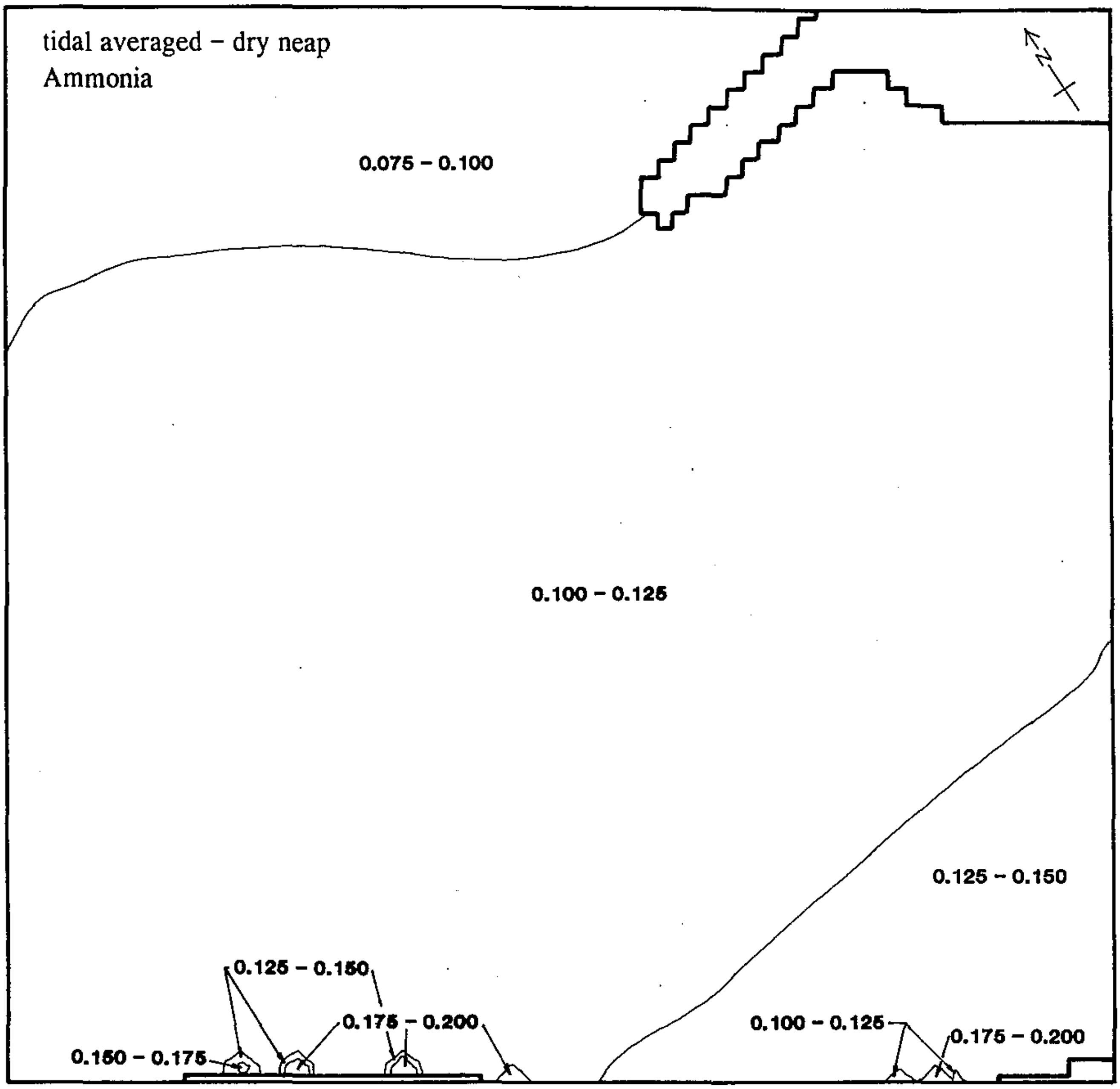


Tide Averaged Distribution of Dissolved Oxygen (% sat), Wet Season, Reclamations Plus Mitigation

Figure 3.37

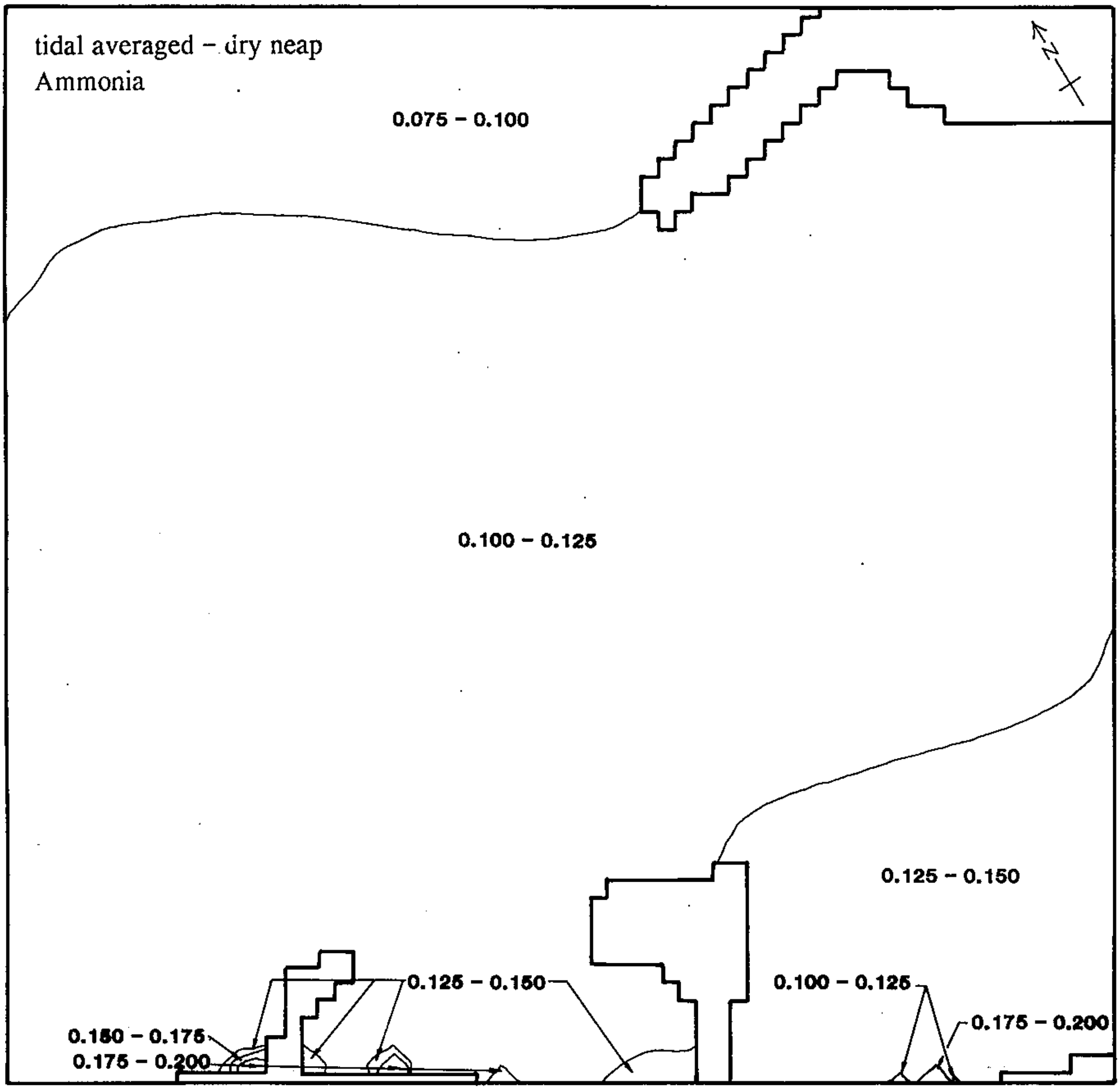


Tide Averaged Dissolved Oxygen (% sat), Wet Season, Full Reclamation plus Mitigation Figure 3.38

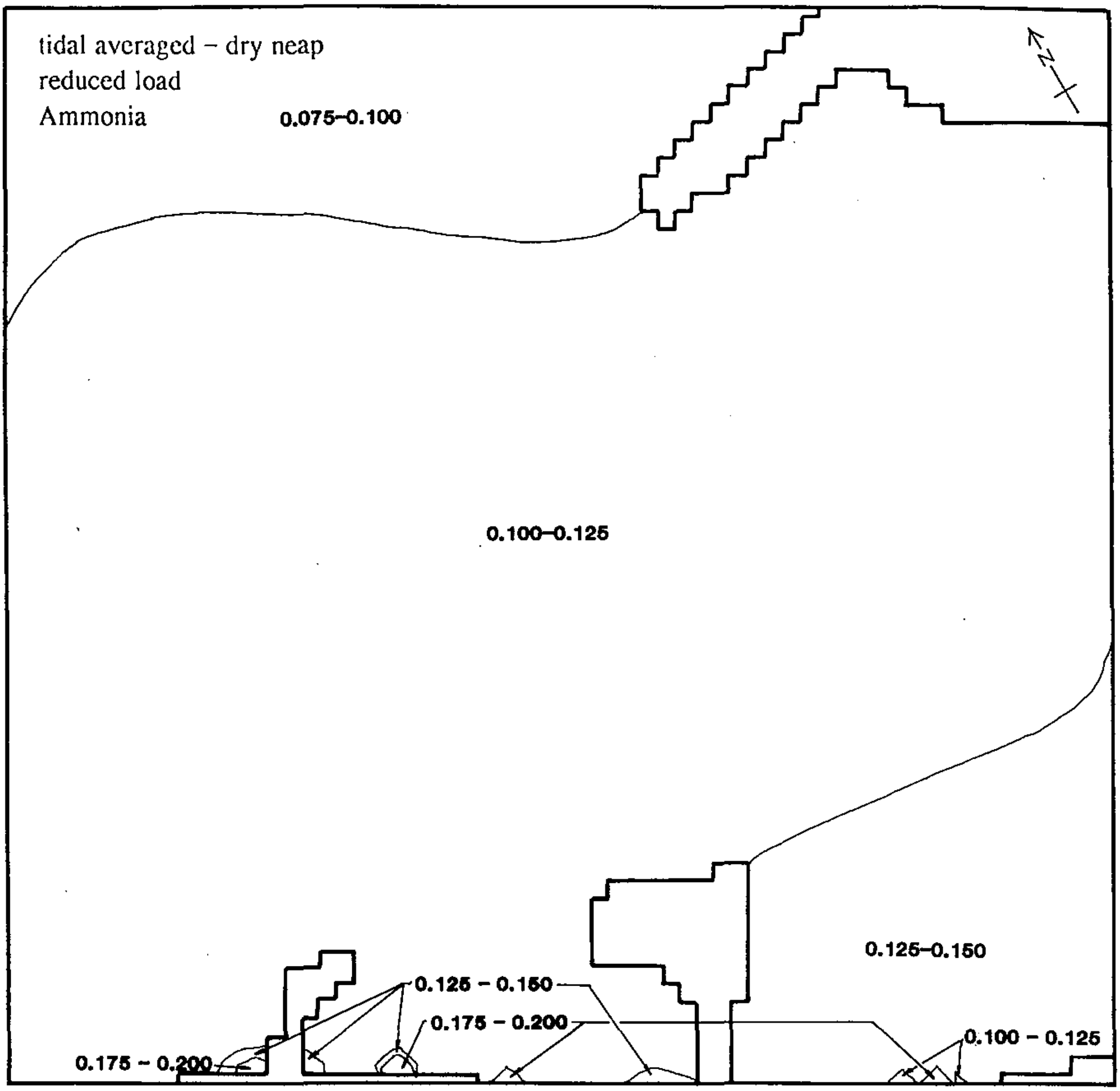


Tide Averaged Distribution of Ammoniacal Nitrogen (mgN/l), Dry Season, Existing Conditions

Figure 3.39

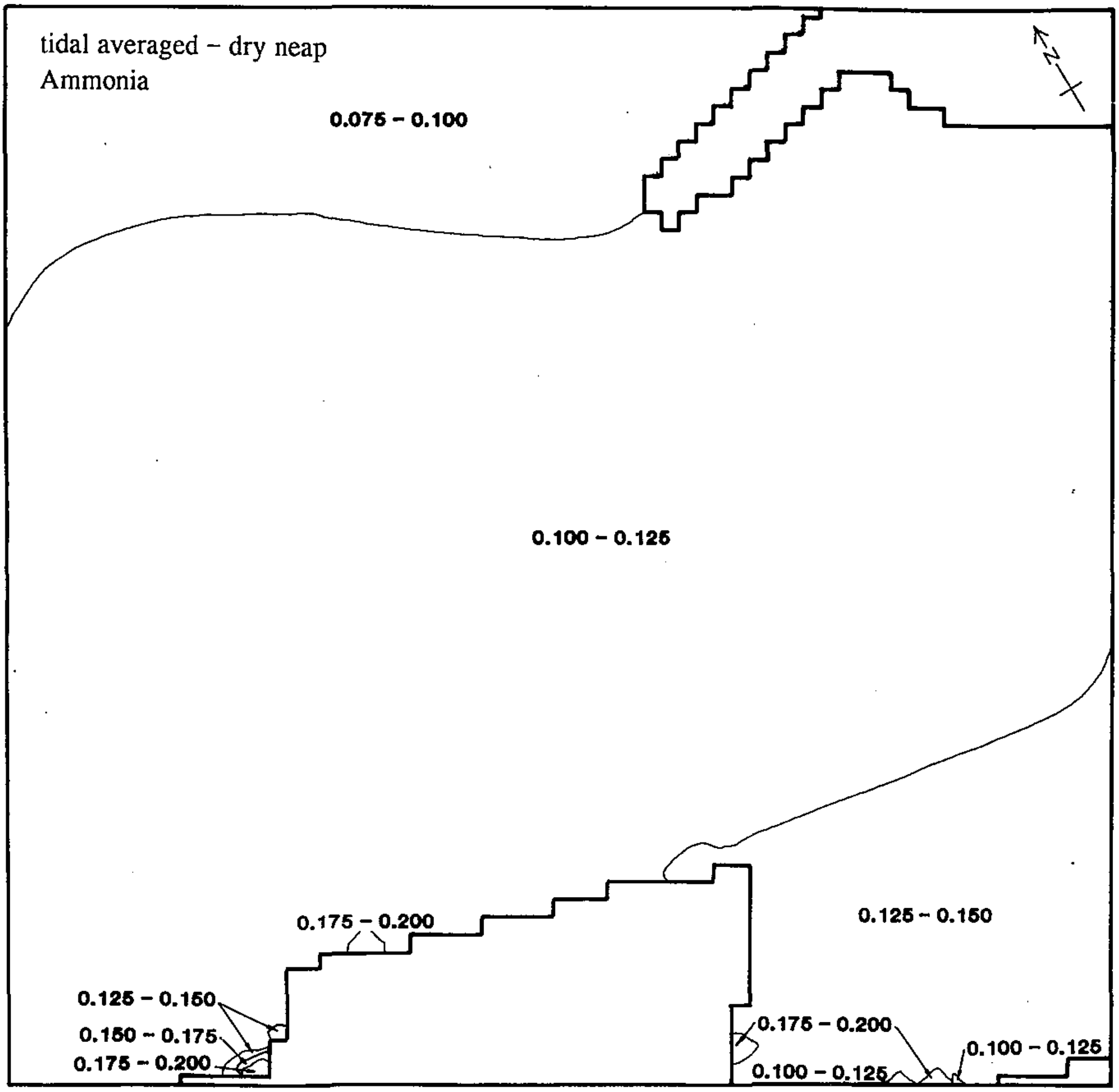


Tide Averaged Distribution of Ammoniacal Nitrogen (mgN/l), Dry Season, Reclamations Figure 3.40

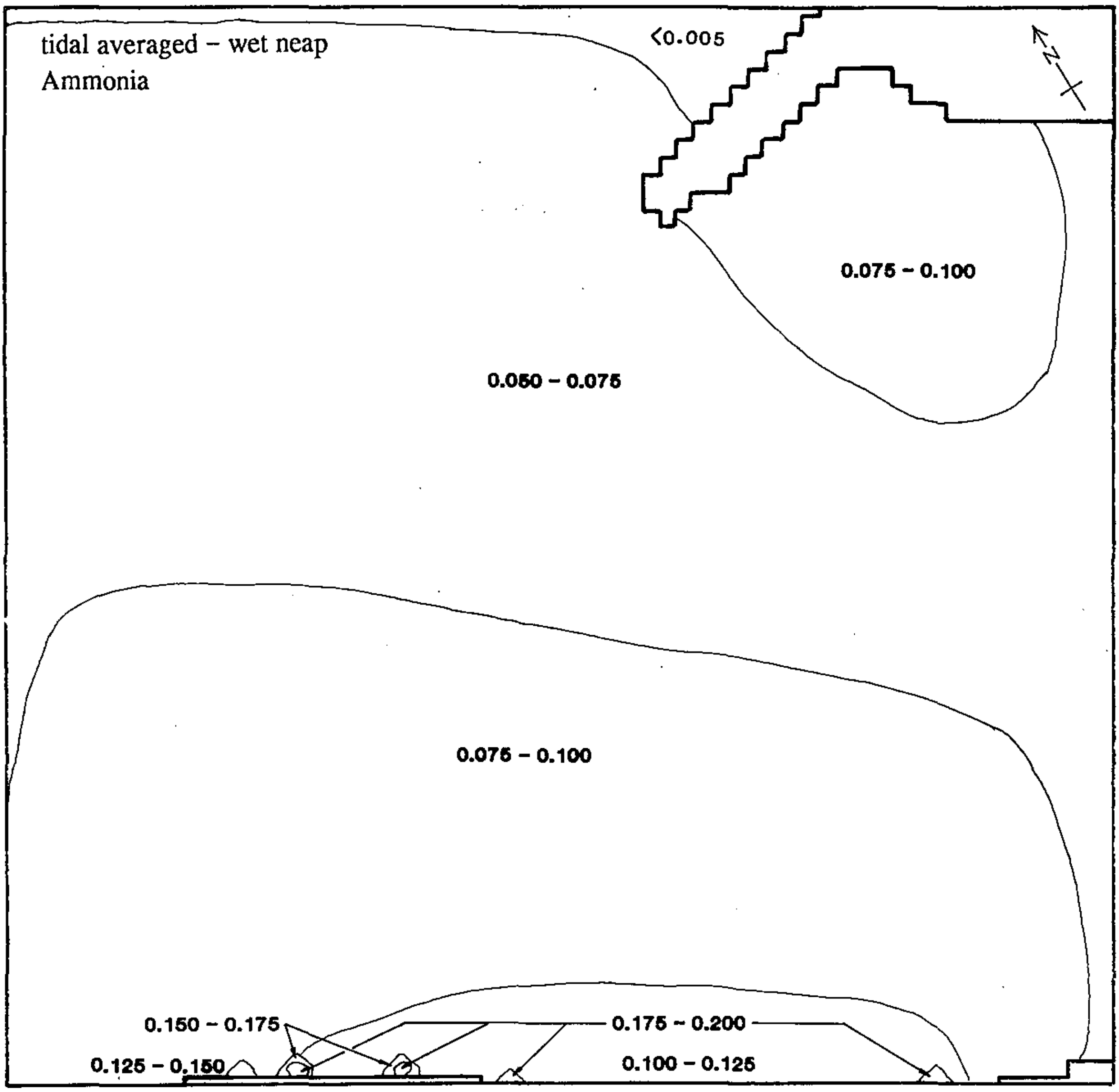


Tide Averaged Distribution of Ammoniacal Nitrogen (mgN/l), Dry Season, Reclamations Plus Mitigation

Figure 3.41

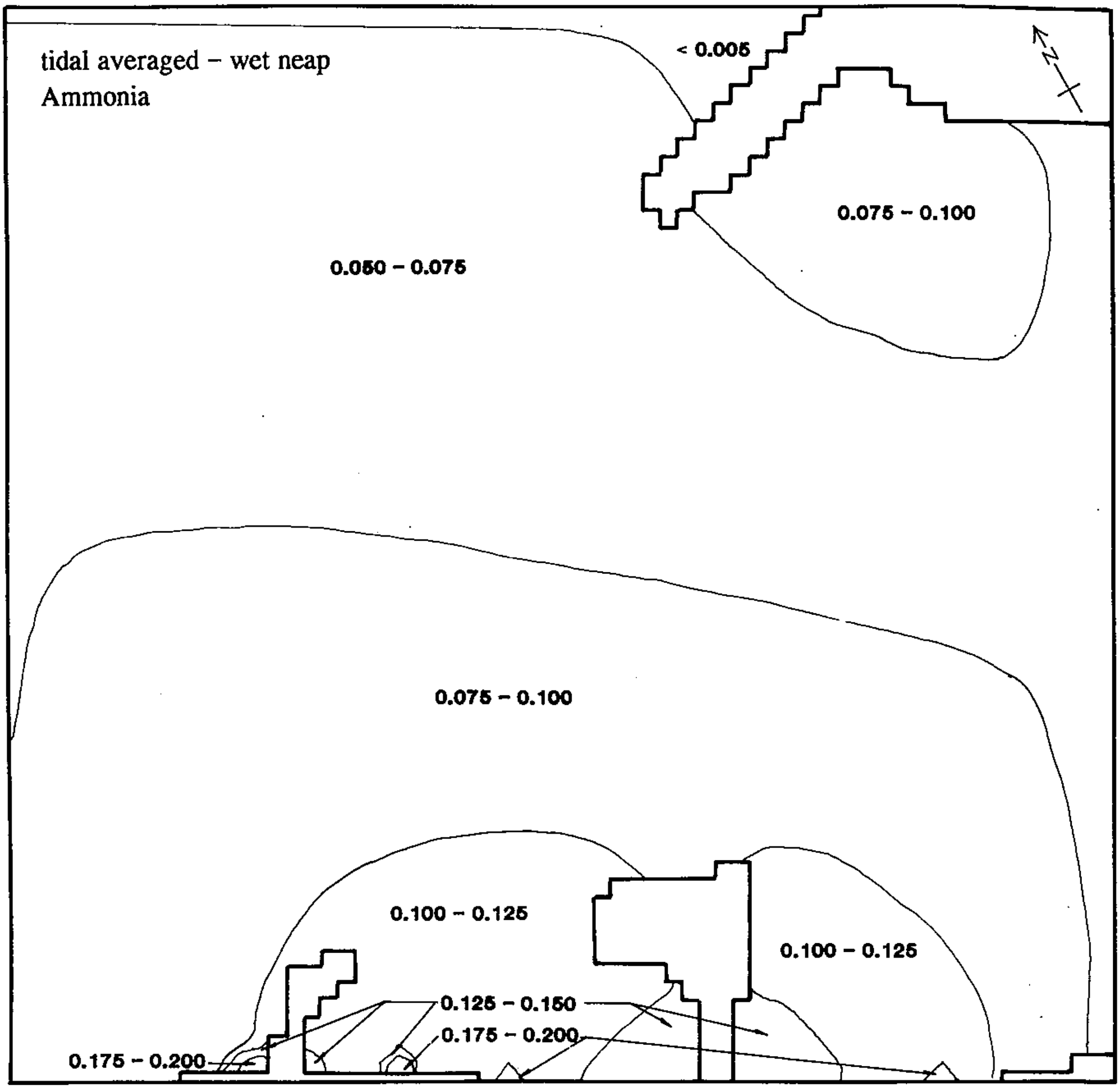


Tide Averaged Ammoniacal Nitrogen (mg/l), Dry Season, Full Reclamation Plus Mitigation Figure 3.42

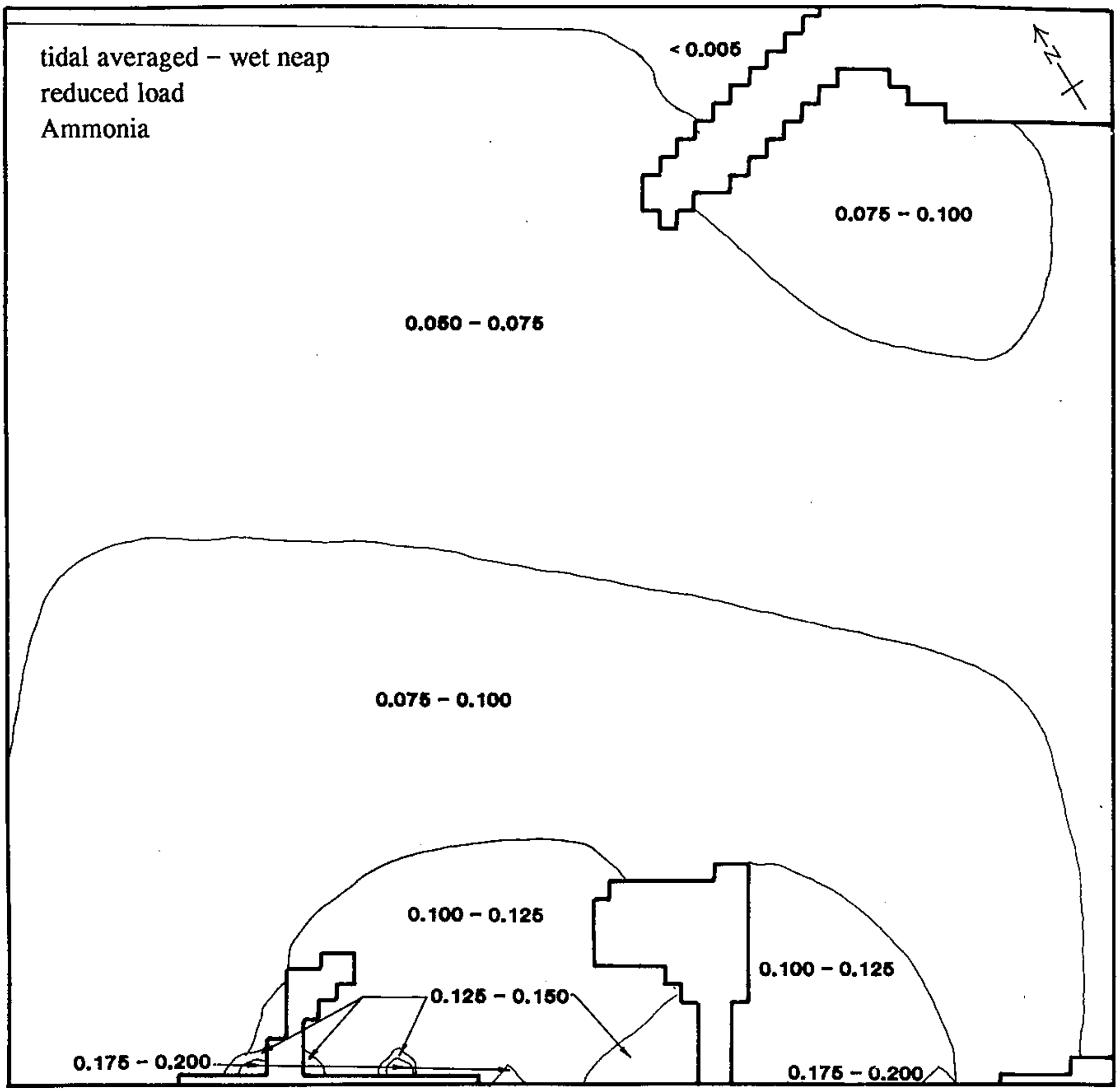


Tide Averaged Distribution of Ammoniacal Nitrogen (mgN/l), Wet Season, Existing Conditions

Figure 3.43

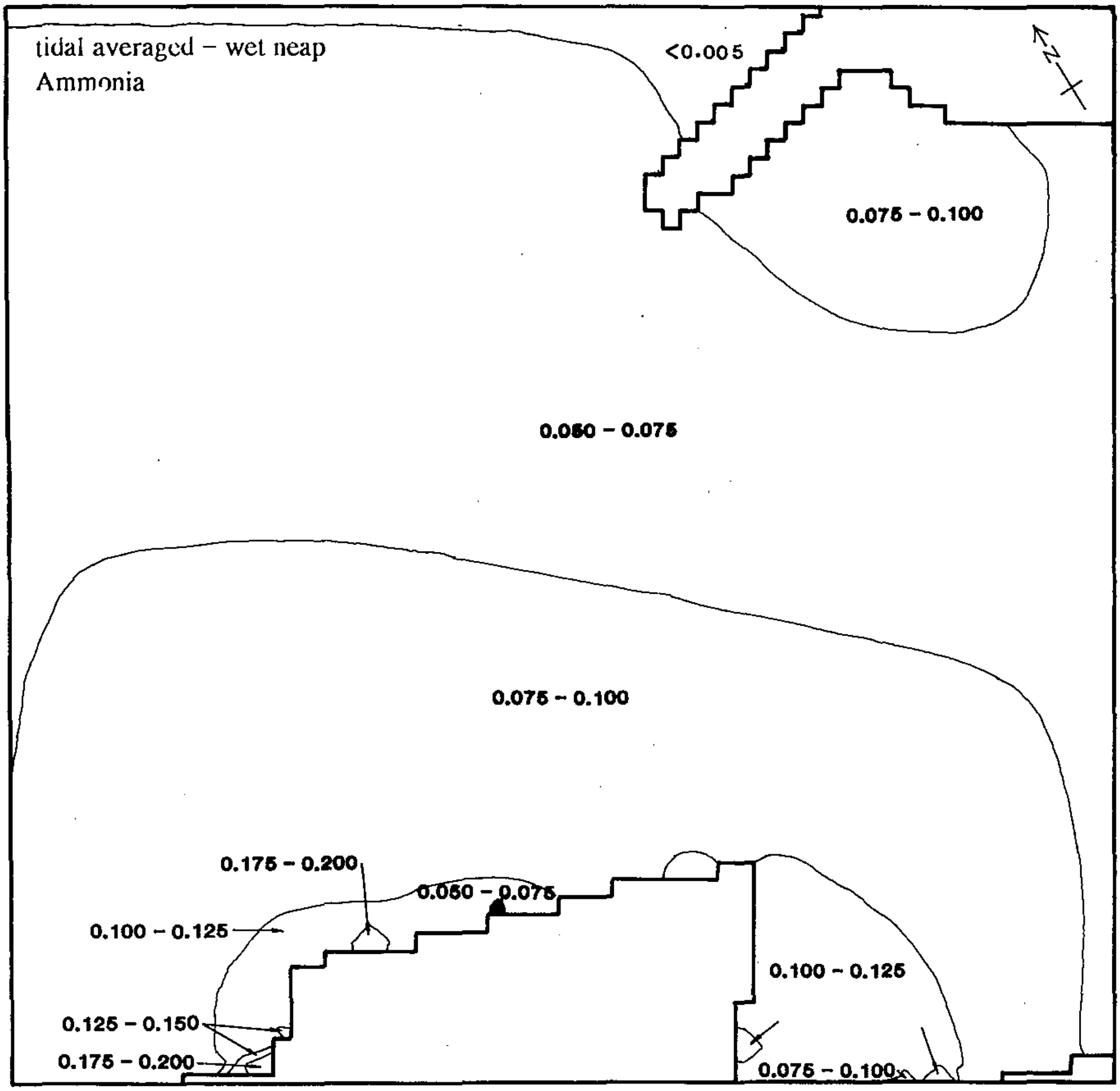


Tide Averaged Distribution of Ammoniacal Nitrogen (mgN/l), Wet Season, Reclamations Figure 3.44

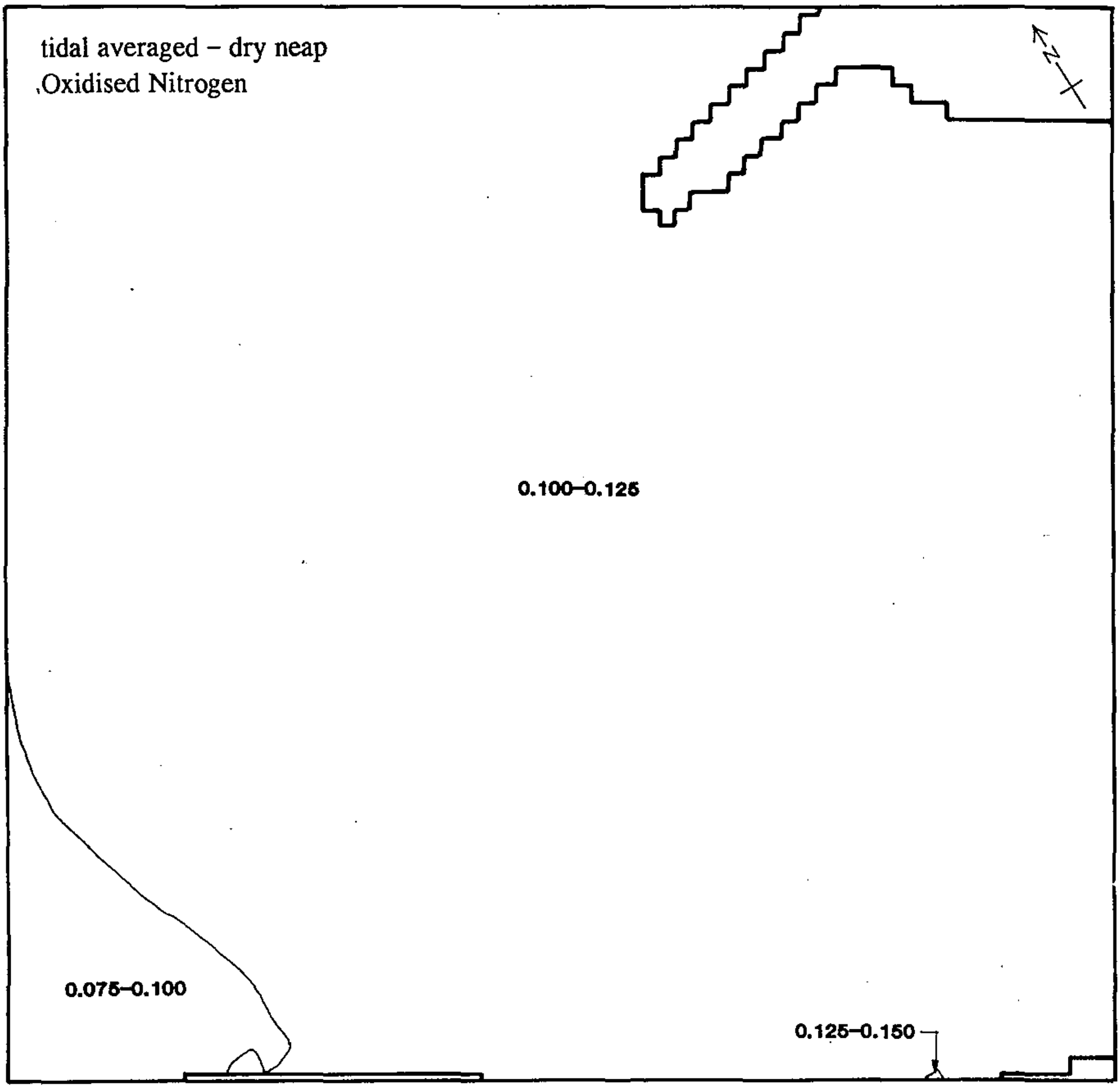


Tide Averaged Distribution of Ammoniacal Nitrogen (mgN/l), Wet Season, Reclamations Plus Mitigation

Figure 3.45

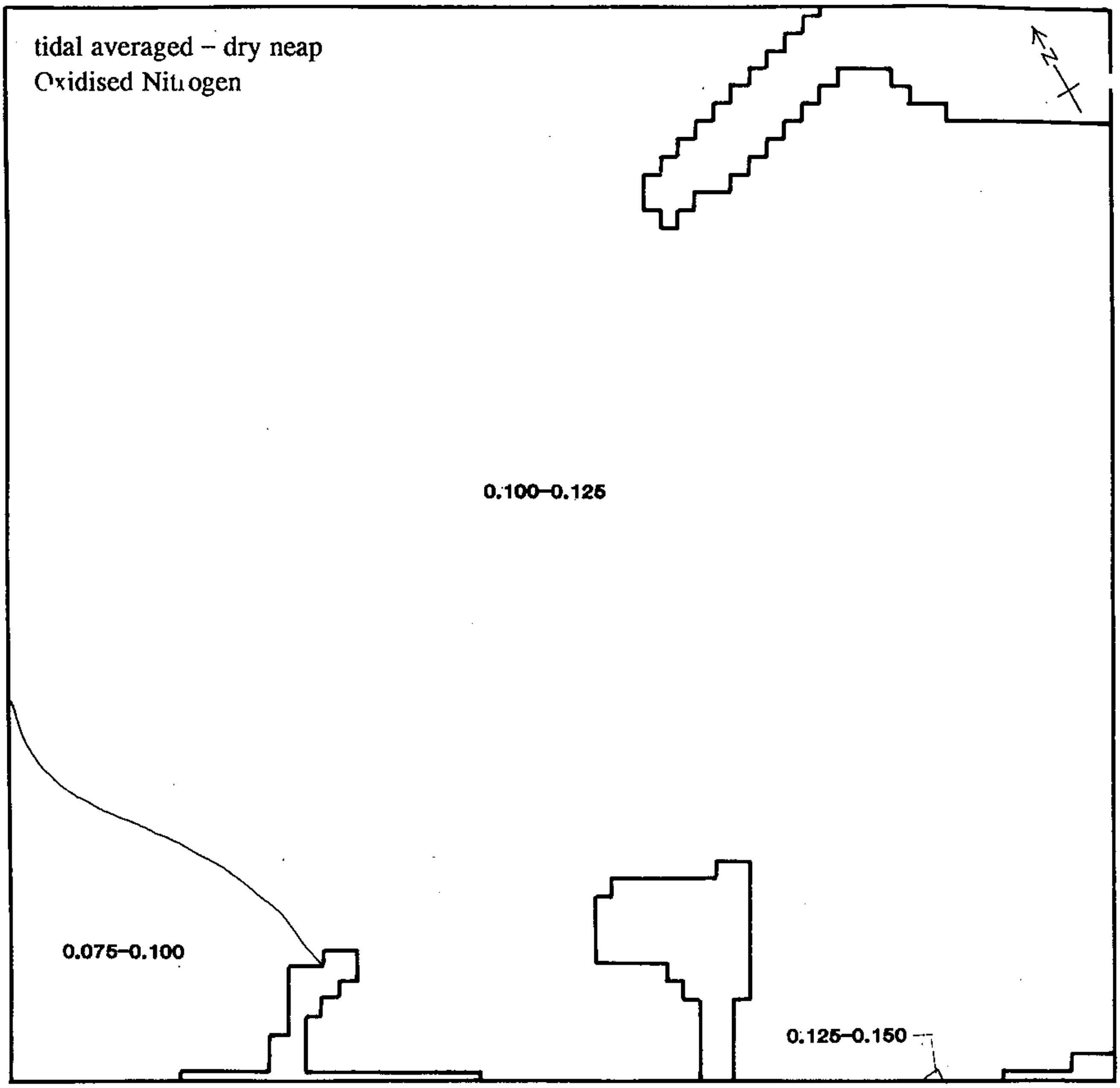


Tide Averaged Ammoniacal Nitrogen (mg/l), Wet Season, Full Reclamation Plus Mitigation Figure 3.46



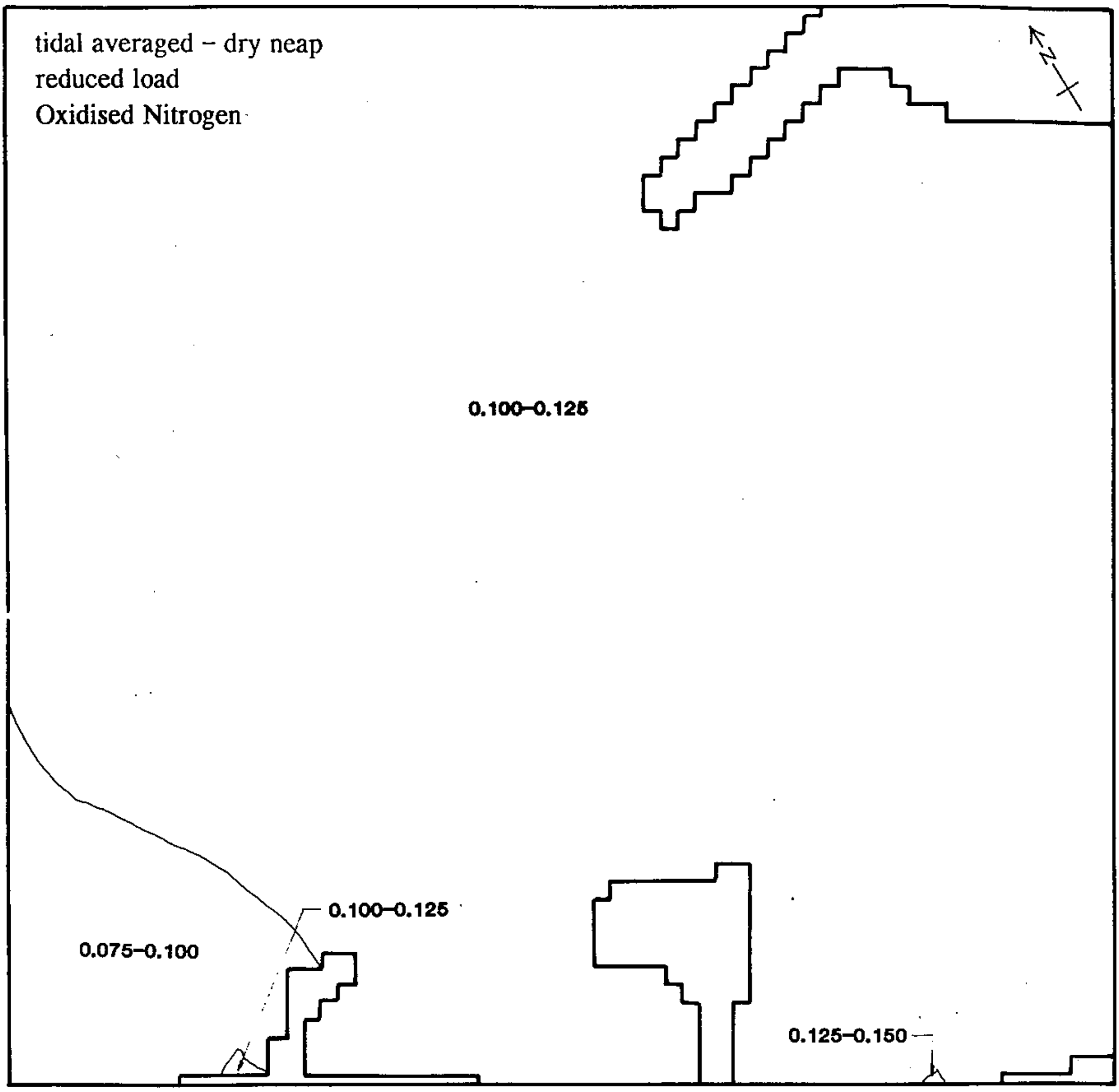
Tide Averaged Distribution of Oxidised Nitrogen (mg N/l), Dry Season, Existing Conditions

Figure 3.47



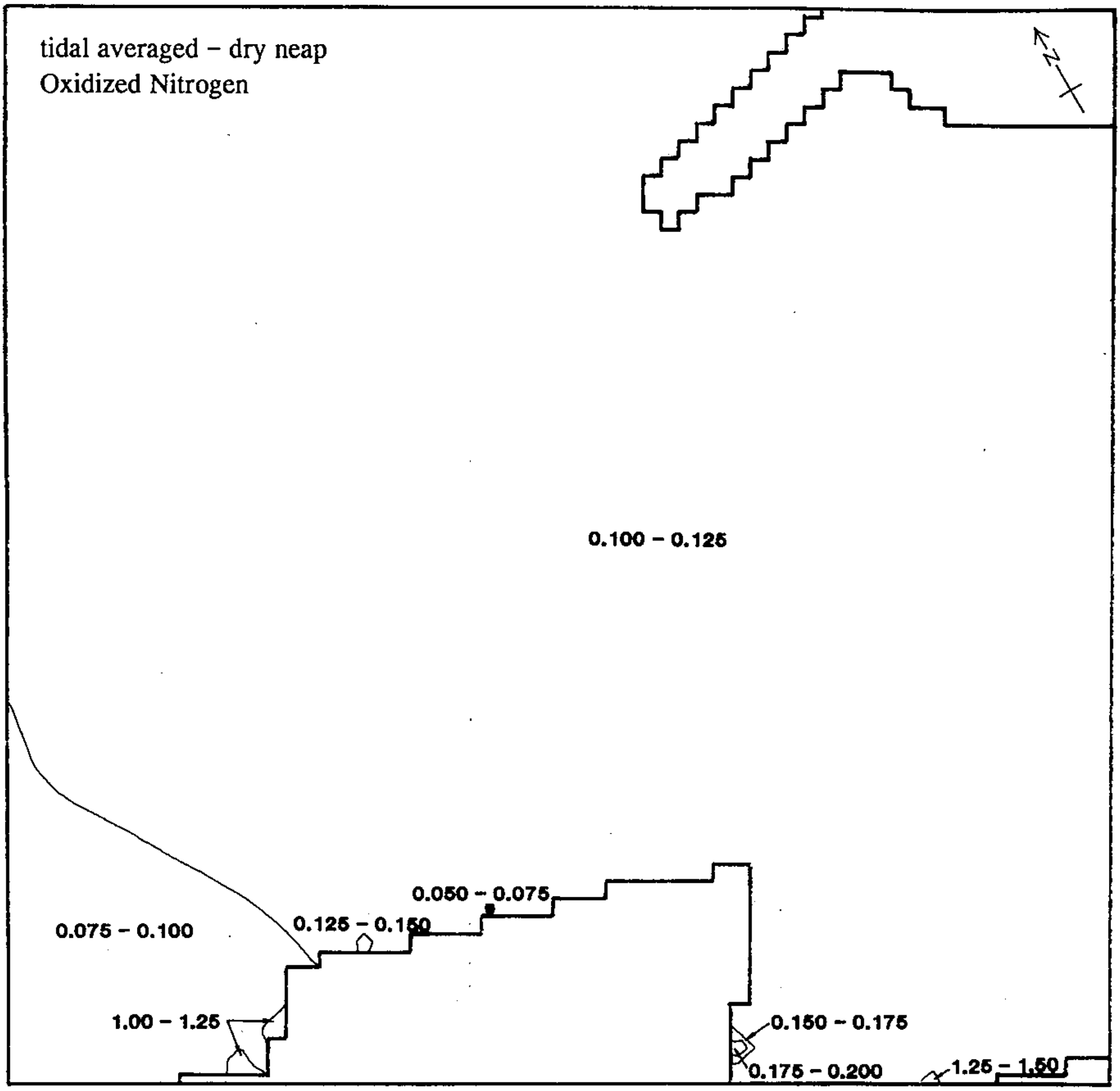
Tide Averaged Distribution of Oxidised Nitrogen (mg N/l), Dry Season, Partial Reclamation

Figure 3.48

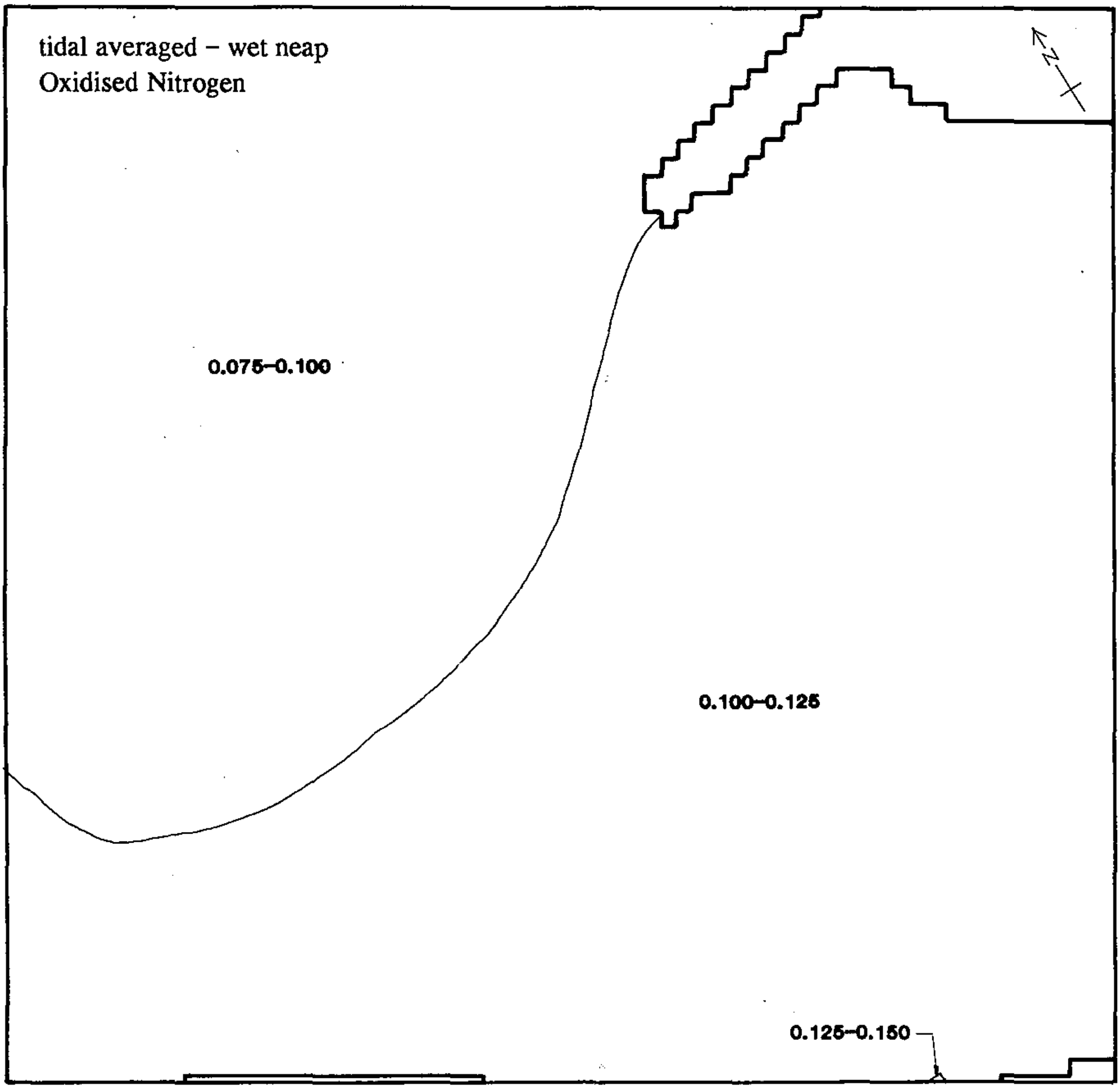


Tide Averaged Distribution of Oxidised Nitrogen (mg N/l), Dry Season, Reclamations Plus Mitigation

Figure 3.49

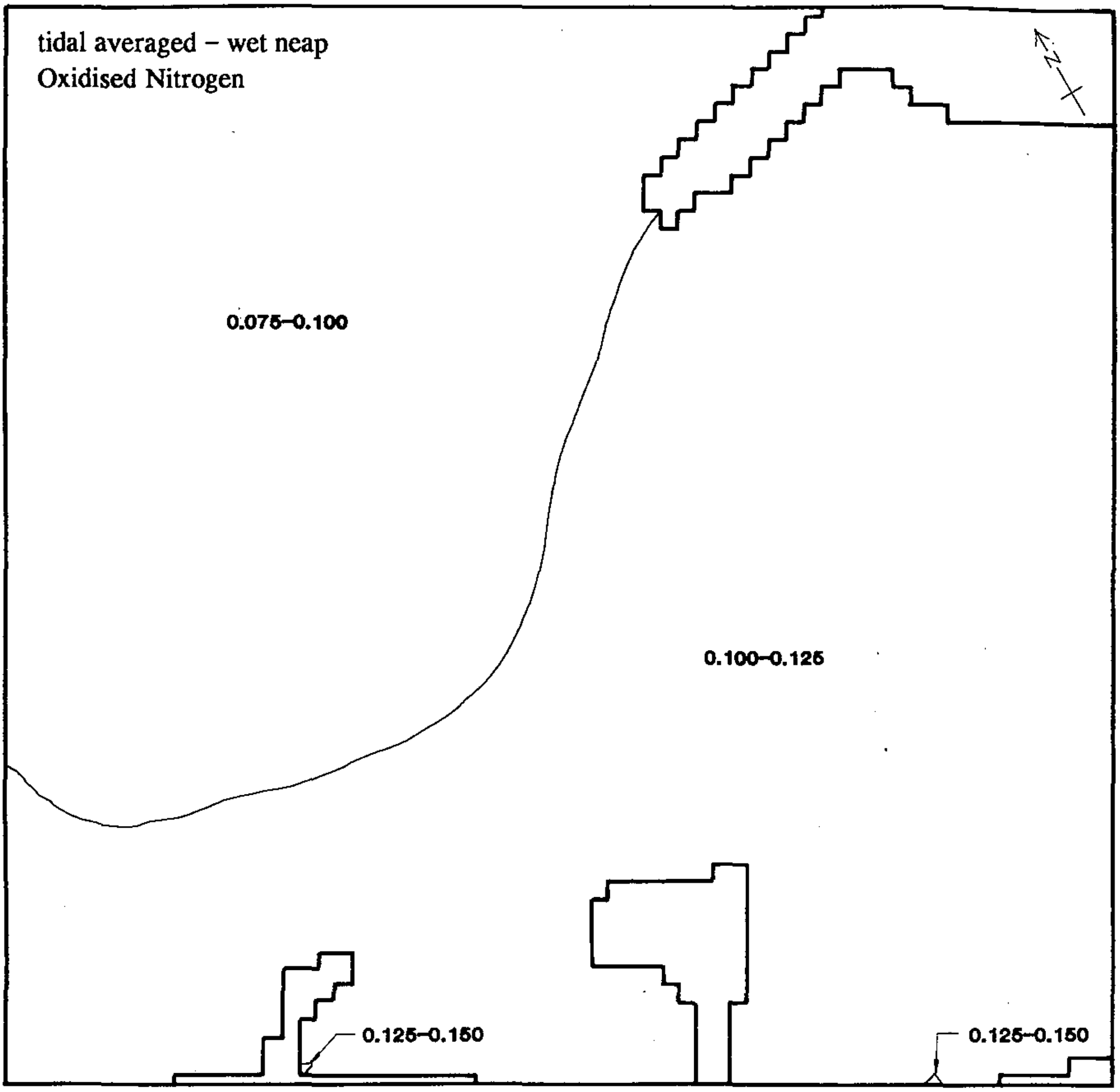


Tide Averaged Oxidised Nitrogen (mg/l), Dry Season, Full Reclamation Plus Mitigation   Figure **3.50**

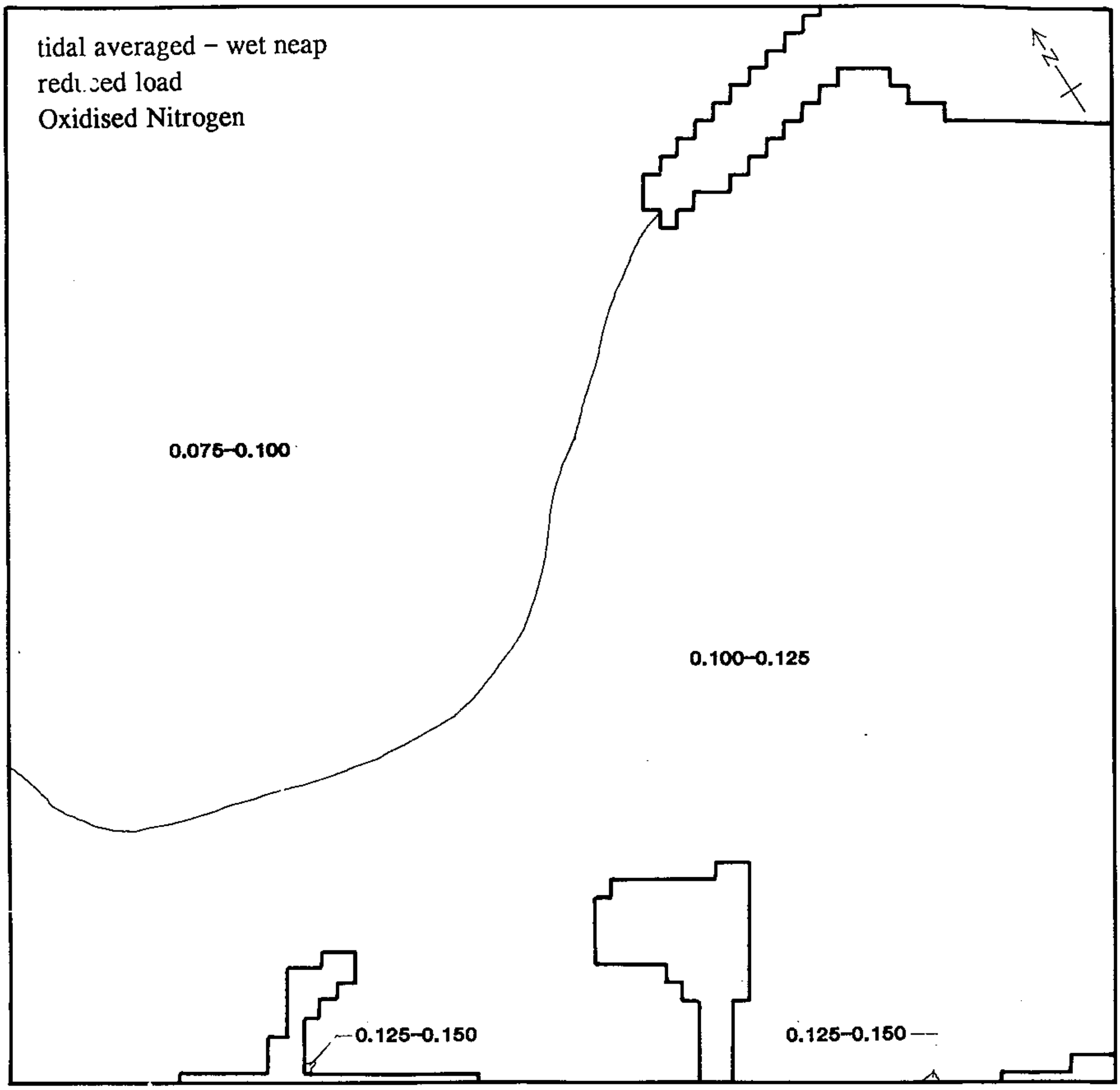


Tide Averaged Distribution of Oxidised Nitrogen (mg N/l), Wet Season, Existing Conditions

Figure 3.51

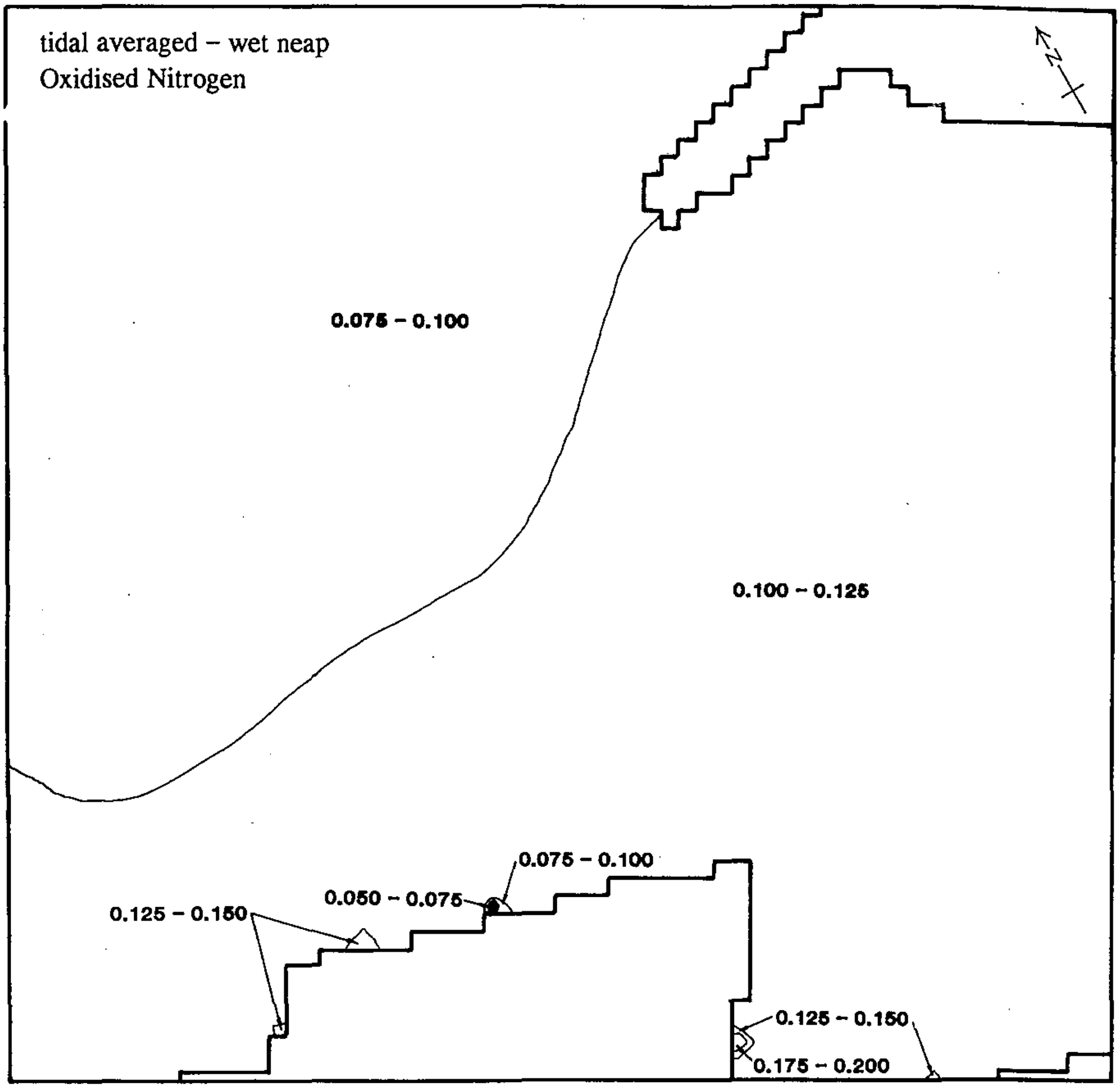


Tide Averaged Distribution of Oxidised Nitrogen (mg N/l), Wet Season, Reclamations Figure 3.52

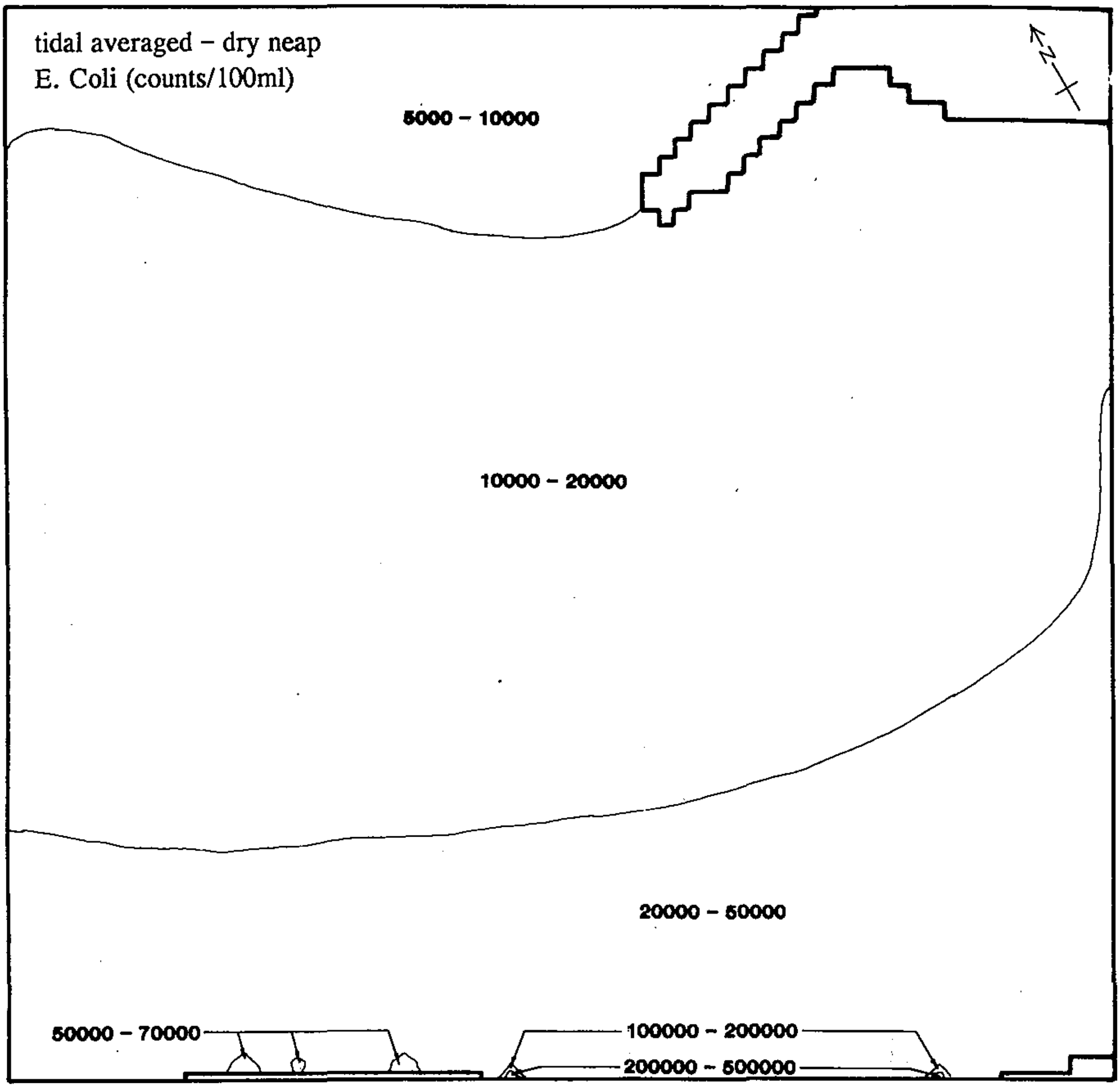


Tide Averaged Distribution of Oxidised Nitrogen (mg N/l), Wet Season, Reclamations Plus Mitigation

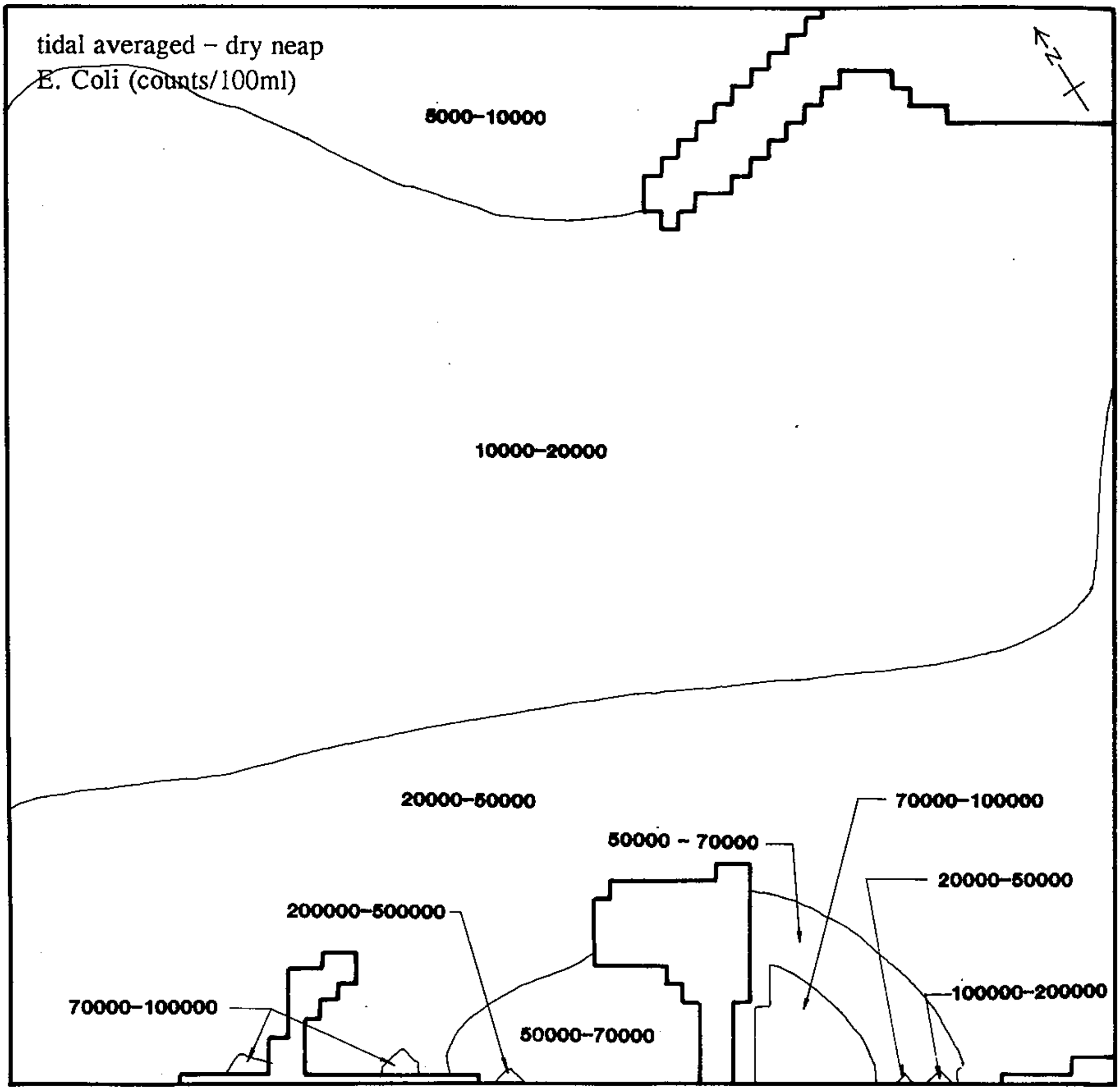
Figure 3.53



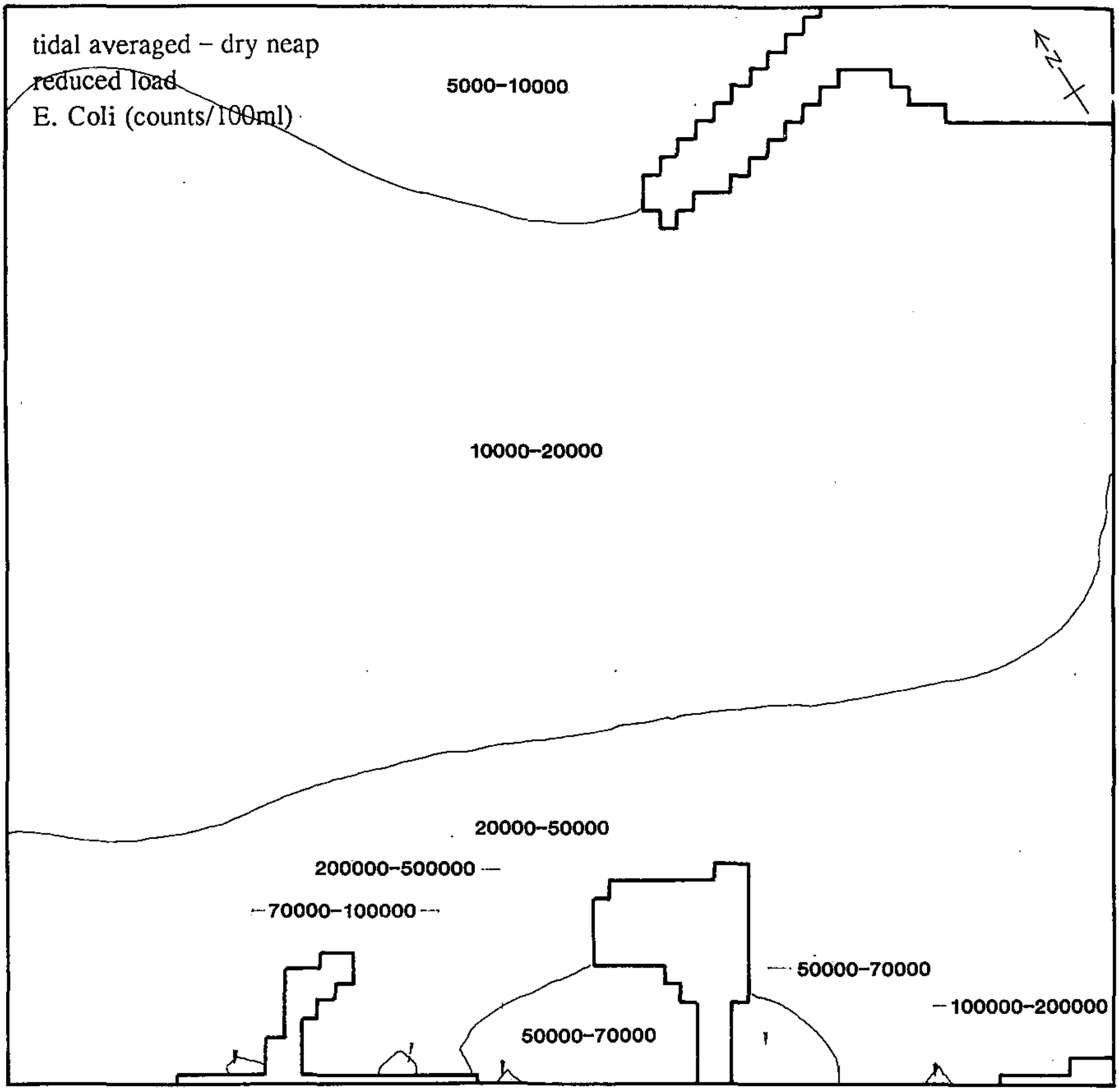
Tide Averaged Oxidised Nitrogen (mg/l), Wet Season, Full Reclamation Plus Mitigation Figure 3.54



Tide Averaged Distribution of E. Coli (no/100ml), Dry Season, Existing Conditions Figure 3.55

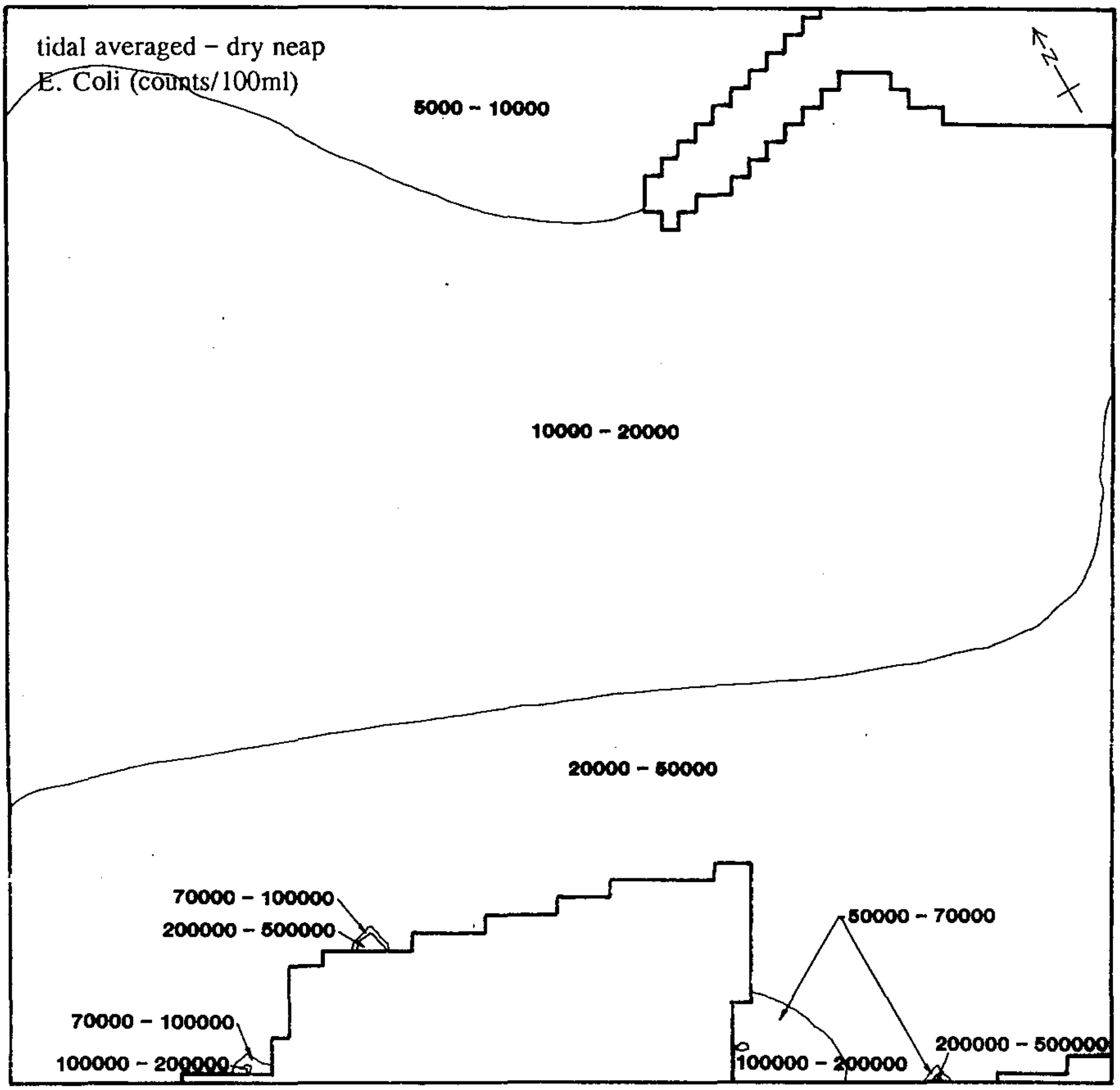


Tide Averaged Distribution of E. Coli (no/100ml), Dry Season, Reclamations Figure 3.56

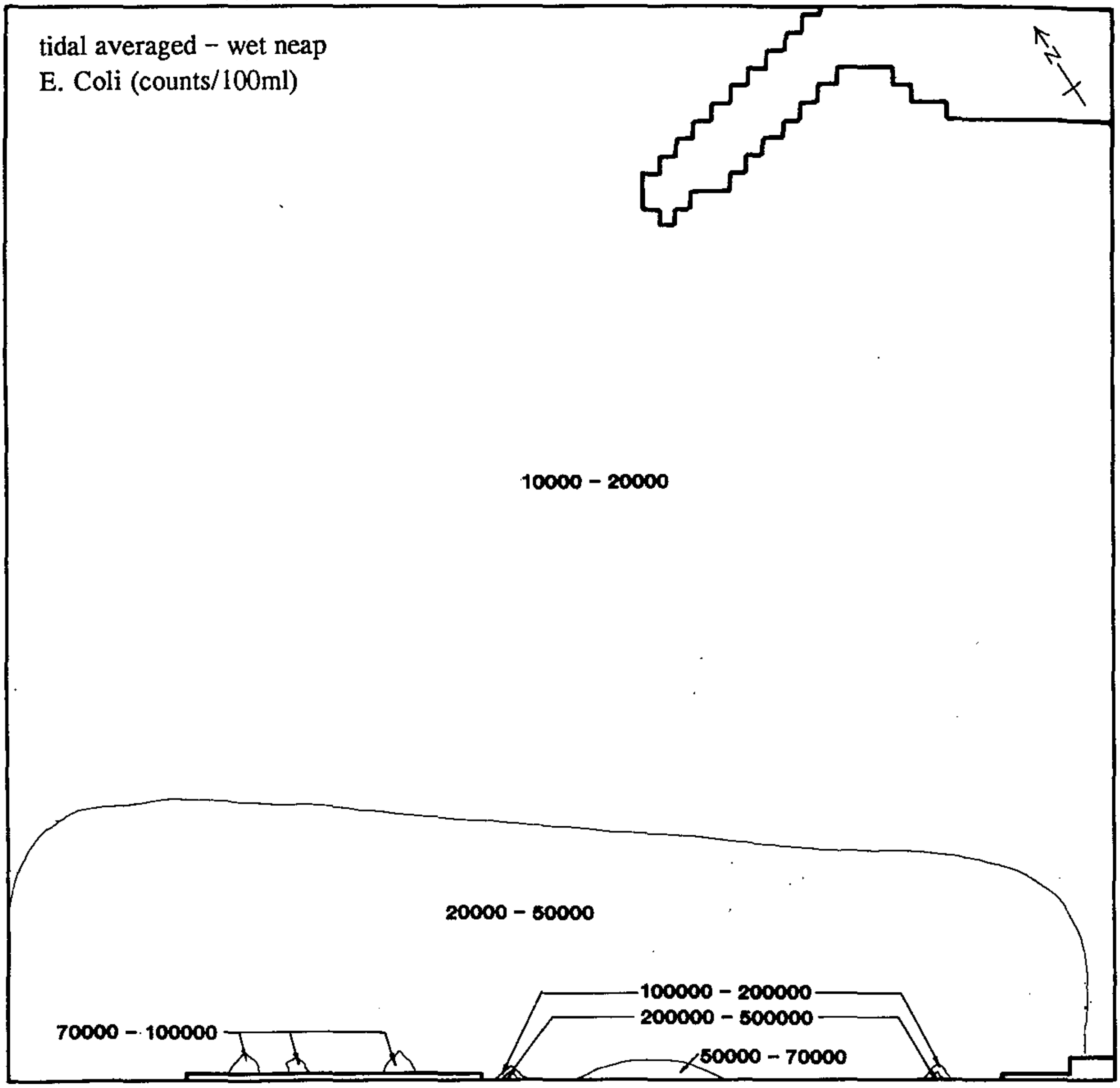


Tide Averaged Distribution of E. Coli (no/100ml), Dry Season, Reclamations Plus Mitigation

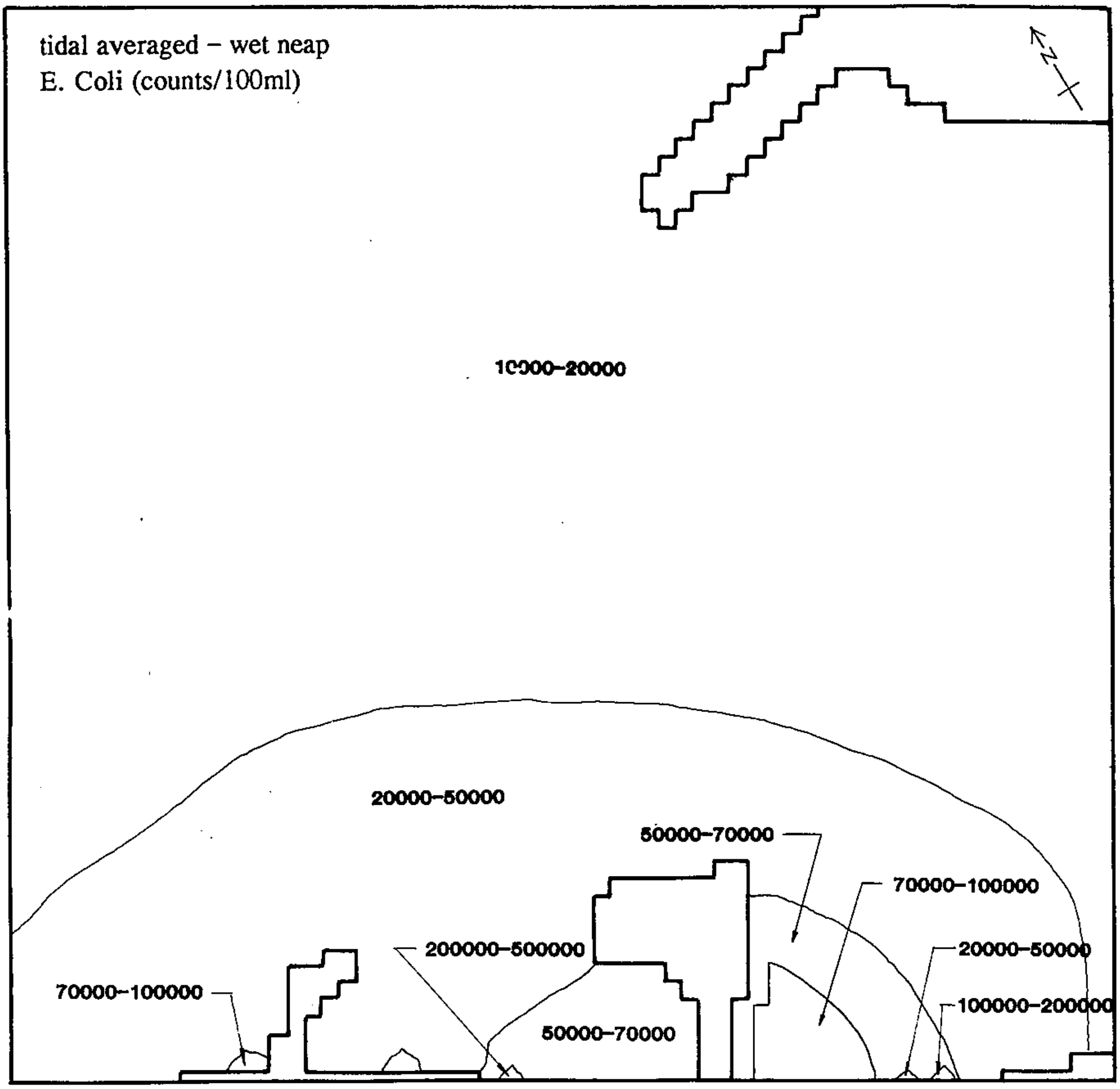
Figure 3.57



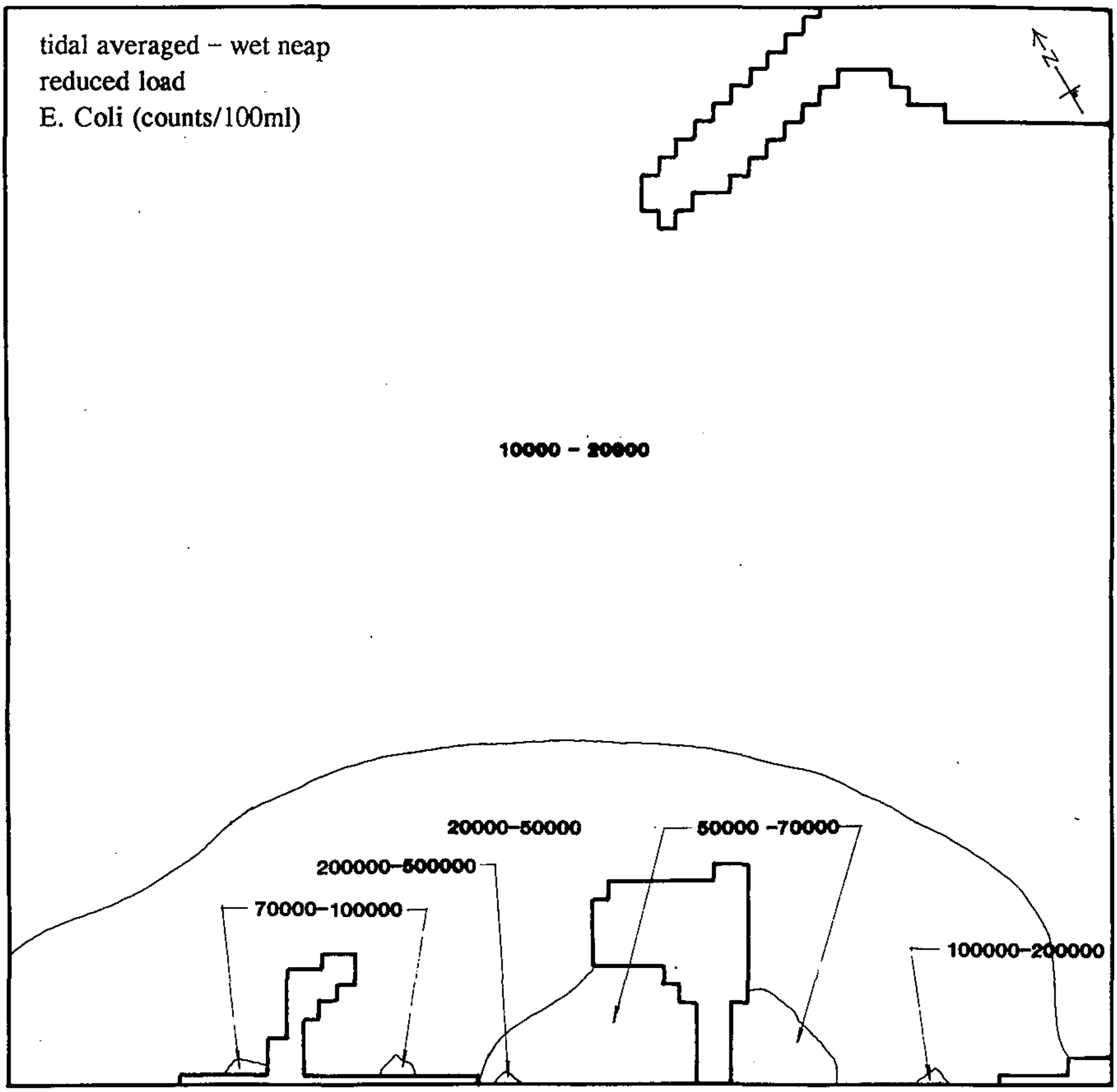
Tide Averaged E. Coli (No./100ml), Dry Season, Full Reclamation Plus Mitigation Figure 3.58



Tide Averaged Distribution of E. Coli (no/100ml), Wet Season, Existing Conditions Figure 3.59

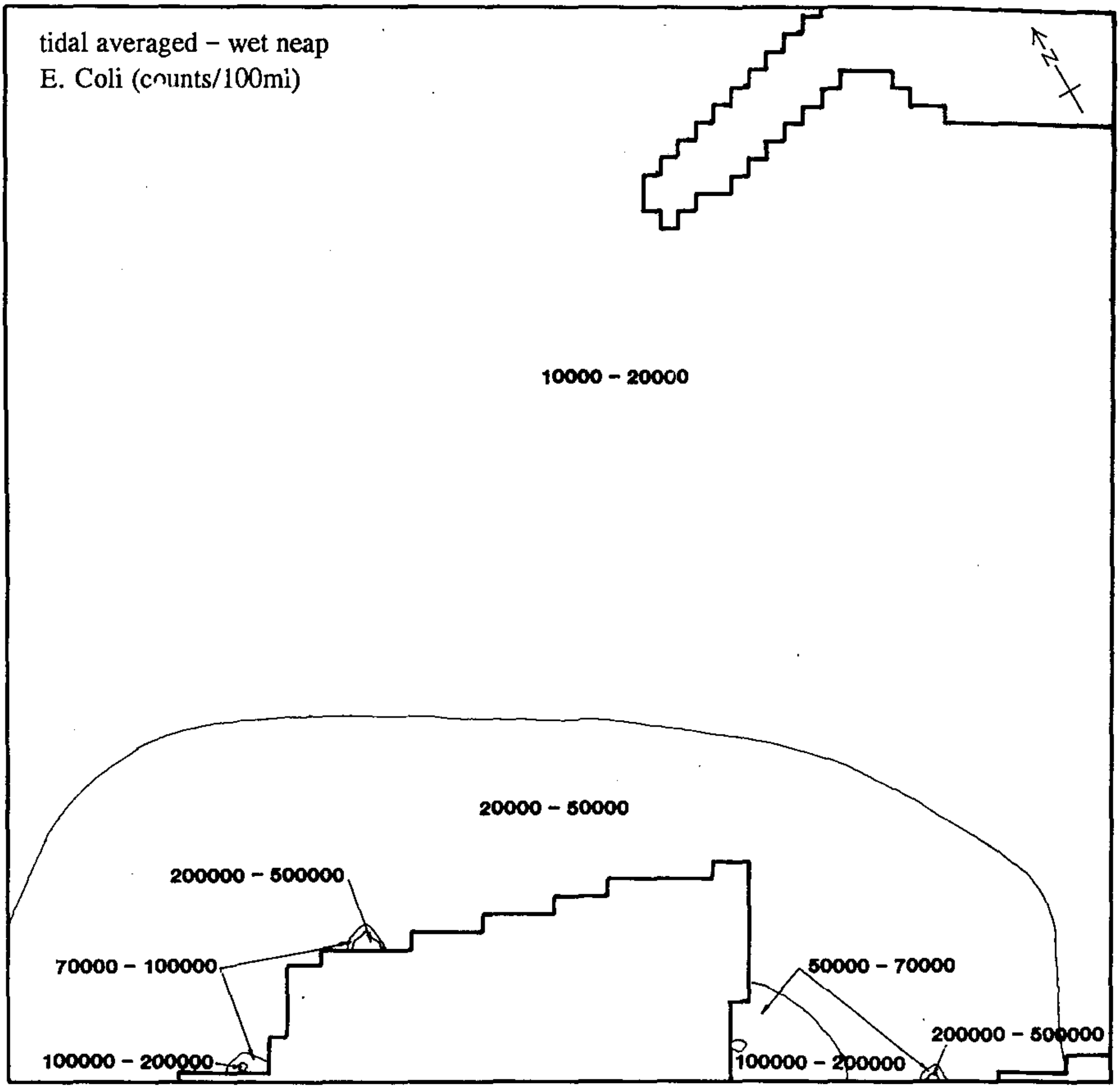


Tide Averaged Distribution of E. Coli (no/100ml), Wet Season, Reclamations Figure 3.60

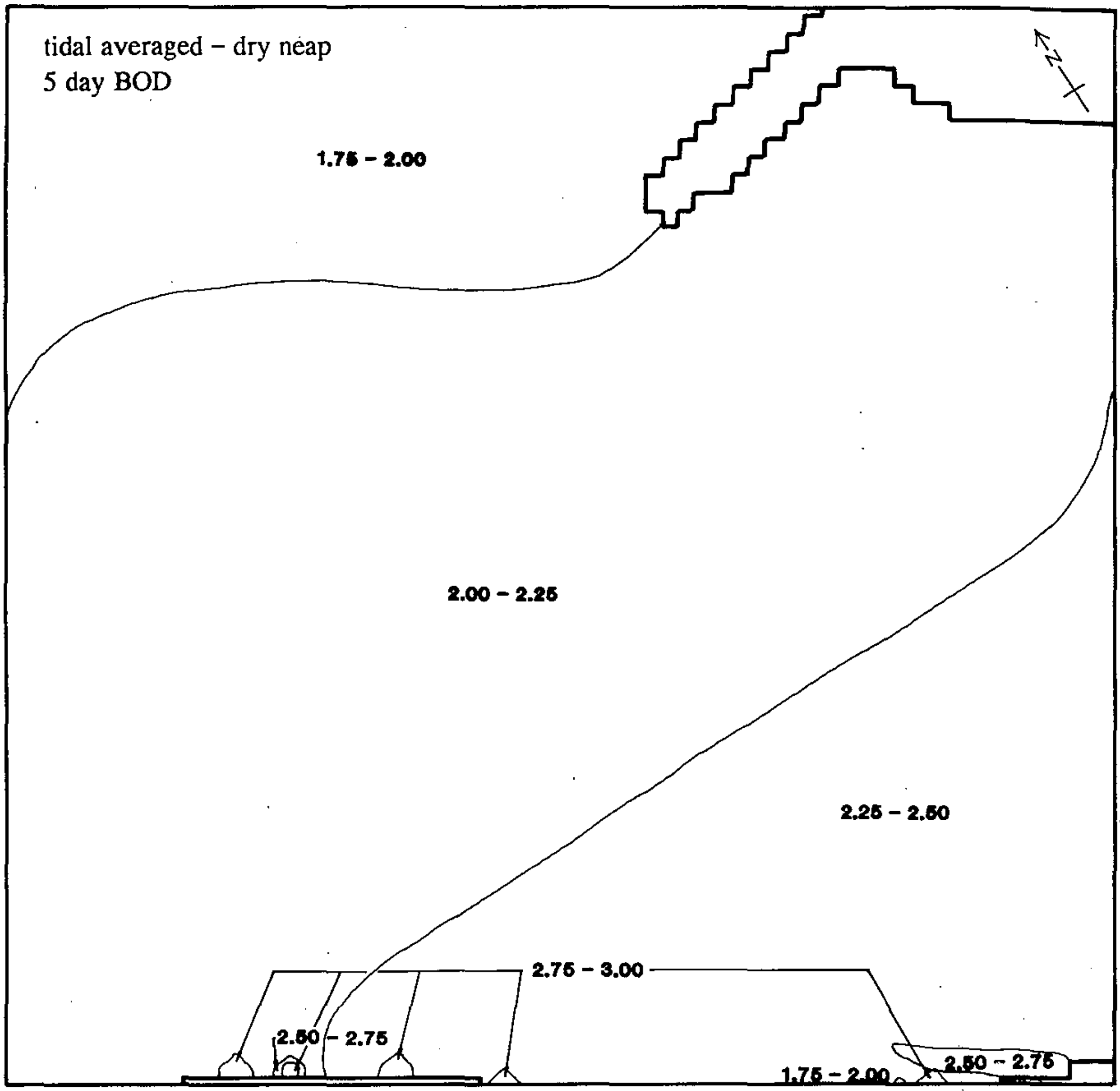


Tide Averaged Distribution of E. Coli (no/100ml), Wet Season, Reclamations Plus Mitigation

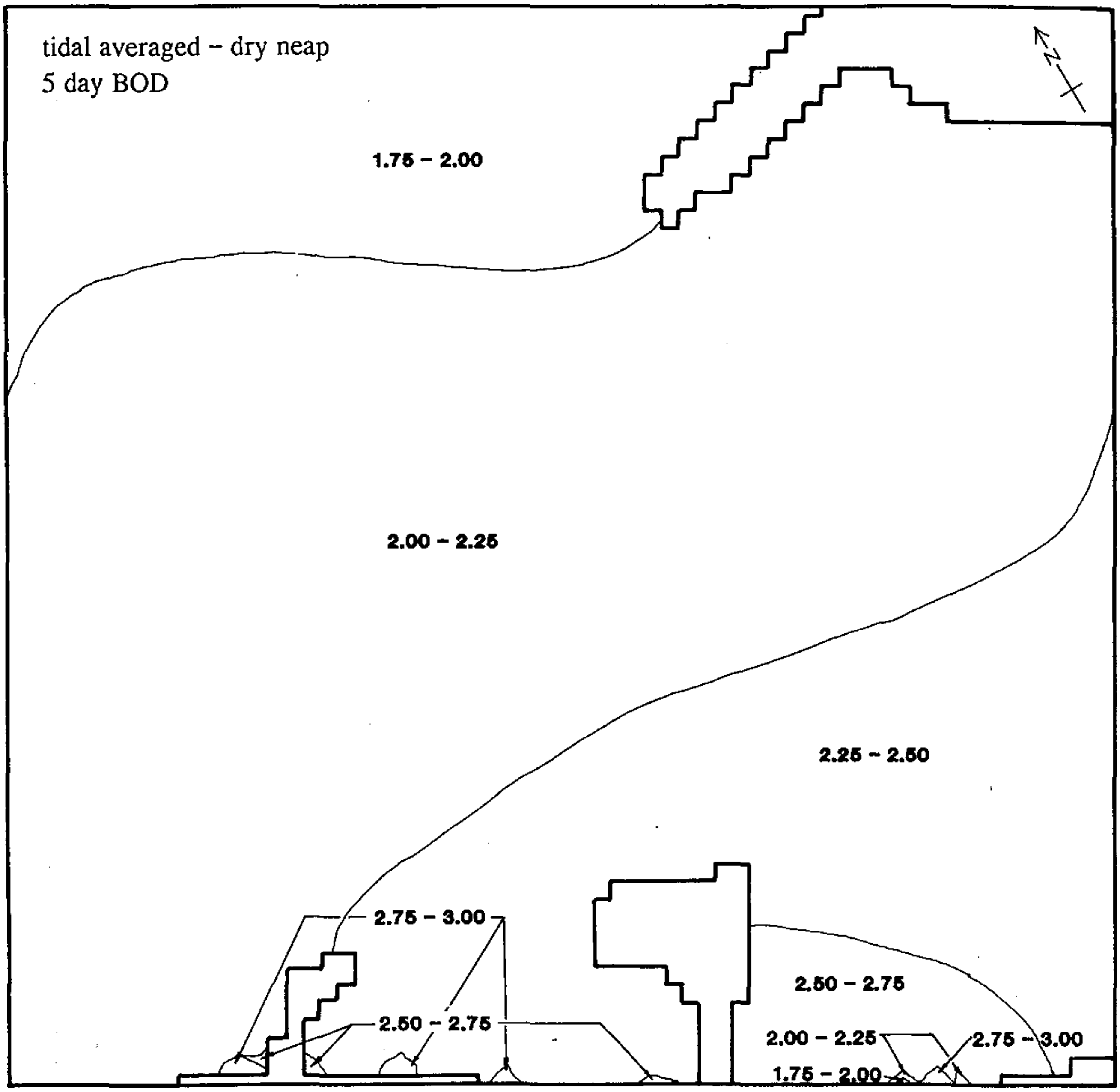
Figure 3.61



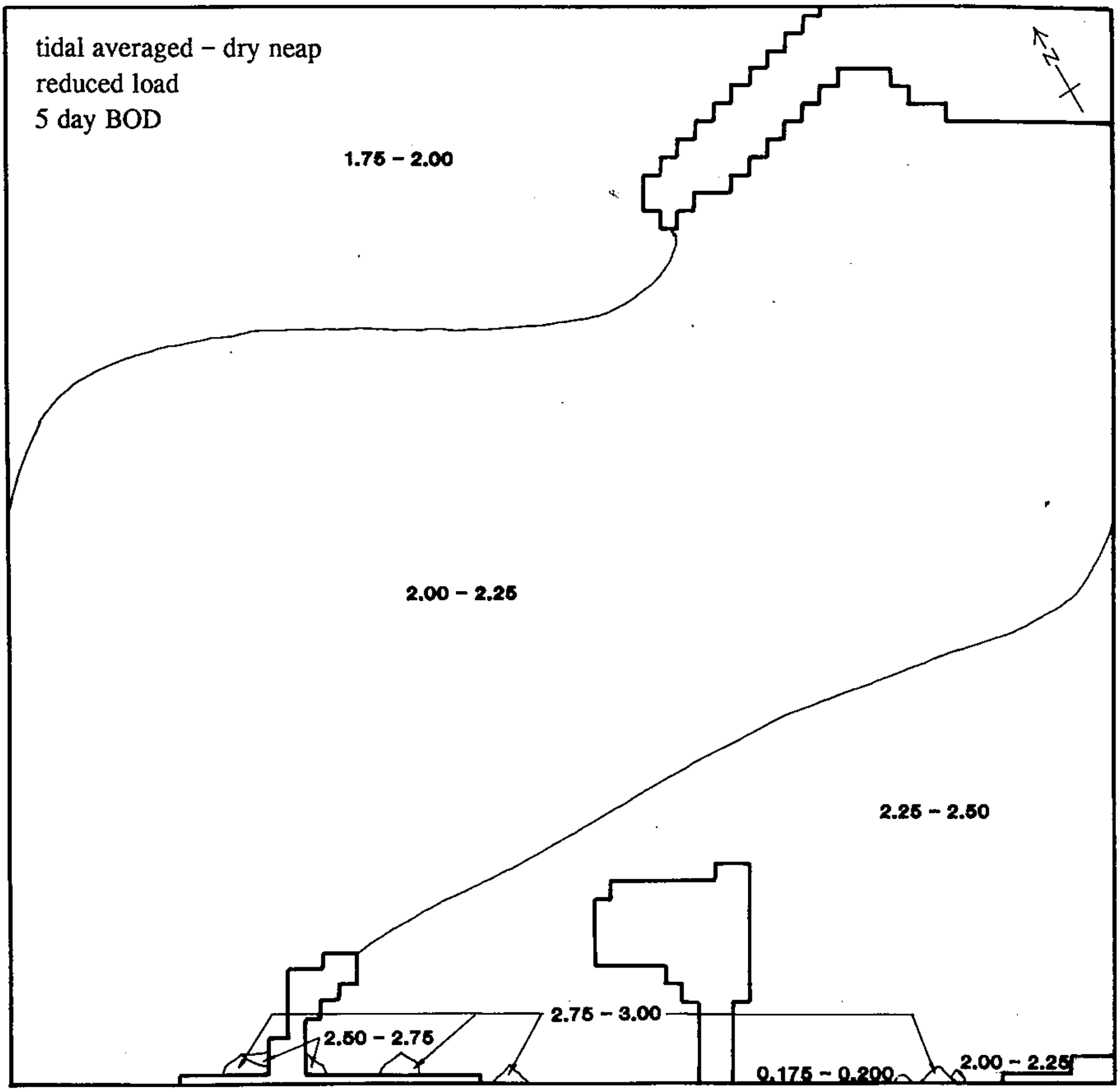
Tide Averaged E. Coli (No./100ml), Wet Season, Full Reclamation Plus Mitigation Figure 3.62



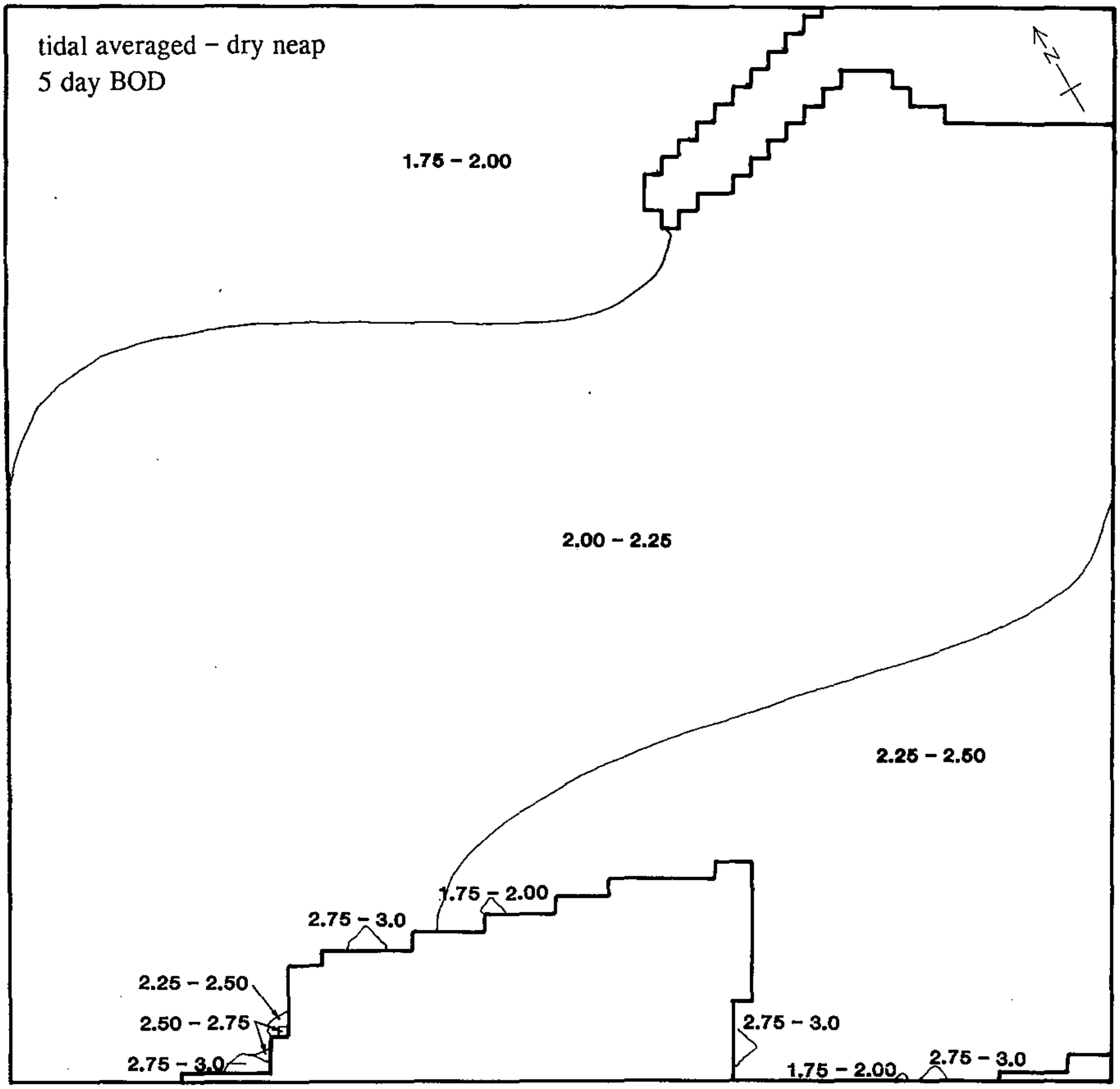
Tide Averaged Distribution of BOD (mg/l), Dry Season, Existing Conditions Figure 3.63



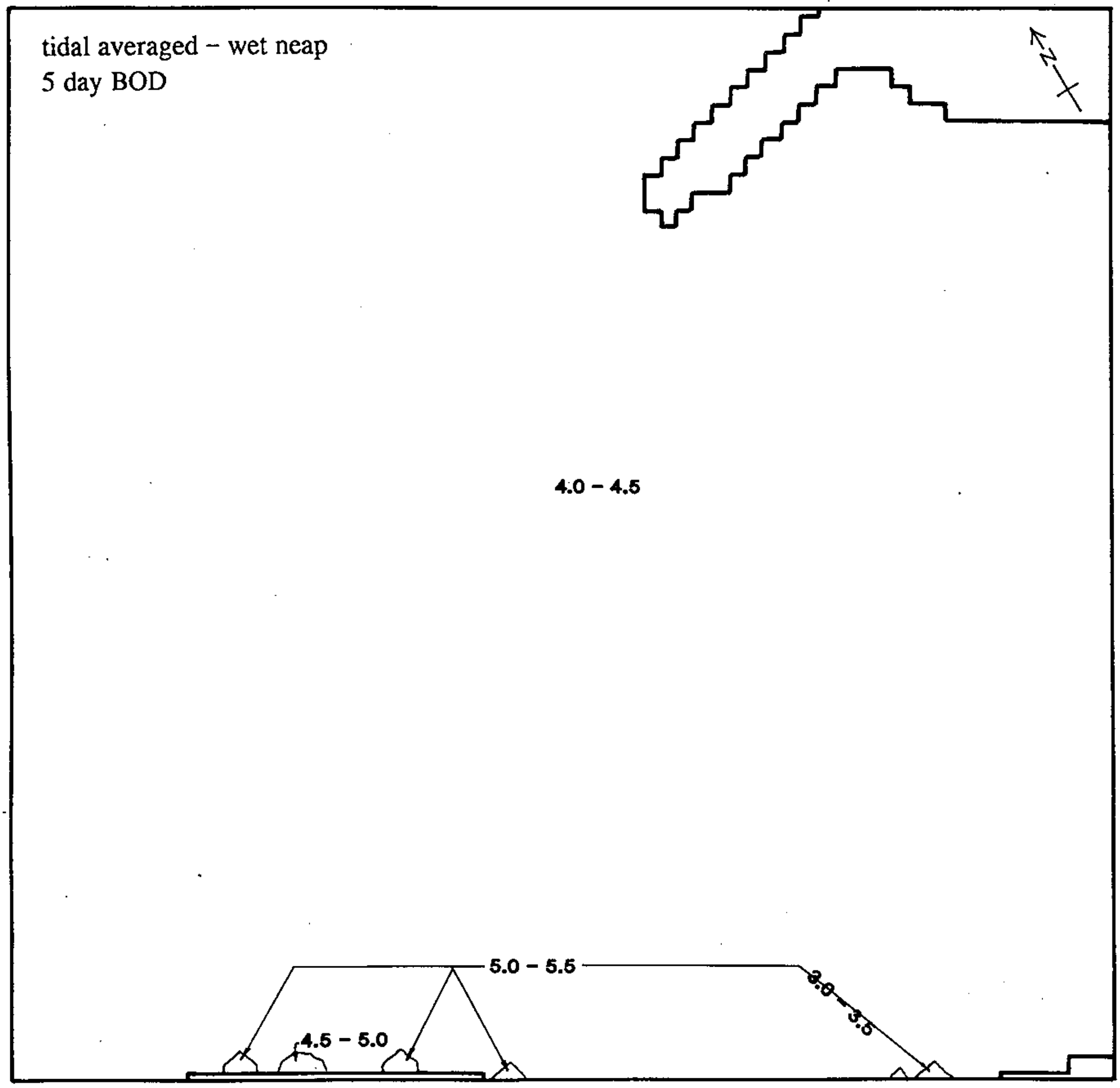
Tide Averaged Distribution of BOD (mg/l), Dry Season, Reclamations Figure 3.64



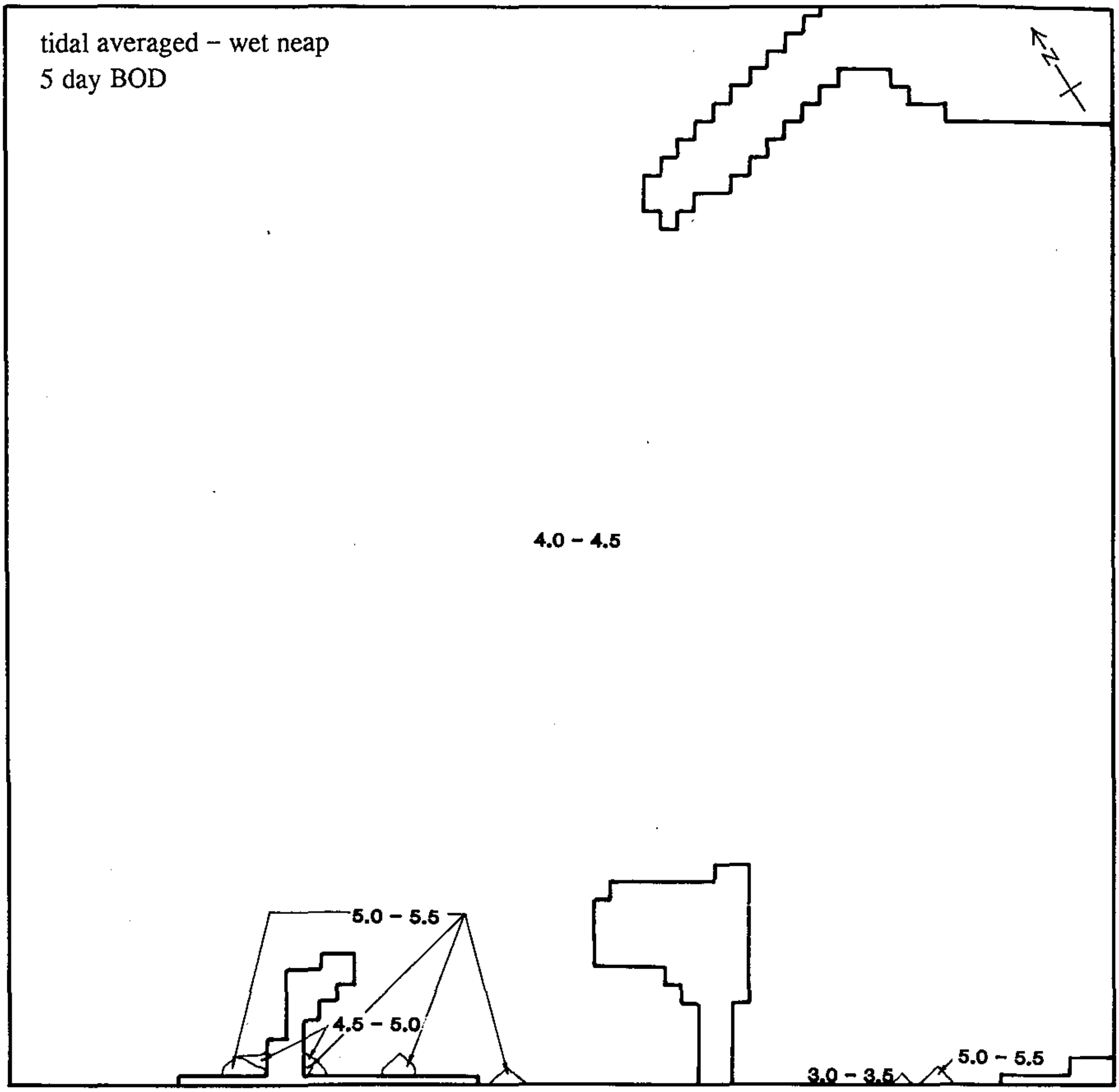
Tide Averaged Distribution of BOD (mg/l), Dry Season, Reclamations Plus Mitigation Figure 3.65



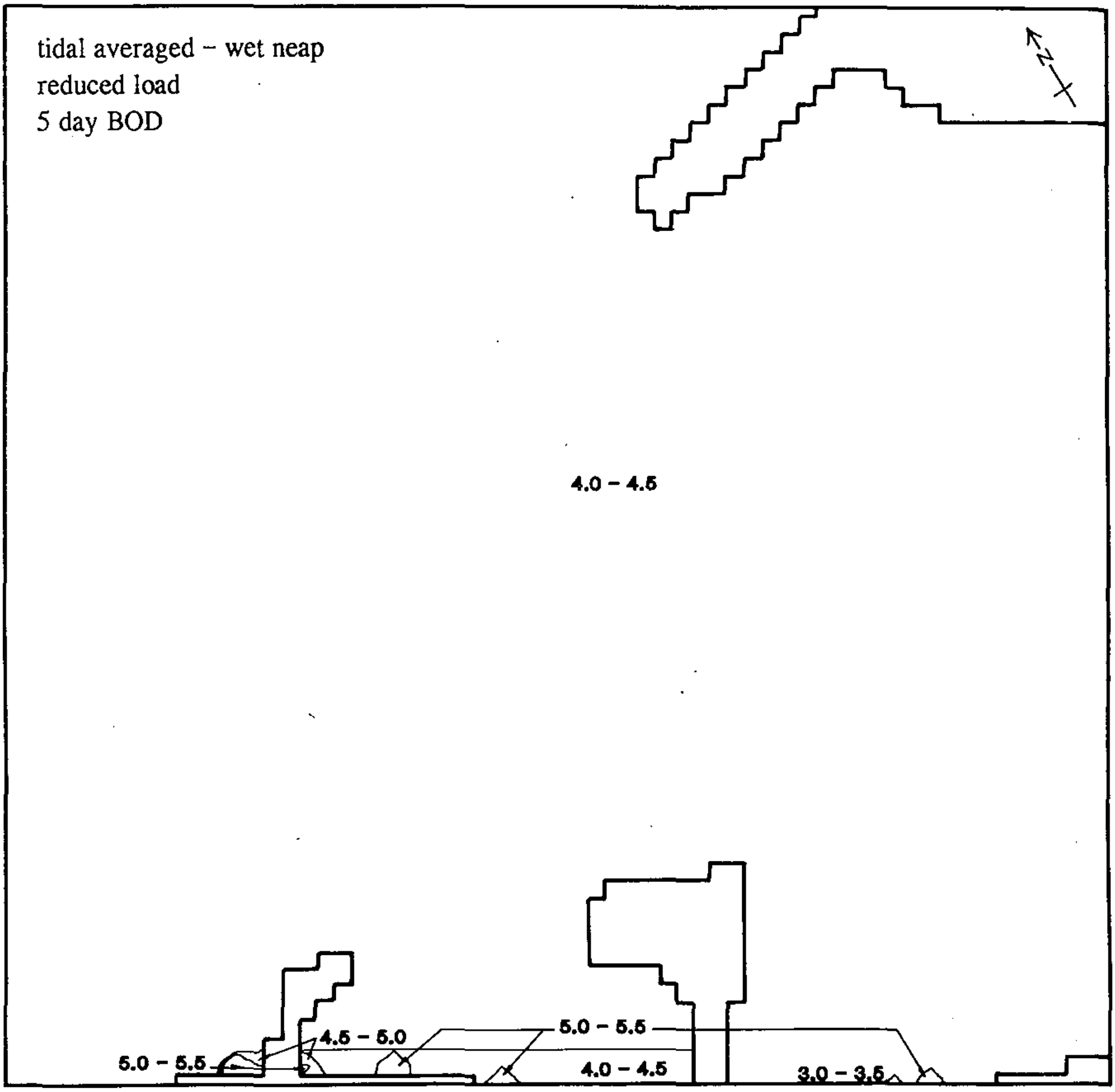
Tide Averaged BOD (mg/l), Dry Season, Full Reclamation Plus Mitigation Figure 3.66



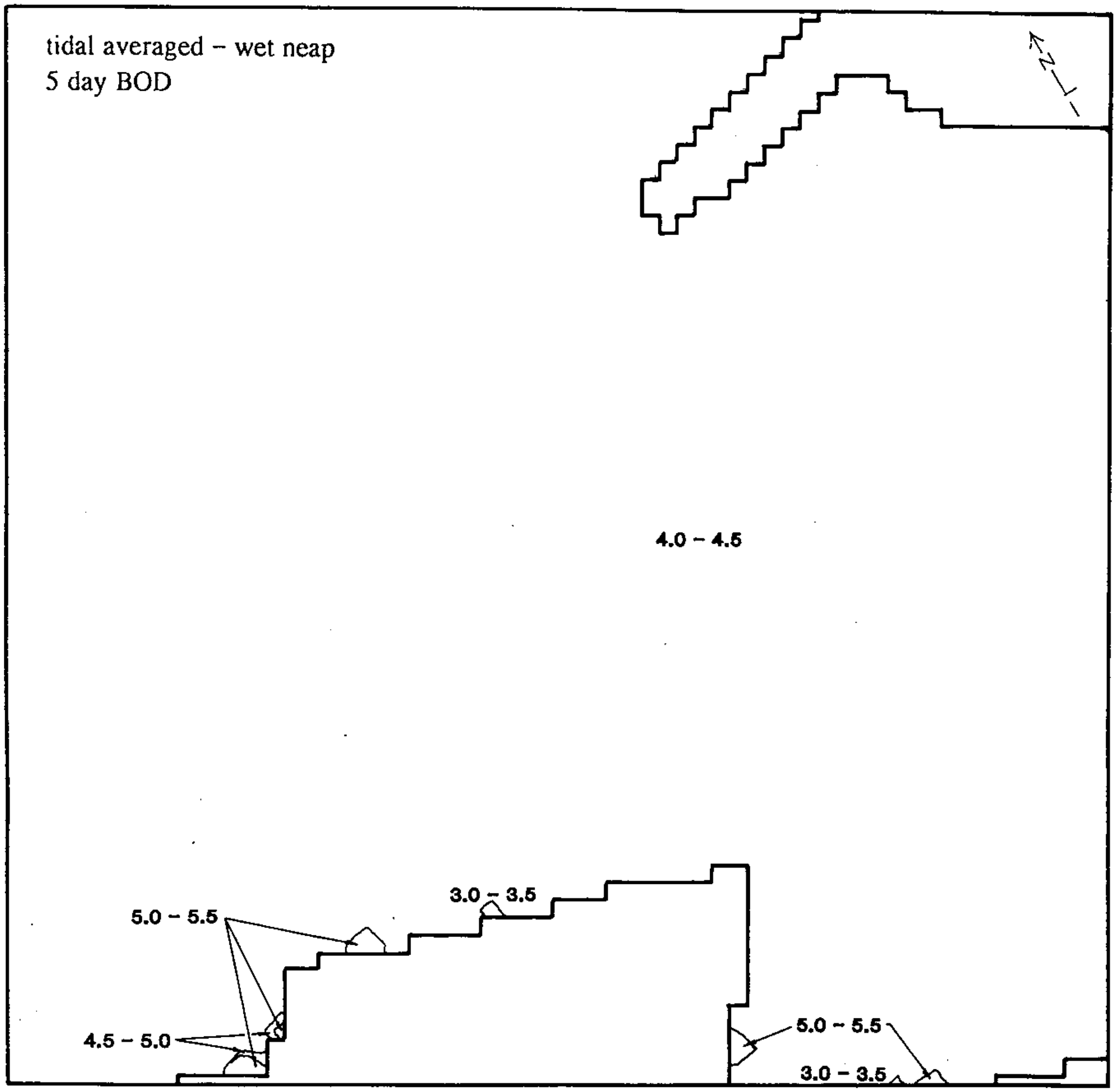
Tide Averaged Distribution of BOD (mg/l), Wet Season, Existing Conditions Figure 3.67



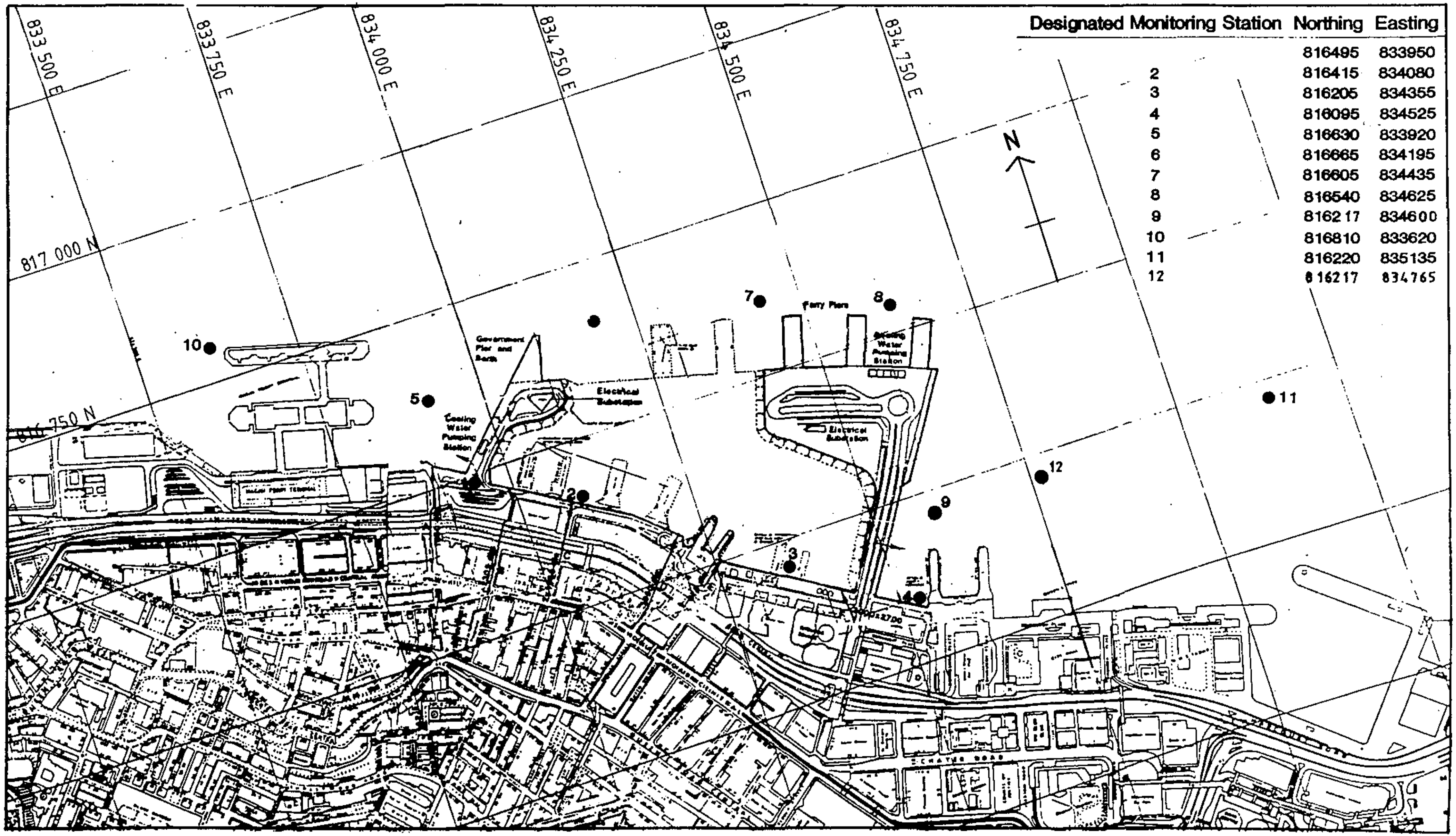
Tide Averaged Distribution of BOD (mg/l), Wet Season, Reclamations   Figure 3.68



Tide Averaged Distribution of BOD (mg/l), Wet Season, Reclamations Plus Mitigation Figure 3.69

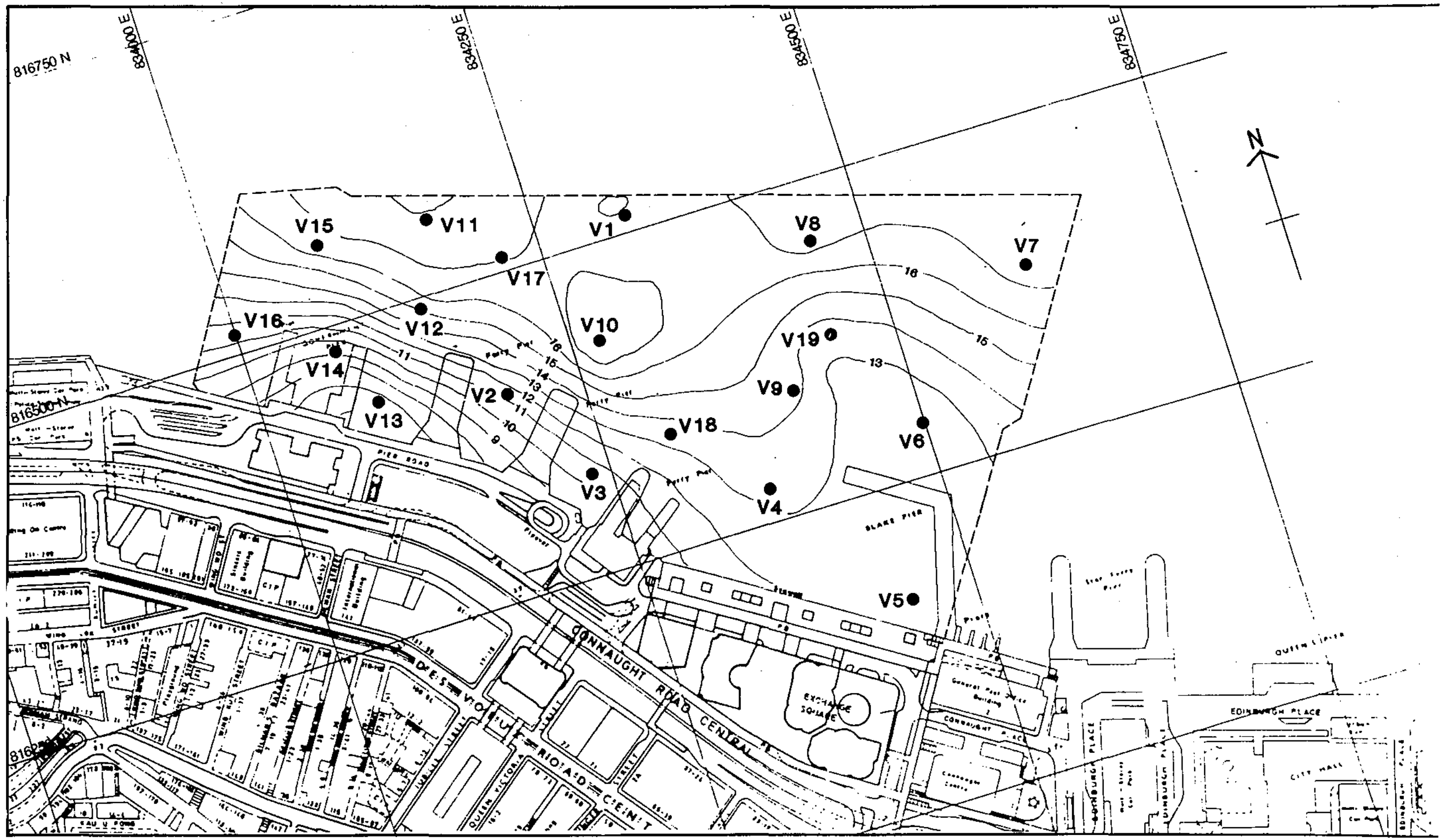


Tide Averaged BOD, Wet Season, Full Reclamation Plus Mitigation Figure 3.70

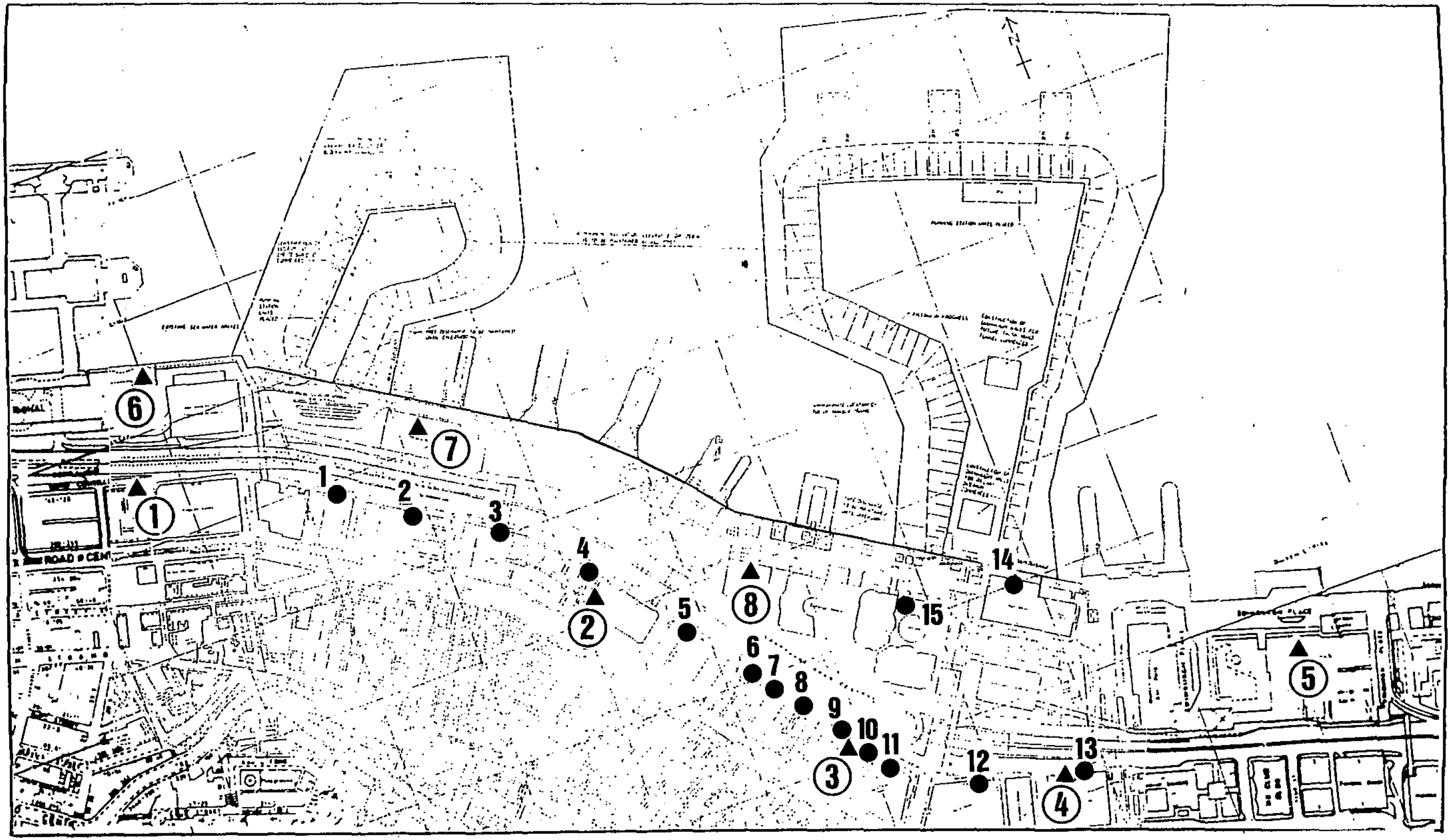


Designated Monitoring Station	Northing	Easting
	816495	833950
2	816415	834080
3	816205	834355
4	816095	834525
5	816630	833920
6	816665	834195
7	816605	834435
8	816540	834625
9	816217	834600
10	816810	833620
11	816220	835135
12	816217	834765

Water Quality Monitoring Locations Figure 3.71



Location of Vibrocore Stations and Contours of the Base of Contaminated Marine Mud Figure 3.7



● Analysis Points for Air Quality Assessment

▲ Noise Sensitive Receivers

Air and Noise Sensitive Receivers

Figure 3.73

Appendix 1 Study Brief

CENTRAL RECLAMATION, PHASE I

Focussed EIA Study

1. Background

Current plans for the reclamation may result in adverse water quality impacts due to the creation of embayed bodies of water between or adjacent to different parts of the reclamation. Without full implementation of the Sewage Disposal Strategy to collect and transfer sewage for treatment and disposal, discharges of sewage and other pollutants will cause significant water pollution in three main areas associated with phase I of the reclamation:

- east of the eastern reclamation arm around Star Ferry terminal and Queens Pier;
- in the embayed area between the two reclamation arms;
- between the western reclamation arm and the Macau Ferry terminal.

A plan showing the proposed phase I reclamation is attached in Annex A.

2. Purpose of the EIA Study

The main purpose of this focussed EIA Study is to assess the water quality impacts in the affected waters due to the construction and staging of phase I of the reclamation, without the Strategic Sewage Disposal Scheme. Air and noise impacts during the construction phase shall also be predicted and assessed. Floating refuse shall be considered in the assessment. Pollution mitigation measures and environmental monitoring and audit requirements shall be recommended.

The findings of the EIA Study are expected to contribute to decisions on any modifications to the configuration, scale or staging of the reclamation and possible measures to reduce pollutant inputs or promote tidal flushing. The mitigation measures recommended in the report may provide input to the pollution prevention clauses in the tender document for the works in the form of tender addenda or variation orders. Responsibility for the environmental monitoring and audit programme will need to be defined.

3. Scope of the EIA Study

The scope of the focussed EIA Study is defined as:

3.1 Identifying the sensitive receivers and quantifying the potential water, noise and air pollution arising from the construction of the reclamation including: dredging, placement of fill and other construction activities, and recommending mitigation measures to minimize adverse effects;

3.2 Recommending how adverse effects on water movement and hence water quality of the neighbouring waters arising from the completed reclamation may be mitigated including measures to reduce pollutant discharges to the affected waters, and modifications to the scale, phasing and configuration of reclamation; and

3.3 Outlining a programme by which the environmental impacts of the works can be monitored and audited to ensure compliance with environmental limits.

4. <u>Technical Requirements</u>

The focussed EIA Study shall include the following tasks:

4.1 Assess the likely impact on affected waters of the polluted discharges from the existing stormwater drains at Wing Wo Street, Gilman Street, Jubilee Street, Connaught Place and Murray Road and recommend appropriate measures to reduce pollution loadings from these sources. Explain the reasons for rejecting any such possible measures. Account should be taken of the recommendations contained in the Central, Western and Wan Chai West Sewerage Master Plan Study Phase I Report and the proposals in Maunsells paper, "Environmental Considerations (Revised)" of May 1992.

4.2 Based on the measures recommended in task 4.1, use mathematical modelling to predict the water quality in the waters affected by the proposed phase I reclamation in stage I including:

- decrease in dissolved oxygen, and
- increase in E. coli., oxidized nitrogen, ammonia, dissolved organics, nutrients and BOD,

and identify any possible contravention of Water Quality Objectives in the Harbour. The mathematical modelling requirements are set out in Appendix 1.

4.3 Examine the proposed scale, configuration and staging of the reclamation in the light of any adverse water quality impacts identified, and investigate design and staging options to reduce these impacts, including measures to increase tidal flushing of the affected waters. Explain the reasons for rejecting any such possible options or measures.

4.4 Assess the potential increase in turbidity levels in the water column due to disturbance of bed sediments during dredging and arising from placement of fill, and the potential for release of metals, sulphides, ammonia or organics during dredging.

4.5 Quantify and assess the short-term air and noise impacts on nearby sensitive receivers arising from dredging, reclamation, and other earth moving activities during the construction phase of the reclamation.

4.6 Evaluate the likelihood and impacts of accumulations of floating refuse in the affected waters.

4.7 In light of the Study results, make recommendations on mitigation measures for the reclamation for inclusion in works contract conditions as tender addenda or variation orders.

4.8 Define environmental monitoring requirements and responsibilities including trigger, action and target limits and event/action plans.

5. Reporting

The output of the assessment shall consist of a focussed EIA study report which satisfies the requirements of this Brief in respect of the prediction and assessment of impacts, identification of necessary mitigation measures and specification of environmental monitoring and audit requirements. The report shall take into account any revisions and supplements as might be required by the Director of Environmental Protection.

Environmental Assessment and Planning Group
Environmental Protection Department

May 1992

a:\brief\Ph1EIA

Appendix 1

Central Reclamation, Phase I
Mathematical Modelling Requirements

The Central Phase I Reclamation will create an embayment within Stage 1 Phase I of the reclamation and slack water areas immediately t the east and west of the reclamations. The purpose of the mathematical water quality and hydraulic modelling is to provide quantitative assessment of the deterioration in water quality arising from containment of stormwater and cooling water discharge in these areas. The models shall also be used to illustrate the efficacy of mitigatory measures to be proposed.

2. The model shall cover the areas with temperature and water quality likely to be affected by the reclamation and shall extend from the west of Macau Ferry to HMS Tammar.

3. The resolution of the mathematical models shall be sufficiently fine and commensurate with the features in the project area, dimensions of the reclamation and area covered by the models. The grid size shall be 25m. x 25m. as agreed by the Director of Environmental Protection.

4. The flow field in the modelled area will be affected by both tidal current and the large quantity of cooling water discharged in the areas. The flow model used shall be able to simulate the complex flow regime due to the tidal and thermal and saline buoyancy effects and this will require 3-dimensional modelling. Additional field data, where necessary, should be collected to provide water velocity, temperature and salinity data model calibration. The model shall also be validated against WAHMO flow model. The consultants shall extract boundary data for the flow model from WAHMO covering a large enough area to reflect the change in flow field in the reclamation area due to the reduction in flow channel created by this reclamation.

5. A two layer water quality model based on the processed flow results will be required for this modelling work.

6. The models shall be used to simulate baseline conditions and the scenarios during construction and on completion of the Phase I (Stage 1) reclamation. The consultants shall provide loading data for input to the models according to mitigatory measures being proposed. Further scenarios shall simulated to demonstrate the efficacy of mitigatory measures to be proposed.

a:\Brief\Ph1M-Mod

Appendix 2 Setting Up and Validation of 3D WAHMO Model

CES
Consultants in Environmental Sciences (Asia) Ltd

CENTRAL AND WANCHAI RECLAMATION - FOCUSED EIA
HYDRAULIC AND WATER QUALITY MODELLING

THREE-DIMENSIONAL MATHEMATICAL MODEL SIMULATIONS OF TIDAL FLOWS AND COOLING WATER DISCHARGES

Report HWR 047

September 1992

ABSTRACT

As part of the environmental impact assessment of Phase 1 of the Central and Wanchai reclamation on water quality, a three-dimensional mathematical model of tidal flows and cooling water discharges was used to simulate existing conditions and the reclamation layout together with the air conditioning system cooling water intake and outfall discharges. The results from the three-dimensional model were then processed and used as the basic hydraulic data input to the WAHMO two-layer model of water quality. This report describes the tidal flow and cooling water simulations.

A 25m grid HEATFLOW-3D model was set up to cover the area of interest and verified for wet and dry season neap tides using results from the established WAHMO model and using available field data. The model was then used to simulate existing thermal conditions resulting from a number of cooling water discharges resulting from air-conditioning systems. The proposed works were installed in the model and the dispersal of cooling water on wet and dry season neap tides was simulated. The HEATFLOW-3D model results were then processed for use in the subsequent water quality studies.

The existing discharges gave rise to plumes which remained close to the shore. Plume temperatures were low and only reached 1°C above ambient within, approximately, a 150m radius of the main outfall. With the reclamations in place the plumes were forced offshore and higher temperatures were reached where the plumes were confined against the reclamation. However temperatures were still quite low and only reached 1°C above ambient within an area about 250m by 50m of the main outfall.

CONTENTS

		Page
1	INTRODUCTION	1
2	THE MODEL	1
2.1	DESCRIPTION OF THE SITE	1
2.2	DESCRIPTION OF THE MODEL	2
3	CALIBRATION OF THE MODEL	2
3.1	WET SEASON NEAP TIDE CALIBRATION	3
3.2	DRY SEASON NEAP TIDE VERIFICATION	4
3.3	TIDE CURVES	4
3.4	CONCLUSIONS	4
4	THERMAL MODELLING OF EXISTING CONDITIONS	4
4.1	WET SEASON NEAP TIDE EXISTING CONDITIONS	5
4.2	DRY SEASON NEAP TIDE EXISTING CONDITIONS	5
5	PREDICTIVE SIMULATION	6
5.1	WET SEASON NEAP TIDE TEMPERATURES	6
5.2	WET SEASON NEAP TIDE FLOWS	6
5.3	DRY SEASON NEAP TIDE TEMPERATURES	6
5.4	DRY SEASON NEAP TIDE FLOWS	7
6	FULL RECLAMATION LAYOUT	7
7	CONCLUSIONS	8
8	REFERENCES	9

FIGURES

1 Location plan showing model area
2 Model layout for existing conditions ; 25m model
3 Positions for time history output from 25m and 250m models
4 Peak velocities in 25m model ; Wet Season Neap Tide
5 Peak velocities in 250m model ; Wet Season Neap Tide
6a Current speed and direction in 25m model ; Wet Season Neap Tide
6b Current speed and direction in 250m model ; Wet Season Neap Tide
7 Comparison of 25m model speeds with observations; Wet Season Neap Tide
8a Salinity in 25m model ; Wet Season Neap Tide
8b Salinity in 250m model ; Wet Season Neap Tide
9 Comparison of model salinities with observations; Wet Season Neap Tide
10 Peak velocities in 25m model ; Dry Season Neap Tide

FIGURES (continued)

11 Peak velocities in 250m model ; Dry Season Neap Tide
12 Current speed and direction in 25m model ; Dry Season Neap Tide
13 Current speed and direction in 250m model ; Dry Season Neap Tide
14a Elevations in 25m model ; Wet Season Neap Tide
14b Elevations in 250m model ; Wet Season Neap Tide
15a Elevations in 25m model ; Dry Season Neap Tide
15b Elevations in 250m model ; Dry Season Neap Tide
15 Elevations in 250m model ; Wet Season Neap Tide
16 Positions of outfalls and intakes and time history output positions
17 Temperature distributions : existing ; Wet Season Neap Tide ; surface layer
18 Temperature time histories ; Wet Season Neap Tide : existing
19 Peak velocity vectors ; Wet Season Neap Tide : existing
20 Current and direction time series ; Wet Season Neap Tide : existing
21 Temperature distributions : existing ; Dry Season Neap Tide ; surface layer
22 Temperature time histories ; Dry Season Neap Tide : existing
23 Peak velocity vectors ; Dry Season Neap Tide : existing
24 Current and direction time series ; Dry Season Neap Tide : existing
25 Model layout during stage 2 of construction
26 Temperature distributions : stage 2 ; Wet Season Neap Tide : surface layer
27 Temperature time histories ; Wet Season Neap Tide : stage 2
28 Peak velocity vectors ; Wet Season Neap Tide : stage 2
29 Current and direction time series ; Wet Season Neap Tide : stage 2
30 Temperature distributions : stage 2 ; Dry Season Neap Tide : surface layer
31 Temperature time histories ; Dry Season Neap Tide : stage 2
32 Peak velocity vectors ; Dry Season Neap Tide : stage 2
33 Current and direction time series ; Dry Season Neap Tide : stage 2
34 Model layout during final construction
35 Temperature distributions : final ; Wet neap tide : surface layer
36 Temperature time histories ; Wet neap tide : final
37 Peak velocity vectors ; Wet neap tide :final
38 Current and direction time series ; Wet neap tide : final
39 Temperature distributions : final ; Dry neap tide : surface layer
40 Temperature time histories ; Dry neap tide : final
41 Peak velocity vectors ; Dry neap tide : final
42 Current and direction time series ; Dry neap tide : final

APPENDIX 1

1 Formulation and validation of HEATFLOW-3D

1 INTRODUCTION

As part of the continuing development of the Hong Kong coastal area, a reclamation is planned to be built along the existing seafront of Central and Wanchai. The phase of the reclamation simulated in the model study described in this report is situated in Central and in an area which plays host to a large number of vessel movements. During construction of the reclamation, an embayed area will be built, allowing ferries to continue working from existing piers until their berths are moved to the new waterfront.

In June 1992, HR Wallingford were commissioned to simulate tidal flows and the discharges of cooling water from air conditioning plants for the existing situation and following the partial construction of Phase 1 of the Central and Wanchai reclamation which would leave a large embayed area between two sea walls.

The study was carried out using the HR Wallingford HEATFLOW-3D three-dimensional model of tidal flows, salt movement and thermal discharges which forms part of the HR TIDEWAY suite of models. This model has been successfully used in several retrospective and predictive simulations of cooling water plumes.

The model was used to simulate a wet season neap tide which included salinity movement and a dry season neap tide in which salinity variations were assumed negligible. These tides were simulated both with and without the reclamation representing the second stage of construction of Phase 1 of the Central and Wanchai Reclamation. The model results were then used to simulate the effect of the reclamation on water quality using the WAHMO two-dimensional two-layer water quality model which is described separately (Ref 4).

This report describes the setting up of the model, its verification using results from the coarser gridded WAHMO model (Ref 1) and field observations (Refs 2 and 3), the simulation of existing thermal conditions and the simulation of conditions with the proposed reclamations.

2 THE MODEL

2.1 DESCRIPTION OF THE SITE

The model extended approximately 1.6km from the Macau Ferry Terminal to HMS Tamar along the Central coastline and extended northwards to include the tip of the Kowloon Peninsula and Ocean Terminal. The shoreline contains many ferry berths and pontoons for light vessel moorings. During construction of the reclamation the existing ferry piers will be dismantled as different facilities are moved onto the new structure finally leaving the embayed area devoid of shipping traffic.

At present, in the immediate area of the embayment, there are several cooling water outfalls from various air conditioning plants. These outfalls discharge cooling water at 5°C above ambient water temperature directly into the water body at a height of between -0.5m and -1.5m relative to Principle Datum (Hong Kong). There are also intakes which are situated at similar levels withdrawing similar discharges from the water body.

2.2 DESCRIPTION OF THE MODEL

The model was set up using bathymetry obtained from Admiralty Chart 1459 (1992 edition). The model has a 25m grid and covers an area of 1.6km square, aligned at 30° to grid north which aligned the local coastline in the reclamation area with the x-axis of the model and also aligned the new local model with the original WAHMO model. The layout of the model is shown in Figure 2.

The modelled area includes the edge of the Macau ferry terminal, the government piers, several ferry (passenger and vehicular) piers and Blake Pier. These piers are supported on piles which are judged to have only 15% reduction on very local flows and are not simulated in the model.

The positions and flow rates for the intakes and outfalls and the layout for the predictive tests were supplied by the Consulting Engineer in drawing number 7230/SK019.

The study was carried out using the HR HEATFLOW-3D model which is based on the well established equations of conservation of mass, momentum and heat, including the important processes of vertical turbulent mixing, buoyant spreading and advection by tides and wind induced currents. Details of the model and summaries of its validation at other sites are given in Appendix A.

The HEATFLOW-3D model was run in this case with five layers where the top four layers each had a thickness of 2.25m and the remaining layer represented the rest of the water column. The upper four layers therefore correspond to the upper layer of the WAHMO model which has an interface depth of about 7m (CD) in this area.

Boundary conditions for levels, flow and salinity were taken from the WAHMO model. Elevations were prescribed at the west edge and velocities at the north and east edges of the model. The salinity was prescribed on all open boundaries. At the open boundaries of the model the excess temperature above ambient was taken to be zero so that any heat reaching these boundaries was lost to the system. In practice, any warm water leaving the modelled area could return on a later phase of the tide but it would be very much diluted. For the area being modelled and the magnitude of the hot water discharges being considered in this study, however, these heat losses were not thought important.

3. CALIBRATION OF THE MODEL

Calibration is the process of adjusting the parameters of the model to obtain the most realistic fit to observations. Verification is an independent comparison with a different set of data made without further adjustment of the model in order to ensure that the calibration process has not constrained the model unduly and that the model can simulate different tidal conditions without further adjustment. In this case the model was calibrated using the wet season neap tide results from the WAHMO model and verified against the dry season neap tide results (Ref 1) . For ease of comparison with the original WAHMO model, the results of the local model are shown after conversion to the WAHMO model's two-layer structure.

One observation station, Station 8, from the data collection exercise used in the verification of the WAHMO model (Ref 1) is just within the model area and another, Station 6, is just to the east of the area modelled. Comparisons are presented with the data from these stations but these must be interpreted with care because of differences between the observed and modelled tide ranges.

3.1 WET SEASON NEAP TIDE CALIBRATION

Figures 4 and 5 show the flow patterns at peak flood and ebb flows for the upper and lower layers. Figure 4 shows the local model (every tenth cell) while Figure 5 shows the outer model. It is seen that the vectors in the 25m model and the WAHMO 250m model are generally similar. There are differences at peak flood, with directional shear being apparent between the layers in the local model and rather stronger currents in the lower layer at the south side. On the ebb tide, there is good agreement between the models in speed and direction in both layers.

Figures 6a and 6b show the variation of current with time at a number of positions within the models. The positions are shown in Figure 3. As with the general flow patterns, the agreement is good on the ebb tide over the modelled area. Differences can again be seen during the flood in the southern part of the model. The directional shear is greater in the local model and also the lower layer currents are generally stronger in the local model. These differences are not unreasonable in view of the greater resolution of the bathymetry in the new 25m local model. The WAHMO model, which was intended to simulate large scale processes over a much wider area, has only a few 250m wide cells covering the width of the channel between Kowloon and Hong Kong island and so can not represent the structure of the Central Fairway or of the Ocean Terminal as well as the fine grid local model. The detail of the Central Fairway would clearly affect the flow in the lower layers of the water column. Comparing the directional shear in the vertical and the pattern of domination of flood by the lower layer and ebb by the upper layer in both models shows reasonable agreement in the wet season and the local model results are supported by the field data comparisons described below. The WAHMO model also agrees with the local model in showing stronger lower layer currents on the flood than on the ebb.

The field measurements were collected over a 3 day period while the WAHMO model only simulated one tidal cycle within that period. At WAHMO Stations 6 and 8, the field observations were collected on a different tide to the one simulated (Ref 1) and the modelled tide was smaller in range and had a longer flood and shorter ebb than the tide observed. No attempt has been made to re-scale the speeds according to tidal range but the observations have been moved in time so that the turn of the simulated and observed tides correspond. WAHMO Station 6 is compared with model position 4 (Fig 3) near the eastern edge of the 25m model. The comparisons of tidal currents are shown in Figure 7.

At WAHMO Station 6 and model position 4, the flood currents compare quite well in speed. The model currents flood north of west in the upper layer and west in the lower layer while the observed currents flood west and west-southwest. The difference between model and observation is consistent with the curvature of the channel between the points being considered while the shear between the two layers is broadly consistent in model and observations. The ebb currents do not agree so well because of the short ebb duration in the observed tide but the general behaviour of the surface currents is reasonable, with a similar variation in direction caused by the curvature of the channel. The observed ebb currents are much smaller in the lower layer than in the upper layer. This contrast is not found in the model at this position but similar contrasts are found elsewhere (eg WAHMO Station 8).

At WAHMO Station 8, which is just inside the modelled area, the agreement in speed and direction is quite good making due allowance for the different tides. The upper layer dominance of the ebb is well represented in the model. The model lower layer ebb direction is rather different from the observations but, because most of the flow is in the upper layer, this is not a serious discrepancy. The velocity directions in the upper layer on the ebb tide and in both layers on the flood tide agree with the observations.

The variations of salinity with time at the same set of positions are shown for the two models in Figures 8a and 8b. The general variation is similar in the two models. There is a natural tendency in the local three-dimensional model for the discrete change in salinity simulated between each layer in the two-layer model to become more of a changing profile over several layers within the three-dimensional model and this reduces the apparent contrast between the layers following the two-layer conversion of the three-dimensional model results.

The salinity field observations (Figure 9) show that the WAHMO tide had generally lower salinities than observed but a realistic degree of stratification. The reduction or disappearance of stratification close to high water is also shown to be realistic. These features are also present in the local model and indicate that the vertical behaviour of the model is reasonable.

3.2 DRY SEASON NEAP TIDE VERIFICATION

Figures 10 and 11 show the comparison of simulated flow patterns for peak flood and ebb tide speeds for the dry season neap tide while Figures 12 and 13 show the comparison of the variations of current with time. A contrast with the wet season, when density gradients generated by differences in salinity influence the flows, is very apparent in that the flows in the two layers are very similar in the dry season. This flow pattern is present in both the WAHMO and new local model and the comparison between the models is good.

3.3 TIDE CURVES

The wet and dry season neap tide curves are shown for completeness in Figures 14 and 15. Over a small area such as that modelled by the local three-dimensional model, there is no significant variation in tidal elevation with position within the model and the surface elevation is entirely controlled by the boundary conditions. The tide curves, therefore, are the same as those obtained from the WAHMO model in this area.

3.4 CONCLUSIONS

It was concluded that the model agreed to a satisfactory extent both with the outer calibrated WAHMO model, making allowance for the greater resolution of the local model, and with the observations, making allowance for the different observed tide and distance between Station 6 and the position in the model used for the comparisons. It was concluded that the predictions from the model should be representative of the actual conditions after construction of the embayment.

4 THERMAL MODELLING OF EXISTING CONDITIONS

For modelling purposes the discharges and withdrawals specified in the drawing provided by the Consultants, Drawing No. 7230/SK019, were grouped together as shown in Figure 16.

The model was run to a repeating state with no thermal discharge during the calibration and verification exercise and it was then run for two full tides with thermal discharges and withdrawals after which the temperature reached a dynamically stable condition.

The output from the thermal modelling tests are presented as plan view isotherm diagrams showing temperatures in the surface layer of the model at the two slack waters and at peak flood and ebb flows, temperature time histories at 15 output positions in the area of interest, peak velocity vectors in the area of interest for the surface and the bed layers, and current and direction time histories in the area of interest. The output positions for the time histories were chosen to show the area of interest in more detail; they are shown in Figure 16.

4.1 WET SEASON NEAP TIDE EXISTING CONDITIONS

Figure 17 shows the isotherms for the wet season neap tide. The plumes can be seen initially (low water slack) close to the shoreline. As the flood tide increases, the plumes spread slightly offshore but remain attached to the shoreline. As the tide turns at high water slack, the plumes pond, particularly around the largest outfall (Blake Pier), then move southeast close to the coast during the ebb tide. The plume temperatures are low, with surface temperatures greater than 2°C above ambient being confined to an area within 75m of the largest outfall.

The temperature time histories (Figure 18) show that the plume does not increase above about 0.2°C in positions 1, 2 and 3 which are approximately 600m offshore, while further inshore at positions 12, 13, 14 and 15 the plume reaches a maximum temperature of approximately 0.5°C above ambient. The maximum temperatures are reached in the area within 50 metres of the outfalls, particularly the outfall at Blake Pier which is discharging more than the other outfalls. The temperature in this area reached a maximum of about 4°C above ambient.

The thermal discharges are small and consequently the buoyancy of the plumes is low and their behaviour is dominated by the ambient currents shown in Figures 19 and 20. The flood currents are strong in the lower layer and there may be some upwelling at the coast. This would enhance the buoyancy of the plume and encourage it to spread away from the shore. In contrast, on the ebb the surface currents are stronger with a weak offshore component near the bed which causes the plume to sink slightly into the lower layers. This can be seen in the temperature time histories, (Figure 18), which, for positions 13 and 14, show the lower layers to be warmer during late ebb and early flood.

4.2 DRY SEASON NEAP TIDE EXISTING CONDITIONS

Figure 21 shows the isotherms for the dry season neap tide. Generally the plumes spread more widely over the surface than in the wet season neap tide simulation because of the different structure of the ambient currents. The areas of highest temperature are similar in size to those in the wet season neap tide simulation and the wider spreading parts of the plumes are at a low temperature.

The time histories in Figure 22 confirm that the plumes remain in the surface layer.

The currents shown in Figures 23 and 24 are seen to be much more uniform than in the wet season with no directional shear and only slightly reduced speeds resulting from bed resistance. There is no associated vertical movement and the buoyancy of the plumes has a greater controlling effect on their behaviour.

5. PREDICTIVE SIMULATION

The works being carried out up to stage 2 of Phase 1 of the construction of the reclamation consist of demolishing Blake Pier and then (after initial dredging) building large concrete bunds where Blake Pier was and between the government piers and the Macau ferry terminal. The model layout with the proposed works is shown in Figure 25. It can be seen that the bund which is at the location of Blake Pier will separate the intakes and outfalls (shown in Figure 16) discharging the greatest amount so that the intakes remain inside the embayment while the discharge is outside.

5.1 WET SEASON NEAP TIDE TEMPERATURES

Figure 26 shows that the works have a significant effect on the pattern of the plumes. The main feature is the plume from the outfall by the eastern bund. This previously moved along close to the shore line but is now confined against the side of the eastern bund. On the flood tide, the plume extends to the outer end of the bund where it is rapidly dispersed in the stronger currents. At high water slack, the plume swings offshore as the tide turns and reaches 500m offshore. On the ebb tide, the plume is confined within an area to the east of the eastern bund by an eddy which causes a small area of 0.2-0.5°C to form surrounded by warmer water. The highest local temperatures are warmer than for existing conditions but these high temperatures are still only found close to the outfall. The 1°C contour extends at most about 250m along the side of the bund and 50m away from it.

The temperature time histories (Figure 27) show that the temperatures inside the embayed area (positions 9, 10, 13 and 14) are all reduced considerably. This confirms that the withdrawal of water by the intakes does not attract the plume back into the embayed area. The main plume, which is shown particularly at locations 11 and 15, is pushed offshore more than during the existing conditions, as indicated by temperature rises found at positions 1 2 and 3.

5.2 WET SEASON NEAP TIDE FLOWS

The reclamation obviously has a significant impact on the flows near to the shoreline (Figures 28 and 29). The flows in the surface layer at peak flood are pushed around the eastern bund increasing the current at the end of the bund. The western bund is in an area of slack water in the lee of the eastern bund and does not generate an eddy on the flood tide. In the bottom layer, the flow is only significantly affected in the immediate area of the reclamation; there is a small eddy between the bunds but very little water actually enters the embayed area. The main feature at peak ebb is the eddy which is formed on the eastern side of the east bund. The plots of current against time show that, as would be expected, the near shore positions, 8-15, are most affected by the works but all the positions are affected to some extent.

5.3 DRY SEASON NEAP TIDE TEMPERATURES

As in the simulation of existing conditions, the temperatures are again more widely dispersed on the dry season neap tide than on the wet season neap tide. At low water slack tide, the main plume is forced offshore by the presence of the eastern bund. The smaller plume outside the western bund is also more noticeable because of the reduced dispersion. The main plume spreads at a low temperature across the entrance of the embayment and joins the other plumes as the flood tide continues. The plumes remain joined at high water slack but separate on the ebb. The eddy structure downstream of the eastern bund is different from that found on the wet season neap tide and the plume is less tightly confined and has lower temperatures. The plume inside the embayment from the outfall on the east of the western bund can be seen throughout the dry season neap tide as a small pool of water over 0.2°C. This pool does not at any point extend more than 175m from the outfall.

The temperature time histories (Figure 31) show that the plume goes considerably further offshore than in the existing conditions (Figure 22). The plume can be seen with temperatures up to 0.5°C at positions 1, 2 and 3 which it does not reach for existing conditions. However the positions at the entrance of the embayment (9 and 10) and the positions within the embayment (13 and 14) both show reductions in temperature compared to existing conditions.

5.4 DRY SEASON NEAP TIDE FLOWS

The flow inside the embayment is reduced considerably by the works (Figures 32 and 33). The water in the embayment is slack even during the times of peak flow. The flow outside is slightly slower than for existing conditions in the immediate area with slightly larger currents being found further offshore (positions 1-3). The eddy downstream of the eastern bund during the ebb tide is weaker than on the wet season tide and most of the currents within 200m of the shoreline are reduced by over 50%.

6 FULL RECLAMATION LAYOUT

Final construction consists of the complete enclosure of the embayed area of stage 2 as given in drawing 7230/SK/019. The intake and outfall details were specified in an annotated version of this drawing. The model layout for this proposed construction is shown in Figure 34. It can be seen that, by comparison with Figure 16, intake positions 1 and 2, and outfall position 1 will be moved from the embayed area to the northern edge of the reclamation, intake position 5 will be changed to the western edge and outfall position 2 slightly further north. The withdrawal and discharge rates at intake and outfall 1 on the north edge of the embayment are 2000 l/s and 2160 l/s compared with 160 l/s from intake and outfall 1 near the western bund during stage 2. The withdrawal at the new intake 2 on the north edge is approximately the same as at the group of intakes at the east side of the embayment in stage 2. The new intake on the west side of the reclamation is approximately equivalent to the existing intakes on the west side of the reclamation area. The overall withdrawal and discharge are increased by 2000 l/s compared with the existing and stage 2 conditions and the extra discharge appears at outfall 1.

6.1 WET NEAP TEMPERATURES

Figure 35, as with Figure 26, shows that the final construction would have a significant effect on the plumes in comparison with the existing conditions (Figure 17). The main difference between stage 2 and final construction is outfall position 1 (Figure 34) where the new 2000l/s outfall produces a plume with temperatures 1°C above ambient at up to 125m from the outfall. Again the plume from the outfall closest to the eastern side of the reclamation is generally confined to the eastern side with a similar structure to that predicted for stage 2. On the flood tide, however, the plume extends round the front of the reclamation at a temperature of 0.2-0.5°C to join the plume from the new outfall.

The temperature time histories are shown in Figure 36. It can be seen that in comparison with stage 2 (Figure 27) the temperature at position 9, close to outfall 1, is considerably increased. Generally the temperatures are a little higher at the offshore positions 1-6 because of the effect of the new outfall but the temperatures still do not rise more than 0.6°above ambient here. There is also a small increase at position 15 and a reduction at position 12 resulting from the small changes in outfall and intake positions.

6.2 WET NEAP FLOWS

Figure 37 demonstrates that in the surface layer there is very little difference between the flows for stage 2 and those for the final construction stage and the slight differences which do exist, occur in the immediate vicinity of the northern edge of the reclamation. Figure 38 shows that in comparison with layer 5, stage 2 (Figure 29), the currents are reduced on the flood tide and increased on the ebb at position 9.

6.3 DRY NEAP TEMPERATURES

As with stage 2, the dry neap tide plumes are more widely dispersed than those of the wet neap tide. The main difference occurs at the front of the reclamation at high water slack where the plume extends further to the west because of the new outfall. Apart from this main difference, the plume is similar to that for stage 2.

The temperature time histories, shown in Figure 40, indicate that there is an overall temperature increase, in comparison with stage 2 (Figure 31), which is again particularly marked at position 9.

6.4 DRY NEAP FLOWS

Comparison of Figures 41 and 42 with Figures 32 and 33 respectively, reveal very little difference between the flows in the final construction simulation and those in the Stage 2 simulation. At position 9 the speed is slightly lower on the flood tide and slightly higher on the ebb (Figure 42).

7 CONCLUSIONS

The Hydraulics Research HEATFLOW-3D three-dimensional model of thermal discharges, salt movement and tidal flows using a 25m grid covering an area between Hong Kong Island and the Kowloon Peninsula was set up and calibrated and was found to simulate flows in this area consistent with the 250m grid WAHMO model and available observations. The model was run for existing conditions to simulate temperature increases presently generated in this area by air conditioning system cooling water discharges and then with reclamations in place representing Stage 2 of Phase 1 of the Central and Wanchai Reclamations to examine the impact of the works. The model was used to simulate both the partially constructed and completed reclamation.

The temperatures simulated following the proposed works are higher in the area outside of the embayment formed by the two bunds but lower in the area between the bunds. The bunds modify the tidal flows locally and reduce flows in the embayment in comparison with the existing conditions and this also causes the plume to remain mainly outside of the embayed area.

The simulation of the final layout showed that the main difference from the stage 2 conditions outside the reclaimed area was caused by the new outfall on the front of the reclamation. The plumes from the other outfalls were very similar to the stage 2 predictions.

The temperatures generated following the introduction of the reclamations are generally quite low, exceeding 1°C above ambient only within an area about 250m by 50m in the worst case which was found to be the wet season neap tide.

8 REFERENCES

1 Hydraulic and Water Quality Studies in Victoria Harbour. Two-layer mathematical model simulation of spring and neap tidal flows in the wet and dry seasons. Hydraulics Research Ltd Report EX 1685, March 1988

2 Hydraulic and Water Quality Studies in Victoria Harbour. Dry Season Data Collection. Electronic & Geophysical Services Ltd Final Report 1987.

3 Hydraulic and Water Quality Studies in Victoria Harbour. Wet Season Data Collection. Electronic & Geophysical Services Ltd Final Report 1987.

4 Central and Wanchai Reclamation Development. Central Reclamation, Phase 1. Focused Environmental Impact Assessment Study. August 1992 Report for the Territory Development Department of the Hong Kong Government

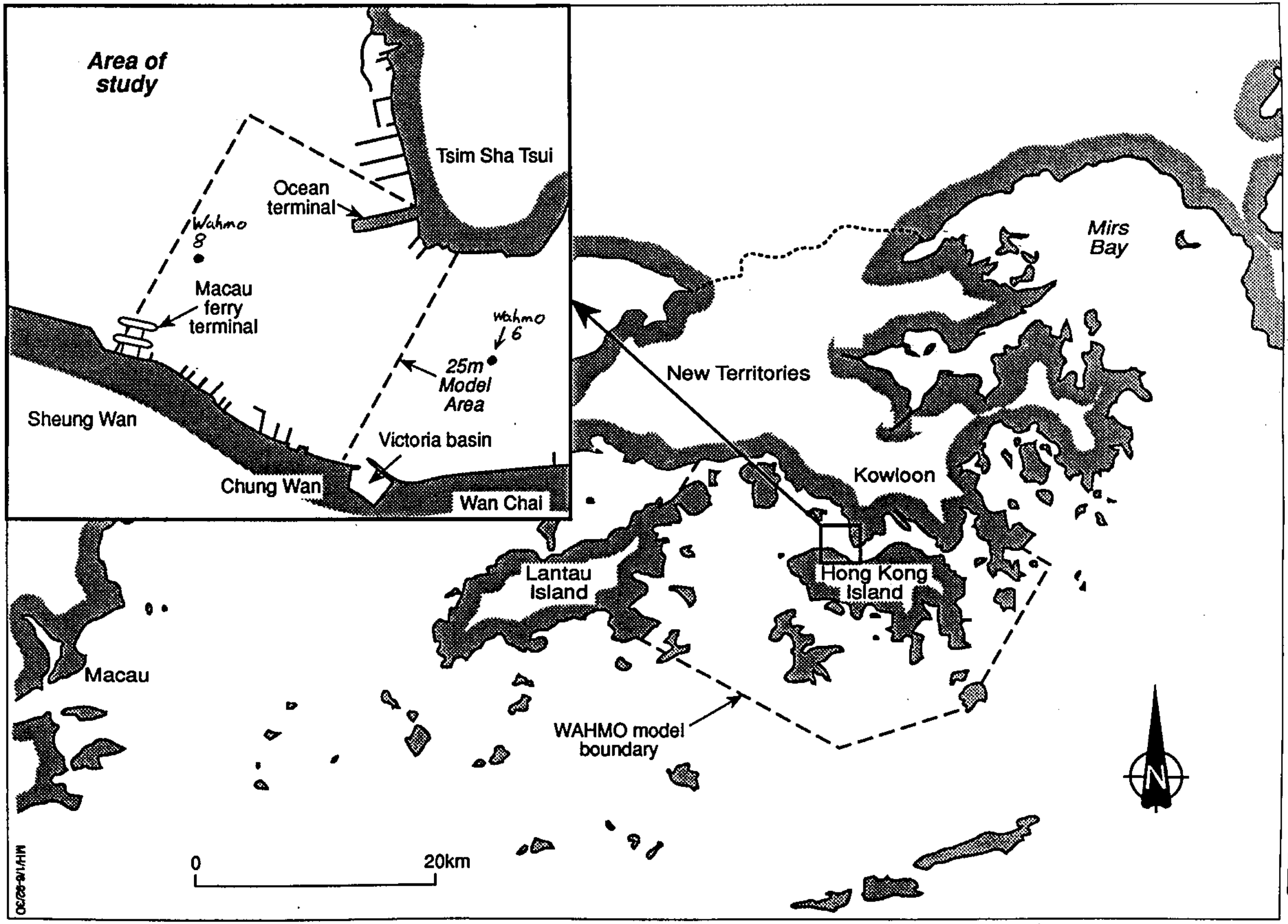


Figure 1 Location plan showing model area

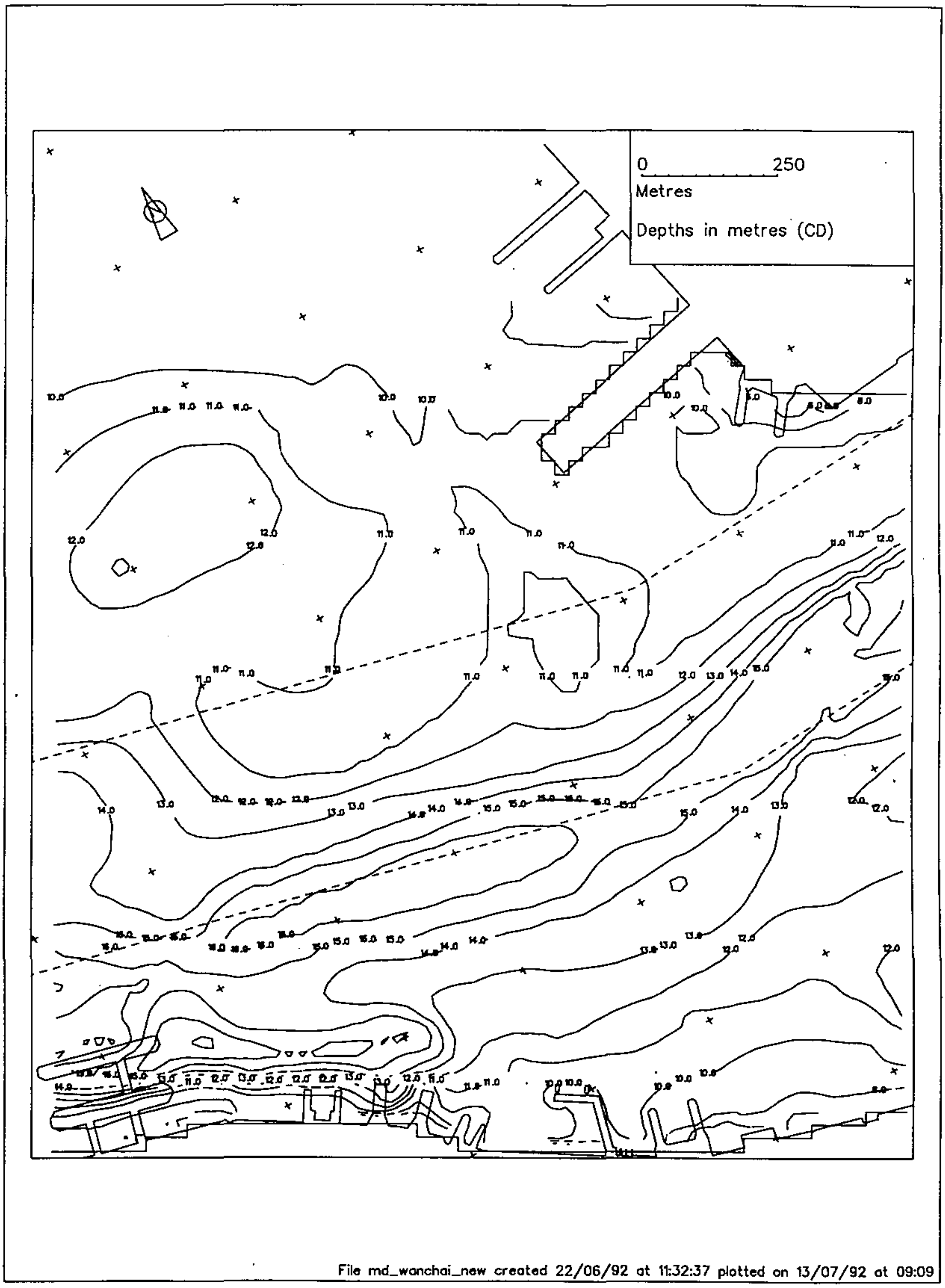


Figure 2 Model layout for existing conditions
25m model

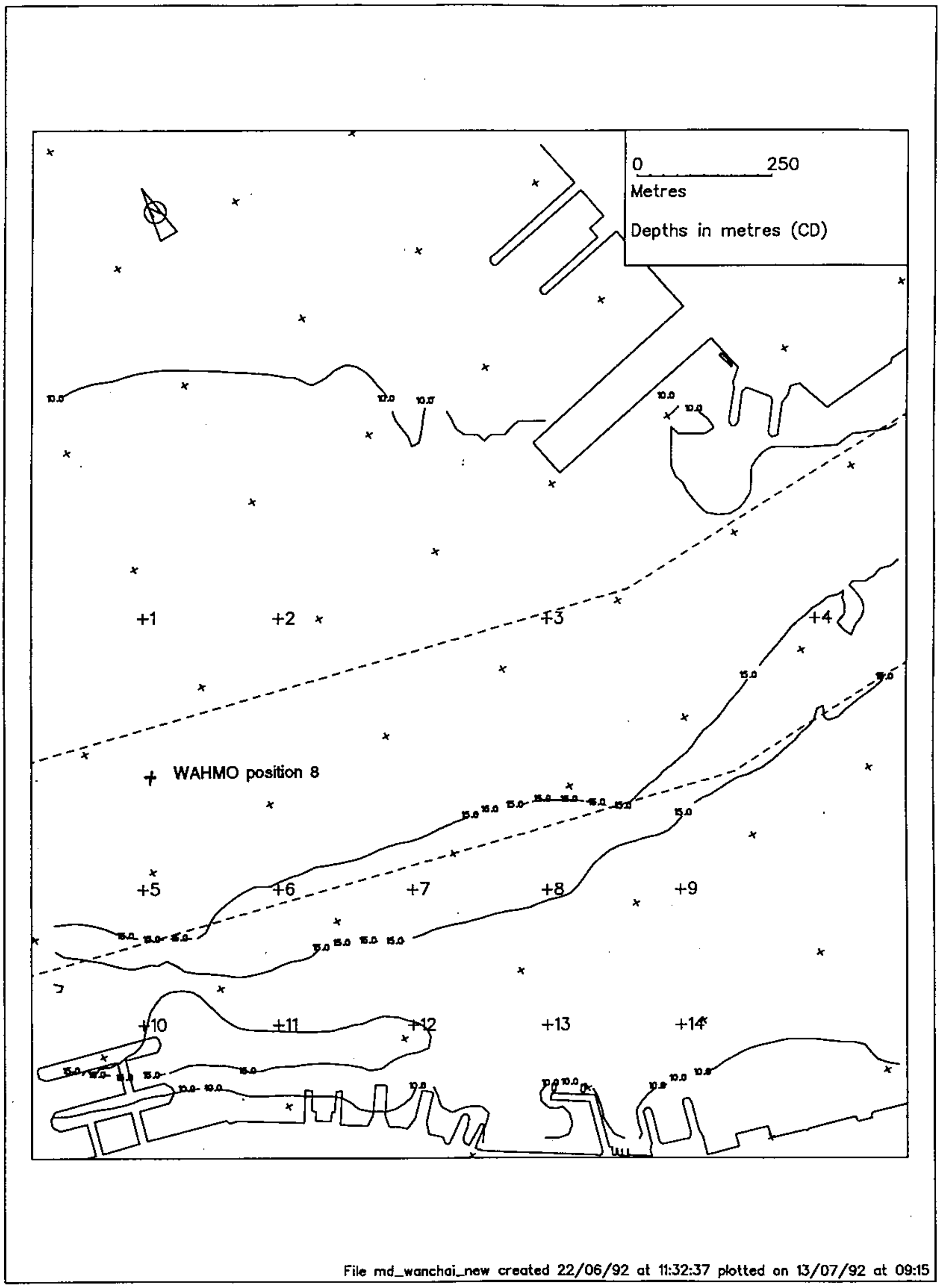


Figure 3   Positions for time history output from 25m and 250m models

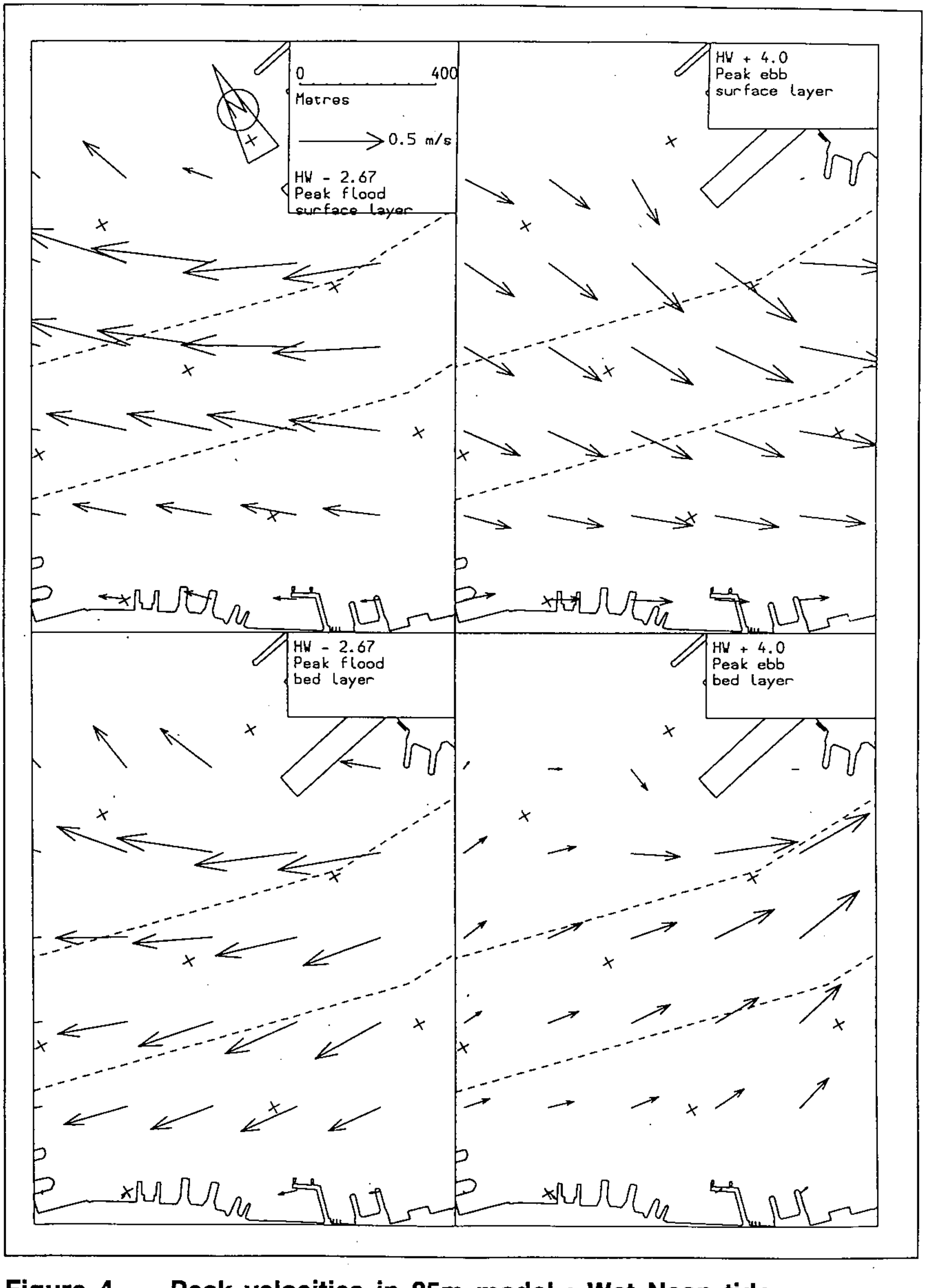


Figure 4 Peak velocities in 25m model ; Wet Neap tide

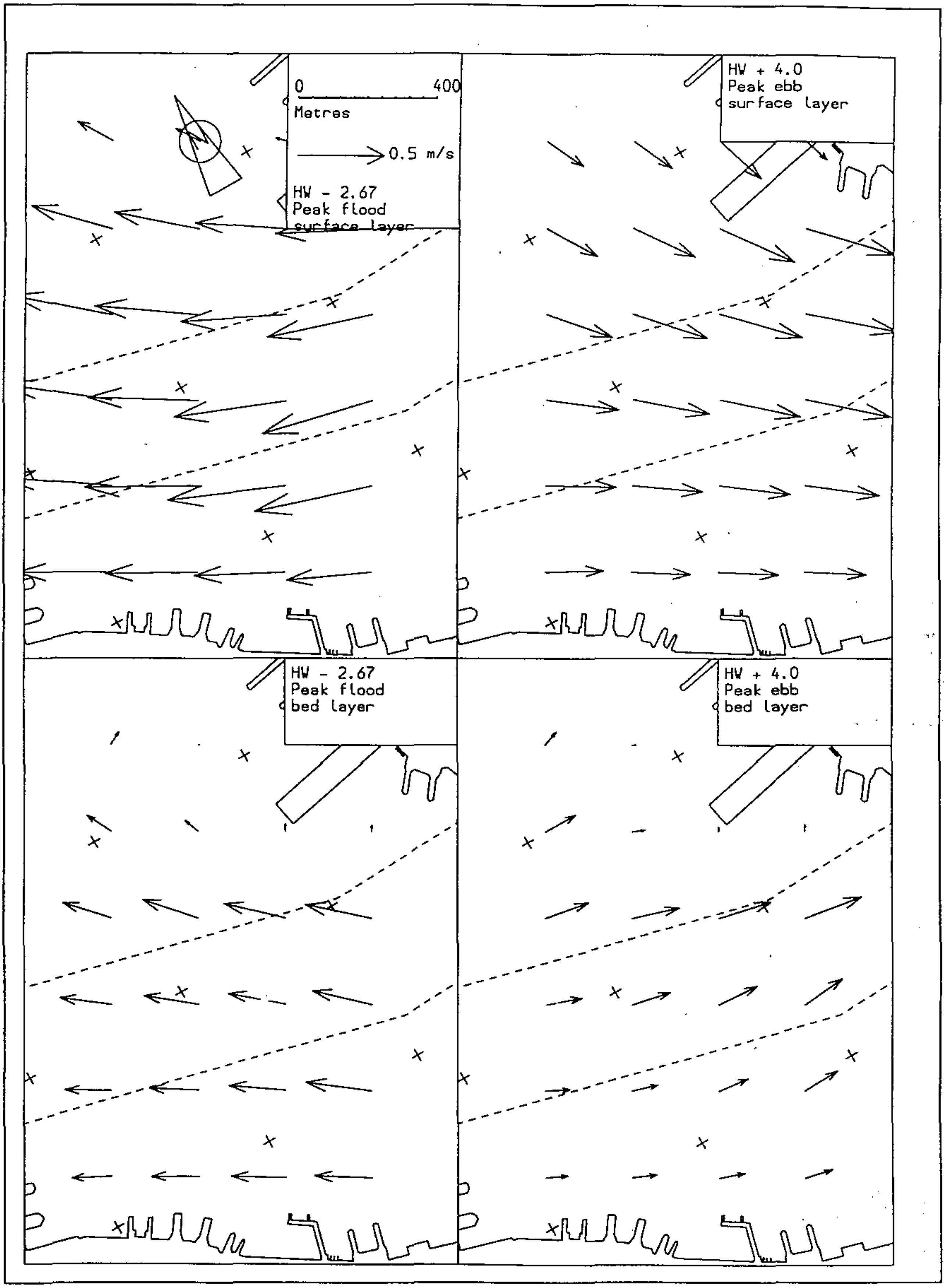
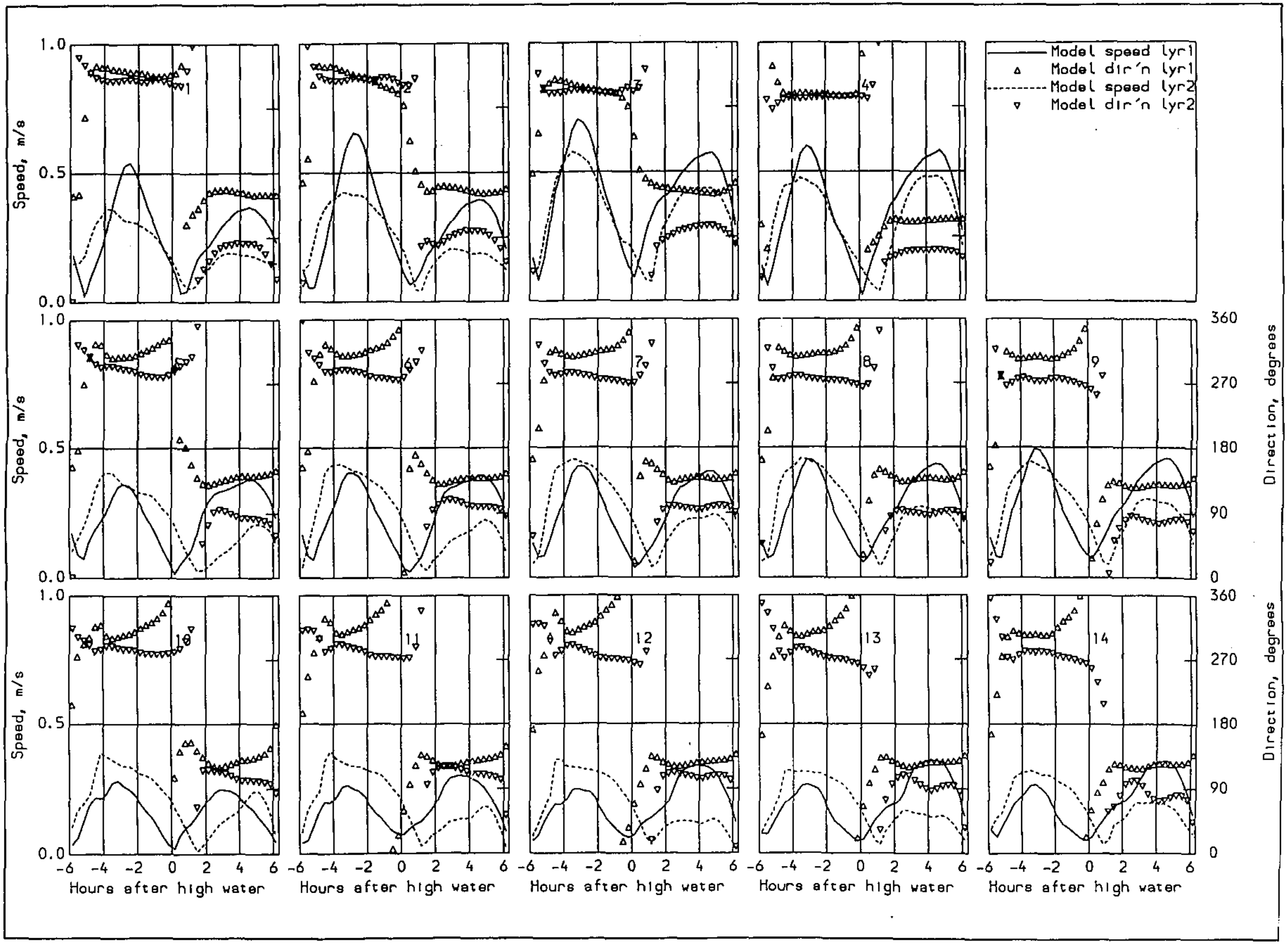


Figure 5 Peak velocities in 250m model ; Wet Neap tide

Figure 6a Current speed and direction in 25m model ; Wet Neap tide



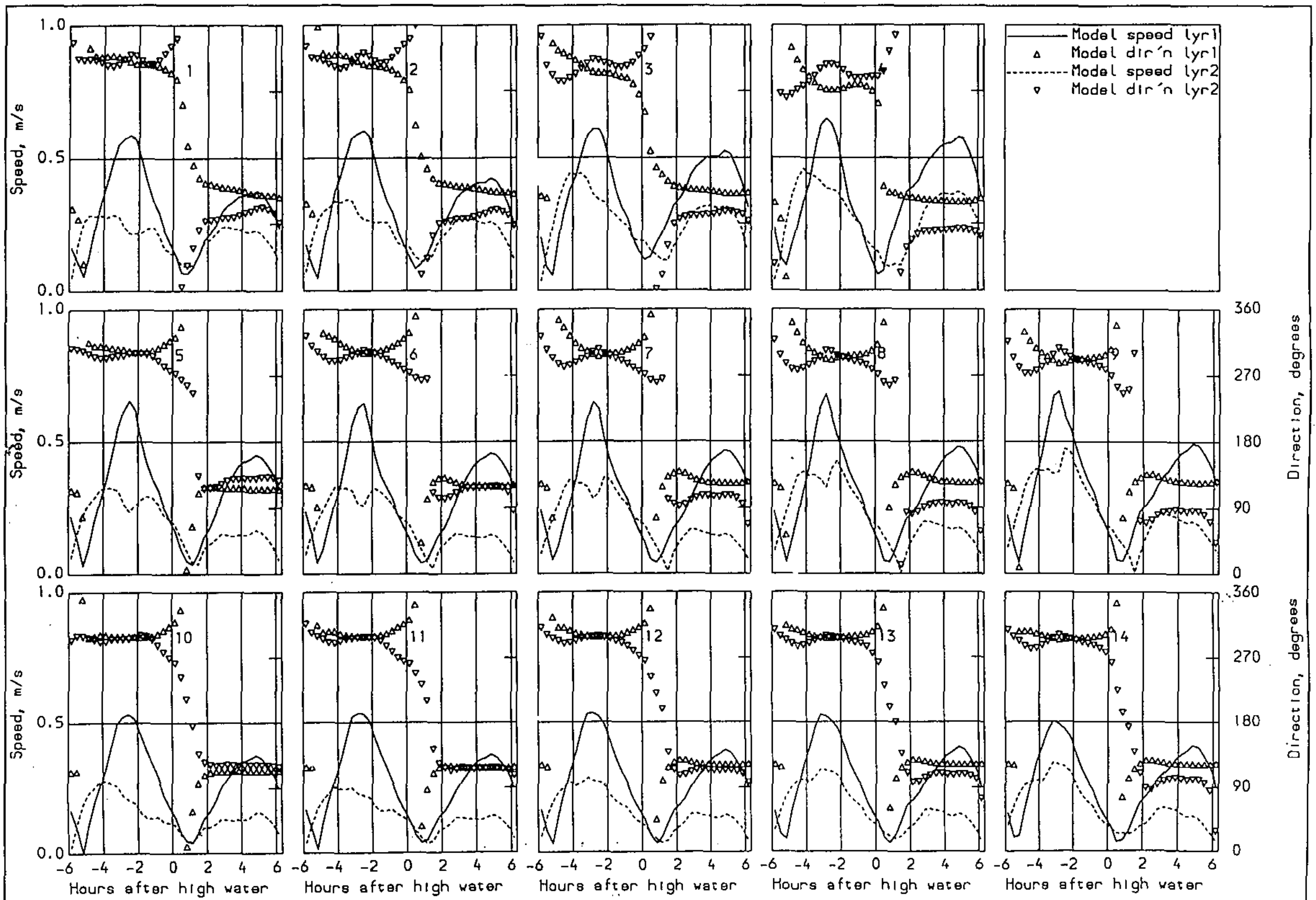


Figure 6b Current speed and direction in 250m model ; Wet Neap tide

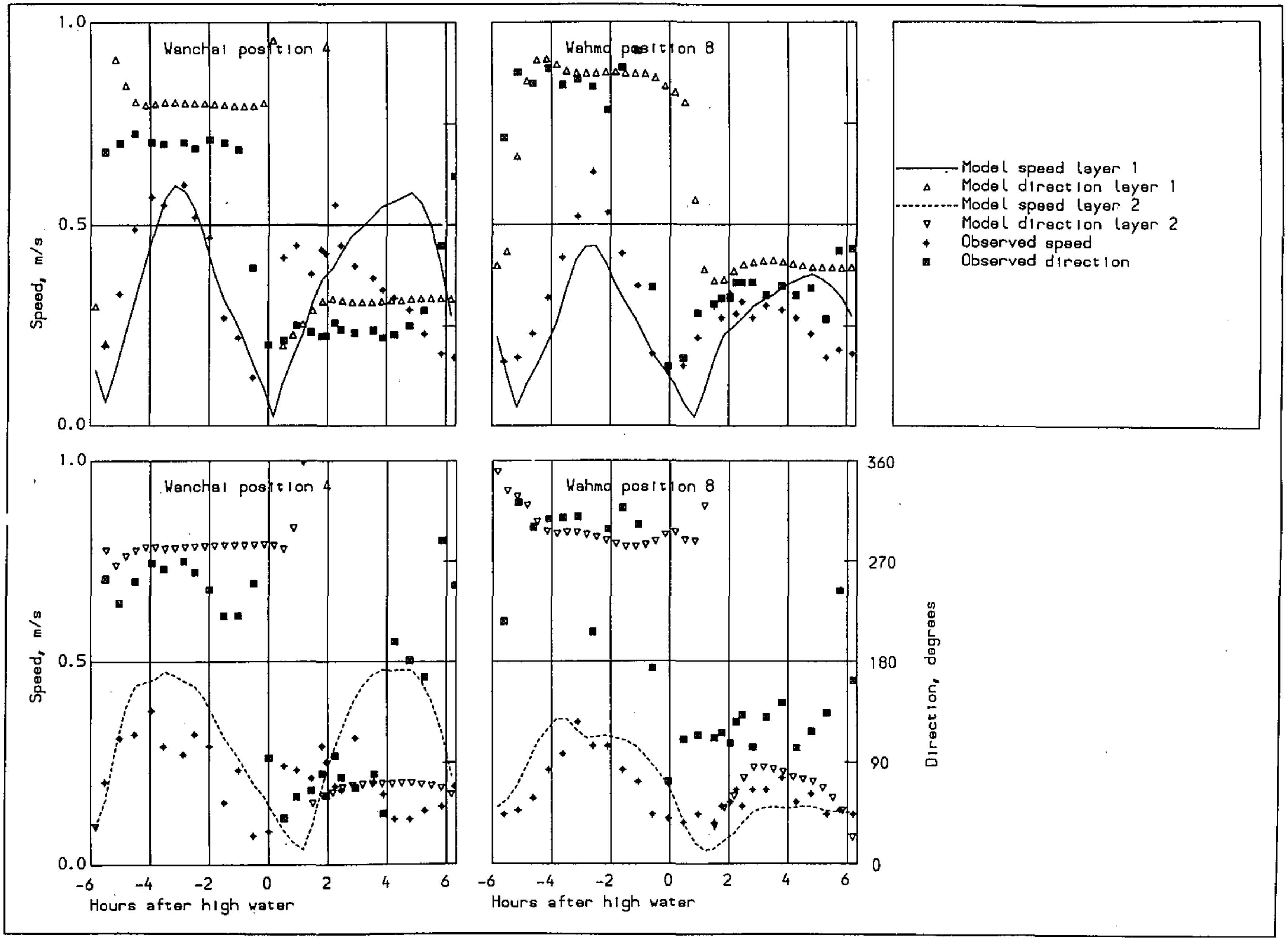


Figure 7 Comparison of 25m model speeds with observations; Wet Neap tide

Figure 8a Salinity in 25m model ; Wet Neap tide

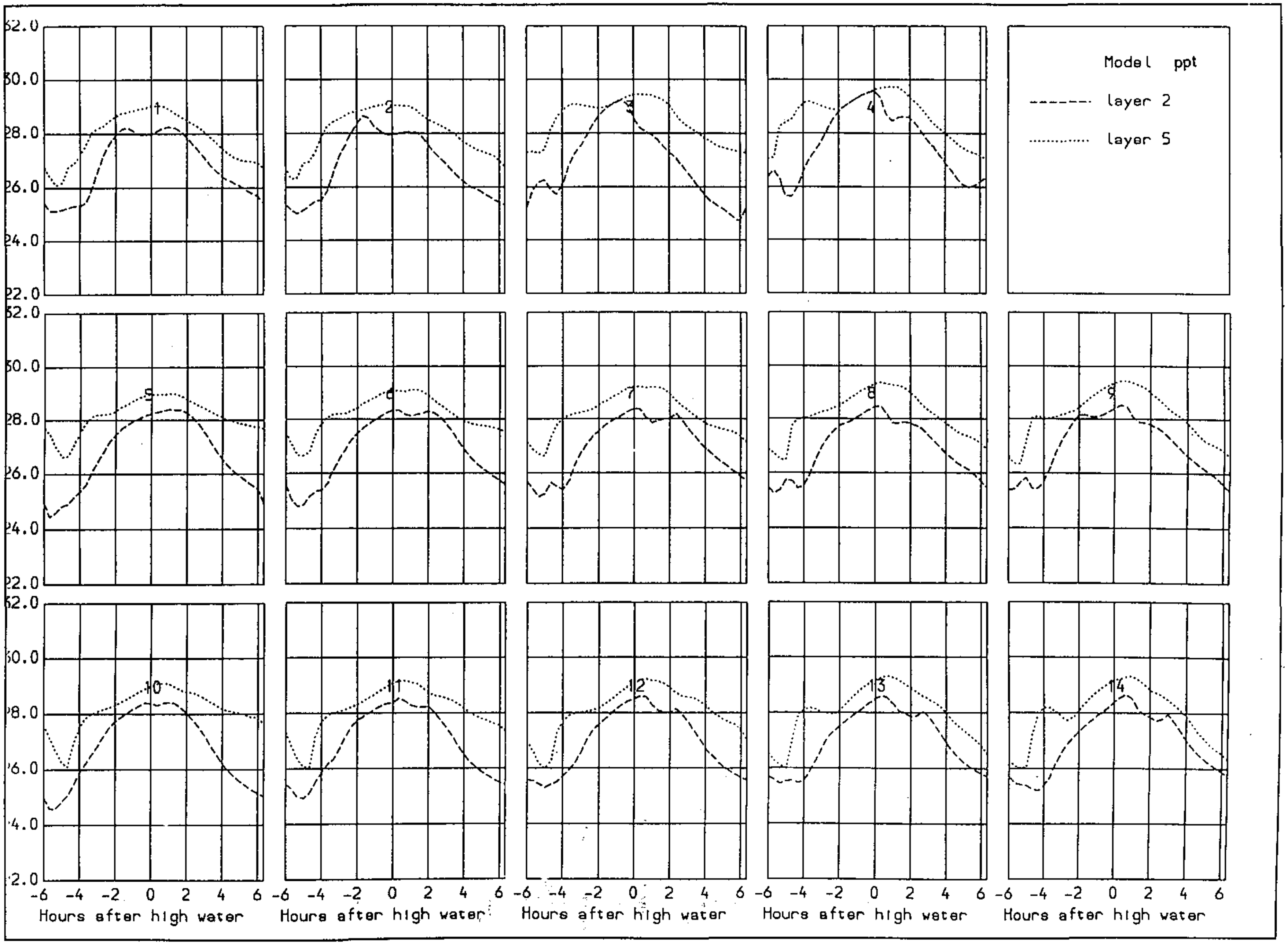
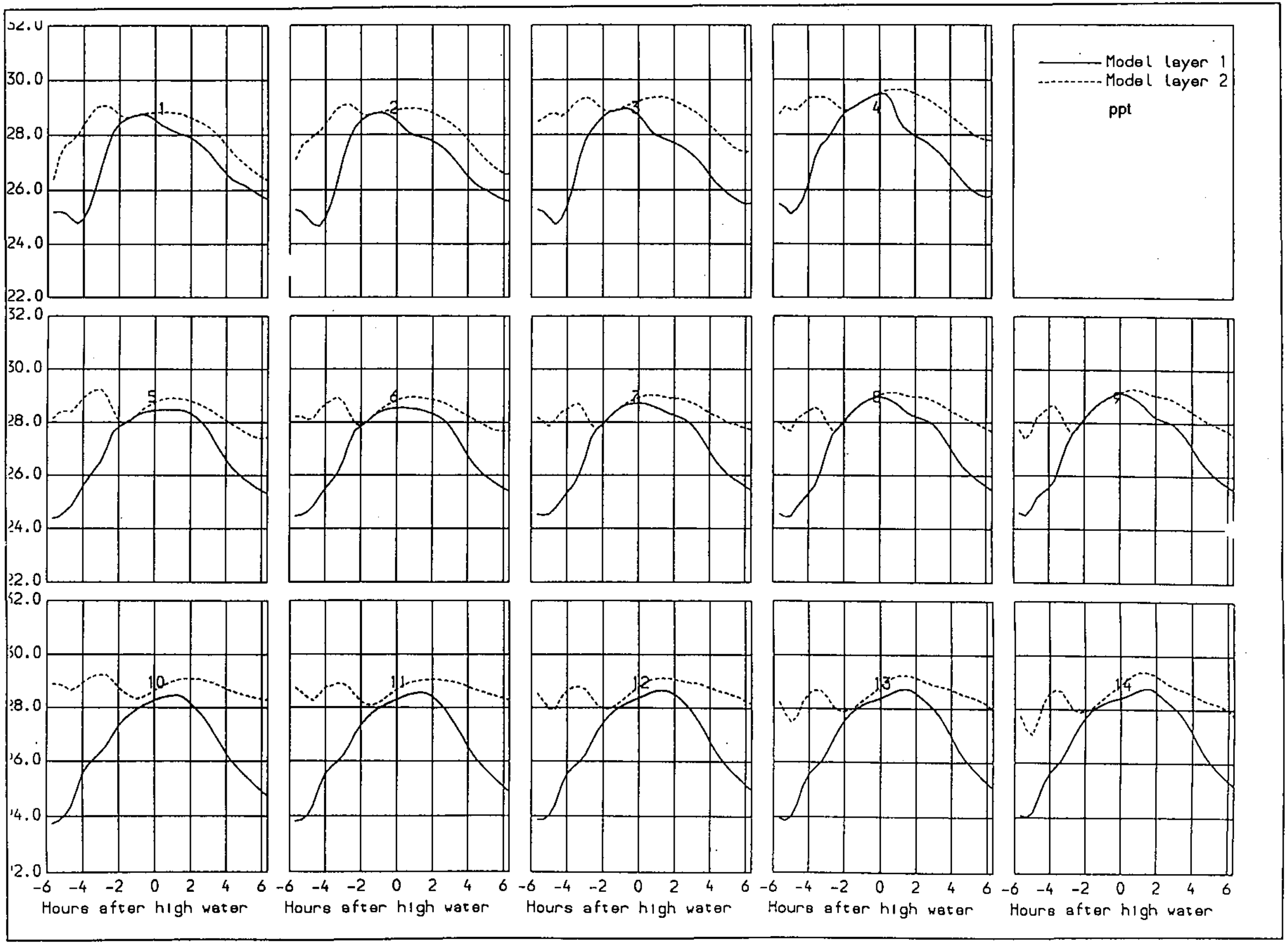


Figure 8b Salinity in 250m model ; Wet Neap tide



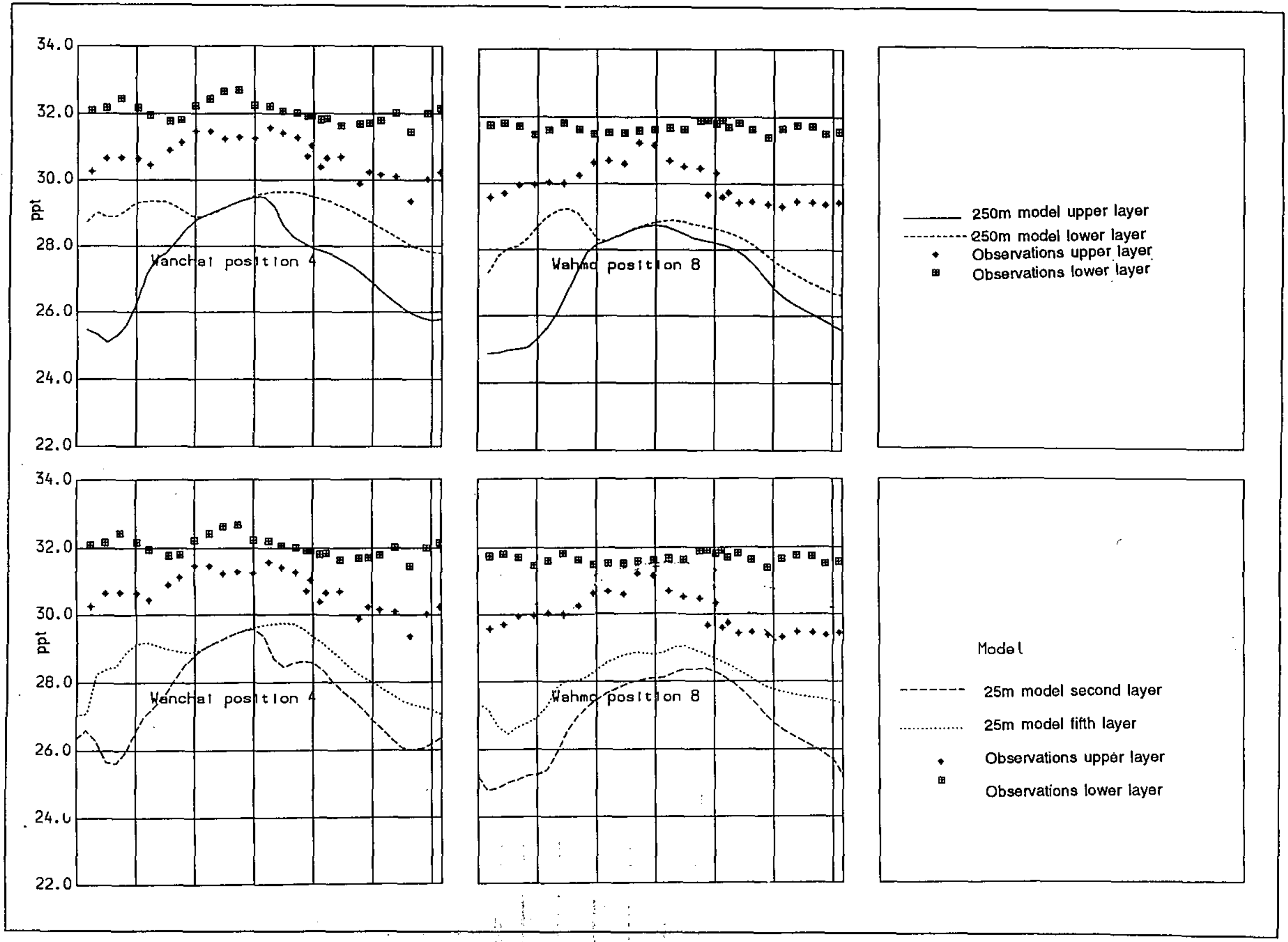


Figure 9 Comparison of model salinities with observations; Wet Neap tide

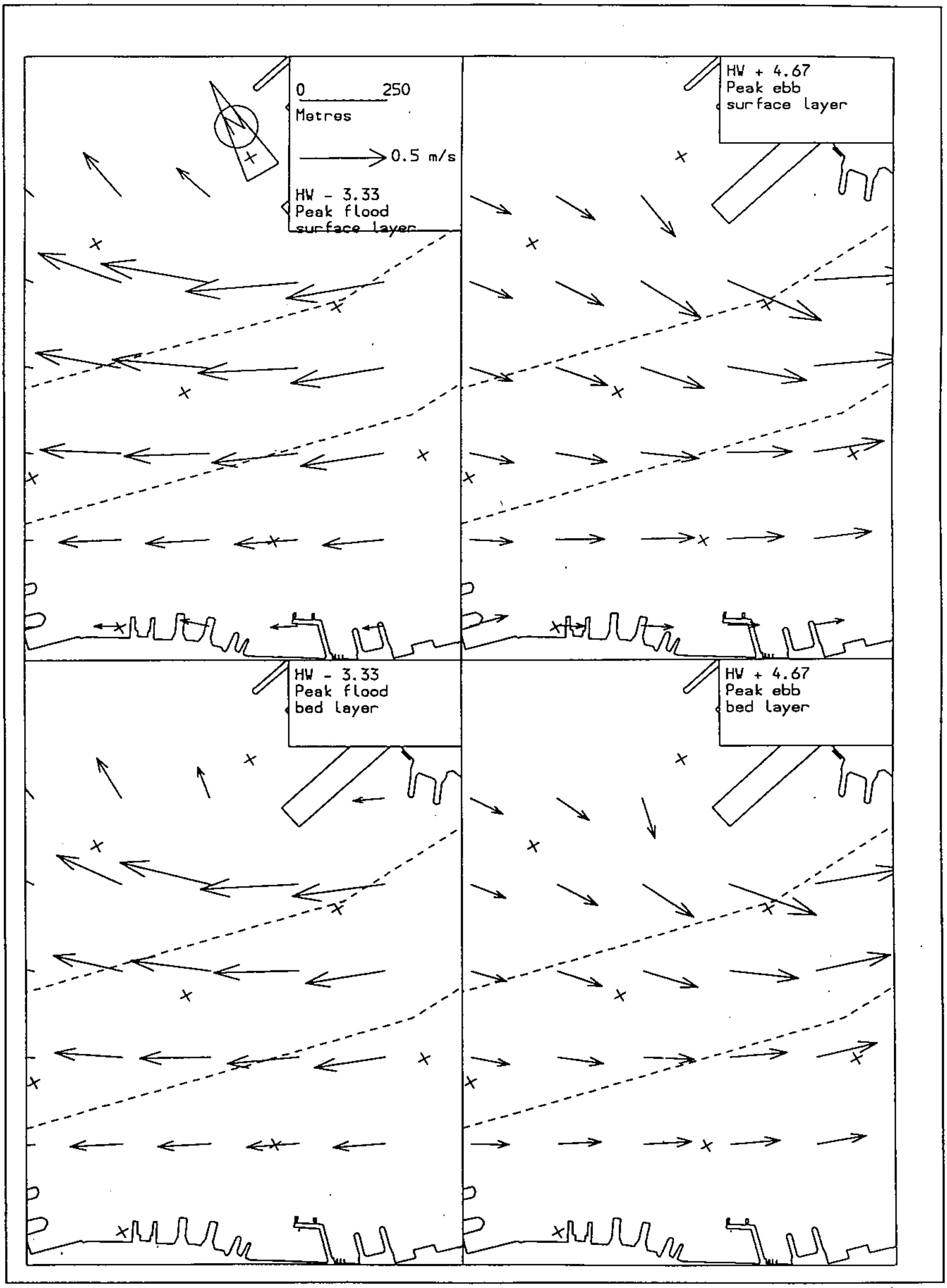


Figure 10 Peak velocities in 25m model ; Dry Neap tide

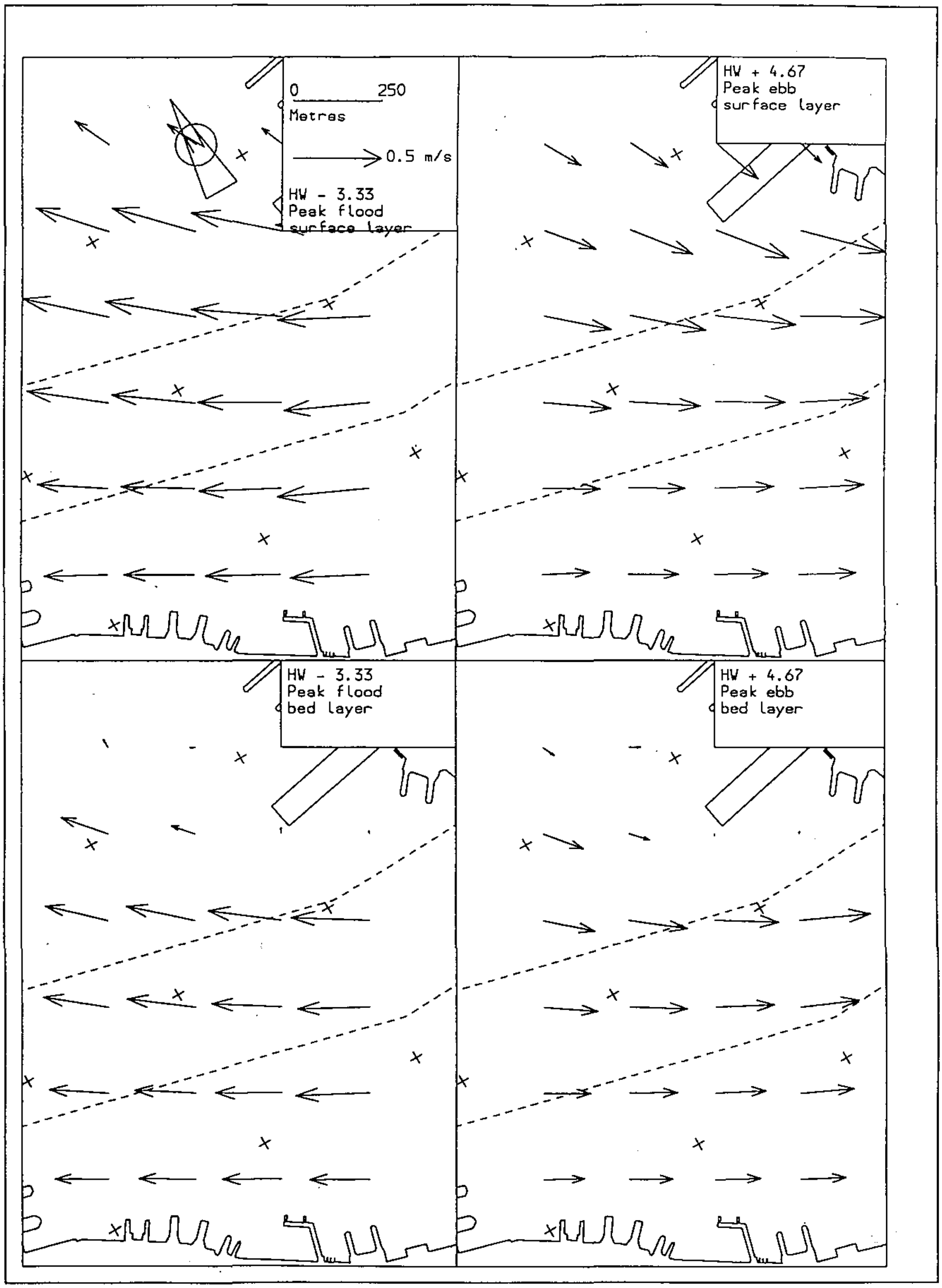


Figure 11 Peak velocities in 250m model ; Dry Neap tide

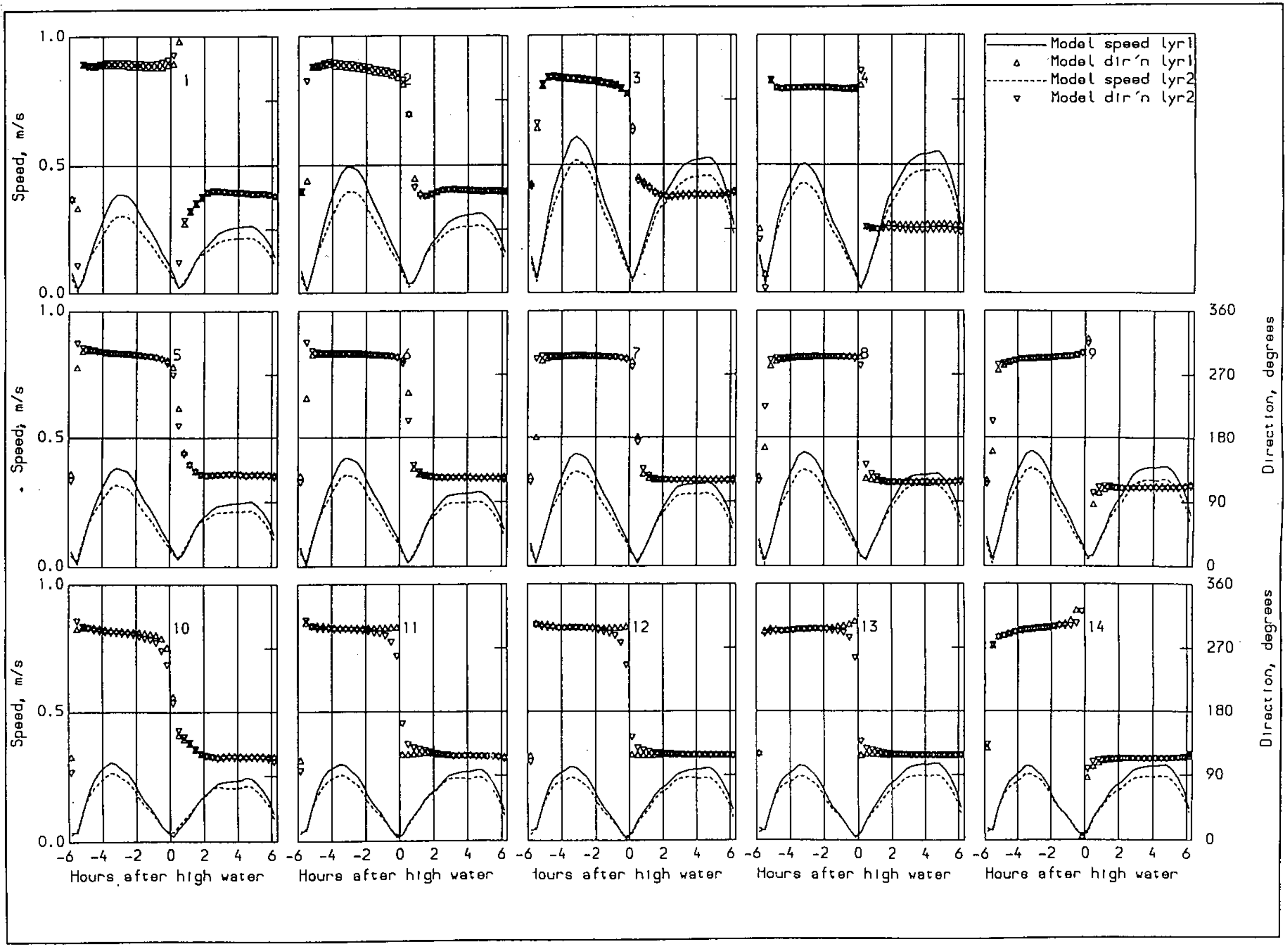


Figure 12 Current speed and direction in 25m model ; Dry Neap tide

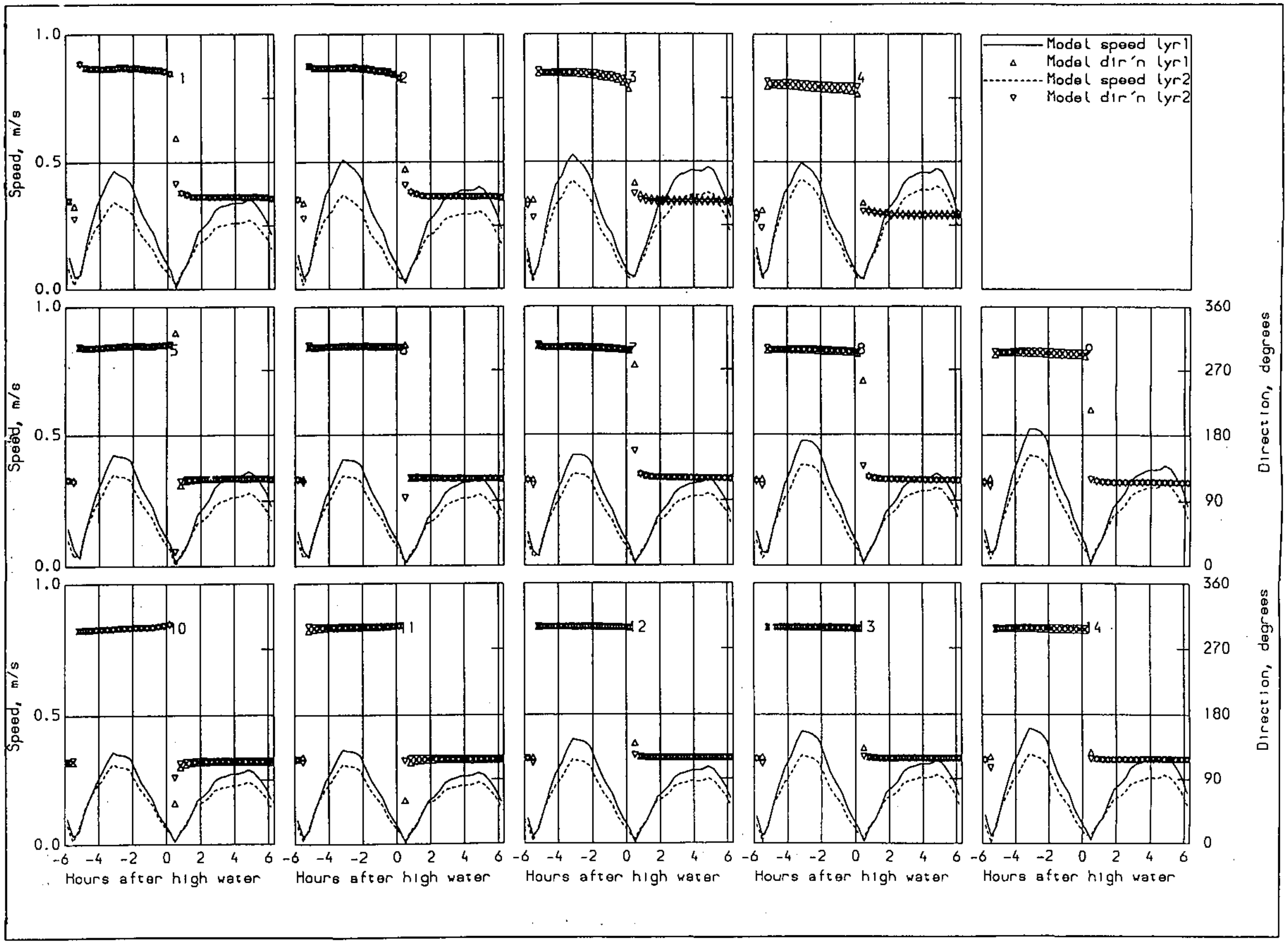
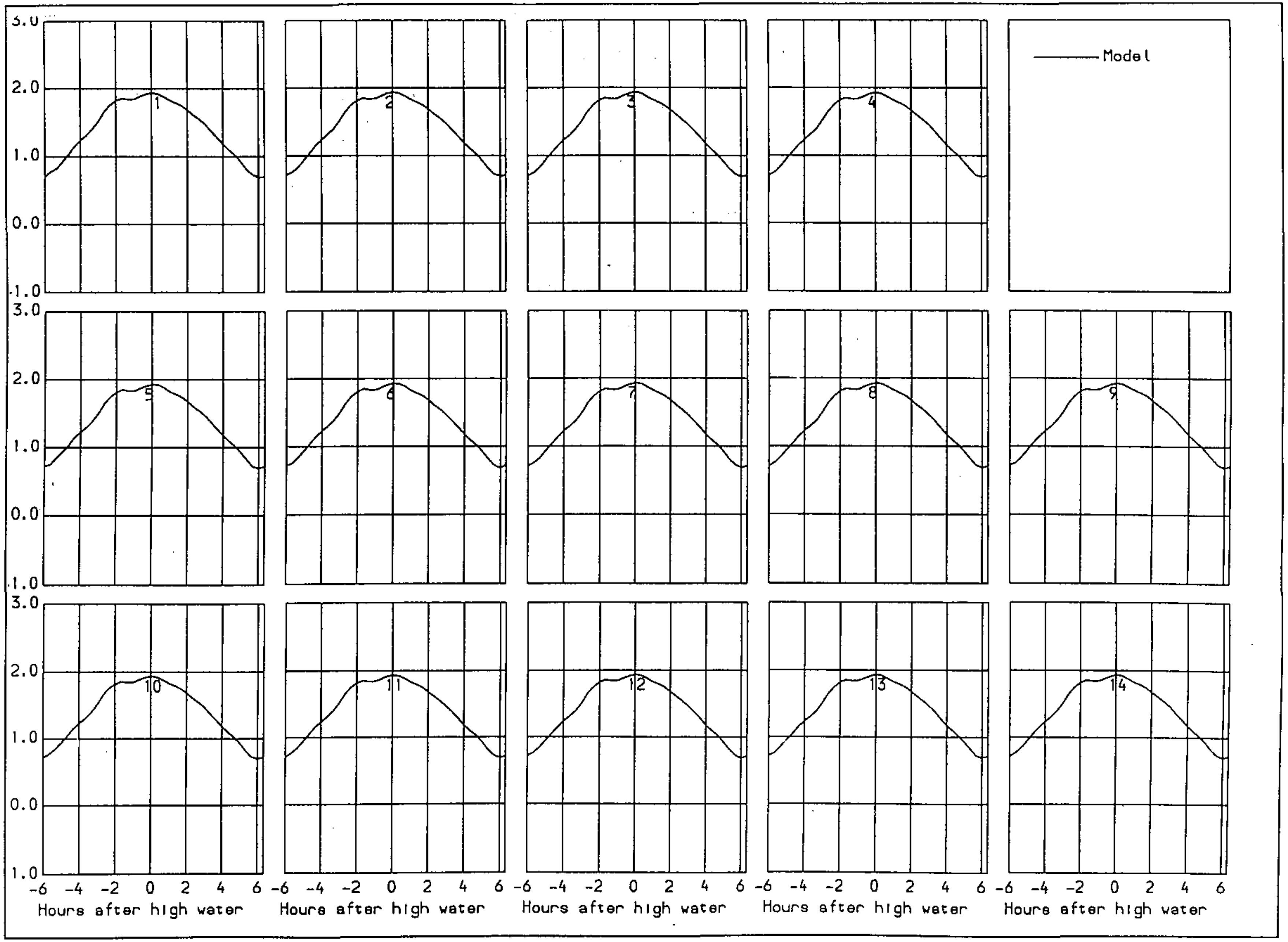


Figure 13 Current speed and direction in 250m model ; Dry Neap tide

Figure 14a Elevations in 25m model ; Wet Neap tide



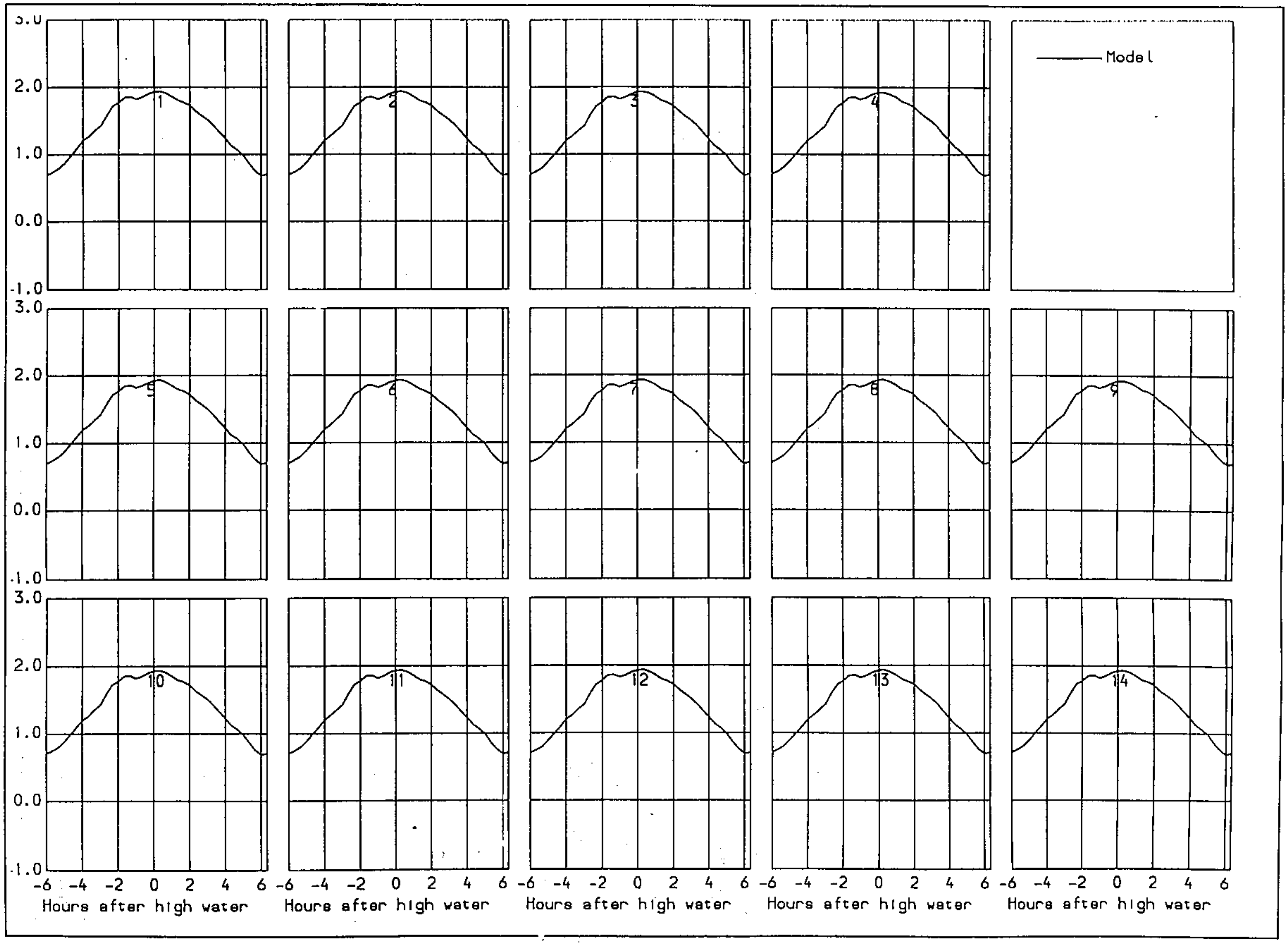


Figure 14b Elevations in 250m model ; Wet Neap tide

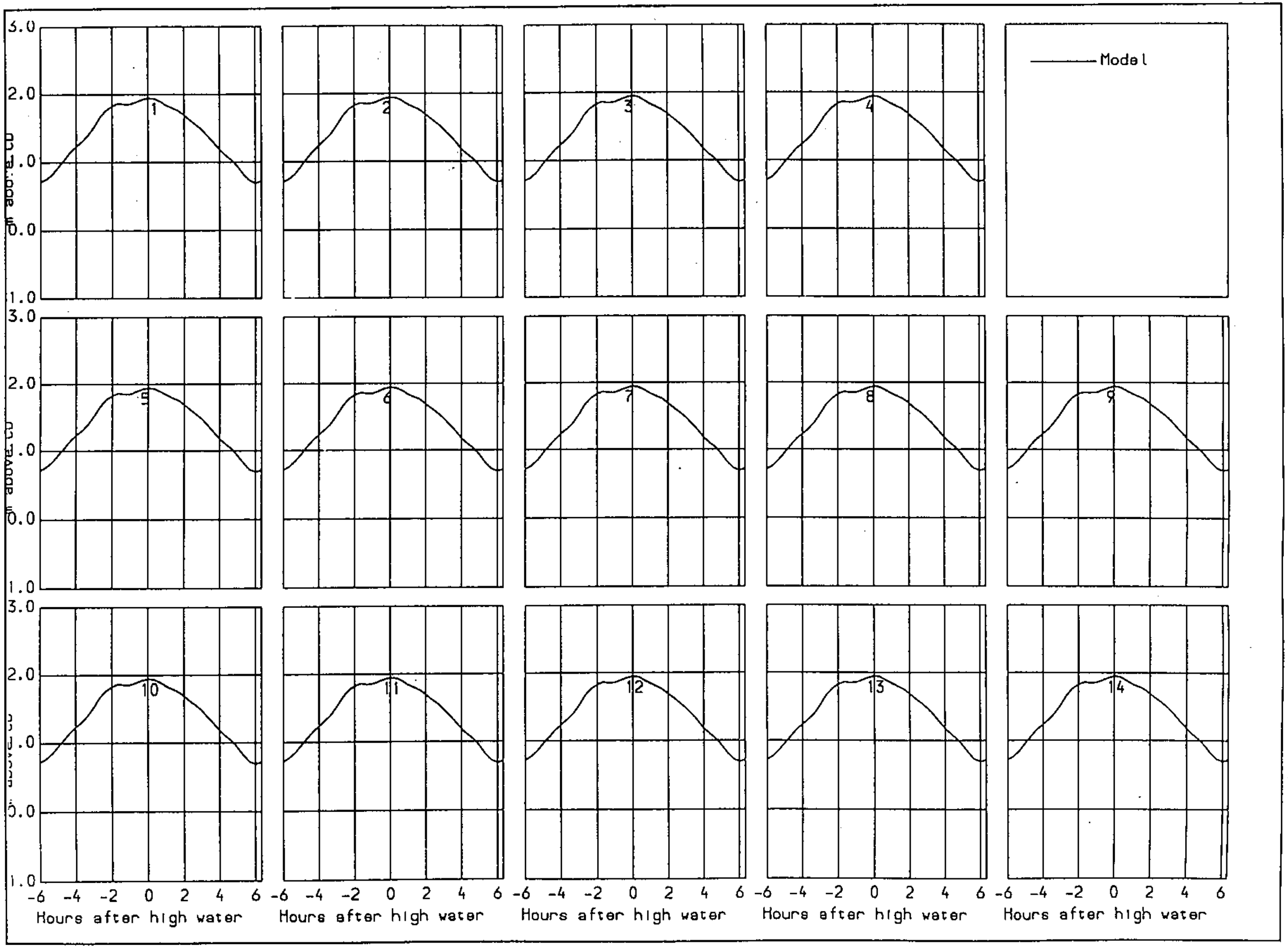


Figure 15a Elevations in 25m model ; Dry Neap tide

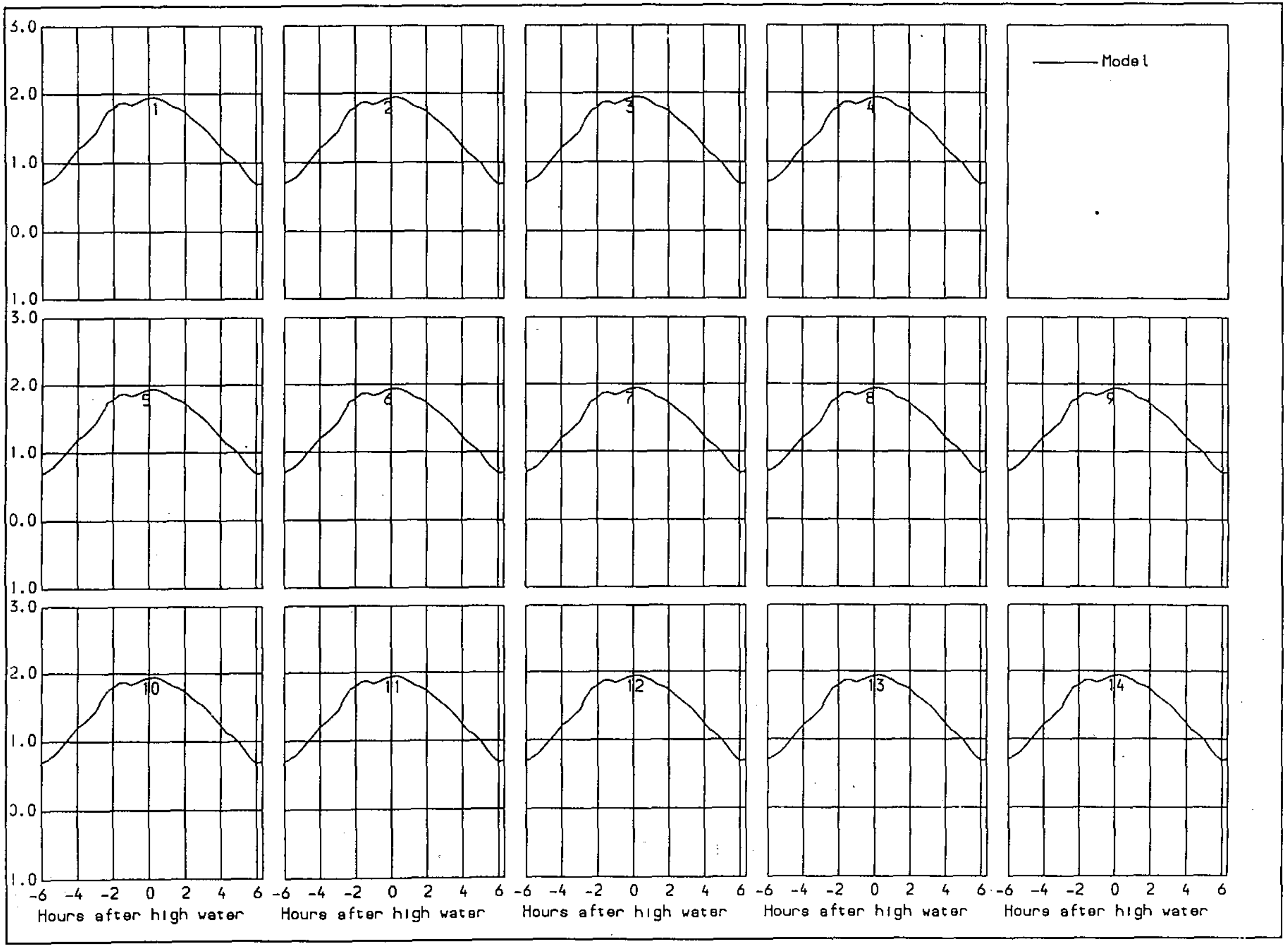


Figure 15b Elevations in 250m model ; Dry Neap tide

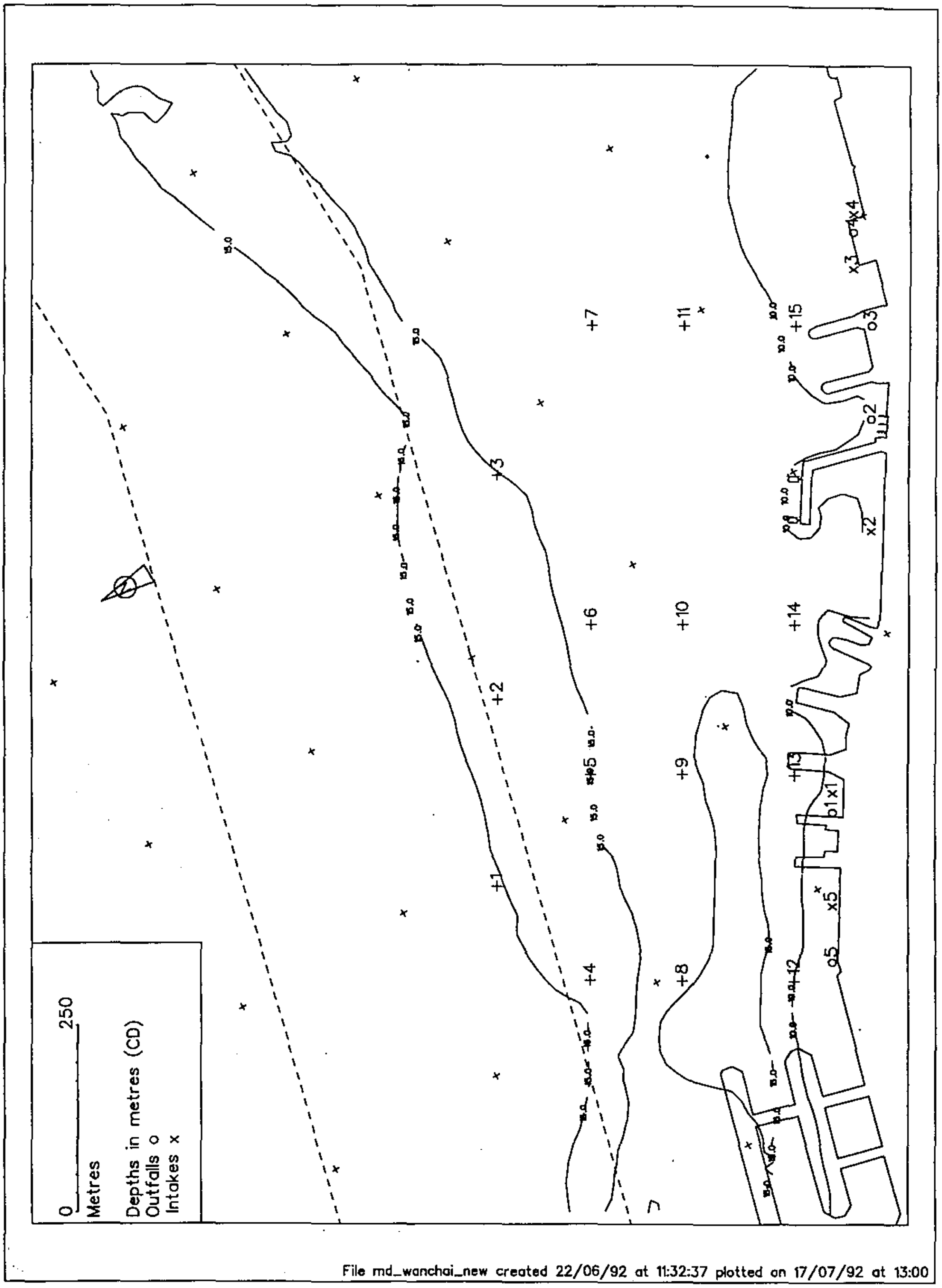


Figure 16 Positions of intakes and outfalls and time history output positions

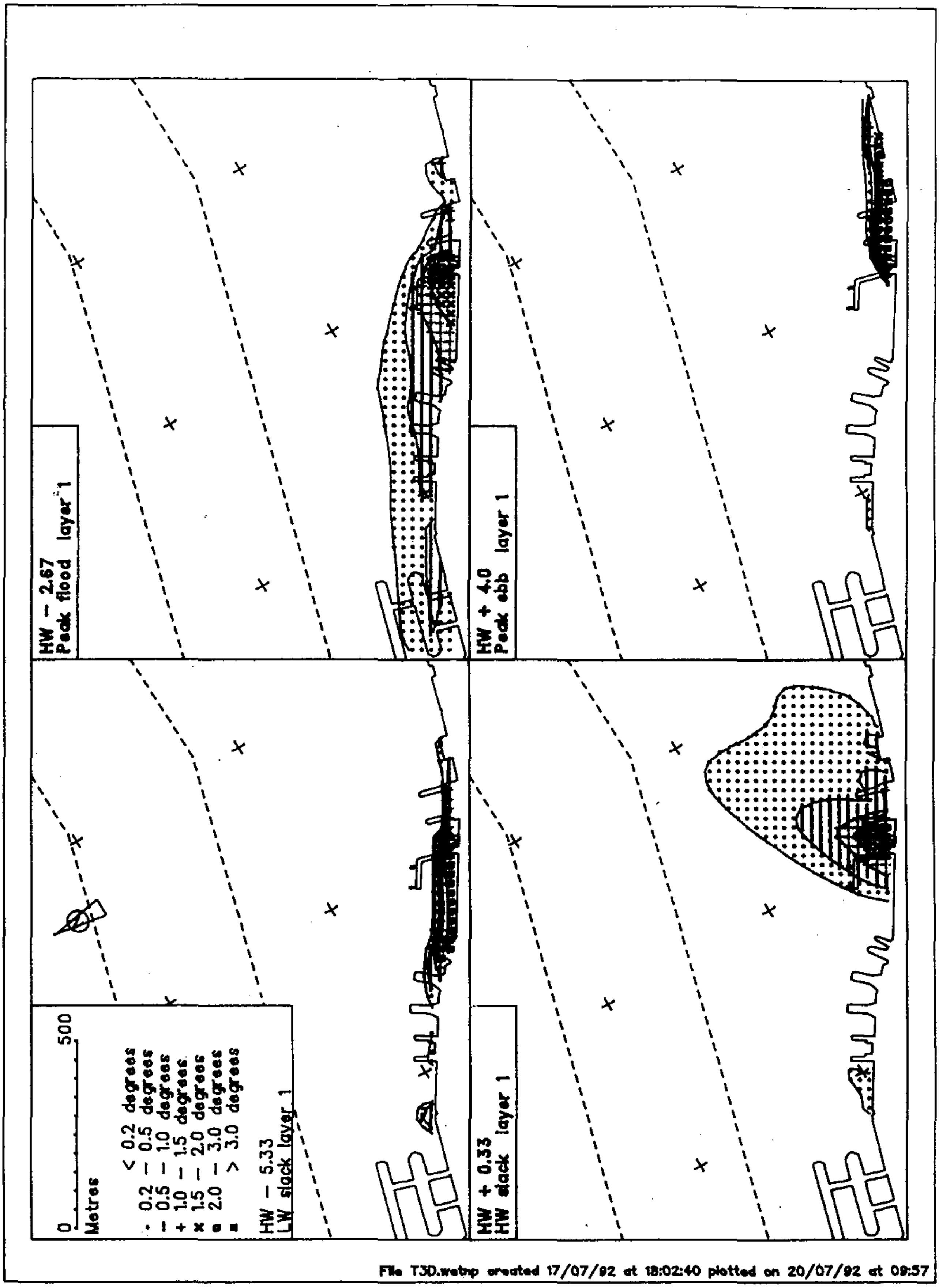


Figure 17 Temperature distributions : existing
Wet neap tide : surface layer

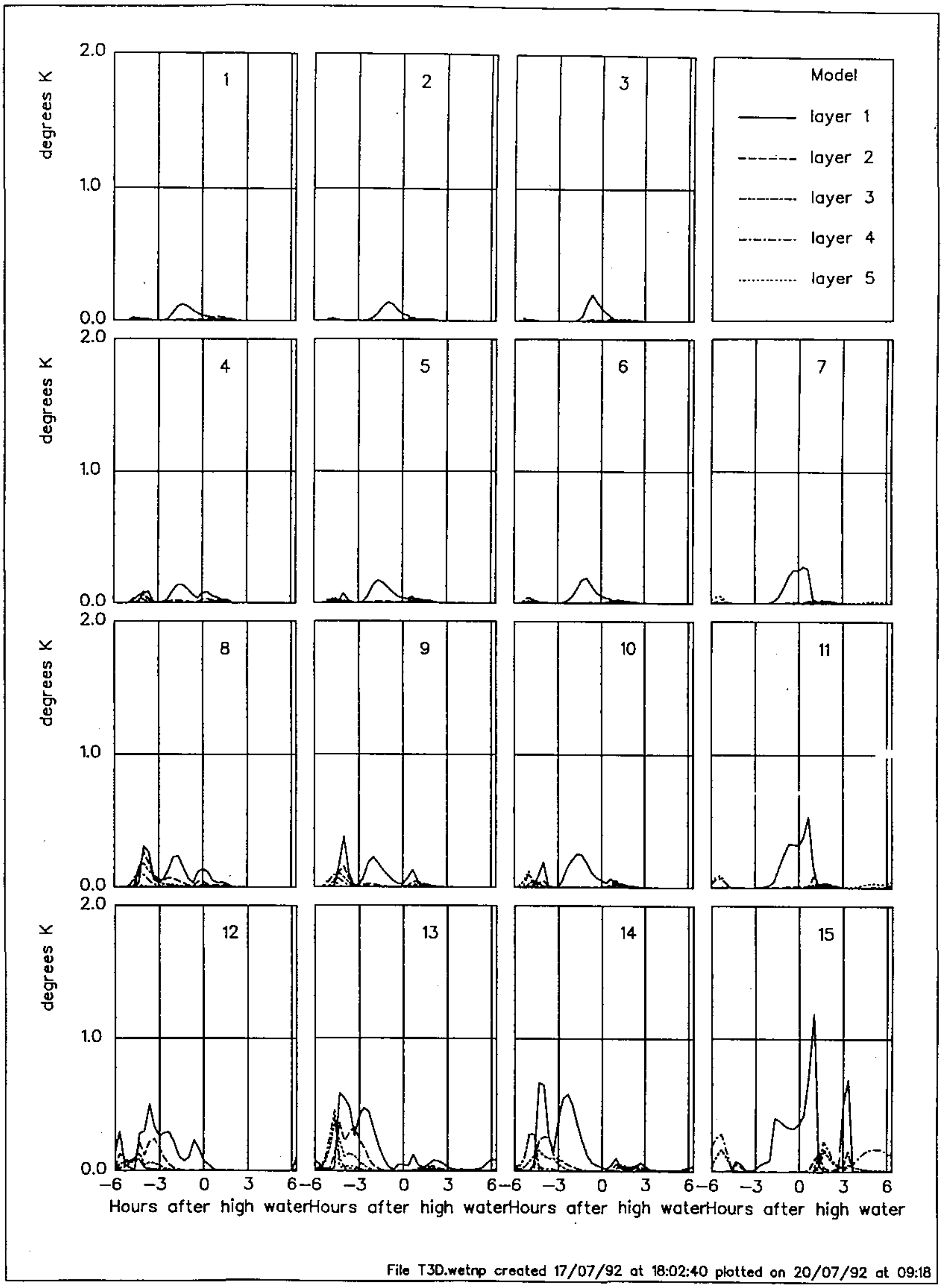


Figure 18 Temperature time histories
Wet neap tide : existing

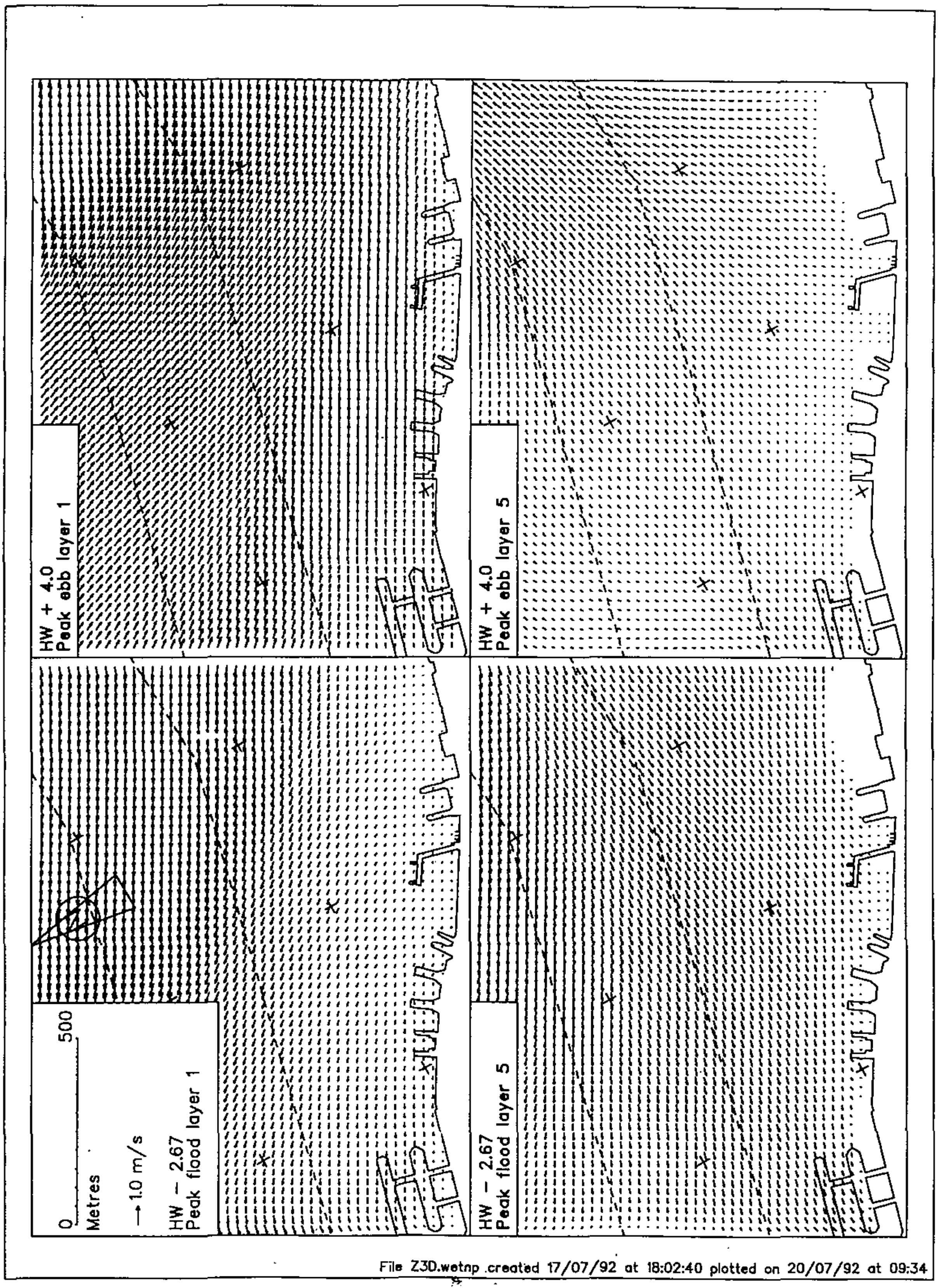


Figure 19 Peak velocity vectors
Wet Neap tide : existing

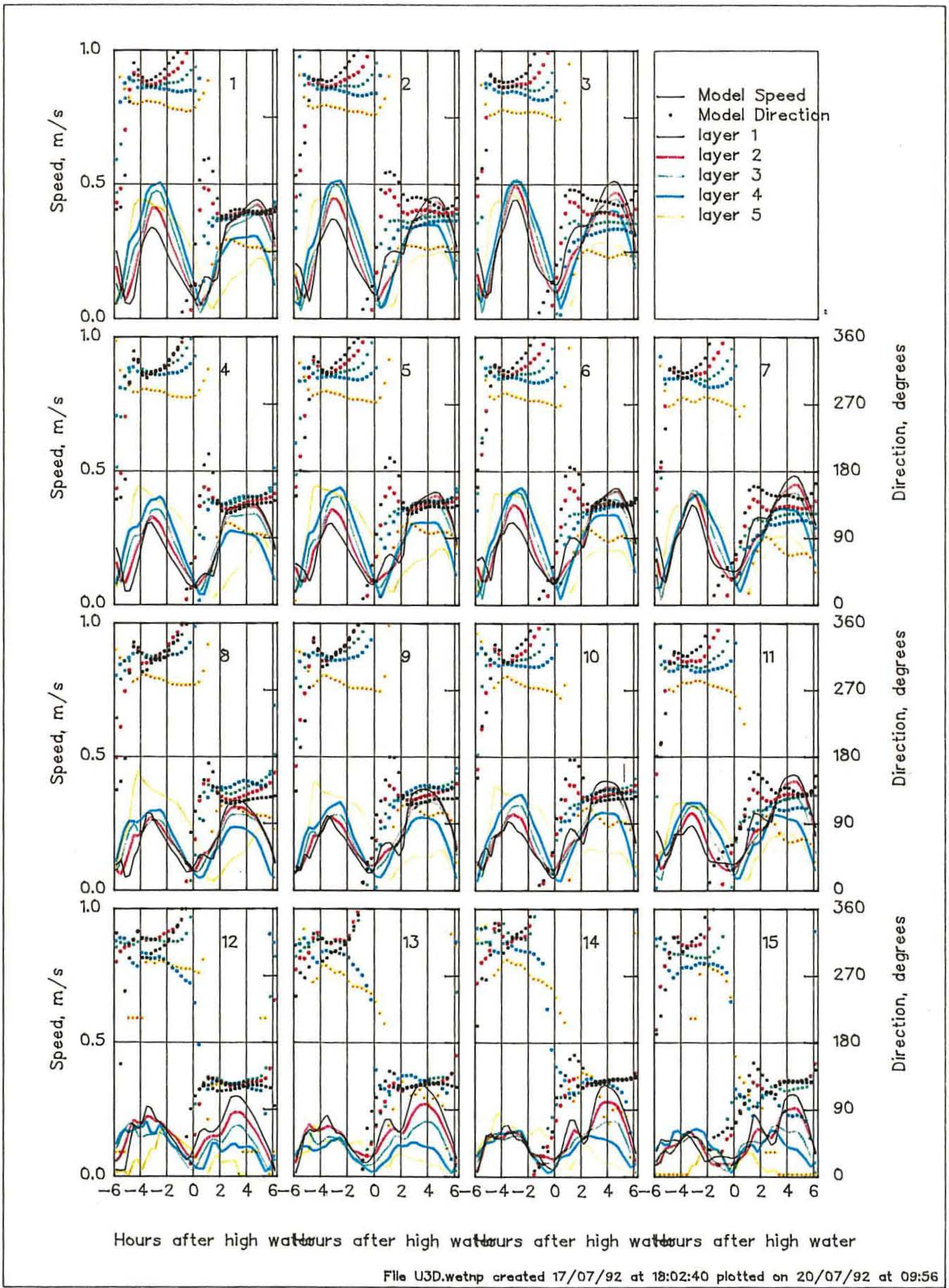


Figure 20 Current and direction time series
Wet neap tide : existing

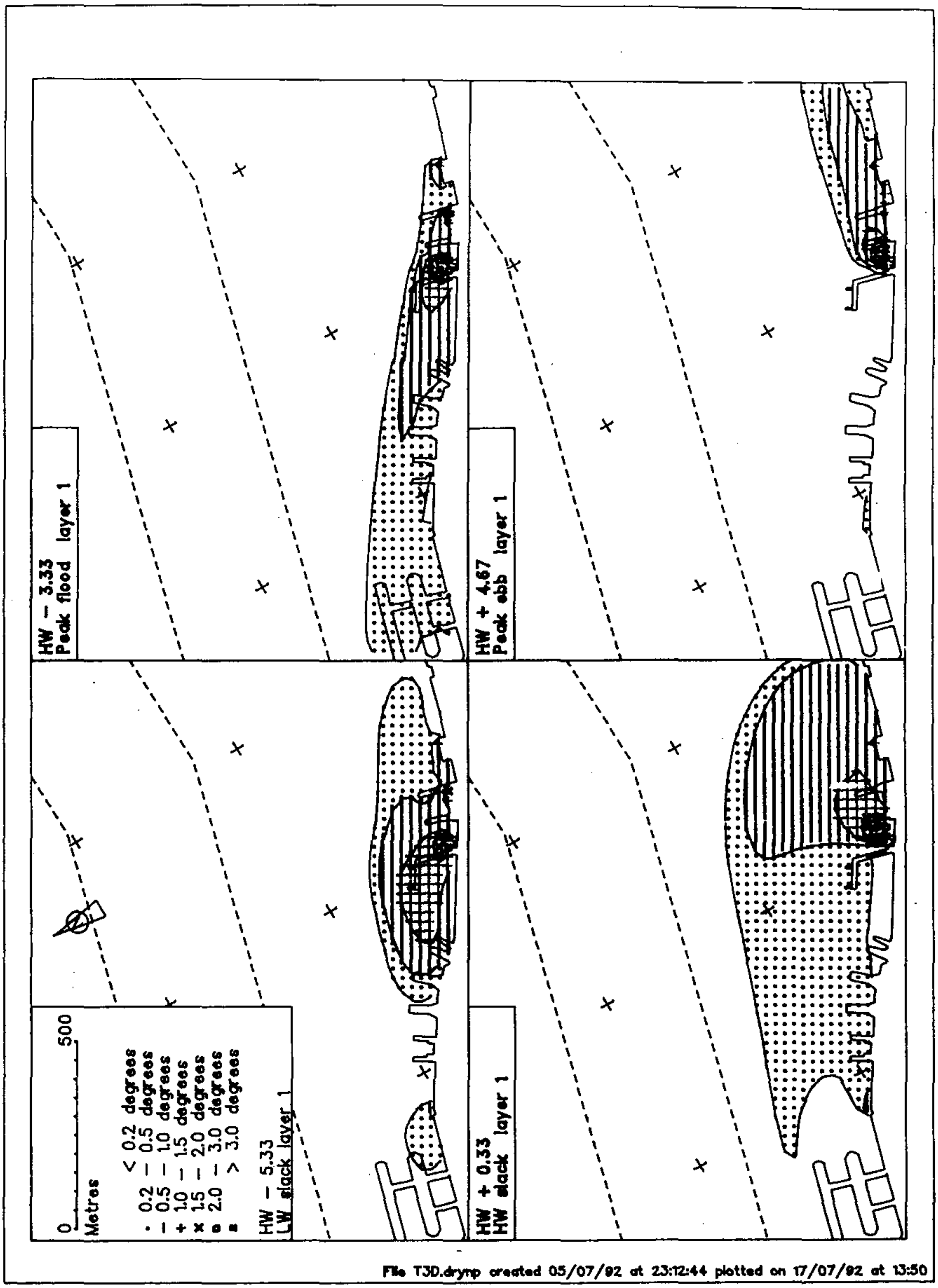


Figure 21 Temperature distributions : existing
Dry neap tide : surface layer

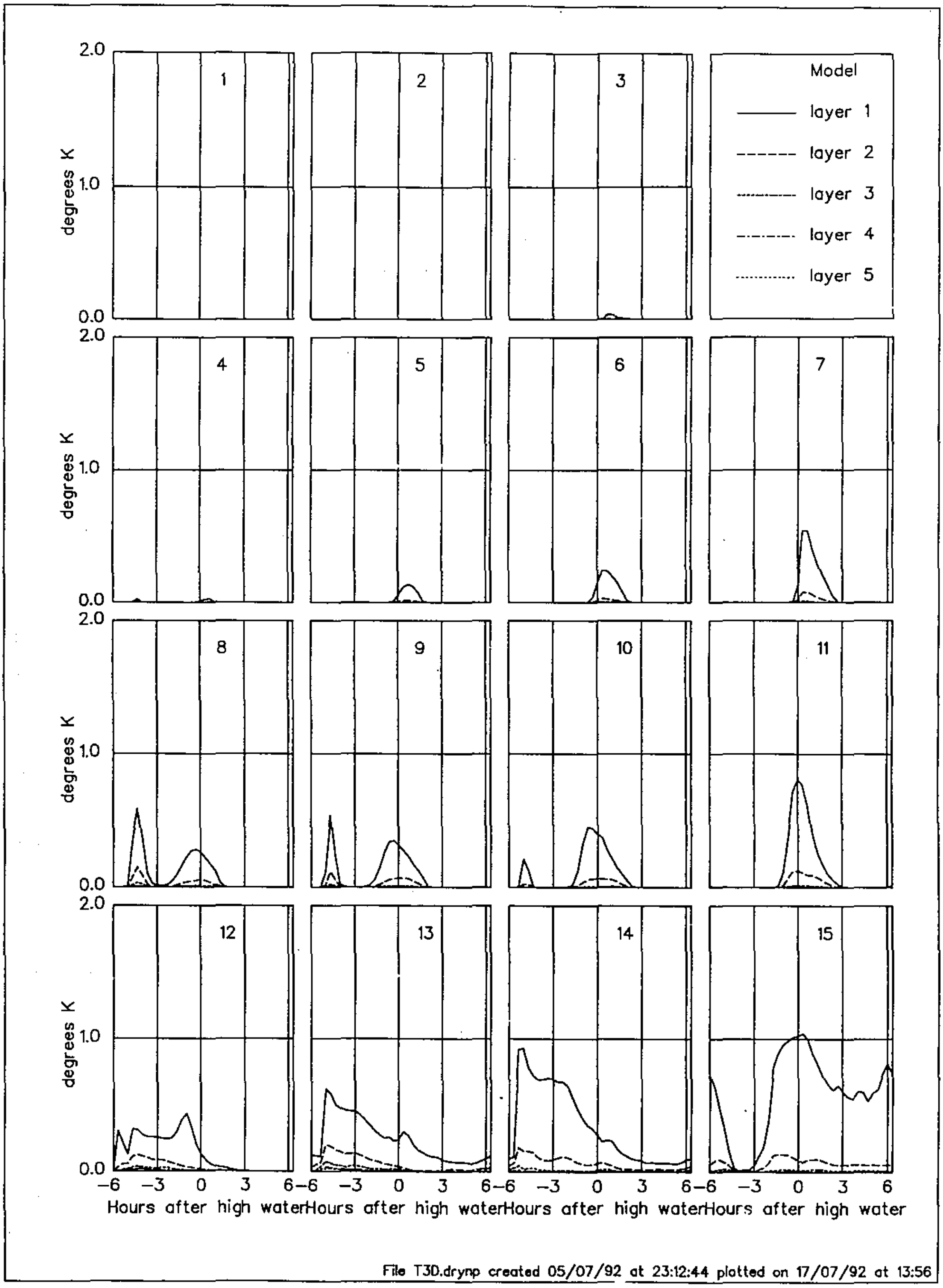


Figure 22 Temperature time histories
Dry neap tide : existing

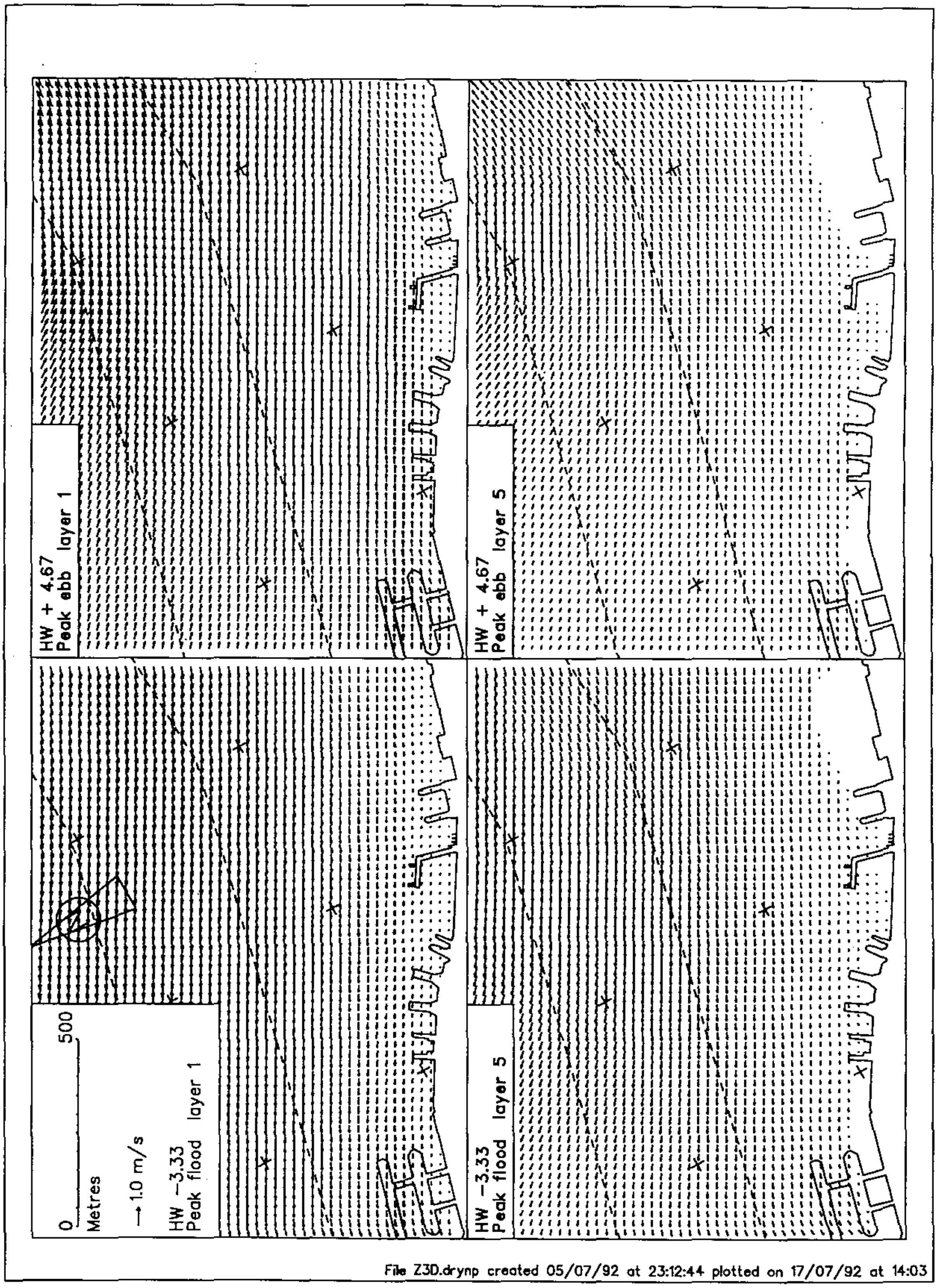


Figure 23 Peak velocity vectors
Dry Neap tide : existing

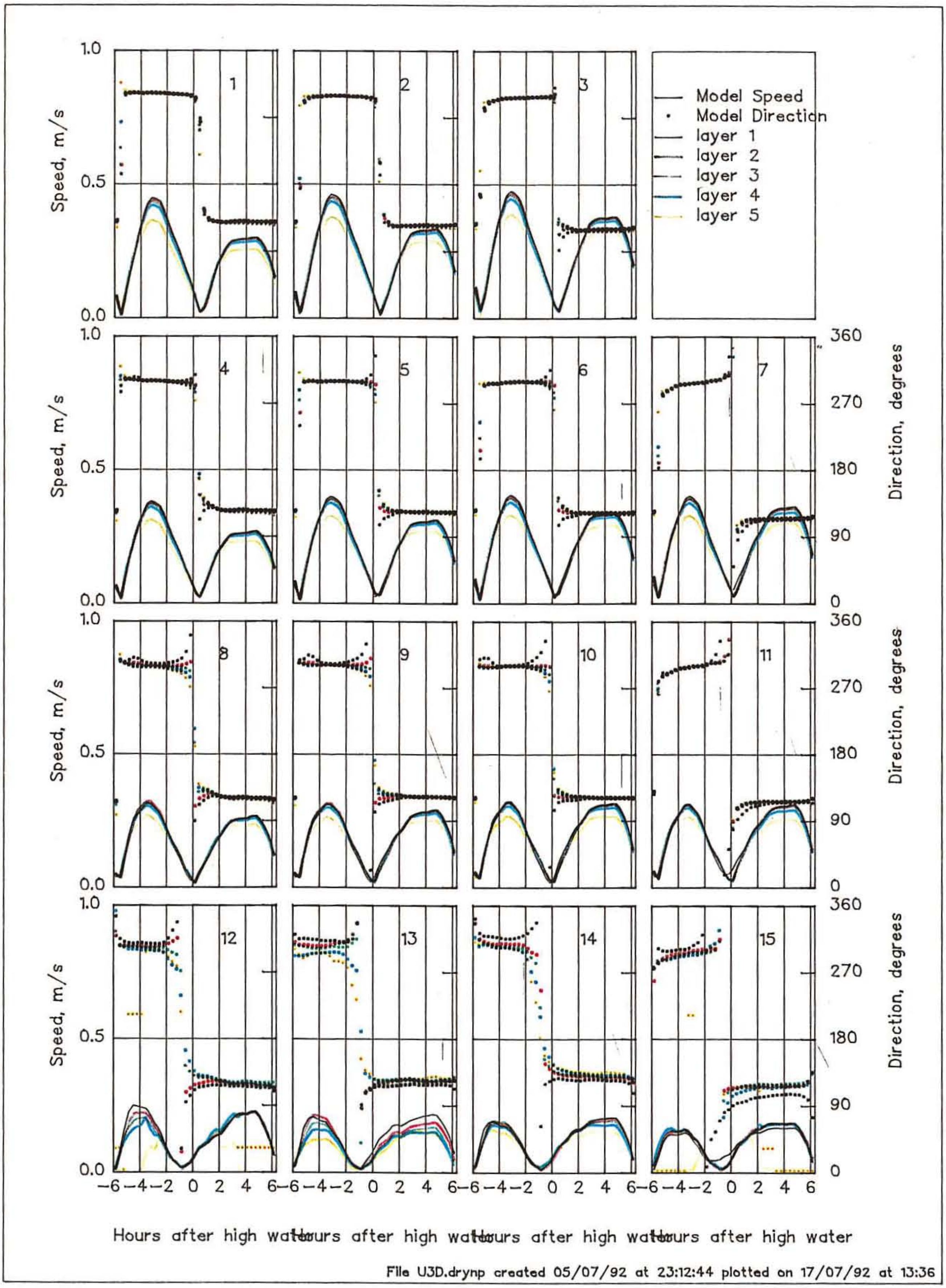


Figure 24 Current and direction time series
Dry neap tide : existing

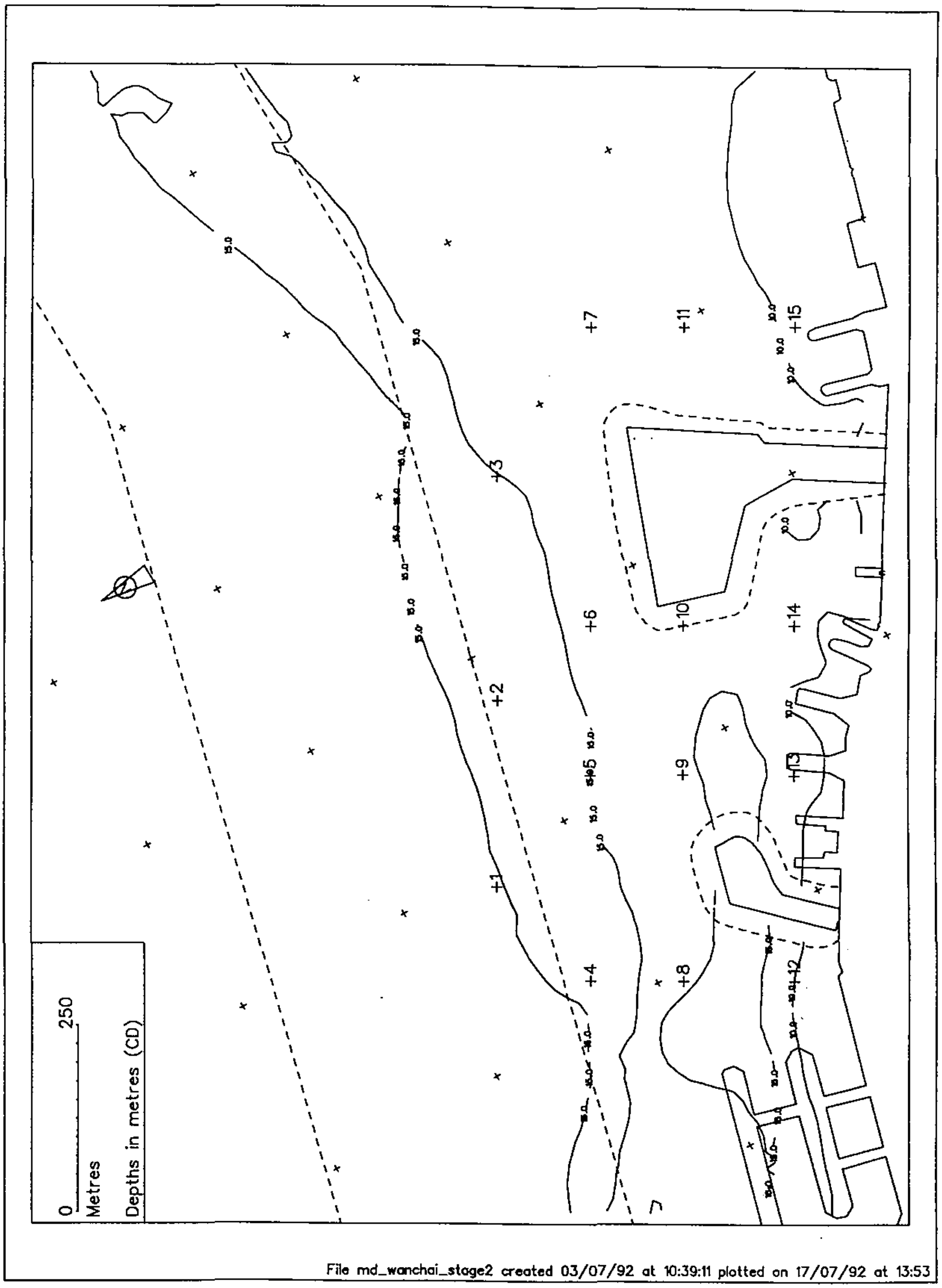


Figure 25 Model layout during stage 2 of construction

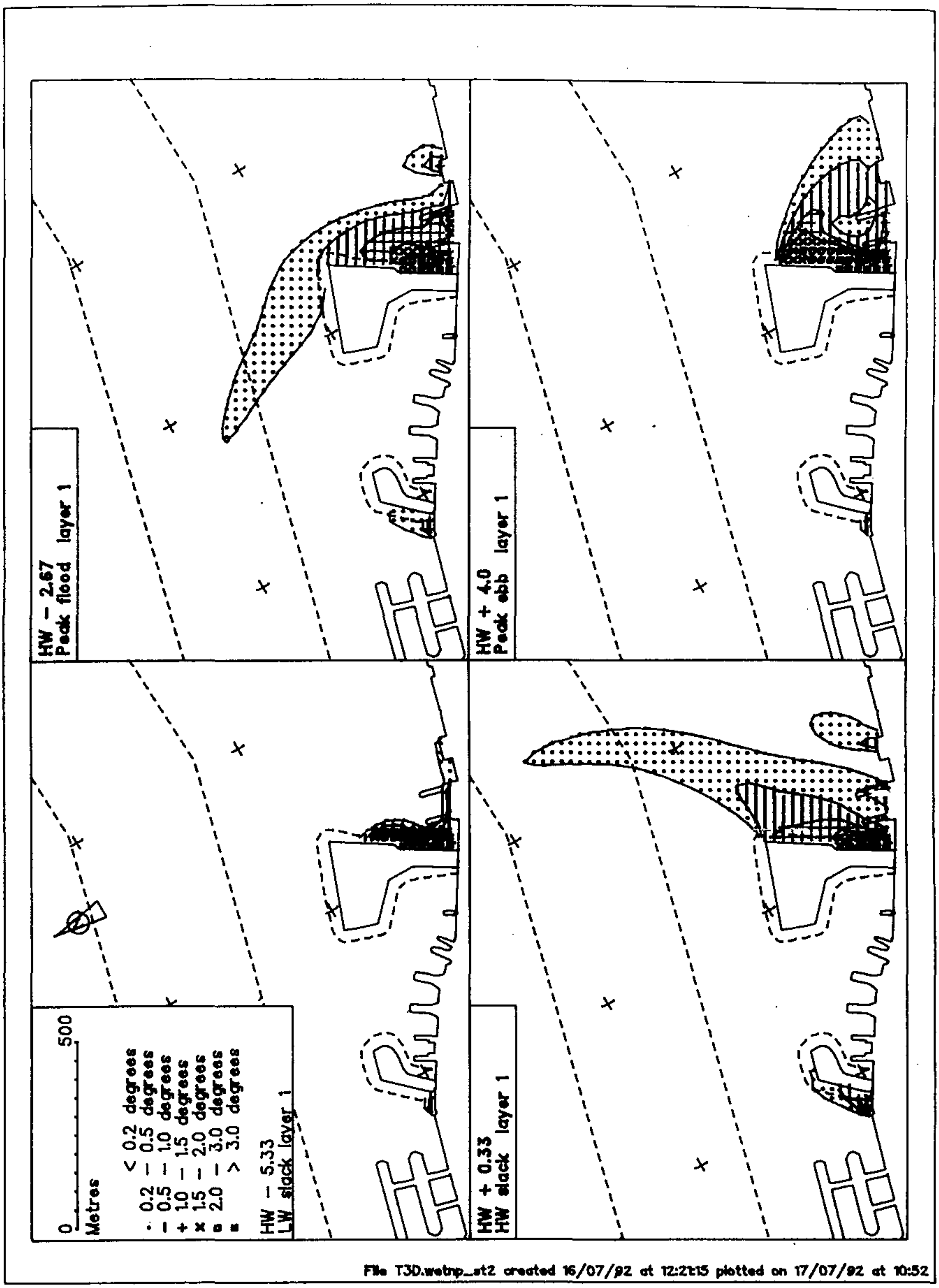


Figure 26 Temperature distributions : stage 2
Wet neap tide : surface layer

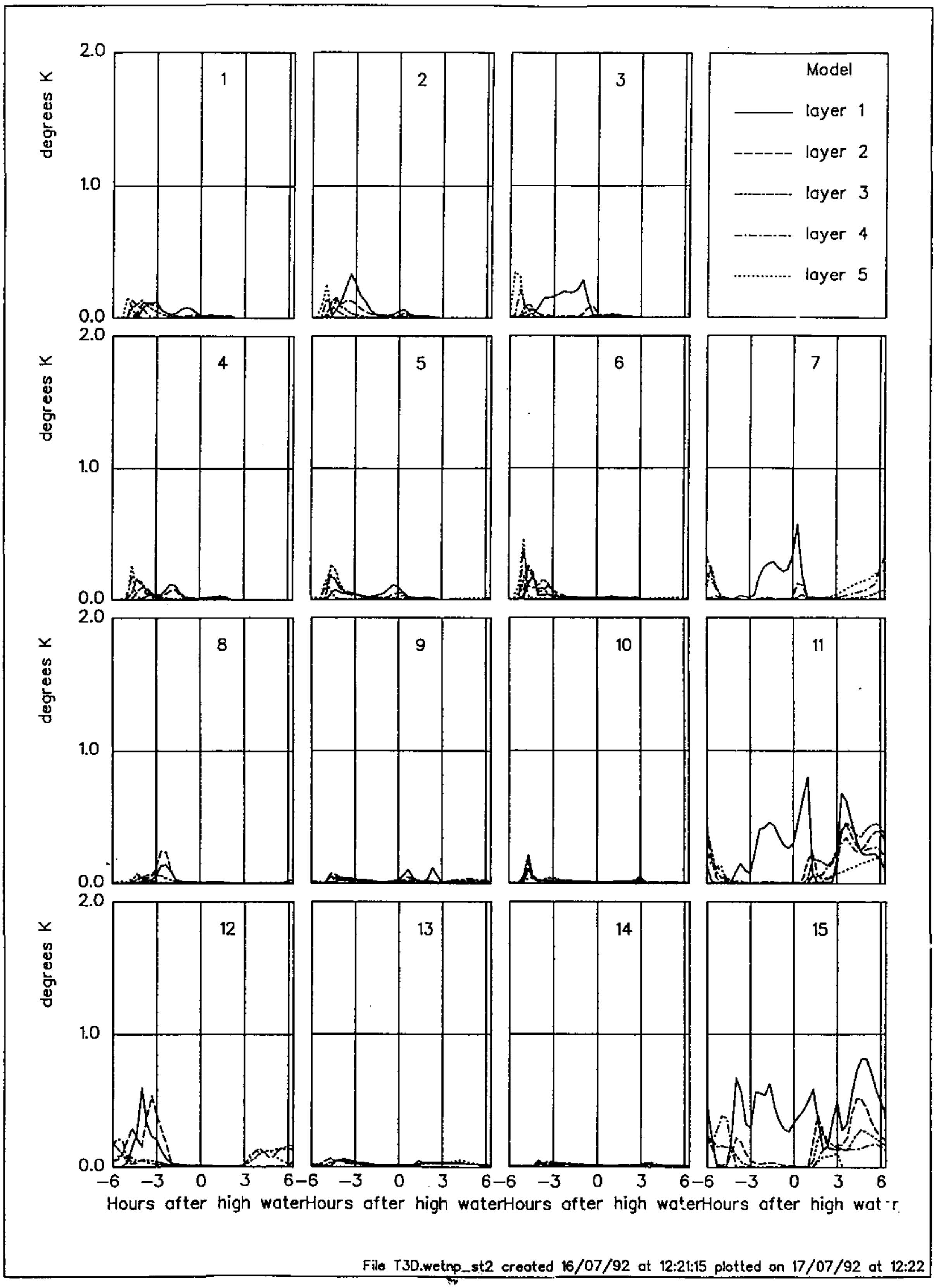


Figure 27 Temperature time histories
Wet neap tide : stage 2

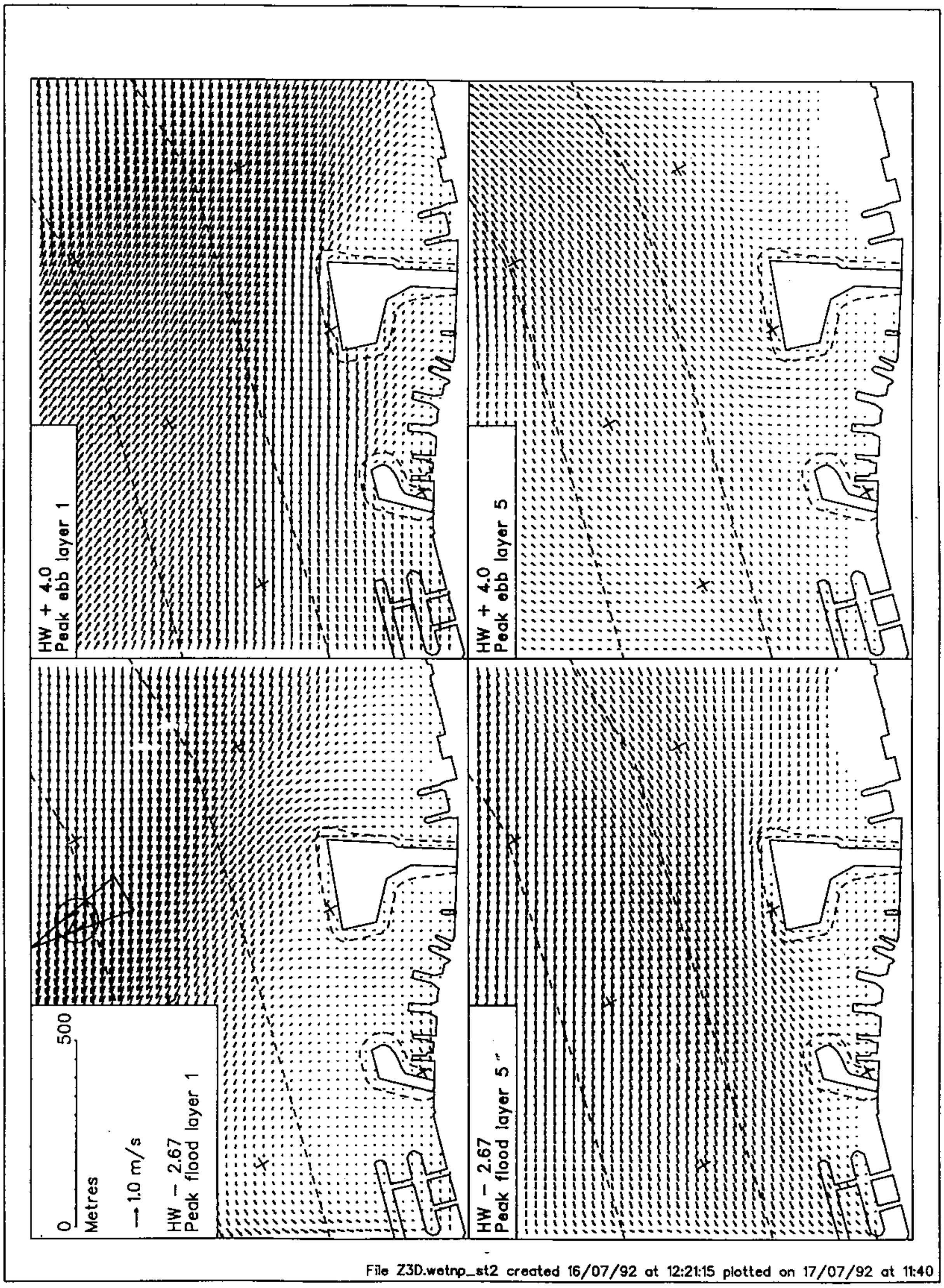


Figure 28 Peak velocity vectors
Wet Neap tide : stage 2

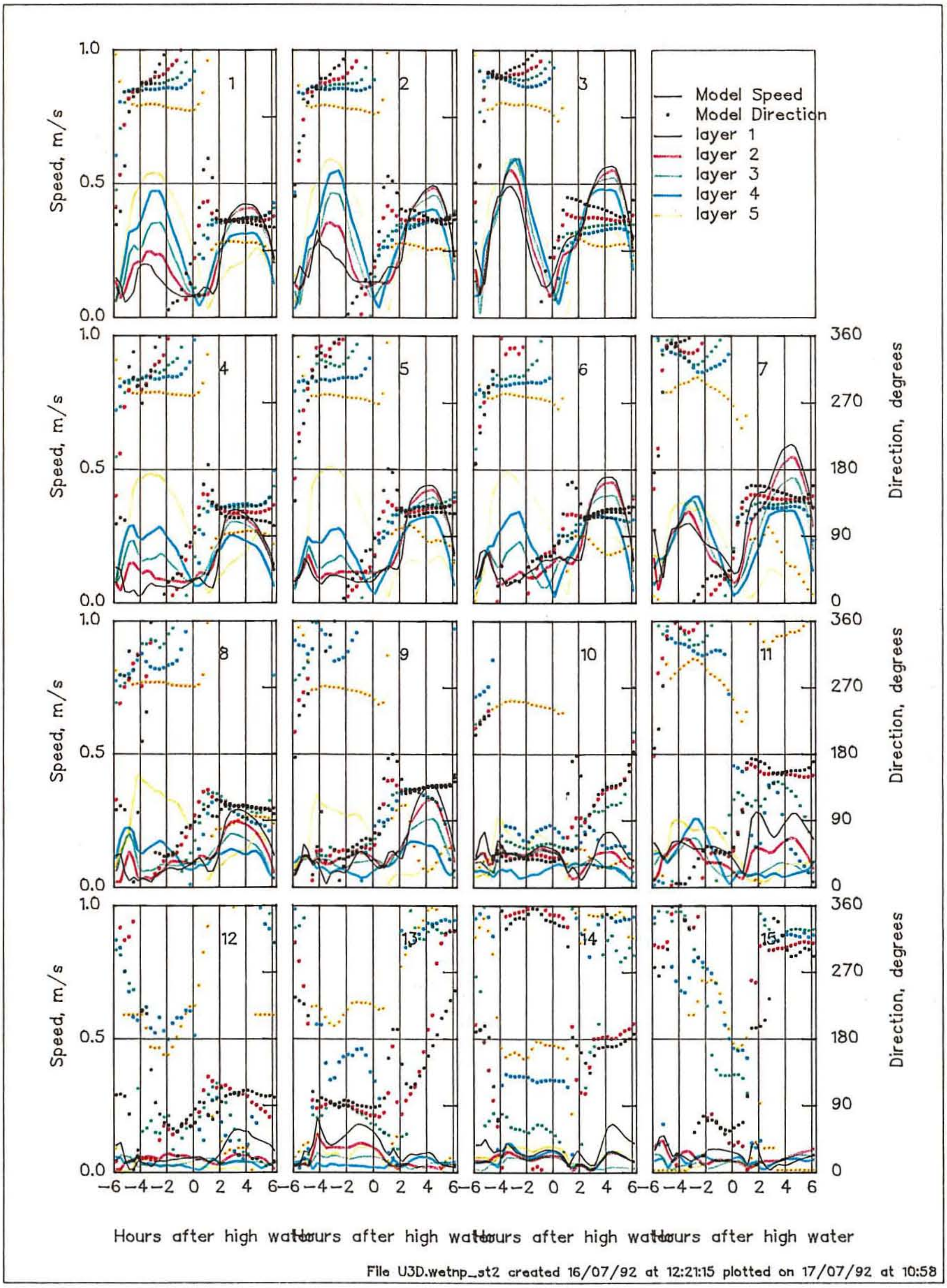


Figure 29 Current and direction time series
Wet neap tide : stage 2

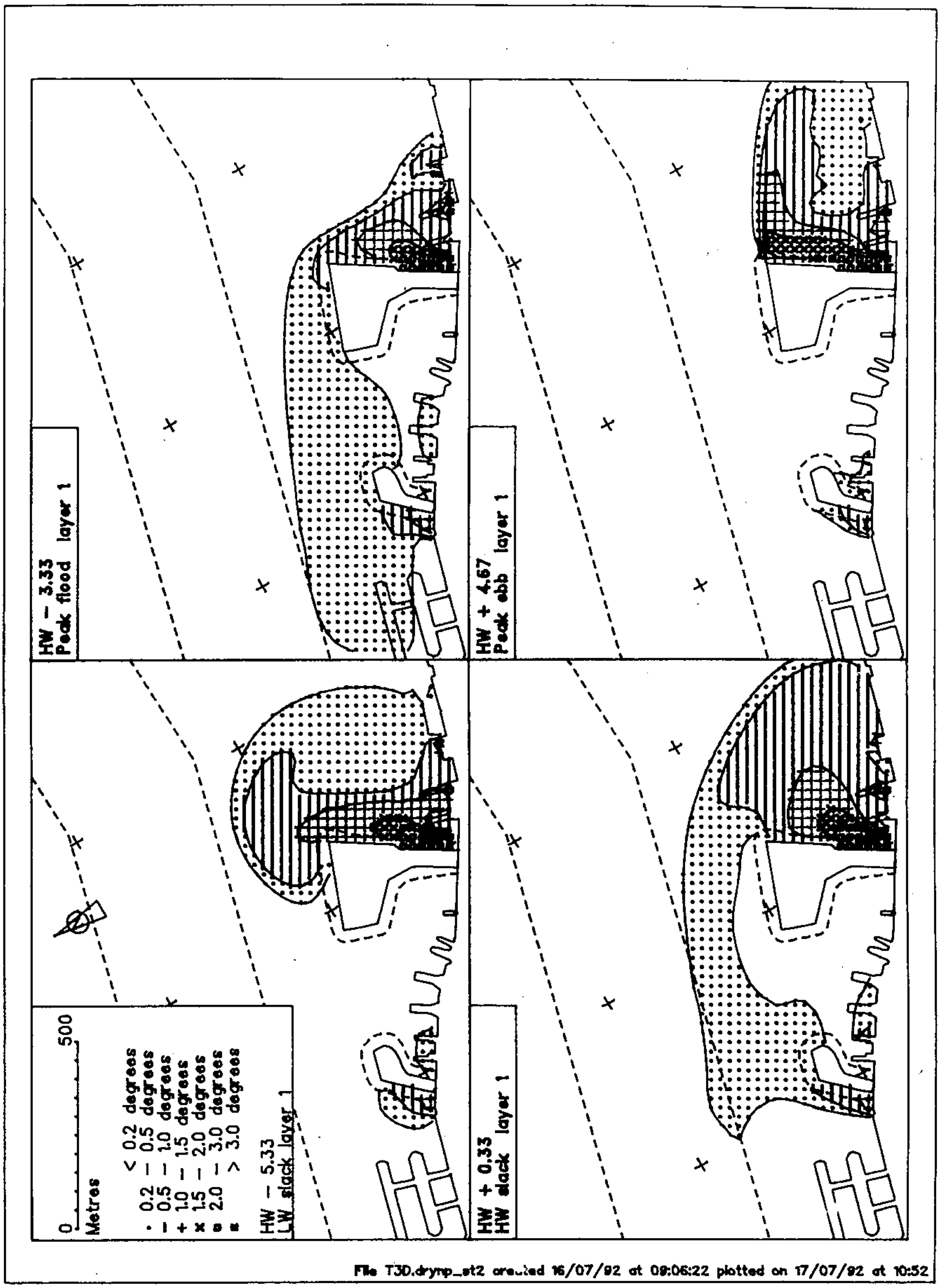


Figure 30 Temperature distributions : stage 2
Dry neap tide : surface layer

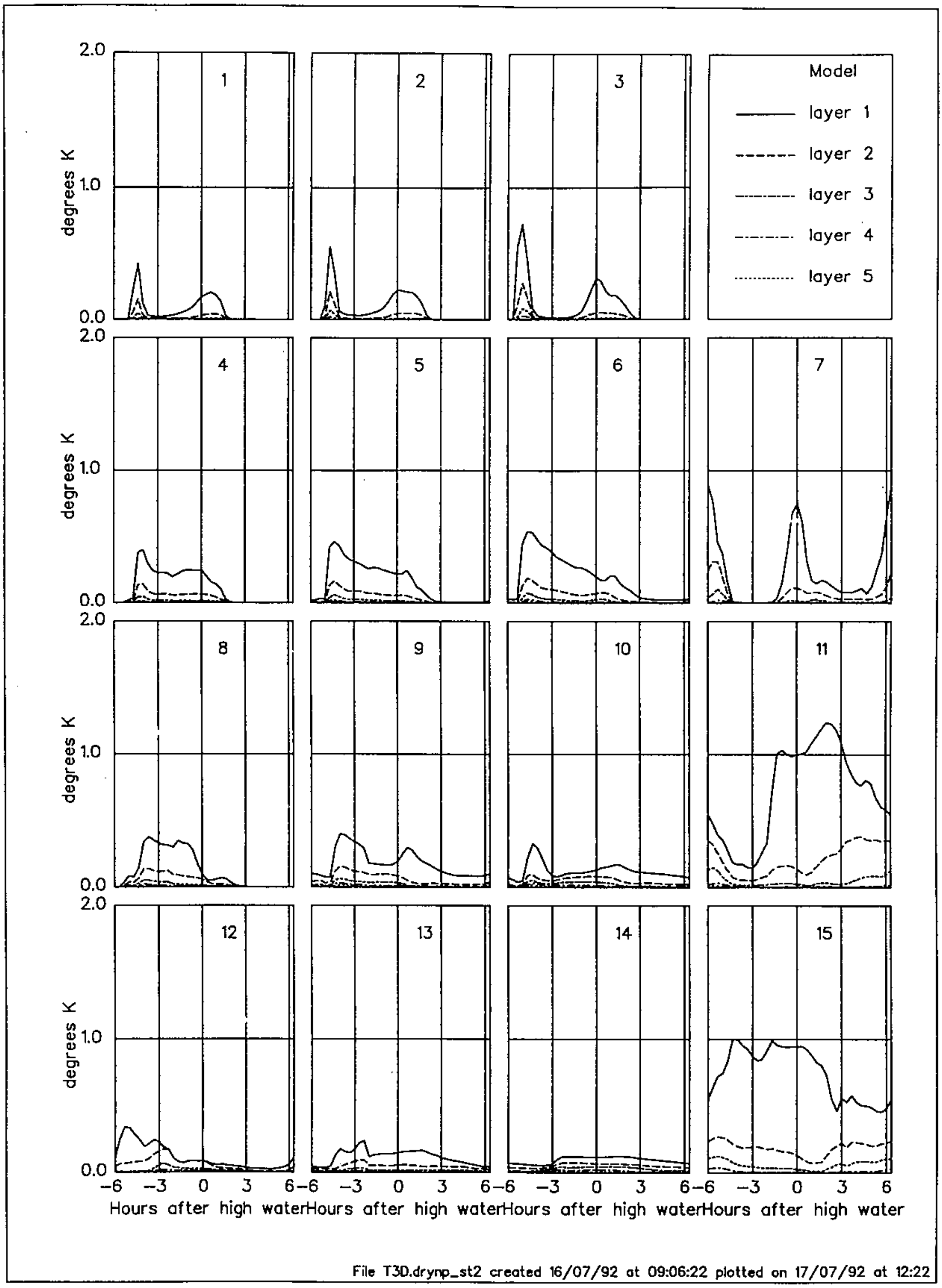


Figure 31 Temperature time histories
Dry neap tide : stage 2

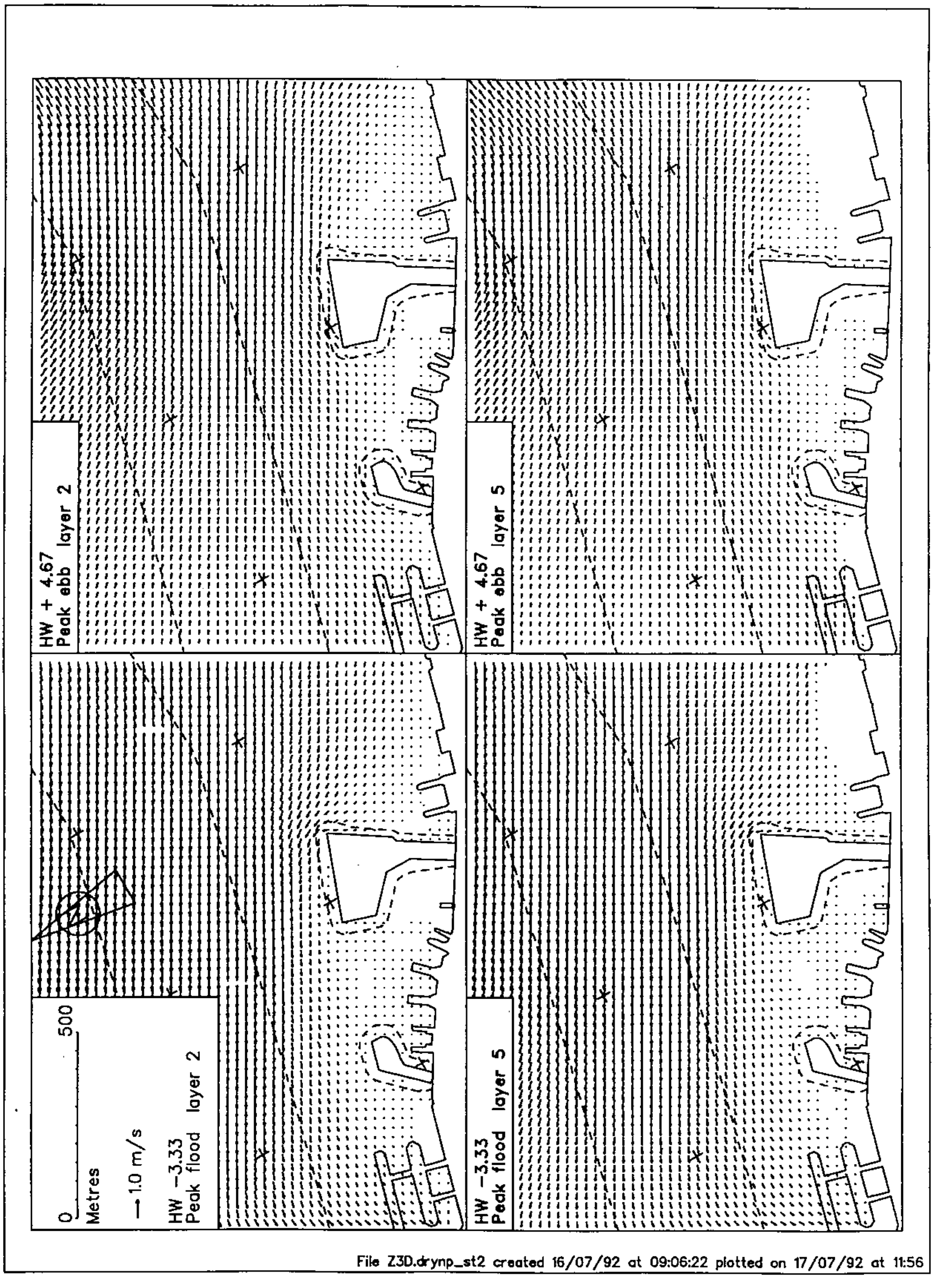


Figure 32 Peak velocity vectors
Dry Neap tide : stage 2

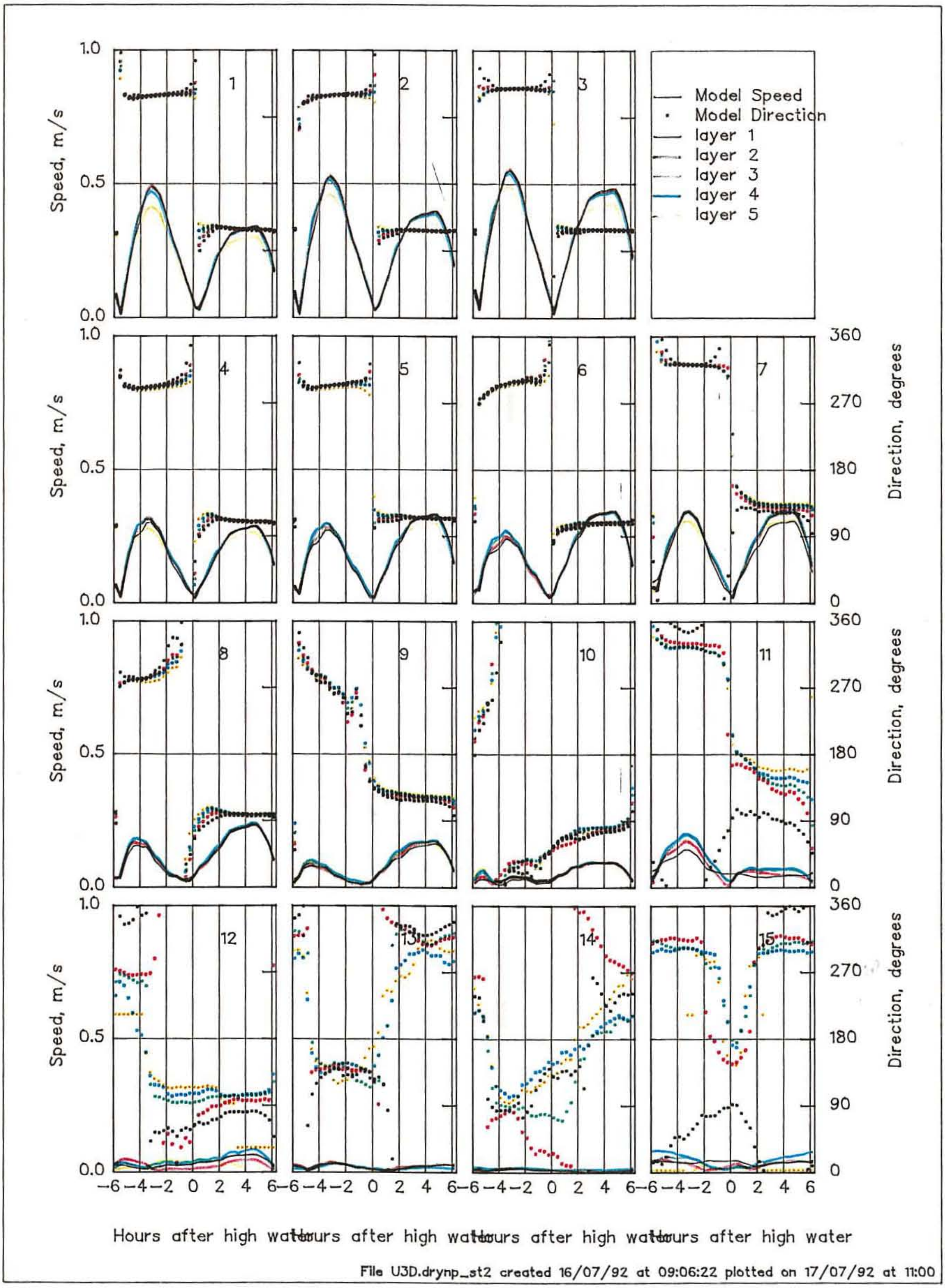
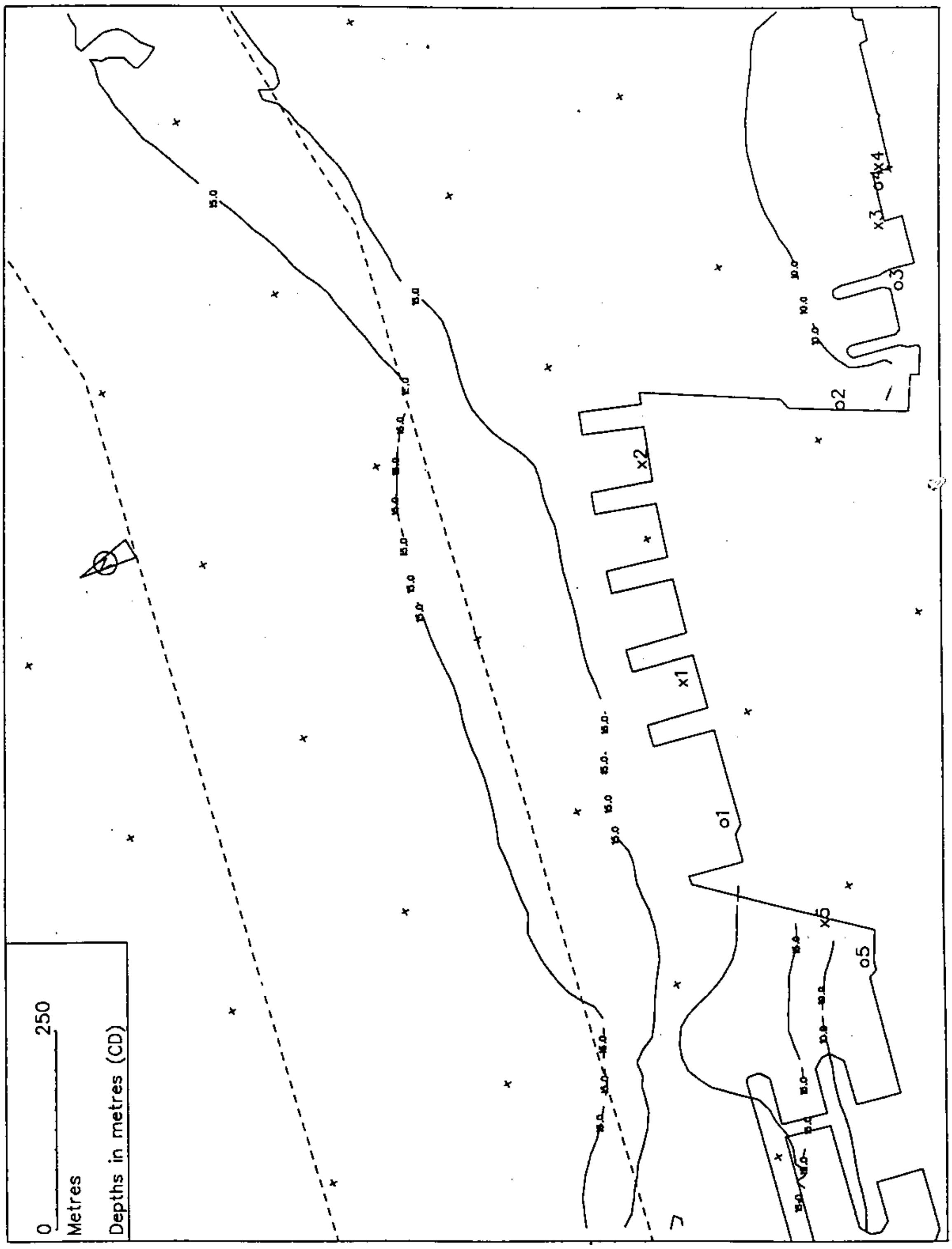


Figure 33 Current and direction time series
Dry neap tide : stage 2



File md_wanchai_final created 11/08/92 at 12:25:59 plotted on 14/08/92 at 12:25

Figure 34 Model layout during final construction

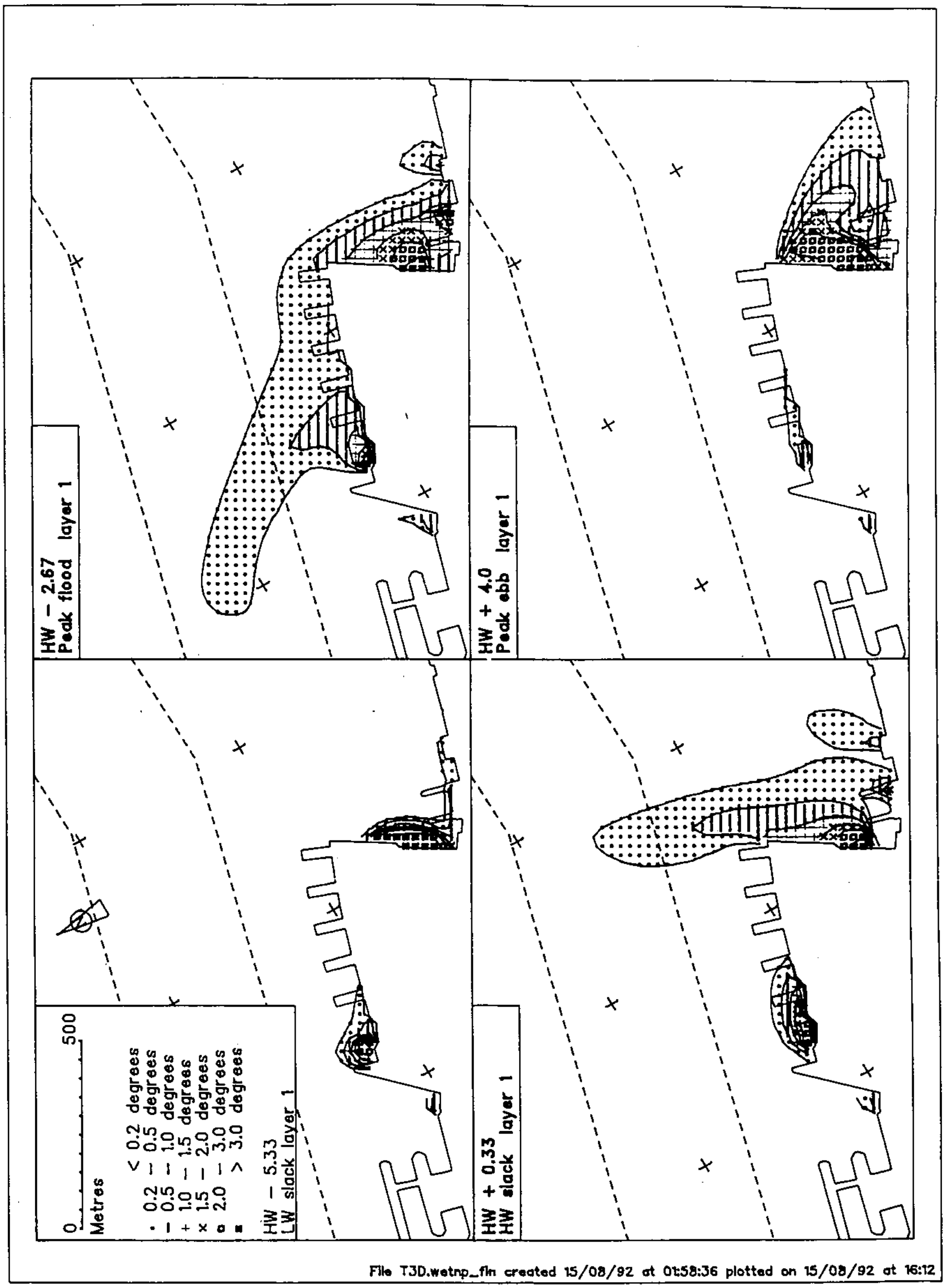


Figure 35 Temperature distributions : final
Wet neap tide : surface layer

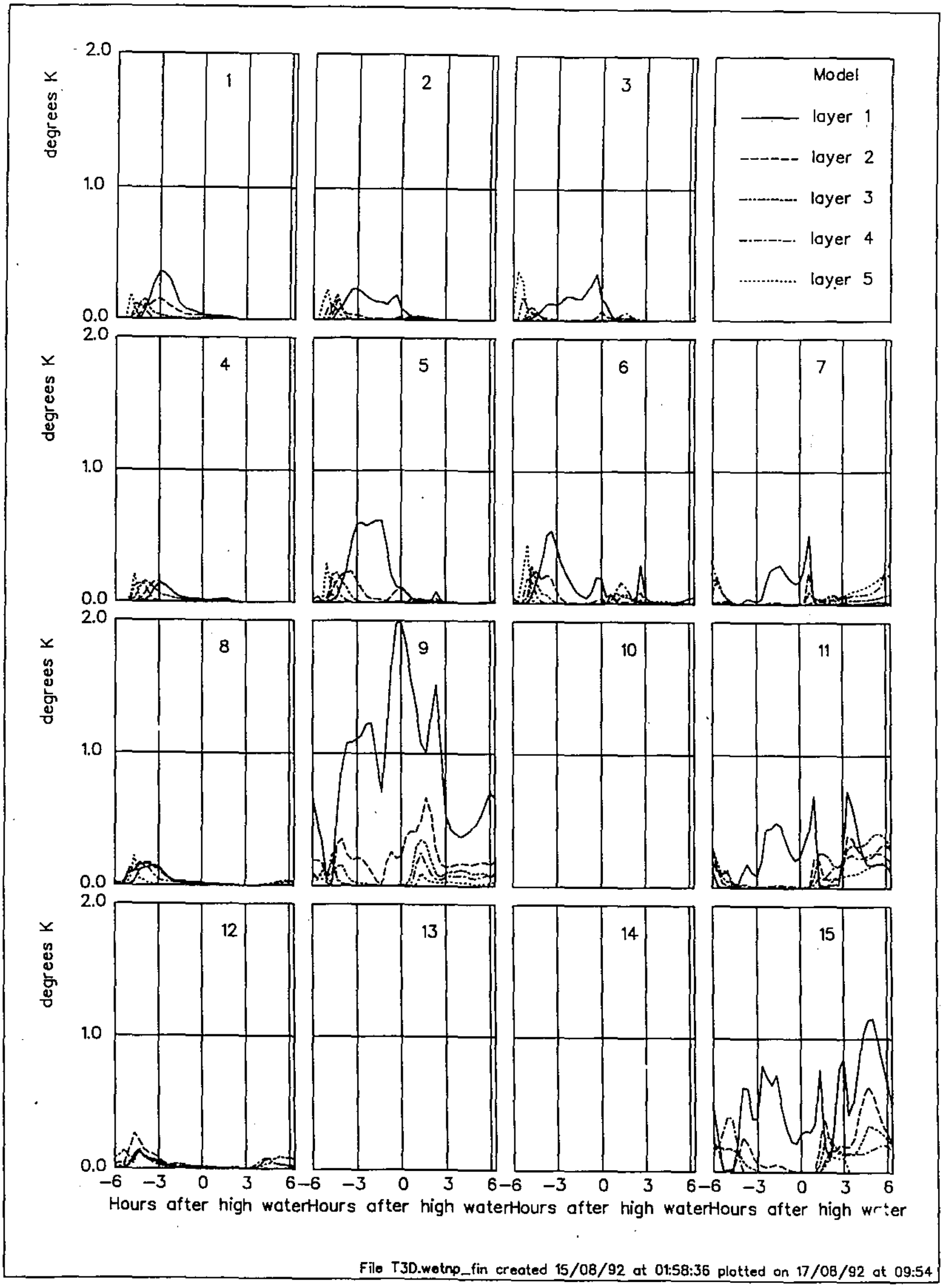


Figure 36 Temperature time histories
Wet neap tide : final

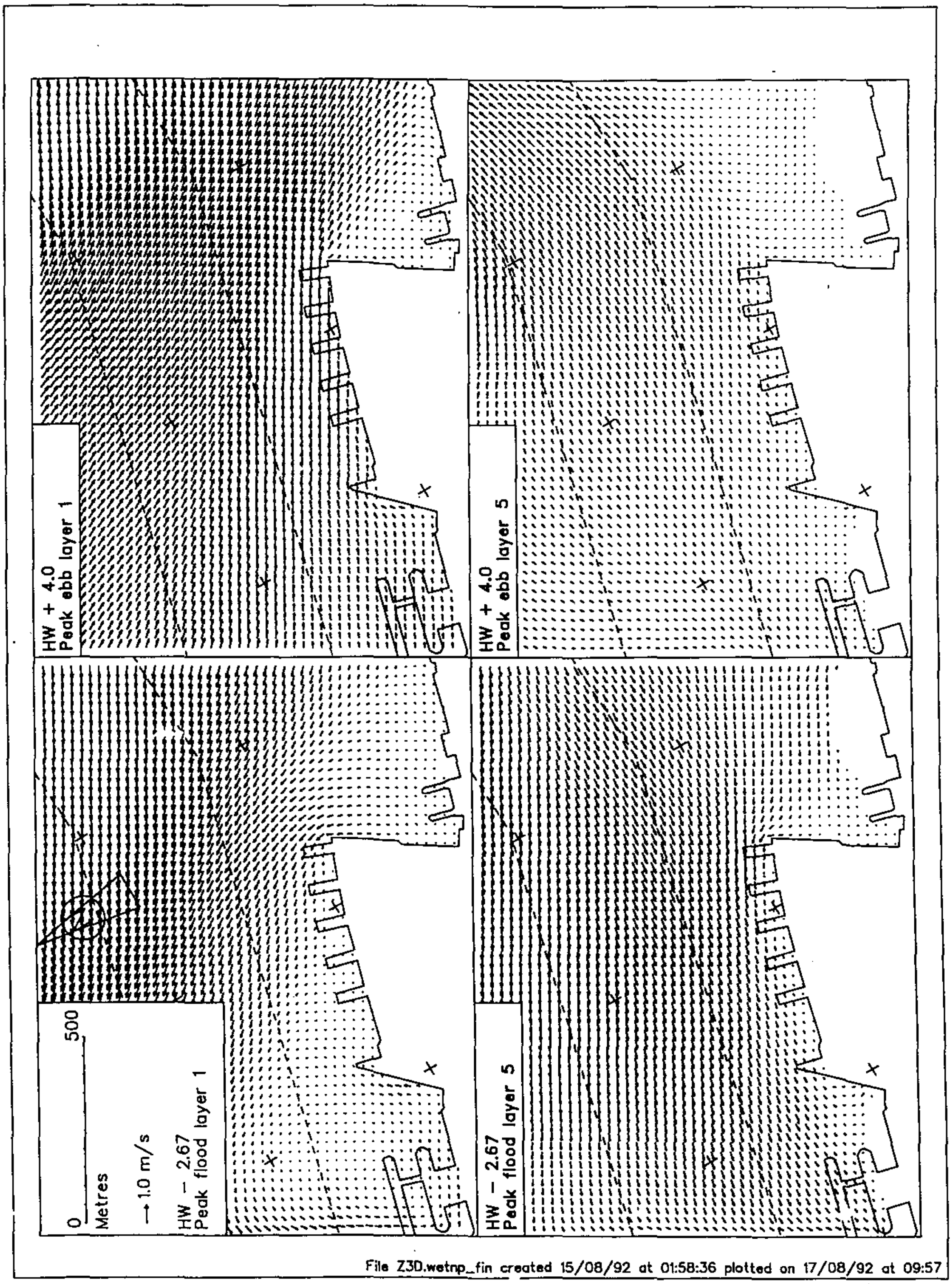


Figure 37 Peak velocity vectors
Wet Neap tide : final

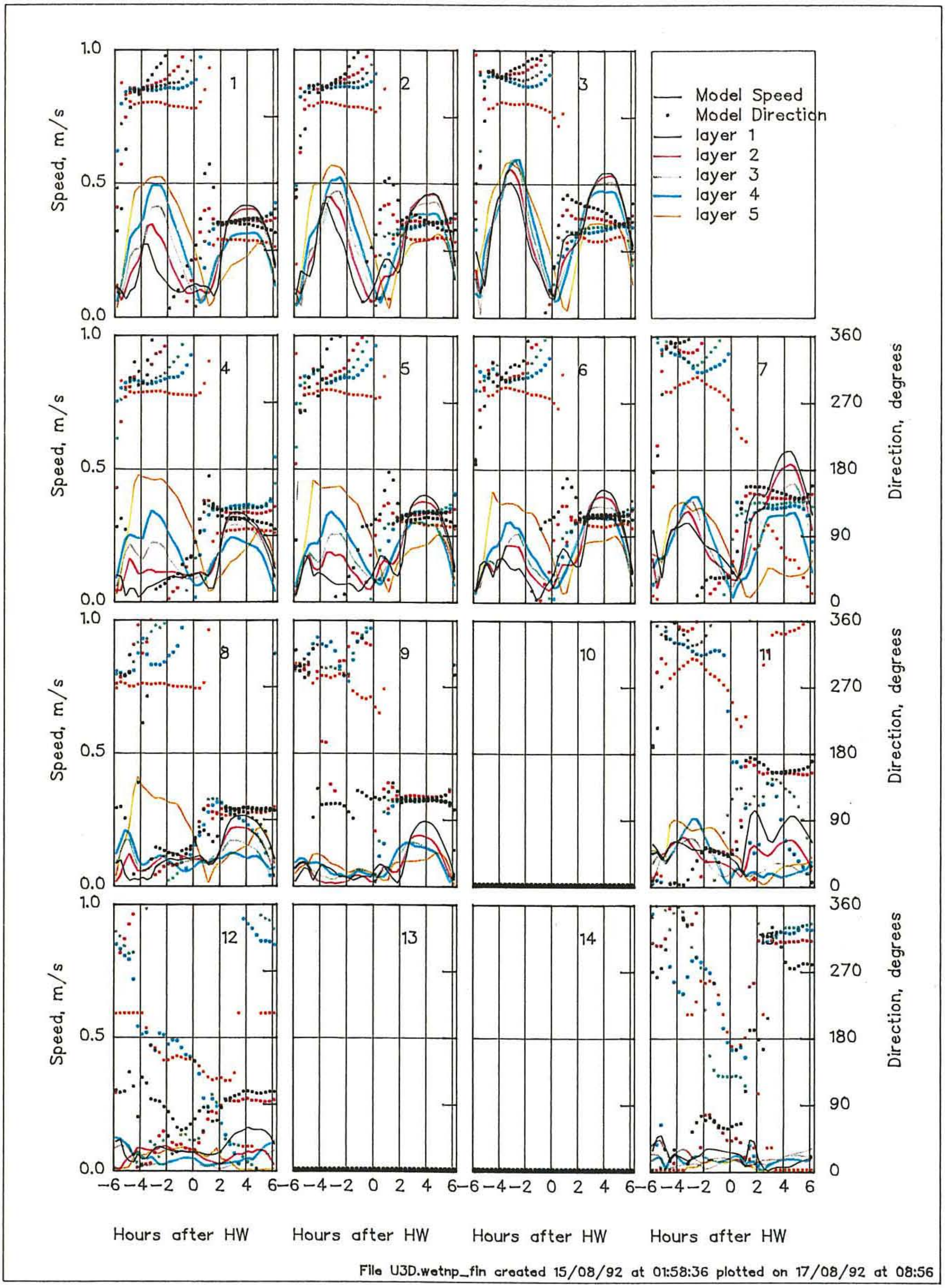


Figure 38 Current and direction time series
Wet neap tide : final

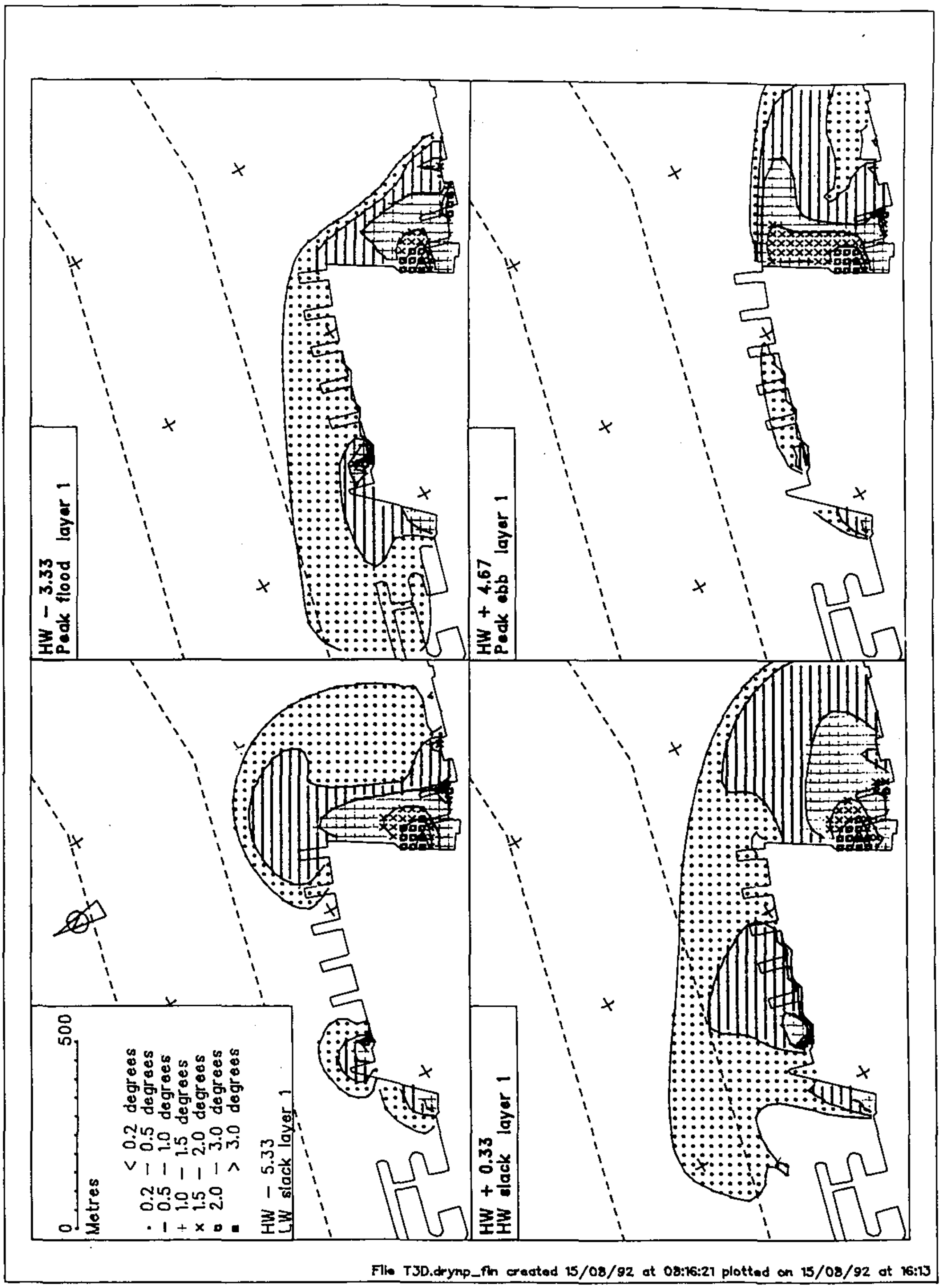


Figure 39 Temperature distributions : final
Dry neap tide : surface layer

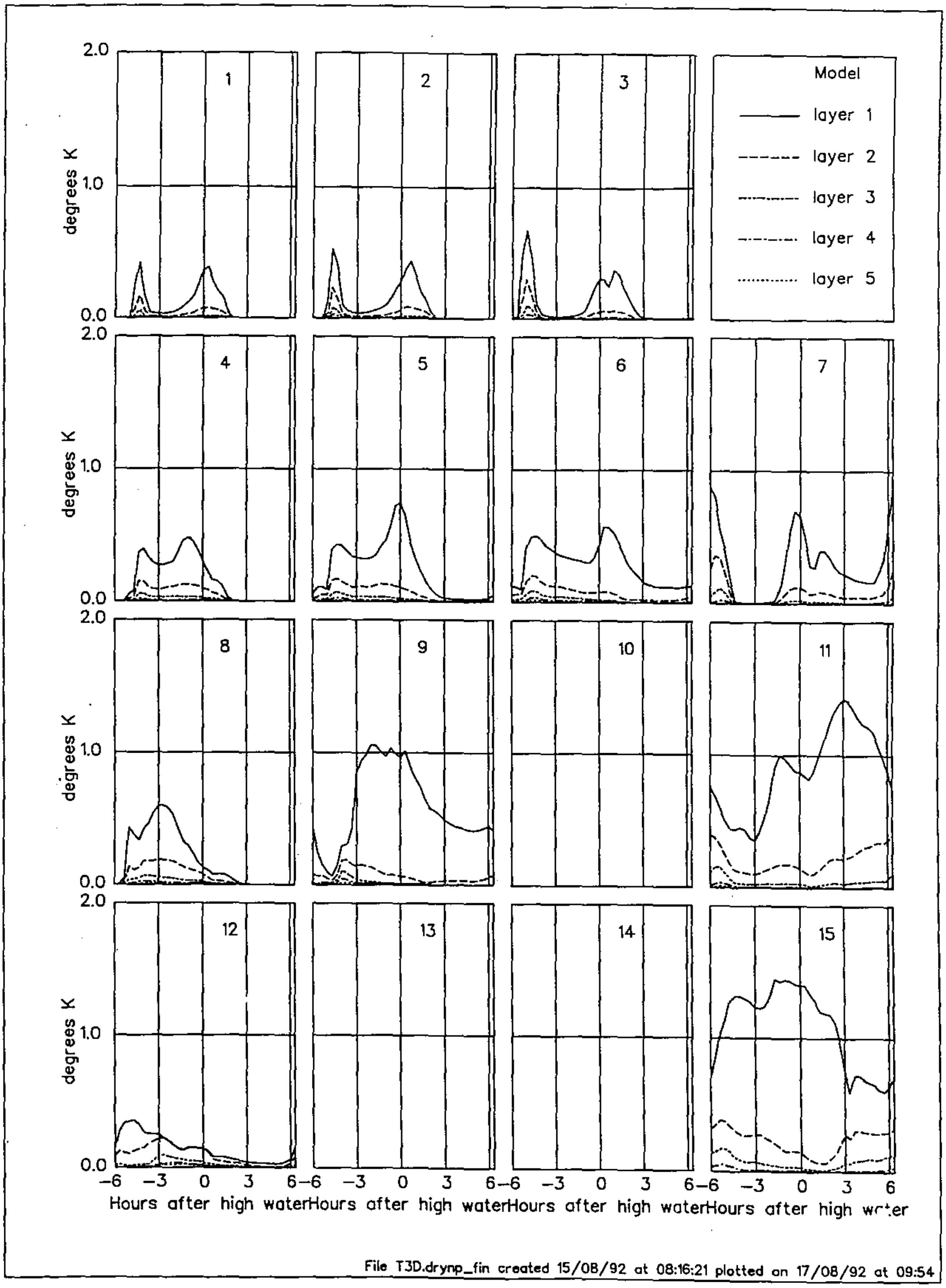


Figure 40 Temperature time histories
Dry neap tide : final

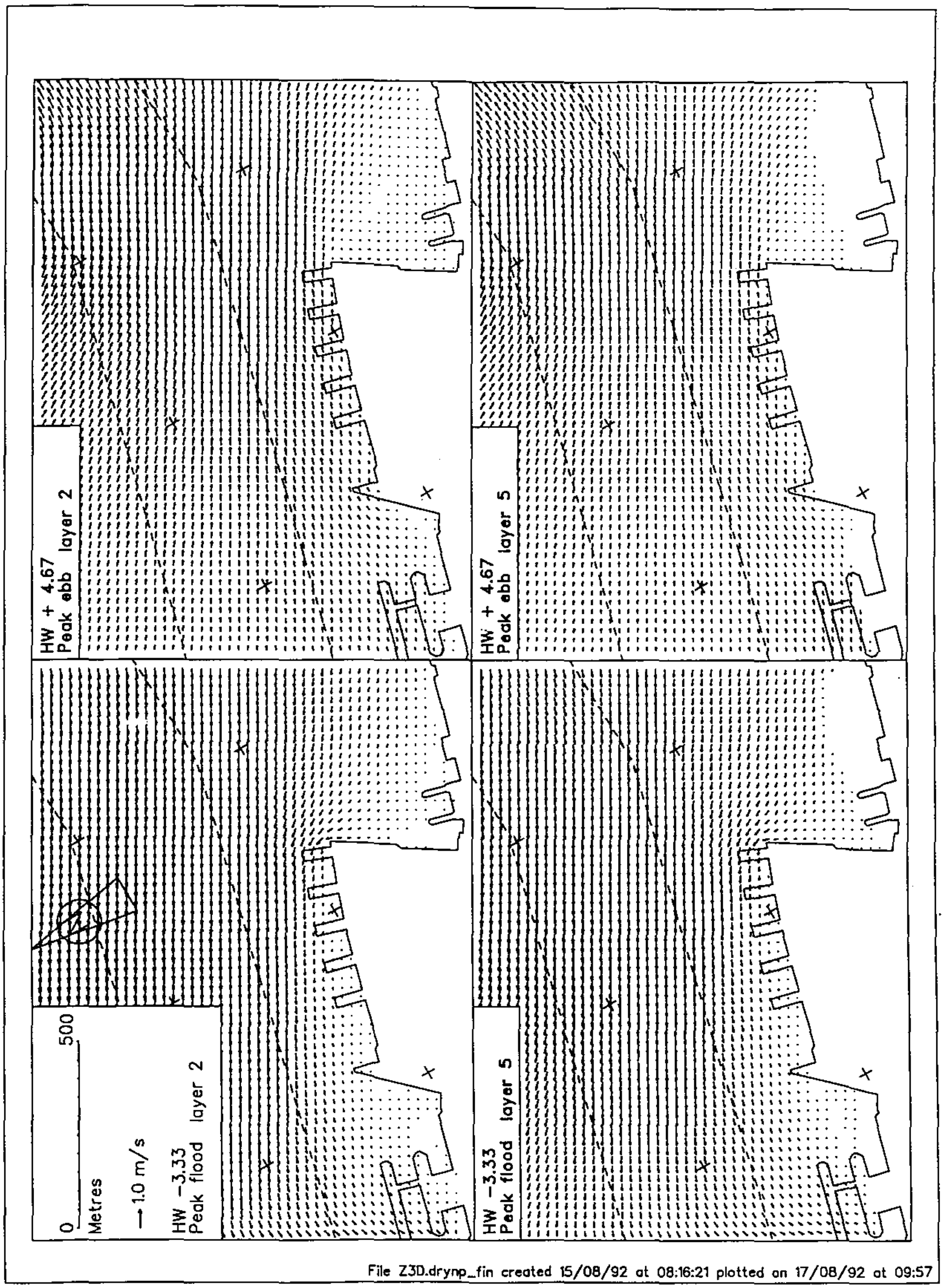


Figure 41 Peak velocity vectors
Dry Neap tide : final

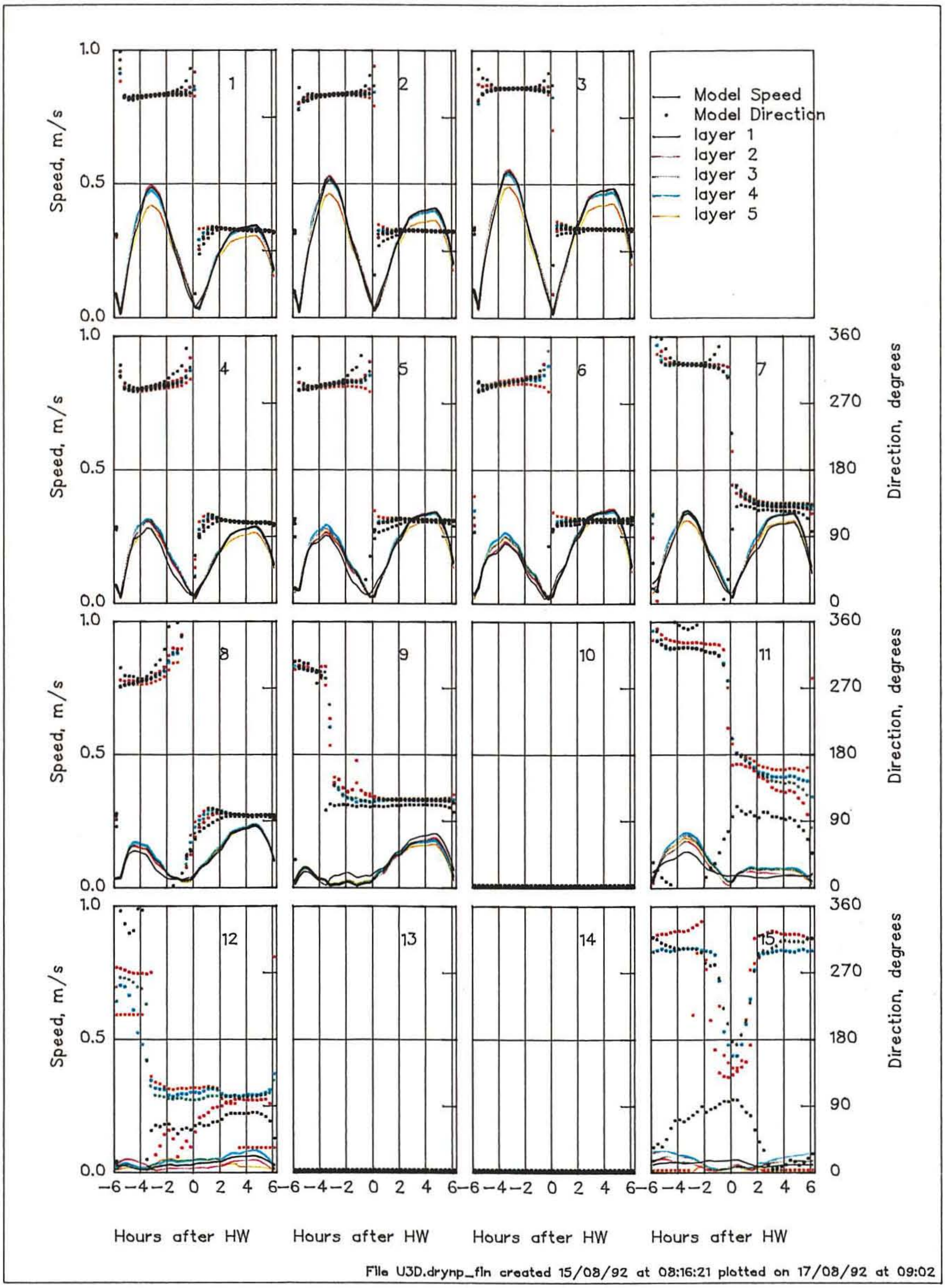


Figure 42 Current and direction time series
Dry neap tide : final

APPENDIX I

Formulation and Validation of HEATFLOW-3D

1. Background

The initial movement and dilution of a cooling water discharge are mainly determined by its momentum. Due to buoyancy the effluent rises to form a surface plume which then undergoes progressive entrainment and mixing and eventually gets captured by the ambient flow. This stage of heat dispersion is usually referred to as the midfield. The main physical processes affecting the subsequent behaviour of the plume are buoyant spreading, advection by tidal and wind induced currents and dilution by turbulent mixing. These are 3-dimensional, unsteady processes with dynamic links between the flow and buoyancy; therefore demanding a 3D, unsteady and dynamically coupled model of flow and heat.

2. Formulation of HEATFLOW-3D model

A standard 2D depth integrated model is inadequate to represent the flow including stratification which occurs near to the cooling water discharge from a power station. For this reason, HR has devised the HEATFLOW-3D model of flow and heat transport.

If a depth integrated model were used to represent the surface plume close to the outfall the plume would be assumed to be mixed through the total depth of water although the true plume thickness is no more than about 3m. This would result in a great underestimate of the plume temperatures. The buoyant plume spreading can also not be effectively accounted for in this kind of model.

The HEATFLOW-3D model has a similar horizontal grid to a 2D flow model but has several layers on top of one another. The flow equations given below are very similar to those for a 2D flow model in each layer but wind stress and bed friction apply to the top and bottom layers respectively and turbulent transport between the layers is modelled to extend these effects through the body of water.

The transport of heat is modelled using explicit upstream differences horizontally but vertically an implicit finite difference scheme is used to handle the vertical turbulent diffusion with unconditional stability. The reduction of vertical mixing by the temperature gradient is an essential element included in the model without which the plume would mix rapidly through the water column unlike what is found in practice. A flux corrected transport algorithm may be used to limit the numerical diffusion that results from using upstream differences in the two horizontal directions.

The governing equations are:

Conservation of water volume

$$\frac{\partial u}{\partial x} + \frac{\partial v}{\partial y} + \frac{\partial w}{\partial z} = 0 \qquad (1)$$

Conservation of momentum in the x and y directions

$$\frac{\partial u}{\partial t} + u\frac{\partial u}{\partial x} + v\frac{\partial u}{\partial y} + w\frac{\partial u}{\partial z} + \frac{1}{\rho}\frac{\partial p}{\partial x} = \Omega v + \nu_H \nabla^2 u + \frac{1}{\rho}\frac{\partial \tau_x}{\partial z} \qquad (2)$$

$$\frac{\partial v}{\partial t} + u\frac{\partial v}{\partial x} + v\frac{\partial v}{\partial y} + w\frac{\partial v}{\partial z} + \frac{1}{\rho}\frac{\partial p}{\partial y} = -\Omega u + \nu_H \nabla^2 v + \frac{1}{\rho}\frac{\partial \tau_y}{\partial z} \qquad (3)$$

where the hydrostatic pressure is

$$p = -g\int_z^\eta \rho dz \qquad (4)$$

Conservation of heat

$$\frac{\partial T}{\partial t} + \frac{\partial}{\partial x}(uT) + \frac{\partial}{\partial y}(vT) + \frac{\partial}{\partial z}(wT) = k_H \nabla^2 T + \frac{\partial f_{sz}}{\partial z} \qquad (5)$$

where

x, y, z are Cartesian co-ordinates, z vertically upwards (m)

u,v,w are the corresponding velocity components (m/s)

t is time (s)

ρ	is density (kg/m^3)
p	is pressure (N/m^2)
Ω	is the Coriolis parameter (s^{-1})
∇^2	is $\partial^2/\partial x^2 + \partial^2/\partial y^2$ (m^{-2})
η	is the value of z at the free surface (m)
ν_H	is horizontal eddy viscosity (m^2/s)
τ_x, τ_y	are horizontal components of vertical turbulent momentum transport (N/m^2)
T	is temperature excess above ambient (°C)
k_H	is horizontal eddy diffusivity (m^2/s)
f_{sz}	is vertical turbulent flux of heat (°C/m/s)

The density ρ is supposed to be a linear function of the excess temperature T, a typical value of the coefficient of proportionality (expansion coefficient) would be -.00025. The model uses a mixing-length description of the turbulence which takes account of different size eddies dominating the turbulent diffusion at different levels in the water column. The form of the mixing length used and the reduction in vertical turbulent exchange by stable stratification are derived from Odd and Rodger[1].

The form of the heat field predicted by the model is usually dominated by the combined action of the turbulent suppression due to the vertical stratification and the gravitational circulation due to the horizontal temperature gradients. These tend to generate a surface plume initially. If discharged down an open channel the plume usually has forward momentum which tends to carry it out to sea, but it entrains some of the slow moving ambient water causing it to slow down and to bend it.

In order to resolve just the top of the water column while the water surface rises and falls with the tide the datum changes at each step and a regridding takes place. This does tend to introduce some vertical mixing but the effect seems to be small compared to the physical diffusion and the plume is not smeared out by the process.

The effect of a windstress on the surface can be included in the model. This produces surface flow in the direction of the wind and an undercurrent in the opposite direction. The effect on the plume is thus the sum of the direct windstress on the plume and the wind induced ambient current tending to bend the plume.

Output from the model is stored in data files which can be accessed to produce plots of temperature at different levels as a function of time at specified stations or isotherm contour plots of the model layers at specified times.

1 Odd N V M and Rodger J G. Vertical mixing in stratified tidal flows, Journal of the Hydraulics Division, American Society of Civil Engineers (ASCE), Vol 104, No HY3, March 1978.

3. Validation of HEATFLOW-3D model at other sites

The normal modelling procedure includes calibration and validation checks to demonstrate that the model was working properly. Calibration involves adjusting the model parameters to obtain agreement with observations from the site, and validation is a subsequent check to ensure that the model has not been unduly forced by comparing the model against a second, independent set of data without changing the model parameters. This procedure has been followed in several previous applications of the HEATFLOW-3D model at sites of different types. A variety of comparison methods has been used and this appendix summarises the methods adopted and the results obtained. The site locations are shown in Figure A1.

3.1 Thermal data

Sea temperatures near a power station are a combination of various natural and artificial (power station) temperature fields. The most significant of these are the local deep sea ambient temperature, the natural estuarial temperature gradient, the natural inshore solar field, the power station background temperature field and the power station cooling water midfield plume. Each of these varies as a result of deterministic tidal and seasonal effects plus random meteorological fluctuations.

There are three basic difficulties in creating a thermal data base

(a) the practical problems (and cost) of actually measuring the complex three-dimensional, time-varying structure of the heat fields
(b) separating the power station contribution from the natural solar fields
(c) assessing the statistical significance of the particular measured data set.

Each of these factors affected the following model comparisons to some extent. Nevertheless the overall impression is that the model works satisfactorily.

3.2 Validation at Hinkley Point, UK

Hinkley Point power station is situated in the Severn Estuary, UK. The site experiences tidal ranges of 11m and tidal excursions of 20km on spring tides. It was not possible to encompass the whole midfield plume in a single model so two models with grid sizes of 100m and 40m were used (Ref A1). The situation is complicated by the presence of a rock platform which dries at low water (LW) and the nature of the cooling water discharge changed from acting like a submerged outfall at high water (HW) to a surface jet at low water constrained by a 30m channel.

An extensive thermal and hydraulic field investigation was carried out over the three month period July to September 1983, and the data recovered from the survey comprised:

(i) thermistor stringer data;
(ii) current meter data;
(iii) tide gauge data;
(iv) meteorological data.

Thermistor stringers were deployed at the stations (L, M, N, O, P, Q, R, S) shown in Figure A2 and two other stations T and U further to the west. Each stringer contained 14 temperature sensors and 4 depth sensors. Data should have been recorded at 10 minute intervals but sometimes there were problems with the instruments or the loggers so there were gaps in the records.

Three tide gauges and two current meters were deployed but one current meter failed to work. Data was again recorded every 10 minutes. A meteorological station was deployed which recorded the atmospheric temperature, wind speed and direction, atmospheric pressure, humidity and solar radiation.

The CEGB Central Electricity Research Laboratory also monitored intake temperatures during the same period and station output figures were also recorded to provide information about the quantity of waste heat discharge.

Exact comparisons between model and infra-red patterns were not possible because the images had not been corrected for distortion and also the signals had not been processed to obtain the actual surface temperatures. Nevertheless, it is clear that the model was reproducing the main features of the infra red imagery, including the extensive buoyancy driven spread at low water with the characteristic sharp leading edge, and the much narrower plume which occurs at LW - 45 min with evidence of bifurcation (Fig A3). From examination of the thermal data it was found that considerable differences could be recorded on different days which had similar tide and wind conditions. The presence of a pulse in a particular record depends on whether the recording position was just inside or outside the sharply defined outer edge of the plume, and the position of the edge of the plume would have been very sensitive to local variations in the wind. Under these circumstances it was considered appropriate to compare the model against observations selected from the data base for a range of typical days so that any discrepancies could be related to the scale of the uncertainties arising from natural variations.

For this purpose, a set of observations was selected from the database ostensibly for the same spring tide ranges with low winds. Note that low winds in this context refer to low daily averages and not necessarily low winds throughout the days in question. In each case a small range of tides was prescribed to obtain a representative selection. The values so obtained are plotted in Figure A4 together with the comparable model results. The observations are plotted as surface-bed differences to remove ambient and farfield variations.

Although the observations show considerable natural variations, there are, nevertheless, some well defined trends in the shapes and timing of pulses.

The model reproduces many of these features. Note, in particular, how the model matches the pattern of two temperature pulses at position L during the flood tide and the intervening period without any plume showing which was a strong feature in the observations. The pulses reflect the passage of the LW slack pool and the broadening of the plume as currents slow towards the end of the flood tide. In between, the plume was swept away inshore of the instruments and consequently nothing was recorded either in the model or by the instruments.

The 40m model was considered to be in very good agreement with the observations bearing in mind the fully three-dimensional, unsteady nature of the problem and the day to day variations seen in the observations. The validation had been taken much further and checked in more detail than any similar work that had been published hitherto.

3.3 Validation at Fawley power station, UK

Cooling water at Fawley power station is extracted from Southampton Water and discharged into the Solent via a twinned outfall structure with side openings to help disperse the plume. The mean spring tidal range at the site is 3.6m. A model of about 7km by 6km was required to include both the intake and the outfall and neighbouring areas of ecological significance, and for this purpose a grid size of 100m was used. (Fig A5) (Ref A2).

An extensive hydrographic survey including the model area was carried out in June and July of 1987. This included measurements of current and temperature profiles at fixed locations through the tidal cycle; tracking of floats released on flood and ebb tides; measurements of temperature profiles within the plume on a series of traverses across the plume; aerial infra-red imagery of the plume at approximately hourly stages through the tide. During the period of the main thermal measurements (17th-19th June) the power station was operating with nearly constant output of 500MWe, gross, from each of three units. This corresponded to a cooling water flow of $48m^3/s$ at an excess temperature of 10K above ambient.

Figure A6 shows a series of surface temperature isotherms for a spring tide with a cooling water discharge of $48m^3/s$ at a temperature excess of 10K above ambient. The model output displayed corresponds to the state of the tide at the times of the aerial infra-red flights, according to the Admiralty Tide Tables (1987) prediction. The real tide, however, was observed to turn an hour or more before the Admiralty predictions and allowances have been made for this in the presentation of results. Comparison between the plan view results and the aerial survey data is difficult because of the distortion induced by the sideways pointing camera on the helicopter. It can be seen, however, that the disposition of the model and observed plumes are similar.

The agreement between thermal cross-sections of the model results and observations Figure A7 is less satisfactory than achieved at Hinkley. This was partly attributed to the problem of resolving the plume bifurcation with the 100m grid but also there was less data from Fawley so the variability of the plume could not be assessed. However, if due allowance is made for these factors then the model plume does seem to occupy a reasonable position in between the two branches of the observed plume and to have reasonable temperatures.

3.4 Validation at Kingsnorth power station, UK

Kingsnorth power station is situated alongside an extensive area of saltings and mudflats in the Medway Estuary where the mean spring tidal range is 5.1m. The power station draws in its cooling water through a submerged intake at the end of a short intake channel and discharges further seaward making use of the natural Damhead and East Hoo Creeks to obtain an effective separation of about 4km at low water.

The model was required to include the intake and appropriate area of the saltings and intertidal areas to the east of Kingsnorth which were likely to be directly affected by the primary or returning plume. On the other hand a finest possible model grid was desirable to resolve the details of the plume and flow over the complex configuration of saltings and intertidal mud flaps. It was necessary to strike a balance between these two conflicting requirements. The chosen compromise was to use a model with a 75m grid including the main channel and the intertidal areas on the NW side of the Medway Estuary. (Fig A8) (Ref A3).

An intensive field survey was carried out between 10 June and 29 July 1987 to provide validation data for the HR plume model. Some of the observations were continued to provide information on long term effects. The main survey included tide recording, recording current metering, current, temperature and sediment profiling and recording thermistor strings. A complementary infra-red imagery survey was organised by CEGB to coincide with the period of most intensive thermal observations. There was also some additional infra-red imagery from a survey in November 1986.

The qualitative behaviour of the HR model plume was examined by comparison with artists impressions of the disposition of the plume based on the video of the 1986 infra-red survey (Fig A9).

For this purpose the models were run with $45m^3$/sec discharge of cooling water at an excess temperature of 10°C corresponding approximately with the power station operating conditions at the time of the survey. At LW + 30m the cooling water was essentially constrained to East Hoo Creek with the leading edge ponding well out into the Medway. Two hours later (LW + 2h 30m) the cooling water plume had been pushed back into East Hoo Creek by the rising tide and was beginning to break out under Bee Ness Jetty onto Stoke Saltings and under Oakham Ness Jetty along Slede Creek. These features are well represented in the model.

At HW + 30m the plume is pushed well back up East Hoo Creek and onto Stoke Saltings. There seems to be a patch of warm water trapped near Oakham Ness in both the observations and model results. At HW + 2hr (the last of the observed results) the warm water is draining back into East Hoo Creek and, in the model, also draining towards Stoke Creek.

Figure A10 shows the comparison of model results with data from the thermistor stringers. The observed data has once again been reproduced relative to a typical ambient. These comparisons shcw that the model is correctly representing the hottest part of the plume. The flat top to the data TS6 is a consequence of an incorrect range limit on the thermistor. The "tails" exhibited by the observations is returning heat which would have been lost through the model boundary during the previous ebb tide.

3.5 Validation at Trawsfynydd power station, UK

Trawsfynydd power station is different from the other three sites in that it is an inland site and uses a lake (of the same name) for cooling water purposes (Ref A4). The warm water from the station outfall is channelled through a series of lagoons to the far end of the lake from where it returns under the influence of the station pumping to the intake. The water cools during its passage through the lagoons and main lake sufficiently to be re-used in the station.

In summer conditions, as modelled in the study, the flow in the various streams entering and leaving the lake is small and the lake was therefore modelled as a closed system, the circulation of the water being entirely driven by the power station pumping, thermal currents and the wind. Data for the calculation of these effects and for the calculation of the heat losses or gains at the surface of the lake were provided by CEGB from station and Meteorological Office records.

The period chosen for the validation of the model was 10-19 July 1969. During these ten days the lake was initially well mixed vertically; it became warmed and stratified during a period of low winds and strong insolation between 12 and 16 July; at the end of the period cooler weather and stronger winds resulted in cooling and de-stratification of the water.

Meteorological data were available from site instruments for input to the model. Water temperature records for comparison with the model results were available from platinum resistance thermometers at Pontoons 27, 28 and 29, and from similar instruments at the intake (Fig A11)

The lake water level was 195.25m AOD. The cooling water pumping rate varied between 19.9 and 20.0m^3s^{-1} and the power station heat rejection was approximately 535 MWth.

The model was run from an initial temperature field supplied by CEGB. Figure A12 shows that the time variation in the surface layer was very well reproduced in the model. The correct diurnal variation and overall warming and cooling are both apparent. The model also shows development and disappearance of stratification in good agreement with the observations.

There is still a slight tendency for the lowest layer to warm too much but the disagreement is less than about 1°C.

It should be remembered while studying Figure A12 that the thermometers and model layers do not correspond exactly. It may not be possible to interpolate linearly between the data from different depths. These difficulties can lead to a poor impression of the model's representation of the vertical temperature structure. A more accurate impression of the vertical structure is gained from the vertical profiles in Figure A13.

The temperature profiles (Fig A13) show that for the most part the vertical temperature structure was well represented by the model. As noted earlier the lower layers started to warm a little too soon (in response to the $7ms^{-1}$ winds on 16 July rather than those of $10ms^{-1}$ in the 18th). It is clear, however that the processes of stratification and mixing were simulated both qualitatively and quantitatively.

(The profiles also show that some of the thermometers were very near the transition zone between the warm surface water and the cooler lower layers. Any small vertical movement would give rise to a large temperature change. This was the cause of the "spiky" observations at 3.0m depth. The model could not reproduce this because of its limited vertical resolution but this does not adversely affect the accuracy of the results for the layer as a whole).

The period of 10-19 July 1969 provided a comprehensive validation test of the model, containing periods of warming and cooling, stratification and mixing, and motion of the plume in response to wind stress without mixing. The model was shown to reproduce all these effects both qualitatively and quantitatively. Agreement with the data was within 1°C and the errors were on the side of pessimistic prediction. This gave confidence in its use in the extreme and predictive simulation which followed.

3.6 Validation at Sizewell power station, UK

Sizewell power station is situated on a stretch of open coastline which runs north-south. The tidal currents flow predominantly parallel to the coast and the mean neap tide range is 1.0m. Cooling water is discharged from an outfall 150m offshore and extracted from an intake 400m offshore and 400m north of the outfall. A model of 4.5km by 2km with a grid size of 50m was used to include the intakes and outfalls of the existing and possible future power stations (Fig A14) (Ref A5).

The validation of the 3D temperature structure of the model plume required surveying work which was carried out by the HR survey department during September 1988. The main thermal measurements were taken in a series of traverses across the plume on lines 500m and 1000m north and south of the 'A' station outfall. At slack water a run was made parallel to the coast. The series of measurements was performed on two successive days, 20 and 21 September 1988 on neap tides of range 1.3m. Temperature recordings were also made at fixed locations through the two days using four thermistor stringers. These were deployed in pairs slightly inshore and offshore of the outfall position and 500m to the north and to the south.

The model was run with a warm water discharge of $32m^3/s$ at 9K above ambient. This was equivalent to a heat rejection of 1200MWth corresponding to the baseload generation of 408MWe during the period of the survey. Computer animations and plots of the temperatures in the model surface layer were compared with video recordings from aerial infra-red surveys of the plume to establish that the general position of the model plume was correct but quantitative temperature comparisons could not be made as the infra-red images were not calibrated.

For the purpose of comparison of model and traverse observations it is easiest to compare plots of temperature against distance offshore for each layer separately. These comparisons are shown in figures A15 and A16 For each output time the model results are compared with data from traverses made at the same time, ±30 minutes, relative to high water slack (HWS).
On the early ebb (HWS + 1.5 hours, Fig A15a) model and observations show the slack water pond crossing the traverse lines. The plume extended to 900m offshore but the highest temperatures were concentrated within 200m-400m offshore. The model and observed temperatures agreed in all three layers within the scatter of the observations. Later in the ebb (HWS + 4 hours, Fig A15b) the warm water streamed northwards in a narrow plume extending 400-600m offshore. The model temperatures on the traverse lines agreed very

well with the observations in magnitude and distribution in both horizontal and vertical.

On the early flood (HWS + 7.33 hours, Fig A16a) there was considerable scatter in the observations. This indicated that conditions were changing rapidly and/or were sensitive to small changes between tides. A small area of warm water close inshore in the top layer was not reproduced by the model but the model temperatures beyond 200m offshore and in the lower layers fell within the scatter of the observations. During the main part of the flood tide when the plume was streaming towards the south (HWS + 10 hours Fig A16b) the plume remained close inshore with a width of 300m-400m. Agreement between model and observed temperatures and plume position was good during this period.

This method of comparison of survey data and model results was found to be an effective tool in the model validation. It supplemented quantitatively the subjective impressions of the plume position which can be obtained from aerial infra-red surveys and was not so sensitive to small variations in plume position as comparisons involving fixed instruments. Comparisons at low water slack indicated great sensitivity of the observations to timing and exact tidal conditions and the model did not reproduce all the observed features. The model was, however, found to simulate the Sizewell power station plume quite adequately during the period around high water slack and very well during the main periods of the flood and ebb tide.

4. Conclusions

The HR model has been successfully applied to five radically different sites and exposed to a wide range of conditions. The good overall performance of the model compared to observations suggests that the model is physically sound, and gives confidence that the model can be used to provide realistic results under conditions substantially different from the site validation or at a new site.

5. References

A1. Hinkley Point C pre-application studies. Midfield plume model study. Report EX 1552, Hydraulics Research Ltd, 1987.

A2. Fawley B power station cooling water plume model. Report EX 1620, Hydraulics Research Ltd, 1987.

A3. Kingsnorth B power station cooling water plume model. Report EX 1622, Hydraulics Research Ltd, 1987.

A4. Trawsfynydd power station cooling lake study. Report EX 1697, Hydraulics Research Ltd, 1988.

A5. Sizewell power station midfield cooling water plume model. Report EX 1882, Hydraulics Research Ltd, 1989.

Appendix 3

CENTRAL RECLAMATION, PHASE 1 - ENGINEERING WORKS
CONTRACT SPECIFICATION PROVISIONS

			Page
Specification, Part A			
	1.113	Collection of Floating Debris	SA1/71
Specification Appendices			
	Appendix 4	Water Pollution Control and Water Quality Monitoring	S.Appx.4/1-8
	Appendix 5	Environmental Protection Requirements	S.Appx.5/1-7
	Appendix 9	Method Specification for Disposal of Dredged Mud	S.Appx.9/1-3
	Appendix 18	Improvements to Existing Sewerage System	S.Appx.18/1,2
	Appendix 26	Engineering Conditions for Marine Borrow Areas and Marine Dumping Areas	S.Appx.26/1-16
Questions to Tenderers			
	11.9.92	Environmnetal Protection Clauses (on Specification Appendices 4, 5, 26)	--
	15.9.92	Marine Dumping, Self Monitoring Equipment	--

Note: Amendments made to Specification and agreed by tenderers for Contract UA 11/91 are indicated by underlining.

The requirements of "Marine Dumping, Self Monitoring Equipment" will form part of Government's licence for marine dumping. As such it is an contractor's obligation and not a specification requirement. The tenderers have confirmed that they will abide by the requirements of this.

1.113 COLLECTION OF FLOATING DEBRIS

The Contractor shall provide, at least one Water-witch or similar craft manned by suitably qualified coxswain and other staff, to operate within and around the reclamation area Site Boundary for the purposes of collecting all floating debris and rubbish generated by or entrapped in or by the works to the satisfaction of the Engineer and other relevant Government authorities.

The Contractor's proposals for equipment and operations in respect of this Clause shall be submitted within one month of the date for Commencement of the Works.

The Contractor is required to collect and to keep the area within the reclamation area Site Boundary free of floating debris. Should the Engineer consider that the performance of the vessel or vessels to be inadequate or ineffective, he will inform the Contractor who shall make proposals for improvement within one week. Should it be necessary to increase the number of or change the type of craft used or to provide, other resources, these shall be provided and operated by the Contractor after approval by the Engineer.

The materials so collected shall be delivered by the Contractor to an approved Government landfill site.

The craft shall be operated for whatever time is necessary to prevent buildup and entrapment of floating debris or rubbish and escape of material associated with the marine operations. The time shall not be less than from 7:30am to 6:30pm continuously seven days per week.

Collection of floating debris and their disposal shall commence not later than the first marine works and shall continue until the completion of the seawall block works in Sectional Area S12 and the final diversion by the Airport Railway's contractor of Culvert C/D.

1.114 COVERS AT EXISTING LANDING STEPS

(1) Cover near Public Landing Steps PS1

The existing cover shall be repainted in accordance with the drawings and both the cover and its lighting maintained until public landing steps at B19B, C, D and E are opened, after which the cover shall be demolished and the area made good.

(2) Cover at near Public Landing Steps PS2

A cover shall be erected as shown on the Drawings, and shall include lighting. The cover shall be maintained until the public landing steps at B19B, C, D and E are opened after which it shall be demolished and the area made good.

APPENDIX 4

WATER POLLUTION CONTROL AND WATER QUALITY MONITORING

(S.A. Clause 1.06)

4.01 GENERAL REQUIREMENTS

(a) The Contractor shall carry out the Works in such a manner as to minimise adverse impacts on the water quality during execution of the Works. In particular he shall arrange his method of working to minimise the effects on the water quality within Hong Kong waters.

(b) Before Contractor's Equipment is used on the Works, it may be inspected by the Engineer to ensure that it is suitable for the project and can be operated to achieve the Water Quality Objective (WQO) as detailed in Clause 4.03. The Contractor shall provide all necessary facilities to the Engineer for inspecting or checking such Contractor's Equipment and shall not use such Contractor's Equipment on the Works without the prior approval of the Engineer. The Engineer may require the Contractor to carry out trials of any Contractor's Equipment to prove its suitability.

(c) The Contractor shall design methods of working to minimise adverse impacts upon water quality stemming from his operation in Hong Kong waters in the terms of the WQO, and shall employ experienced personnel with suitable training to ensure that these methods are implemented.

(d) In accordance with the requirements of Clauses 7 and 17 of the GCC the Contractor shall submit to the Engineer drawings, documents and information pertaining to the method of construction the Contractor proposes to adopt for marine works.

The information shall include, but not exclusively, the following :-

(i) Contractor's Equipment for dredging, dumping and filling

(ii) work methods and procedures

(iii) methods of screening existing cooling water intakes

(iv) methods of establishing and recording "accurate positional control" required by Clause 4.09(d).

The drawings, documents and information shall be submitted to the Engineer not less than 14 days before commencing marine works.

(e) After commencement of the Works if the Contractor's Equipment or work methods are believed by the Engineer to be causing unacceptable adverse impacts upon water quality, the Contractor's Equipment or work methods shall be inspected and remedial proposals drawn up for approval by the Engineer. Where such remedial measures include the use of additional or alternative Contractor's Equipment such plant shall not be used on the Works until approved by the Engineer. Where remedial measures include maintenance or modification of previously approved Contractor's Equipment such plant shall not be used on the Works until such maintenance of modification is completed and the adequacy of the maintenance or modification is demonstrated to the satisfaction of the Engineer.

4.02 <u>DEFINITIONS</u>

For use in this Appendix of the Specification only, the following definitions are used :

(i) marine mud - dredged material to be removed from the reclamation or borrow areas and which will not be reused in the Works;

(ii) contaminated marine mud - material defined on the Drawings or by the Engineer to be removed from the reclamation area requiring particular handling and disposal procedures;

(iii) fill material - dredged or land sourced material to be used in the reclamation, (including in foundations to seawall, embankments and other areas of fill, drainage embankment layers etc.);

(iv) unsuitable material - material, other than marine mud, taken from the area of the Works (including borrow areas), which is unsuitable for use as fill material. Such material is to be disposed of at Government Landfills. The material may include builder's debris, spoil and seabed debris.

(v) Turbidity - turbidity of the water measured in accordance with Clause 4.04 (b)(i) and 4.05 (c)(ii).

4.03 <u>WATER QUALITY OBJECTIVE</u>

The objective is to minimise adverse impacts resulting from the Contractor's operations on the water quality within Hong Kong waters. To achieve this objective the Contractor's method of construction shall :

(i) minimise disturbance to the seabed while dredging;

(ii) minimise leakage of dredged material during lifting;

(iii) minimise loss of material during transport;

(iv) prevent discharge of fill or dredged material except at approved locations;

(v) prevent excess suspended solids from being present in intake waters;

(vi) prevent the unacceptable reduction, due to the Works, of the dissolved oxygen content of the water adjacent to the Works.

4.04 WATER QUALITY MONITORING EQUIPMENT

(a) The Contractor shall appoint an independent Consultant/Laboratory (approved by the Engineer) to undertake all Water Quality Monitoring.

(b) The appointed Consultant/Laboratory shall provide the following equipment within one week of the commencement of the Contract.

(i) Turbidity Measurement Instrument

Turbidity within the water shall be measured in-situ by the nephelometric method. The instrument shall be a portable, weatherproof turbidity-measuring unit complete with cable, sensor and comprehensive operation manuals. The equipment shall be operated from a DC power source, it shall have a photoelectric sensor capable of measuring turbidity between 0-1000 NTU and be complete with a cable with at least 25 metres long. (Partech Turbidimeter Model 7000 3RP Mark 2 or similar approved).

The Turbidity meter shall be calibrated to establish the relationship between Turbidity readings (in NTU) and levels of Suspended solids (in mg/L). After calibration, turbidity measurements shall be taken as a true representation of levels of suspended solids only before laboratory test results for suspended solids are known.

(ii) Temperature Sensor

A temperature sensor with an accuracy of at least 0.5 degree Celsius, to measure temperature at the sample site. This shall be calibrated against a mercury thermometer of 0.1°C scale.

(iii) Suspended Solids

A water sample shall be taken at the same time as the turbidity results are obtained using a Niskin Water Sampler (or similar approved) of at least 2.5 litre capacity with messenger and a 10m line. Gravimetric suspended solid concentrations in each sample will be determined in the laboratory according to Method No. 2540 D in "Standard Methods for the Examination of Water and Wastewater" 17th Ed., 1989, American Public Health Association. Samples shall be taken to confirm the evidence of the Turbidity recorded in the field.

(iv) Depth Gauge

A portable, battery-operated Echo Sounder shall be used for the determination of water depth at each Designated Monitorin Station. This unit can either be handheld or affixed to th bottom of the work boat if the same vessel is to be used throughout the monitoring programme. (Seafarer 700 or simila aproval)

(v) Dissolved Oxygen and Temperature Measuring Equipment

The instrument shall be a portable, weatherproof dissolve oxygen measuring instrument complete with cable, sensor, comprehensive operation manuals, and be operable from a D power source. It shall be capable of measuring:

i) a dissolved oxygen level in the range of 0-20 mg/l an 0-200% saturation; and

ii) a temperature of 0-45 degree Celsius.

It shall have a membrane electrode with automatic temperatur compensation complete with a cable of not less than 25m in length. Sufficient stocks of spare electrodes and cable shal be maintained for replacement where necessary. (YSI model 5 meter, YSI 5739 probe, YSI 5795A submersible stirrer with reel and cable or similar approved)

(c) All monitoring instruments shall be checked, calibrated and certified by an accredited laboratory approved by the Engineer before use on the Works and subsequently re-calibrated at bi-monthl intervals throughout all stages of the water quality monitoring. Responses of sensors and electrodes should be checked with certified standard solutions before each use.

4.05 WATER QUALITY MONITORING

(a) The Contractor's appointed Consultant/Laboratory shall provic qualified technicians capable of operating the equipment.

(b) Water quality monitoring shall be undertaken at the followi Designated Monitoring Stations indicated below:

Designated Monitoring Station	Northing	Easting
1	816495	833950
2	816415	834080
3	816205	834355
4	816095	834525
5	816630	833920
6	816665	834195
7	816605	834435
8	816540	834625
9	816217	834600
10	816810	833620
11	816220	835135
12	816217	834765

Monitoring at Designated Monitoring Stations defined above can be shore or boat based as appropriate.

(c) Water Quality Monitoring shall be carried out in-situ and in accordance with the following :

(i) 'Baseline conditions for the various water quality parameters are to be established prior to the commencement of the marine works under the Contract. The Contractor shall establish the 'Baseline' conditions by measuring the following water quality parameters : turbidity, dissolved oxygen concentration (DO in mg/L), dissolved oxygen saturation (DOS in %), temperature and suspended solids at all Designated Monitoring Stations on 4 sampling days per week, at mid-flood and mid-ebb, for 4 consecutive weeks within 6 weeks of the commencement of the Works. All measurements of temperature, dissolved oxygen concentration, dissolved oxygen saturation and turbidity shall be carried out in situ at 3 water depths, namely, 1m below water surface, mid-water depth, and 1m above sea bed. Water samples for suspended solids analysis shall be taken at the same three depths.

(ii) During the course of the Works, monitoring shall be undertaken on three working days a week. Monitoring at each station shall be undertaken at both mid-ebb and mid-flood on the same day. The interval between sets of samplings on different days shall not be less than 36 hours. The values of turbidity, DO, DOS, temperature and suspended solids shal be determined in accordance with Clause 4.04(b). Two measurements at each depth of each station shall be taken. The probes must be retrieved out of water after the first measurement and then redeployed for the second measurement. Where the difference in value between the first and second readings of each set is more than 25% of the value of the first reading, the reading shall be discarded and further readings shall be taken. For the purpose of evaluating the water quality, all values shall be depth averaged.

(iii) Should the monitoring programme record levels of turbidity, suspended solids or dissolved oxygen which are, in the opinion of the Engineer, indicative of a deteriorating situation such that, in the opinion of the Engineer, closer monitoring is required, then the Engineer may direct that monitoring shall be undertaken daily at each Designated Monitoring Station until the recorded depth averaged values of these parameters indicate to the satisfaction of the Engineer an improving and acceptable level of water quality.

4.06 NOT USED

4.07 REPORTING OF MONITORING DATA

(a) The results of all Water Quality Monitoring shall be provided by the Contractor to the Engineer, in an agreed format, no later than 24 hours after the sampling.

(b) At monthly intervals at times to be agreed with the Engineer, the Contractor shall provide to the Engineer a summary report in both printed and magnetic media form, to an approved format, giving details of all water quality data obtained in that month. This will include a summary report of any repeat monitoring or remedial measures taken to maintain or improve the water quality.

(c) When any Station Result for Turbidity or suspended solids exceeds the Alarm or Action Levels (as defined in Clause 4.08), the Contractor will notify the Engineer within one hour of the result being known.

When in the opinion of the Engineer, monitoring indicates a significant deterioration in water quality, the Engineer shall instruct the Contractor to take action. The level of deterioration and the action to be taken will be based upon the Action Plan.

4.08 ACTION PLAN ON DETECTION OF A DETERIORATING WATER QUALITY

(a) Should the Station Result indicate a deterioration in water quality as evidenced by suspended solids levels or by increase in turbidity the following Action Plan should be followed.

(b) As indicated in Figure 1 below the Alarm Level concentration will be 70 mg/l suspended solids and 3 mg/l dissolved oxygen. The action Level concentration will be 140 mg/l suspended solids and 2 mg/l dissolved oxygen.

Figure 1 Action Plan for Suspended Solids

Station Result is Less Than 70 mg/l suspended solids and/or more than 3 mg/l dissolved oxygen	No Action Required
Station Result is Greater than 70 mg/l suspended solids and/or less than 3 mg/l dissolved oxygen (Alarm Level)	Contractor reviews working procedures and notifies Engineer.

Station Result is Greater than 140 mg/l suspended solids and/or less than 2 mg/l dissolved oxygen (Action Level)	1. Contractor takes immediate remedial action to reduce turbidity 2. Contractor notifies Engineer 3. Contractor increases monitoring frequency. Water sampling is repeated at all stations on following day to demonstrate efficacy of remedial measures.
Station Results is greater than 140 mg/l suspended solids and/or less than 2 mg/l dissolved oxygen on three consecutive day (Action Level)	If, in the opinion of the Engineer, the Contractor has not taken appropriate and effective measures to reduce turbidity, the Engineer may instruct the Contractor to take such measures as he considers necessary, and, if deemed necessary, may stop the Contractor from carrying out further dredging or reclamation works until acceptable proposals are received from the Contractor and put into practice.

4.09 GENERAL PROCEDURES FOR THE AVOIDANCE OF POLLUTION DURING DREDGING, TRANSPORTING, AND DUMPING

(a) All Contractor's Equipment shall be designed, maintained and used to minimise the risk of silt and other contaminants being released into the water column or deposited in other than designated locations.

(b) The Contractor shall take the following pollution avoidance measures which shall include but will not be limited to the following :

(i) mechanical grabs shall be designed and maintained and used to avoid spillage and shall seal tightly. While being lifted, closed grabs shall be used;

(ii) cutterheads of suction dredgers shall be suitable for the material being excavated and shall minimise overbreak and sedimentation around the cutter;

(iii) where trailing suction hopper dredgers are used for dredging of marine mud, overflow from the dredger, and the operation of loan mixture overboard systems, will not be permitted.

(iv) all Contractor's Equipment shall be sized such that adequate clearance is maintained between vessels and the sea bed at all states of the tide to ensure that undue Turbidity is not generated by turbulence from vessel movement or propellor wash;

(v) all pipe leakages are to be repaired promptly and Contractor's Equipment is not to be operated with leaking pipes;

(vi) the Works shall cause no visible foam, oil grease, scum, litter or other objectionable matter to be present on the water within the reclamation, marine borrow or dumping areas.

(vii) all barges and hopper dredgers shall be fitted with tight fitting seals to their bottom openings to prevent leakage of material;

oss of material takes place outside the marine dumping areas. The Contract scharge and will be required to submit his proposals for establishing and recording accurate positional control at disposal sites to the Engineer f approval before commencing dredging.

4.10 CONTAMINATED MARINE MUD

Where material to be dredged is designated as contaminated, the plan locations and depths of the contaminated marine mud will be indicat on the Drawings or directed by the Engineer on site. The Contract is to ensure that the contaminated marine mud is dredged, transported and placed in the Marine Dumping area designated for contaminated mud disposal in accordance with the provisions of Clause 4.09, Clause 4. and Appendix 9.

4.11 SPECIAL PROCEDURES FOR THE AVOIDANCE OF POLLUTION DURING DREDGING, TRANSPORTATION AND DISPOSAL OF CONTAMINATED MARINE MUD

When dredging, transporting and disposing of contaminated marine mu the Contractor shall implement additional special procedures for the avoidance of pollution which shall include but are not limited to the following:

(i) dredging of contaminated marine mud shall only be undertaken by a suitable grab dredger using a closed watertight grab;

(ii) transport of contaminated marine mud shall be by split barge of not less than 750 m^3 capacity; well maintained and capable of rapid opening and discharge at the disposal site;

(iii) discharge from split barges shall take place only within the area allocated for the disposal of contaminated marine mud; an

(iv) discharge shall be undertaken rapidly and the hoppers shall then immediately be closed; any material adhering to the sid of the hopper shall not be washed out of the hopper and t hopper shall remain closed until the barge next returns to the disposal site.

APPENDIX 5

ENVIRONMENTAL PROTECTION REQUIREMENTS

(S.A. Clause 1.06 and 1.26)

1. AVOIDANCE OF NUISANCE

(1) The Contractor shall conform with the Public Cleansing and Prevention of Nuisances By-Law 1972 and the Public Cleansing and Prevention of Nuisance (New Territories) Regulation 1972, as required in Clause 34 of the GCC.

(2) The Contractor shall be responsible for ensuring that no earth, rock or debris is deposited on public or private rights of way as a result of his operations, including any deposits arising from the movement of plant or vehicles. The Contractor shall provide a washpit or a wheel washing and/or vehicle cleaning facility at the exits from the Site whence excavated material is hauled, to the consent of the Engineer and to the requirements of the Commissioner of Police. Water in wheel washing facilities shall be changed at frequent intervals and sediments shall be removed regularly. The Contractor shall provide a hard surfaced road between the wheel washing facilities and any finished road.

(3) The Contractor shall at all times ensure that all existing stream courses and drains within, and adjacent to the Site are kept safe and free from any debris and any excavated materials arising from the Works. The Contractor shall ensure that chemicals and concrete agitator washings are not deposited in watercourses.

(4) All water and waste products arising on the Site shall be collected, removed from Site via a suitable and properly designed temporary drainage system and disposed of at a location and in a manner that will cause neither pollution nor nuisance. In addition, the effluents shall comply with the standards stated in the 'Technical Memorandum on Effluents Standards'.

(5) The Contractor shall construct, maintain, remove and reinstate as necessary temporary drainage works and take all other precautions necessary for the avoidance of damage by flooding and silt washed down from the Works. He shall also provide adequate precautions to ensure that no spoil or debris of any kind is allowed to be pushed, washed down, fall or be deposited on land or on the seabed adjacent to the Site.

(6) In the event of any spoil or debris from construction works being deposited on adjacent land or seabed or any silt washed down to any area, then all such spoil, debris or material and silt shall be immediately removed and the affected land or seabed and areas restored to their natural state by the Contractor to the satisfaction of the Engineer.

(7) No burning of construction wastes or vegetation shall be allowed on the Site.

(8) An adequate fire break shall be maintained between the site and areas outside of the Site.

AIR QUALITY

2. GENERAL REQUIREMENTS

(1) The Contractor shall install effective dust suppression measures as may be necessary to ensure that at the Site boundary and any nearby sensitive receiver the concentration of total suspended particulates shall not exceed those defined in the Hong Kong Air Quality Objectives or 0.5 milligrams per cubic metre whichever is the lesser at standard temperature (25° C) and pressure (1.0 bar) averaged over one hour.

(2) The Contractor shall not install any furnace, boiler or other similar plant or equipment using any fuel that may produce air pollutants without the prior written consent of the Director of Environmental Protection (DEP) pursuant to the Air Pollution Control Ordinance.

(3) The Contractor shall not burn debris or other materials on the Site.

(4) The Contractor shall implement dust suppression measures which shall include, but not be limited to the following:

(a) Stockpiles of sand and aggregate greater than 20 m^3 for use in concrete manufacture shall be enclosed on three sides, with walls extending above the pile and 2 metres beyond the front of the pile.

(b) Effective water sprays shall be used during the delivery and handling of all raw sand and aggregate, and other similar materials, when dust is likely to be created and to dampen all stored materials during dry and windy weather.

(c) Areas within the Site where there is a regular movement of vehicles shall have an approved hard surface and be kept clear of loose surface material.

(d) Conveyor belts shall be fitted with windboards, and conveyor transfer points and hopper discharge areas shall be enclosed to minimize dust emission. All conveyors carrying materials which have the potential to create dust, shall be totally enclosed and fitted with belt cleaners.

(e) Cement and other such fine grained materials delivered in bulk shall be stored in closed silos fitted with a high level alarm indicator. The high level alarm indicators shall be interlocked with the filling line such that in the event of the hopper approaching an overfull condition, an audible alarm will operate, and the pneumatic line to the filling tanker will close.

(f) All air vents on cement silos shall be fitted with suitable fabric filters provided with either shaking or pulse-air cleaning mechanisms.

(g) Weigh hoppers shall be vented to a suitable filter.

(h) The filter bags in the cement silo dust collector must be thoroughly shaken after cement is blown into the silo to ensure adequate dust collection for subsequent loading.

(j) The provision of adequate dust suppression plant including water bowsers with spray bars.

(k) Areas of reclamation shall be completed, including final compaction, as quickly as possible consistant with good practice to limit the creation of wind blown dust.

(l) Unless otherwise approved by the Engineer the Contractor shall restrict all motorized vehicles on the Site to a maximum speed of 15 km per hour and confine haulage and delivery vehicles to designated roadways inside the Site.

(m) The Contractor shall arrange his blasting techniques so as to minimise dust generation.

(5) At any concrete batching plant or crushing plant being operated on the Site the following additional conditions shall be complied with:

(a) The Contractor shall undertake at all times to prevent dust nuisance as a result of his activities. An air pollution control system shall be installed and shall be operated whenever the plant is in operation.

(b) Where dusty materials are being discharged to vehicles from a conveying system at a fixed transfer point, a three-sided roofed enclosure with a flexible curtain across the entry shall be provided. Exhaust fans shall be provided for this enclosure and vented to a suitable fabric filter system.

(c) Any vehicle with an open load carrying area used for moving potentially dust producing materials shall have properly fitting side and tail boards. Materials having the potential to create dust shall not be loaded to a level higher than the side and tail boards, and shall be covered by a clean tarpaulin in good condition. The tarpaulin shall be properly secured and shall extend at least 300 mm over the edges of the side and tail boards.

(d) The Contractor shall frequently clean and water the concrete batching plant and crushing plant sites and ancillary areas to minimize any dust emissions.

(e) Dry mix batching shall be carried out in a totally enclosed area with exhaust to suitable fabric filters.

3. OPERATING MINERAL WORKS (CRUSHING PLANTS) ON SITE

(1) Should the Contractor opt to operate Mineral Works (Crushing Plant) on Site with an annual output exceeding 5000 tonne, he shall be responsible for undertaking the necessary action to obtain the necessary licence under Section 14 of the Air Pollution Control Ordinance before operation and for complying with all statutory regulations. The Contractor shall apply for the licence at least 60 days prior to anticipated operation date and be responsible for payment of all Government fees connected with this operation.

(2) Emission of pollutants from the above operation shall be limited as stated in Table A.5.1.

Table A.5.1 : Air Quality Objectives for Air Control Zones

Pollutant	Concentration ($\mu g\ m^{-3}$) [i] Average Time				
	1 hour [ii]	8 hour [iii]	24 hour [iii]	3 month [iv]	1 year [iv]
Sulphur Dioxide	800		350		80
Total Suspended Particles			260		80
Respirable Suspended Particulates			180		55
Nitrogen Dioxide	300		150		80
Carbon Monoxide	30000	10000			
Photochemical Oxidant (as O_3)	240				
Lead				1.5	

[i] Measured at 298 K and 101.325 kPa.

[ii] Not to be exceeded more than 3 times per year.

[iii] Not to be exceeded more than once per year.

[iv] Arithmetic means.

4. DUST LEVELS - GENERAL

(1) The Contractor shall carry out the Works in such a manner as to minimize dust emissions during execution of the Works.

(2) The Engineer may require equipment intended to be used on the Works to be made available for inspection and approval to ensure that it is suitable for the project.

(3) The Contractor shall devise and arrange methods of working to minimize dust emissions, and shall provide experienced personnel with suitable training to ensure that these methods are implemented.

(4) Before the commencement of the Works, the Contractor shall submit to the Engineer the proposed methods of working.

(5) After commencement of the Works if the equipment or work methods are believed by the Engineer to be causing serious air pollution impacts, the equipment or work methods shall be inspected and remedial proposals shall be drawn up by the Contractor, consented to by the Engineer, and implemented. In developing these remedial measures, the Contractor will be expected to inspect and review all dust sources that may be contributing to the pollution impacts. Where such remedial measures include the use of additional or alternative equipment such equipment shall not be used on the Works until permitted by the Engineer. Where remedial measures include maintenance or modification of previously approved equipment such equipment shall not be used on the Works until such maintenance or modification is completed and the adequacy of the maintenance or modification is demonstrated to the satisfaction of the Engineer.

(6) If the Engineer finds that approved remedial measures are not being implemented and that serious impacts persist, he may direct the Contractor to cease related parts of the Works until the measures are implemented. No claims by the Contractor shall be entertained in connection with such a direction.

5. MONITORING OF DUST (TSP) LEVELS

(1) The Engineer will carry out dust impact monitoring throughout the construction period.

(2) The Contractor shall provide two high volume air samplers and associated equipment and shelters in accordance with Part 50 of Chapter 1 Appendix B of Title 40 of the Code of Federal Regulations of the USA within one week of the commencement of the Contract. The samplers, equipment and shelters shall be constructed so as to be transferable between monitoring stations.

(3) The Contractor shall construct suitable access, hardstanding and a galvanised wire fence and gate at each monitoring station in the following areas. Alternative locations may be necessary if difficulties arise in obtaining access, or if the locations become unsuitable:-

(a) Harbour View Street
(b) Pier Road near Harbour Building

The exact location and direction of the monitoring equipment at each monitoring station shall be agreed with the Engineer. Monitoring stations shall be free from local obstructions or sheltering.

(4) The dust (TSP) levels will be measured by the "High Volume Method for total suspended particulates" as described by the United States Environmental Protection Agency in 40 CFR. Part 50.

(5) The Engineer will carry out baseline monitoring prior to the commencement of the construction works to determine and agree with the Contractor ambient dust (TSP) levels at each specified monitoring station. The baseline monitoring will be carried out for a period of at least two weeks, with measurements to be taken every day at each monitoring station.

(6) Impact monitoring during the course of the Works will normally be undertaken at any one or more of the monitoring stations as determined by the Engineer at least once every six days.

(7) Should the impact monitoring record dust levels which are indicative of a deteriorating situation such that closer monitoring is reasonably indicated, then the Engineer may undertake daily impact monitoring at any one or more of the monitoring stations until the results indicate an improving and acceptable level of air quality.

6. ACTION ON CONSTRUCTION DUST (TSP) LEVELS

(1) Where the Engineer determines that the recorded dust (TSP) level is significantly greater than the levels established in the baseline survey, the Engineer may direct the Contractor to take effective measures including, but not limited to, reviewing dust sources and modifying working procedures.

(2) The Contractor shall inform the Engineer of all steps taken. Written reports and proposals for action shall be passed to the Engineer by the Contractor whenever the Engineer determines that air quality monitoring shows that the recorded dust (TSP) level is significantly greater than the levels established in the baseline survey.

7. NOISE CONTROL ON WORKS SITE

(1) The Contractor shall comply with the provisions of the Noise Control Ordinance 1988.

(2) All plant and equipment supplied by the Contractor for use on the Works shall be in good working condition without emission of excessive fume and shall be effectively "sound-reduced" by means of silencers, mufflers, acoustic linings or shields or acoustic sheds or screens to avoid disturbance to any nearby noise sensitive receivers. The measured sound levels during any 5-minute periods from 0700-1900 hours on any day not being a general holiday at 1 m from the closest external facade of the nearby noise sensitive receivers shall not exceed an equivalent sound level (L_{eq}) of 75 dB(A) otherwise the construction operations, if deemed by the Engineer to be causing the excess, shall be regarded as causing serious noise pollution impacts. In particular, hand-held breakers and portable compressors shall comply with the requirements laid down in the Noise Control (Hand Held Percussive Breakers) Regulations and Noise Control (Air Compressors) Regulations. Any works causing excessive noise may be prohibited when it is considered necessary by the Engineer or Engineer's Representative notwithstanding the above-mentioned noise level restriction.

(3) Provided that the provisions of this Clause shall not be applicable in the case of emergency work necessary for the saving of life or property or for the safety of the Works or in the case of blasting operations necessitated by urgency and permitted by the Engineer or Engineer's Representative.

(4) The Contractor shall provide four approved integrating sound level meters for the exclusive use of the Engineer's Representative at all times during the continuance of the Contract. Each meter shall comply with International Electrotechnical Commission Publication 651:1979 (Type 1) and 804:1985 (Type 1), and shall be maintained by the Contractor in proper working order throughout the Contract and shall be replaced if necessary when it is under repair.

(5) The Contractor shall carry out the Works in such a manner as to minimise noise impacts on the surrounding environment during execution of the Works.

(6) The Engineer may require equipment intended to be used on the Works to be made available for inspection and approval to ensure that it is suitable for the project in terms of operating noise levels.

(7) The Contractor shall devise and arrange methods of working to minimise noise impacts, and shall provide experienced personnel with suitable training to ensure that these methods are implemented.

(8) Before the commencement of the Works, the Contractor shall submit to the Engineer the proposed method of working.

(9) After commencement of the Works, if the equipment or work methods are believed by the Engineer to be causing serious noise pollution impacts, the equipment or work methods shall be inspected and remedial proposals drawn up by the Contractor, approved by the Engineer, and implemented. In developing these remedial measures, the Contractor will be expected to review all construction noise sources that may be contributing to the pollution impacts, and propose changes to scheduling of activities, installation of plant soundproofing, provision of alternative plant, erection of sound barriers around part of the site or the location of construction noise sources, or any other measures that may be effective in reducing noise. Where such remedial measures include the use of additional or alternative equipment, such equipment shall not be used on the Works until approved by the Engineer. Where remedial measures include maintenance or modification of previously approved equipment, such equipment shall not be used on the Works until such maintenance or modification is completed and the adequacy of the maintenance or modification is demonstrated to the satisfaction of the Engineer.

(10) If the Engineer finds that approved remedial measures are not being implemented and that serious impacts persist, he may direct the Contractor to cease related parts of the Works until the measures are implemented. No claims by the Contractor shall be entertained in connection with such a direction.

APPENDIX 9

METHOD SPECIFICATION FOR THE DISPOSAL OF DREDGED MUD

9.1 LOCATION OF DREDGED MATERIAL DISPOSAL SITE

(a) Uncontaminated dredged material may be dumped at either or both of P33 or P34 shown on the Drawings at the discretion of the Contractor. Placement of the material shall be carried out in accordance with Clause 9.3 below.

(b) All contaminated dredged material is to be placed in Area P35 shown on the Drawings. Placement of the material shall be carried out in accordance with Clause 9.3 below.

9.2 TRANSPORT OF DREDGED MATERIAL

(a) The dredged materials shall be transported to the disposal site in suitable well maintained vessels which do not permit any leakage or escape of material. Care shall be taken to ensure that the barges are loaded in such a manner that dredged material does not spill onto decks and exposed fittings. The barges shall be loaded to a level which ensures that no material will be lost by overflow during transit to the disposal area.

(b) When the dredged material has been unloaded at the disposal site, any material which has accumulated on the deck or other exposed parts of the vessel shall be removed and placed in the hold or hopper. Under no circumstances must the decks be washed clean in a way that would permit material to be released overboard. Hoppers and holds may not be flushed with water to remove any remaining material and must remain tightly closed at all times.

9.3 PLACEMENT OF DREDGED MATERIAL

The dredged material is to be placed in successive even layers not exceeding 3m thick, over the seabed commencing in the deepest part of the disposal area in such a manner that, when all of the material has been placed, the final surface of the placed material in each layer is horizontal and sensibly level.

9.4 CONTRACTOR TO MAINTAIN DETAILED RECORDS

(a) The Contractor shall maintain detailed daily records of the number of vessels transporting dredged material to the disposal site, including details of the vessels capacities, the approximate volumes of material transported, the vessels' registration numbers, and the location, time and duration of all disposal operations. The daily records shall be signed by the Engineer's Representative and submitted to the Engineer on the following day.

(b) Before sailing to the disposal area, each barge shall be photographed using a Polaroid camera (or similar approved) equipped with flash. The reverse of each photograph shall be annotated with the vessel registration number, the trip number and the date and time of departure from the dredging site. The photographs shall be signed and numbered by the Engineer's Representative before departure and shall be taken to the disposal site and handed to the Engineer's Representative on the disposal barge prior to the commencement of disposal operations.

9.5 CONTRACTOR'S METHOD STATEMENT

(a) The Contractor shall submit at least four weeks prior to the commencement of disposal operations to the Engineer for approval detailed drawings illustrating the equipment which he proposes to use to place the dredged material on the seabed in the disposal area together with a written method statement describing in detail the procedures to be adopted, and the area to be used.

9.6 SURVEYS

(a) Survey Equipment and Methods

(i) All survey work is to be carried out by the Independent Hydrographic Surveyor (IHS), approved by the Engineer (Refer S.A. Appx 27).

(ii) The IHS shall provide a dual frequency, survey-quality echo sounder capable of simultaneous operation at 210 and 30kHz (or similar approved frequencies) using narrow-beam transducers together with a suitable survey vessels, positioning systems and personnel to undertake bathymetric surveys in accordance with Clauses 9.6 (b), 9.6 (c) & 9.6 (d). The echo sounding system shall be capable of recording bathymetric data in digital form on computer storage media for later processing and as a hard copy for visual assessment.

(iii) At the commencement of each survey period, the echo sounder shall be calibrated at the survey location by means of a bar check and again at the end of each survey period. Calibration must be undertaken at intervals of no longer than 6 hours if the survey period exceeds this time.

(iv) All surveys shall be undertaken to the highest standards and only during periods when waves and swell do not affect record and data quality.

(v) The IHS shall install and maintain for the duration of the works or use an approved existing recording tide gauge at a location reasonably close to the disposal area. The level of the gauge shall be accurately referenced to Principal Datum and the records shall be used to reduce survey data to Principal Datum.

(vi) Surveys shall be undertaken by or under the direct supervision of a qualified hydrographic surveyor who shall be present at all times when surveying is in progress.

(b) Preliminary Survey of Disposal Area

(i) Prior to the commencement of disposal operations, the disposal area proposed in the Contractor's method statement shall be surveyed to determine the existing bathymetry.

(ii) The survey shall be undertaken along north-south lines and orthogonal (east-west) lines run at 30 metre spacing. No disposal operations will be permitted until the results of the survey have been submitted to the Engineer.

(c) Interim Surveys

After placing each 20,000 m^3 of dredged material and in any event at intervals of no more than 2 weeks during dredging periods, the IHS shall undertake an interim bathymetric survey of the disposal area along the same lines and using the same equipment as the preliminary survey.

(d) Completion Survey

On completion of disposal operations, the IHS shall undertake a bathymetric survey of the disposal area along the same lines and using the same equipment as the preliminary survey.

(e) Presentation of Survey Results

(i) The results of the surveys shall be submitted to the Engineer together with detailed calculations of the volume of material represented by the difference of seabed level between two successive surveys where applicable.

(ii) Seabed levels are to be plotted relative to Hong Kong Principal Datum at a scale of 1:2,000 for both the high frequency and low frequency observations. The Contractor shall provide the Engineer with two copies of the survey data in digital form on appropriate computer data storage media to be agreed with the Engineer.

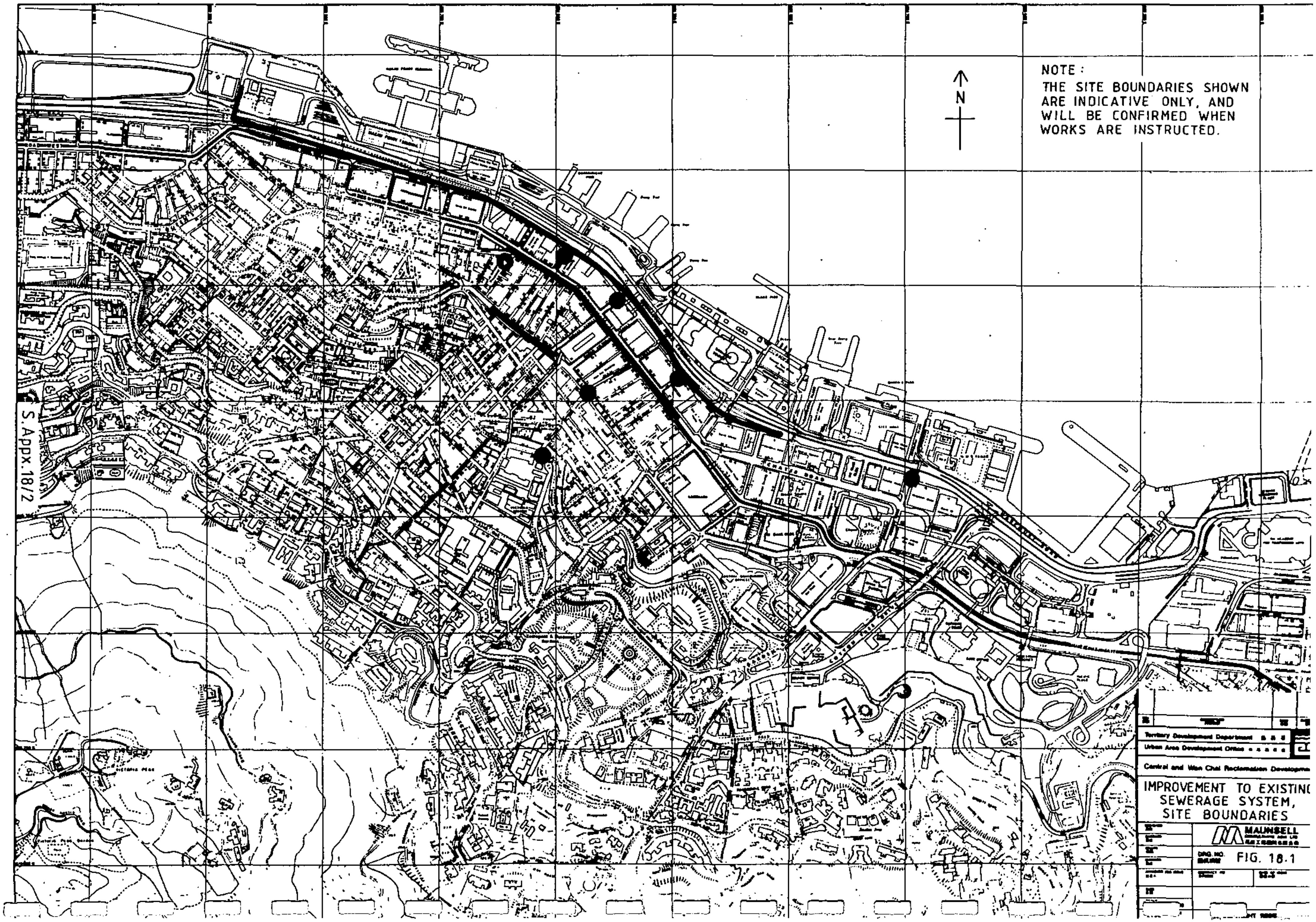
(iii) The volume calculations are to be undertaken for both the high and low frequency echo sounder returns.

APPENDIX 18

IMPROVEMENTS TO EXISTING SEWERAGE SYSTEM

(S.A. Clause 1.112)

The site boundaries for improvement works to the existing sewerage system which may be instructed under the contract are shown indicatively in page S.Appx.18/2. The boundaries will be better defined when the works are instructed.


NOTE:
THE SITE BOUNDARIES SHOWN ARE INDICATIVE ONLY, AND WILL BE CONFIRMED WHEN WORKS ARE INSTRUCTED.
N
Territory Development Department
Urban Area Development Office
Central and Wan Chai Reclamation Development
IMPROVEMENT TO EXISTING SEWERAGE SYSTEM, SITE BOUNDARIES
MAUNSELL
FIG. 18.1

APPENDIX 26

ENGINEERING CONDITIONS FOR MARINE BORROW AREAS AND MARINE DUMPING AREAS

PREAMBLE

1. The Employer has agreed to certain Engineering Conditions for allocation of marine borrow areas and marine dumping area to the Project Client (referred to in the Engineering Conditions as PM/UA) the details of which are included in this Appendix. The Contractor acknowledges that he has, prior to executing the Contract, read and understood these Engineering Conditions.

2. For the purposes of this Contract, all references to Fill Management Committee and to FMC shall be deemed to be references to the Engineer and all references to the Allocatee shall be deemed to be references to the Contractor.

3. Without prejudice to its obligations contained elsewhere in the Contract, the Contractor shall observe and perform the obligations on the part of the Allocatee contained in the Engineering Conditions and shall indemnify and keep indemnified the Employer against all claims, damages, losses and expenses arising out of or resulting from any breach thereof caused by the Contractor's failure to observe the said Engineering Conditions or any negligence in the observance or performance thereof.

FILL MANAGEMENT COMMITTEE STANDARD ALLOCATION CONDITIONS FOR MARINE BORROW AREAS AND MUD DISPOSAL SITES

SURRENDER CONDITIONS

1. Not used.

2. In the event of any subsequent significant reduction in the quantities of sand required to be extracted from the allocated borrow area as a result of :

   (a) any change in scope or reclamation design of the Works, or

   (b) the partial utilisation of fill sources,

   the FMC reserves the right to de-allocate all or part of the allocated borrow area, so that fill resources that are surplus to stated requirements can be re-allocated.

3. The borrow area shall be available for the exclusive use of the Contractor up to the end of the allocation period or up to substantial completion of the reclamation, as certified by the Engineer whichever is sooner. Subsequent working within the borrow area may be allowed on a non-exclusive basis, with the prior consent of, and for a period to be determined by, the FMC Secretary.

FILL EXTRACTION CONDITIONS

4. The fill material extracted from within the borrow area shall only be used for the purpose for which it is allocated.

5. For areas where marine traffic will be affected, a works programme and navigational arrangements shall be agreed with the Director of Marine before dredging works commence (Annex 1).

MUD DISPOSAL CONDITIONS

6. The dumping of surplus mud shall be strictly within the designated marine disposal site(s) and carried out in accordance with the requirements of the Director of Environmental Protection (Annex 2). The dumping of mud in

these areas shall be controlled through a separate licence, to be issued by the Director of Environmental Protection, who may at any time during the contract, with reasonable notice, reduce the areas available for dumping within the designated marine disposal site(s). No surplus mud from the reclamation site shall be disposed of within the borrow area(s) without the prior approval of the FMC.

7. All mud dumped within the designated marine disposal site(s) shall be uncontaminated, prior confirmation in writing of which shall be obtained from the Director of Environmental Protection.

SURVEYS REQUIRED

8. Bathymetric surveys shall be carried out over the borrow area(s) and the designated marine disposal site(s) at the following times during the allocation period:

- before the commencement of dredging in borrow area(s) or mud dumping in the designated marine disposal site(s).("base-line survey").

- after completion of dredging in the borrow area(s) or mud dumping within the designated marine disposal sites ("final survey").

- at three-monthly intervals from the commencement of dredging or mud disposal works until completion of such works ("intermediate surveys").

The bathymetric surveys shall be carried out over the entire extent of the borrow area(s) and the marine disposal site(s) with depth soundings of the sea-bed to be continuously recorded on a line spacing no wider than 25m for the base-line and final surveys and on a line spacing no wider than 50m for the intermediate surveys. You shall forward separate copies, both on paper and on computer disk, of all these surveys to the Director of Marine, the Director of Civil Engineering Department and the FMC Secretary. The survey method used shall be approved by the Director of Civil Engineering Department before commencement of the base-line survey. Additional surveys may be required by the Director of Marine at more frequent intervals over all or part of the borrow area(s) and marine disposal site(s) for navigation purposes (Annex 1).

OTHER CONDITIONS

9. The dredging operations shall be carried out in such a manner as to minimise any adverse effect on water quality at the borrow area(s), in waters adjoining the sites and on transport routes. A comprehensive water quality monitoring programme shall be submitted to the Director of Environmental Protection for his approval before the commencement of any dredging works (Annex 2).

10. The Contractor shall fully co-operate with Government officers to allow access to dredgers and other craft for the purpose of sampling dredged material and for the inspection of samples and other appropriate monitoring and control information. The Contractor shall make available to the FMC, at any time upon the written request by the Secretary of the FMC, all information and records relevant to the dredging and mud disposal operation. This information shall include, but not be limited to, all data on the plant used by the Contractor and up-to-date periodic data on production rates etc.

ANNEXES

1. Marine Department - General Conditions for Dredging and Backfilling at Marine Borrow Area.

2. Environmental Protection Department - Mud Disposal Conditions and Water Quality Monitoring Requirements.

ANNEX 1

Marine Department

General Conditions for Dredging and Backfilling at Marine Borrow Area

(1) The Contractor shall provide the Director of Marine with detailed plans showing the proposed works area(s), a working schedule, and a full description of the method of dredging and backfilling, including the number and type of craft to be employed, at least one month in advance of the commencement date of the work. No marine work shall be commenced without the written approval of the Director of Marine.

(2) The Contractor shall carry out the Works in all respects in conformity with all conditions which may be imposed by, and to the entire satisfaction of the Director of Marine.

(3) The Contractor shall ensure that the works of excavation and backfilling of the seabed shall be planned and carried out in the closest liaison with the Vessel Traffic Centre so that any interruption to marine traffic passing through the works area shall be reduced to a minimum.

(4) The Contractor, his agents, workmen and sub-contractors shall observe and carry out any directions given by the Director of Marine in connection with the control and safety of marine traffic in the vicinity of the works area.

(5) Marker buoys shall be positioned at or adjacent to the works area(s) in accordance with the requirements of and to the satisfaction of the Director of Marine.

(6) All working craft shall carry appropriate signals to indicate the nature of their work.

(7) The Director of Marine shall have the right to require all working to cease and all working craft to be removed whenever he deems it necessary.

(8) The Contractor shall provide all reasonable facilities for representatives of the Director of Marine to be present during the work and shall take such precautions as such representatives may recommend to avoid any damage to the property of the Government of Hong Kong which in the opinion of such representatives are likely to arise as a result thereof.

(9) The Contractor shall institute a system of monitoring, using either suitably qualified supervisors and/or appropriate instrumentation, to ensure that all surplus material is dumped only in the designated areas.

(10) All materials are to be dumped in uniform layers over the designated areas such that no high spots are formed.

(11) Not used.

(12) Continuous communications shall be established by the working craft on a dedicated frequency

with the Vessel Traffic Centre of the Marine Department. A listening watch shall be maintained by the working craft at all times so that instructions can be given to vacate the works area at short notice.

(13) The Contractor shall ensure that the Contractor nominates a responsible person or persons on site to be in overall control of all his marine craft movements. Such person or persons shall closely liaise with the Vessel Traffic Centre, Hong Kong Pilots Association and other operators that the Director of Marine may specify to ensure that the working craft will not cause obstruction to the passage of other large vessels through the works areas.

(14) Backfilling of the borrow area and restoration of seabed levels are not required.

(15) The Contractor shall carry out regular sounding surveys at the works areas and submit the survey plans to the Director of Marine as follows :

(i) a base-line survey before the commencement of dredging or backfilling;

(ii) intermediate surveys at 3-monthly intervals from the date of commencement of dredging or backfilling until completion of the Works;

(iii) When dredging or backfilling works are carried out in or adjacent to the navigation channels, the Contractor shall submit monthly detailed up-to-date sounding plans of the affected area to the Director of Marine; and

(iv) a final survey within two weeks upon completion of all operations within the works areas.

(16) The Contractor shall be responsible for the placement, removal and/or relocation of navigation buoys at suitable positions to mark the navigation channel as and when required by the Director of Marine. Upon completion of all dredging and backfilling operations within the works areas, the Contractor shall ensure that all navigation buoys are replaced in their original positions unless agreed otherwise by Marine Department.

ANNEX 2

Environmental Protection Department

Mud Disposal Conditions and Water Quality Monitoring Requirements

A. Mud Disposal Conditions

The Contractor shall:

1. Not used.

2. Dump the marine mud within the designated area (hereinafter called the designated dump site). The onus will be on the Contractor to properly locate and fix the boundaries of the dumping area to ensure that the mud is dumped at the correct location.

3. Dump material in uniform layer over the dumping area under the agreed schedule such that no high spots are formed.

4. Provide a programme for the work and frequency of the dumping operation on a monthly basis. The Contractor shall provide a return showing the number of barge loads and the estimated quantity of dumped material at the dumping site within one week after the completion of dumping.

5. Carry out a final sounding survey on completion of the operations.

B. Water Quality Monitoring Requirements

B.1 Water Quality Monitoring Equipment

The Contractor shall provide the following equipment :-

(a) Dissolved oxygen and temperature measuring equipment

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

i) a dissolved oxygen level in the range of 0-20 mg/L and 0-200% saturation; and

ii) a temperature of 0-45 degree Celsius.

It shall have a membrane electrode with automatic temperature compensation complete with a cable of not less than 30 m in length. Sufficient stocks of spare electrodes and cable shall be maintained for replacement where necessary. (YSI model 58 meter. YSI 5739 probe, YSI 5695A submersible stirrer with reel and cable or similar approved)

(b) Turbidity Measurement Instrument

Turbidity within the water shall be measured by the nephelometric method. The instrument shall be a portable, weatherproof turbidity-measuring instrument complete with sensor and comprehensive operation manuals. The equipment shall be operable from a DC power source. It shall have a photoelectric sensor capable of measuring turbidity between 0-1000 NTU. (Partech Turbidimeter Model 7000 3RP Mark 2 or similar approved)

(c) Water Depth Detector

A portable. battery- operated Echo Sounder shall be used for the determination of water depth at each Designated Monitoring Station. This unit can either be handheld or affixed to the bottom of the work boat if the same vessel is to be used throughout the monitoring programme. (Seafarer 700 or similar approved)

(d) All monitoring instruments shall be checked, calibrated and certified by an approved accredited laboratory before use on the Works and subsequently re-calibrated at 3-month intervals throughout all stages of the water quality monitoring. Responses of sensors and electrodes should be checked with certified standard solutions before each use. The turbidity meter shall be calibrated to establish the relationship between turbidity readings (in NTU) and levels of suspended solids (in mg/L).

B.2 Water Quality Monitoring

The Contractor shall provide approved qualified technicians, capable of operating the monitoring equipment, together with a suitable work boat for carrying out the monitoring.

Monitoring shall be carried in accordance with the following :

(a) 'Baseline' condition for the various water quality parameters are to be established prior to the commencement of the dumping or dredging operation. The Contractor shall establish the 'Baseline' conditions by measuring the following water quality parameters, viz. turbidity, dissolved oxygen concentration (DO in mg/L) and dissolved oxygen saturation (DOS in %) at all Designated Monitoring Stations, on 4 sampling days per week, at mid-flood and mid-ebb, for 1 week prior to the commencement of the operation. All measurements shall be taken in-situ and at 3 water depths, namely, 1 m below water surface, mid-water depth, and 1 m above sea bed.

(b) During the course of the operation, monitoring shall be undertaken two days a week. Monitoring at each Designated Monitoring Station shall be undertaken on a working day. The interval between each series (mid-ebb and mid-flood) of samplings shall not be less than 36 hours. The values of turbidity, DO and DOS shall be determined. Two measurements at each depth of each Station shall be taken. Where the difference in value between the first and second reading of each set is more than 25% of the value of the first reading the readings shall be discarded and further readings shall be taken.

(c) Should the monitoring programme record levels of turbidity, or dissolved oxygen levels which are indicative of a deteriorating situation such that, in the opinion of DEP, closer monitoring is required, then DEP may direct that monitoring shall be undertaken daily at each Designated Monitoring Station until the recorded values of these parameters indicate to the satisfaction of DEP an improving and acceptable level of Water Quality.

B.3 Reporting of Data

(a) The Contractor shall submit the results of all monitoring to DEP at the end of each month. At any third exceedance of target limits, the Contractor shall report to DEP within 48 hours. The Contractor shall also provide a summary of any specific activities recently undertaken which may affect the water quality parameters, and any remedial measures deemed necessary as a result of non-compliance.

(b) If, in the opinion of DEP, the Contractor has not taken appropriate and effective measures to reduce the water quality impacts, DEP may instruct the Contractor to take such measures as he considers necessary to improve the water quality.

B.4 Target Limits

For each monitoring station the initial target limit for Turbidity shall be 30% above the average reading obtained for each station at the 'Baseline' Stage. As for dissolved oxygen, the target limit should be 2 mg/l within 2 metres of the seabed and 4 mg/l for the remaining water column.

B.5 Avoidance of Water Pollution

(a) All operating plant shall be properly designed and carefully maintained so as to minimise the risk of sediments or other pollutants being released into the water column and deposited in the seabed other than designated locations.

(b) The Contractor shall design methods of working to minimise pollution and shall provide experienced personnel and provide suitable training to ensure that these methods are implemented.

(c) Pollution avoidance measures shall include the following :

- All vessels shall be sized such that adequate clearance is maintained between the seabed and vessels at all states of the tide, to ensure that undue turbidity is not generated by turbulence from vessel movement or propeller wash.

- The Contractor's work shall cause no visible foam, oil, grease, scum, litter or other objectionable matter to be present in the water within the Site.

- Adequate freeboard shall be maintained on barges to ensure that decks are not washed by wave action.

- Any other pollution avoidance measures deemed suitable and appropriate by the Contractor.

SPECIAL ALLOCATION CONDITIONS FOR MARINE BORROW AREAS AND MUD DISPOSAL SITES CONTRACT NO. UA 11/91 CENTRAL RECLAMATION, PHASE 1 - ENGINEERING WORKS

In addition to the FMC Standard Allocation Conditions for Marine Borrow Areas and Mud Disposal Sites, the special conditions are listed below:

Water Quality Monitoring at Marine Borrow Areas

1. Water quality monitoring at marine borrow areas shall be in accordance with the water quality requirements as specified in Annex 2 of the FMC Standard Allocation Conditions for Marine Borrow Areas and Mud Disposal Sites.

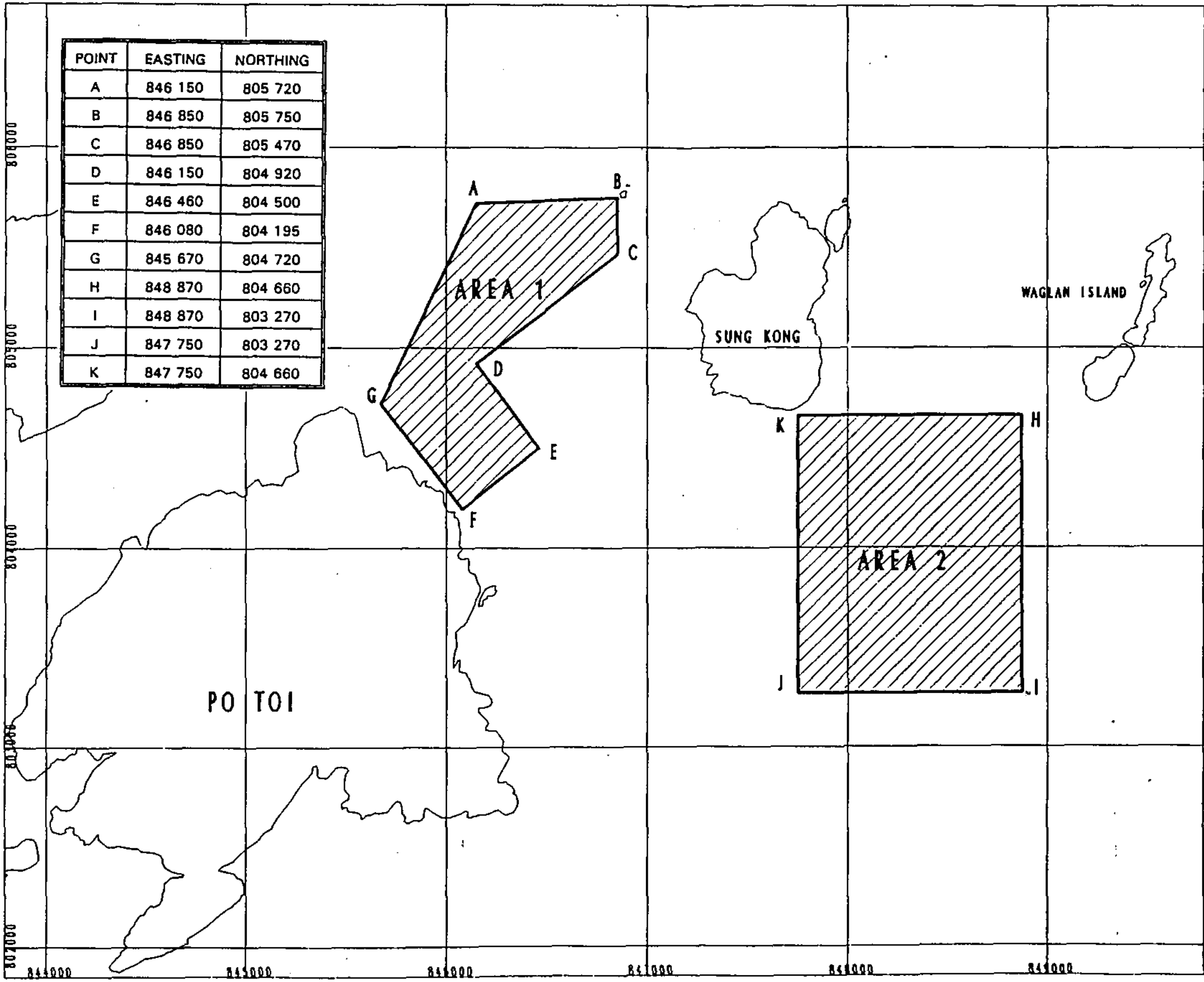
2. Water quality monitoring shall be required at eight locations, five in the general area of the borrow areas and three in the vicinity of Cape D'Aguilar. The precise locations will need to be agreed with EPD prior to the commencement of fill extraction works.

3. The Contractor shall be required to amend or cease dredging in the event that turbidity levels at Cape D'Aguilar exceed that level specified in Clause B4 of Annex 2 of the FMC Standard Allocation Conditions for Marine Borrow Areas and Mud Disposal Sites.

Water Quality Monitoring at Uncontaminated Mud Disposal Sites

4. No water quality monitoring shall be required for uncontaminated mud disposal sites.

POINT	EASTING	NORTHING
A	846 150	805 720
B	846 850	805 750
C	846 850	805 470
D	846 150	804 920
E	846 460	804 500
F	846 080	804 195
G	845 670	804 720
H	848 870	804 660
I	848 870	803 270
J	847 750	803 270
K	847 750	804 660



TITLE
EAST PO TOI BORROW AREA
ALLOCATION
FOR CENTRAL RECLAMATION
PHASE 1 - ENGINEERING WORKS

DATE 03-JAN-1992

FILE NO.

COMPILED BY
N W Woods

DRAWN BY
W.C. Yeung

DRAWING NO.
FMC/70

SCALE
1: 20000

OFFICE
Planning Division
Geotechnical Engineering Office

Civil Engineering Department
Hong Kong

Conditions for Disposal of Contaminated Mud

- The Contractor shall be permitted to use the disposal pit on a non-exclusive basis only, and shall be prepared to temporarily delay dumping operations if other users are positioned to dump at the same time.

- The mud shall be placed in the pit by bottom dumping, at a location within the pit to be specified, from time to time, by Secretary FMC/ENPO consultant,

- The contractor shall ensure that all barges/dredges shall be stationary throughout the dumping operation and the flushing of the hopper.

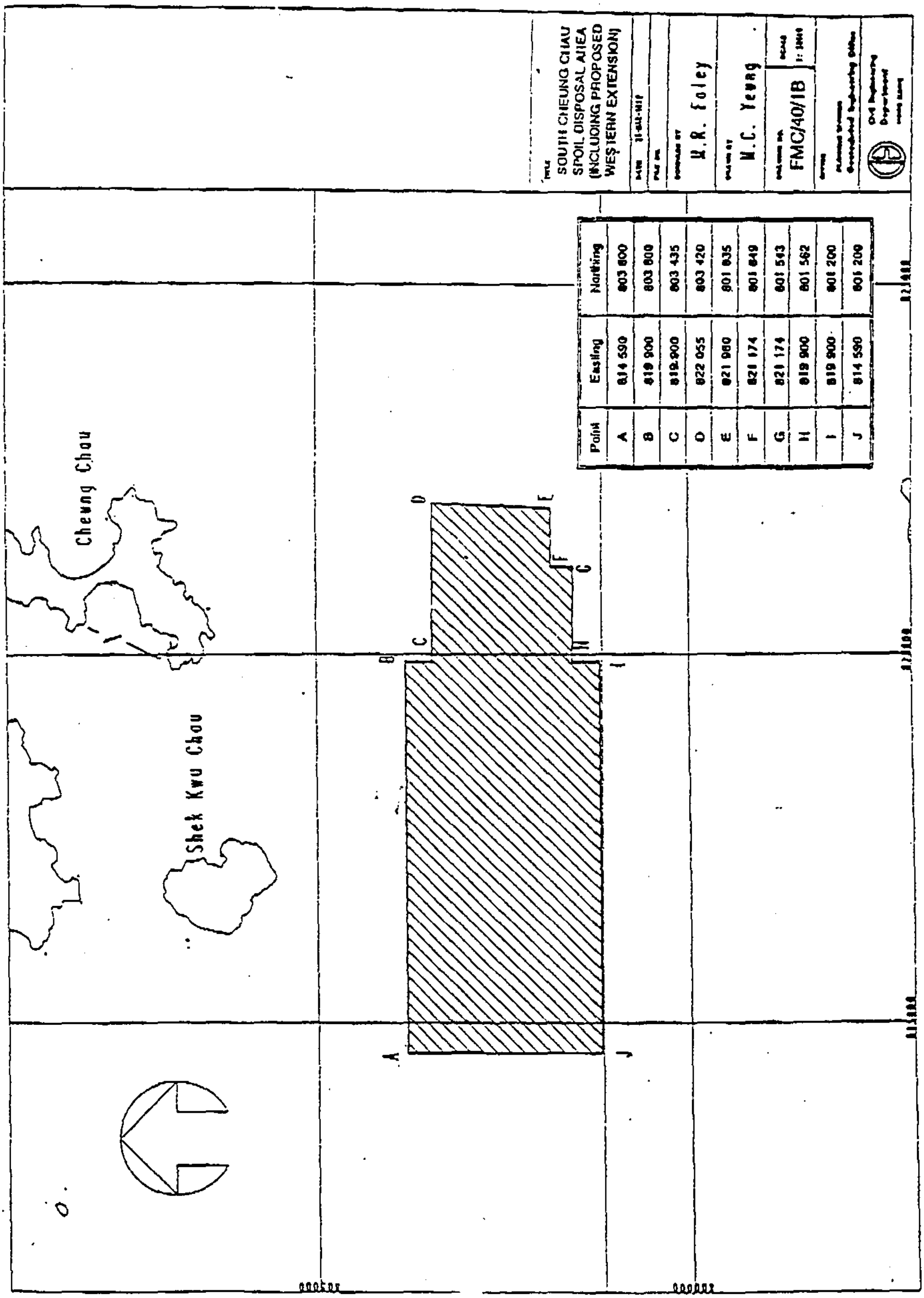
- The Contractor must be able to position the dumping vessel to an accuracy of +/- 5m,

- The Engineer for the Contract which is disposing of the contaminated mud will supervise and record the disposal operation, details of the supervision and record keeping to be agreed beforehand by the Director of Environmental Protection.

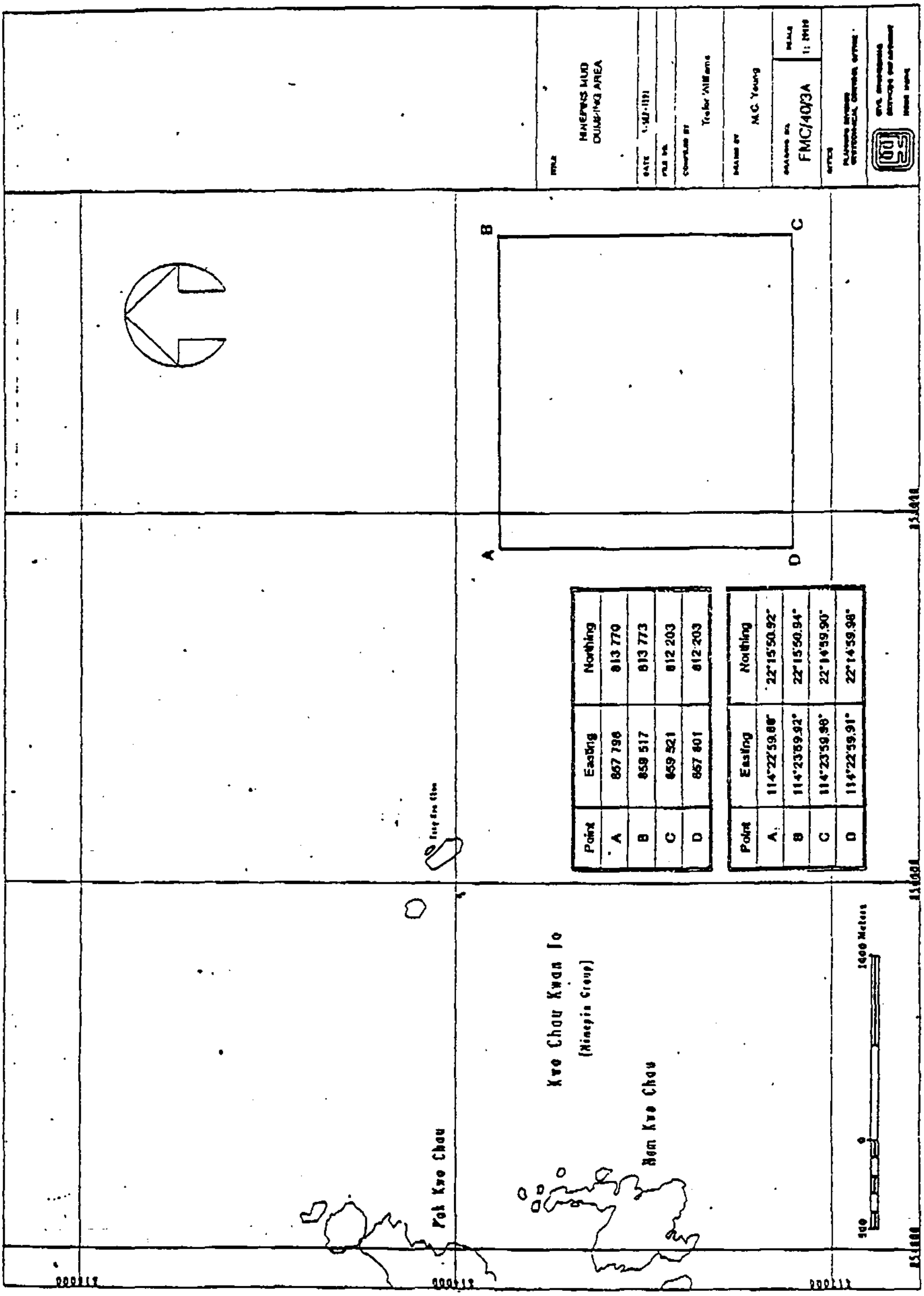
- The Contractor shall carry out regular bathymetric surveys of the pit for disposal of contaminated mud together with the surrounding area as and when required by Secretary of FMC.

- The location of the contaminated mud disposal site at East Sha Chau as shown in Drg. No. FMC/68A is approximate only. The exact location shall be determined on site by Secretary of FMC.

- No water quality monitoring is required for the East Sha Chau contaminated mud disposal site.



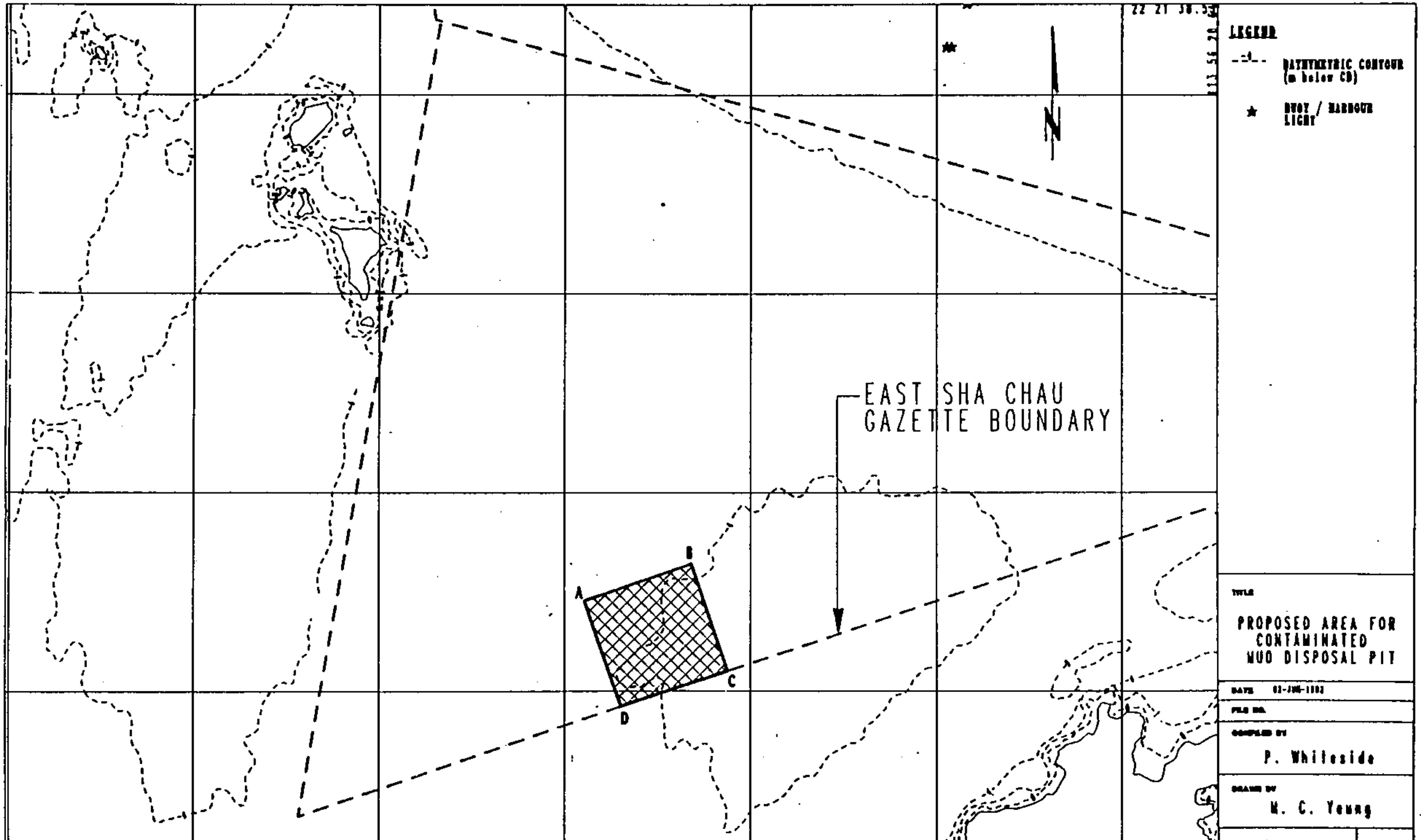
Point	Easting	Northing
A	814 590	803 800
B	819 900	803 800
C	819 900	803 435
D	822 055	803 420
E	821 980	801 835
F	821 174	801 849
G	821 174	801 543
H	819 900	801 562
I	819 900	801 200
J	814 590	801 200



Point	Easting	Northing
A	857 798	813 770
B	859 517	813 773
C	859 521	812 203
D	857 801	812 203

Point	Easting	Northing
A	114°22'59.88"	22°15'50.92"
B	114°23'59.92"	22°15'50.94"
C	114°23'59.98"	22°14'59.90"
D	114°22'59.91"	22°14'59.98"

S.Appx. 26/16



POINT	EASTING	NORTHING
A	113°54'04.19"	22°19'38.42"
B	113°54'27.24"	22°19'45.78"
C	[illegible]°54'[illegible]	2[illegible]4.24[illegible]

Addendum No. 3
Specification - Appendices
Appendix 26

MASS TRANSIT RAILWAY CORPORATION
CONTRACT NO. UA11/91
CENTRAL RECLAMATION, PHASE I - ENGINEERING WORKS

CONFIDENTIAL

QUESTION AND ANSWER

Q/1191/ /001

Date : 11.9.92

Tenderer's Name : B, D, F

Subject : Environmental Protection Clauses

Question : It is intended to instruct changes to the Specification clauses listed below to that shown on the attached sheets. Please confirm that there will be no programme implications and advise what financial implications will result. The clauses to be amended are:

S.Appx.4.04(b)(i), (c)
4.05(b), (c)(ii)
4.08(b)
4.10
S.Appx.5 clause 5(6), 7(2)
S.Appx.26 clause 2 (Water Quality Monitoring at Marine Borrow Areas)

Answer : Date :

Effect on Price :

Effect on Programme :

Leave Blank - MTRC use only Date :

(The relevant changes are shown in the previous part of this Appendix and are indicated by underlining)

MASS TRANSIT RAILWAY CORPORATION

CONTRACT NO. UA11/91

CENTRAL RECLAMATION, PHASE I - ENGINEERING WORKS

CONFIDENTIAL

QUESTION AND ANSWER

Q/1191/ /001

Date : 15.9.1992

Tenderer's Name : B, D, F

Subject : Marine Dumping
Self Monitoring Equipment

Question : Installation and operation of equipment described on the attachments will be a requirement of the marine dumping licence. Please confirm that you have allowed for this in your tender rates.

Answer : Date :

Effect on Price :

Effect on Programme :

Leave Blank - MTRC use only Date :

PERFORMANCE SPECIFICATION OF THE AUTOMATIC MONITORING SYSTEM FOR THE MARINE DUMPING OPERATION

The open-gate barges and split-bottom barges have a nominal capacity of about 1000 to 1300 tonnes. Their sizes are approximately 60 m (length) x 12 m (width) x 4.5 m (vertical height from deck). The change of draught between full load and empty load is around 2 to 2.5 metres.

The automatic self-monitoring system as illustrated in Fig 1 comprises the following components :-

- marine positioning receiver
- draught sensor or equivalent sensing device
- data capture unit and data logger
- interface unit and interface box
- data recorder
- 24V or 12V DC battery with necessary charging system

The operational principles of the system are mainly associated with the marine positioning receiver (MPR) and draught sensor. The receiver (MPR) employs a global positioning system (GPS) which receives satellite signals to continuously fix the position in latitude and longitude with a typical accuracy within 50 metres. The draught sensor or equivalent sensing device monitors the draught of the vessels (i.e. vertical movement w.r.t. water level) at selected interval with an accuracy better than 5% of the draught variation (i.e. within plus or minus 5 cm in the case of 2 metre variation in draught measurement). Since the barge is subject to wave and sea swell in open sea, the draught sensor device must be capable to average its measurement within a preset time interval (say 5 to 60 seconds) and the calculated data will be recorded in the data capture unit.

The marine positioning receiver (MPR) installed on board a barge would automatically feed the barge location, date and time via an interface unit (if necessary) to a data logger and/or data recorder. Any change in the draught of the barge would also be picked up by the draught sensor or equivalent sensing device and fed to the data logger and/or data recorder via the interface unit (if necessary). The data logger or the data capture unit should be capable to store the necessary information in ASCII code which may be downloaded through RS232 port to a IBM - compatible computer. Alternatively, a data recorder can be employed and the storage medium is a 3.5 inch floppy disk from which data can be retrieved for display on a video plotter. The video plotter or PC at EPD's office should display the track of the concerned barge together with other data on a high resolution colour monitor display. The display should allow the user to examine either the trips over a particular period or all the recorded trips. The recording interval is preferably set at 10, 15 or 20 minutes in order to allow over 1-month data storage without the need to replace the cartridge or disk. The data stored by the data recorder and the cartridge would allow EPD to readily check where and when each dumping operation is carried out, and hence any short dumping incident can be spotted.

The technical specifications of the system components are summarised in Appendix A. All the hardware equipment, cabling and associated fittings have to meet the protection standard for the marine environment. Each self-monitoring system should have its own identification number enabling EPD to differentiate individual barge. The recorded data cannot be transferred from one barge to the other. Any tampering or disconnection of the system will be self-detected and recorded as appropriate.

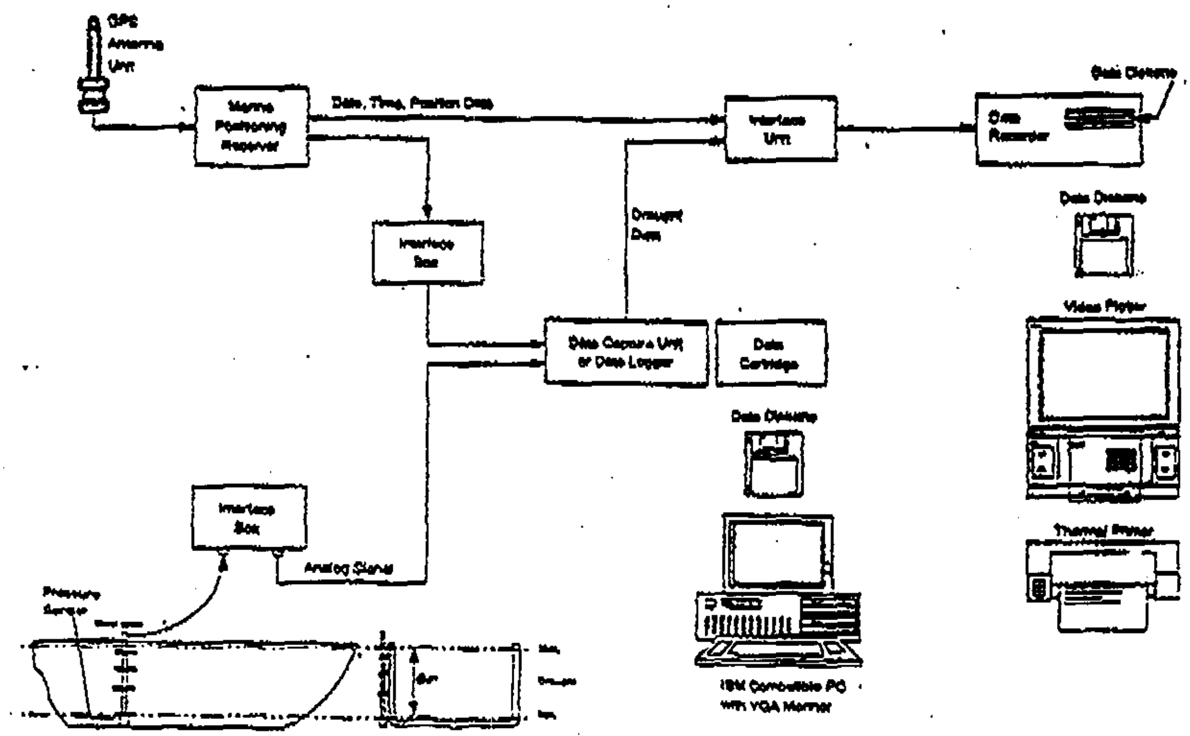
INSTALLATION REQUIREMENT

The marine positioning receiver together with the data logger and other accessories have to be mounted in a secure enclosure with Plexiglass window to allow visual examination. The GPS antenna will be mounted on the roof of the cabin with unrestricted view. The draught sensor or equivalent sensing device will be fitted into a steel pipe and installed at the back of or alongside each barge. AC power source may not be available on board the barge and the 24 V or 12 V dc battery is required for continuous operation of the device. Batteries and auxilliary power generation equipment such as solar power cells or battery charging device may be employed to ensure continuous operation without attention for at least 2 months.

DATA MANAGEMENT & REQUIREMENT

The performance requirements are summarised in Appendix B.

Fig. 1 Schematic Diagram of the Self-monitoring System for Marine Dumping Barges



Technical Specifications of the Self-monitoring system for marine dumping operation

(I) Marine Positioning Receiver

- Receiver characteristics
  - Receiving channel : at least 2 channels
  - Position accuracy : better than 50m rms
- Display/processor characteristics
  - Display : LCD
  - Date/Time : date, hour, minute, second in GMT or local
  - Data update interval : every second
  - Data output : NMEA 0183 or other format compatible with the recording device
- Power supply
  - 10 to 40 V DC, 110/220 VAC
- Environmental conditions
  - Ambient temperature : 0°C to +45°C
  - Humidity : 95% at 40°C
  - Protection : Splash proof

(II) Draught Sensor

Range of measurement	: 0-5 metre in marine water
Zero adjustment	: plus or minus 10% of span
Accuracy	: plus or minus 5 cm
Output signal	: 4-20 mA dc
Power supply	: 10-30 V dc
Operating temperature	: 0°C to +40°C
Operating environment	: harsh and saline condition, fully protected in marine water

(III) Data Capture Unit and Data Cartridge

Memory	: internal RAM or removeable data cartridge
Data format	: ASCII - code interface with IBM compatible computer
Back-up battery	: built in to retain the data in all circumstances
Protection	:: IP-65 and shock proof

(IV) Data Recorder

Function	: Record picture and logger data from navigational equipment
Equipment interfaced	: Colour video plotter
Data storage medium	: 3.5 inch floppy disk
Recording interval	: 5, 10, 15, 20, 30 minutes or any other time interval
Power supply	: 10-40 V dc
Operating temperature	: 0°C to +45°C
Protection	: IP - 65

No. PL-2A as at 8.6.92

AUTOMATIC SELF-MONITORING SYSTEM FOR BARGES

Performance requirements of data management & presentation

1. The information to be stored in the recording device (eg. data logger, data capture unit, or data recorder + data cartridge) for regular retrieval by authorised EPD personnel includes :

   Identification number of the vessel
   Position of the vessel (both latitude & longitude)
   Date and time of each position record
   Draught reading of the vessel

2. Any data stored in the recording device should be in ASCII code to facilitate downloading to an IBM-compatible computer for further data processing, listing or plotting.

3. The software is an essential component of the automatic self-monitoring system such that :

   - o the vessel movement has to be displayed graphically on a digitised map of the territorial waters of Hong Kong;
   - o the three designated spoil grounds at South of Cheung Chau, East of Nine Pins, and Mirs Bay should be delineated on the map;
   - o the draught reading corresponding to each vessel position has to be displayed on the screen as a function of time;
   - o the graphical display has to be shown on a VGA monitor or a video plotter. The screen shall automatically change to keep the vessel movement of a particular trip in view as the vessel transits through different mapping area or grid;
   - o a particular mapping area or grid can be zoomed in and out through the keyboard to view the concerned area in details;
   - o the trackline associated with vessel movements over a specified period of time can be reviewed on the screen;
   - o sudden change in the draught of the vessel between the recording intervals outside the designated spoil grounds has to be highlighted automatically to facilitate quick review by EPD. The highlights (or warning symbols or signs) can either be shown in the graphical displays or the data printouts;
   - o hard copy of the graphical displays can be obtained from a printer.

Appendix 4 Comments and Responses

Comments and Responses

1.	TDD, UADO	(64) in UAH 2/4/101
2.	DSD	( ) in 15/1/II XIII
3.	EPD	(30) in EP2/H/4/071 IV
4.	EPD	(31) in EP2/H4/071 IV
5.	MD	(9) in PA/S/ 492/41 (38)
6.	EPD	( ) in 2/H4/07

Central Reclamation, Phase I - Engineering Works - Focused Environmental Impact Assessment Study

Territory Development Department
Urban Area Development Office (ref: (64) in UAH 2/4/101)

	Comments:	**Responses:**
1	General Comments	
1.1	A chapter for summarised findings and recommendations should be included.	Noted. This will be included in the Final Report.
1.2	The result of the model for the completed reclamation has not been included in the report. Referring to the telecon (Dr T Rudd/David Lo) on 29.8.92, this result will be presented to the meeting on 3.9.92 at EPD's office.	Noted. The draft report on modelling the completed reclamation was presented to the meeting on 3.9.92 at EPD's offices.
2	Detailed Comments	
2.1	The estimated quantity of marine sand required for the Central Reclamation contract is 3.1 million cu.m. However, 2.2 million cu.m. (0.9 + 1.2 million cu.m) is shown in Page 2.2 of item 2.1.3 (a). Please check and clarify.	The figure should read 0.9 + 2.2 = 3.1. Text will be amended.
2.2	4.65 mPD shown in Fig 2.6 should be - 4.65 mPD and should be the bottom level of the base slab of the cooling water pumping station.	This should read -4.65 mPD. Text will be amended.
2.3	The outfall of Culvert F shown in Fig 2.9 should be diverted to the east of the eastern reclamation bund at the intermediate construction stage (see Fig 2.10).	Noted. Figure will be amended.
2.4	Please clarify which improvements stated in Section 2.2 were adopted for simulation of scenarios (ii) & (iii) in item 3.1.3.	For scenario (ii) the stormwater outfalls from catchments B and F were diverted outside the embayed area. This is the completion of Stage 1 of the contract. In addition the cooling water discharges from Harbour Building, Wing On Centre, St George Building, Exchange Square, Landmark, Jardine House and the General Post Office were all diverted outside the embayed area. No mitigation measures were included in this scenario.

		For scenario (iii) the stormwater and cooling water outfalls were as in scenario (ii). The mitigation measures included were as specified in Section 2.2.3 (e) for catchment F and Section 2.2.3 (f) for catchment J1. The measures were the removal of cross connections and relaying of hydraulically inadequate sewer sections in catchments F and J1.
2.5	The concentration of ammoniacal nitrogen 14 mg/l for most of the tide shown in 1st para of p3.5, item 3.1.4 (b) seems very high compared with the range of 0.11 - 0.14 mg/l shown. Please check and clarify.	Typographical error; 14 mg/l should read 0.14 mg/l. Text will be amended.
2.6	The reclamation will be formed between the years 1992 and 1996, not between 1992 and 1998 as shown in p3.11, item 3.3.2.	Noted. Text will be amended.
2.7	Please check and clarify will MTRC regarding the completion date for the Hong Kong station and tunnel works as shown in p3.15, item 3.4.3.	MTRC has confirmed that their target completion and opening dates for the station and tunnels is mid-1997. The station contract is expected to start in November 1994. Text will be amended.
2.8	For clarify, please use the same numbering system for noise sensitive receivers shown in Fig 3.24 with Table 3.14.	The noise sensitive receivers are the same in Table 3.14 and Figure 3.24. NSRs 1 to 4, as they are given in Table 3.14, appear as triangles marked 1 to 4 on Figure 3.24. Air quality assessment points are also shown on this Figure.
3	<u>Typing Errors</u>	
3.1	Page 1, Contents : "Executive Summary" to be deleted.	Noted. Text will be amended.
3.2	Page 2.1, item 2.1.1, 2nd para, line 6 : delete "the" after "provided".	Noted. Text will be amended.
3.3	Page 2.2, item 2.1.3 (c), 1st para, line 3 : "concreted to" should be "concrete to".	Noted. Text will be amended.
3.4	Page 2.2, item 2.1.3 (c), 3rd para, line 3 : "ad" should be "and".	Noted. Text will be amended.
3.5	Page 2.3, item 2.1.3 (h), 2nd para, line 2 : "remained" should be "remainder".	Noted. Text will be amended.
3.6	Page 2.4, item 2.1.3 (k), 2nd para, line 2 : "Ths" should be "This".	Noted. Text will be amended.
3.7	Page 2.4, item 2.2.1, 2nd para, line 7 : "As" should be "An".	Noted. Text will be amended.
3.8	Page 2.5, item 2.2.1, 1st para, line 1 : "purpose" should be "purposely".	Noted. Text will be amended.
3.9	Page 2.5, item 2.2.1, 2nd para, line 3 : "Band" should be "B and".	Noted. Text will be amended.
3.10	Page 3.7, item 3.1.6, 2nd para, line 1 : "Figure 3.1" should be "Figure 3.22."	Noted. Text will be amended.

3.11	Page 3.8, item 3.2.1, 2nd para, line 2 : "cane" should be "care".	Noted. Text will be amended.
3.12	Page 3.9, item 3.2.3, 2nd para, line 1 : "Figure 3.2" should be "Figure 3.23".	Noted. Text will be amended.
3.13	Page 3.9, item 3.2.4, 1st para, line 5 : "Figure 3.1" should be "Figure 3.23".	Noted. Text will be amended.
3.14	Page 3.12, item 3.34, 1st para, line 2 : "Figure 3.3" should be Figure 3.24".	Noted. Text will be amended.
3.15	Page 3.18, item 3.4.4, 1st para, line 1 : "Figure 3.3" should be "Figure 3.24".	Noted. Text will be amended.

Drainage Services Department (ref: 15/1/11 XIII)

Comments:	**Responses:**
(a) <u>General Comments</u>	
(i) The Report states in para 2.2.1 that the major sources of pollution are cross-connections and overflows from the foul sewers to the stormwater drains and that these connections and overflows were purpose built by Government in order to relieve hydraulic inadequacies in the sewerage system. The Report implies that, by such simple, quick and cheap measures as lowering pump start electrodes and desilting a trunk sewer, then pollution would be reduced by 45% because high-level overflows would not operate due to lower sewage levels and that by removing nine known cross-connections a further reduction of 30% would be achieved. This would give a total reduction of pollution of 75% in the drains entering the embayment area however I regret that I am unable to support this view.	The sources of pollution and estimates of pollution reduction were based upon the findings of the Central Western and Wan Chai West Sewerage Master Plan (SMP). This study completed a fabric survey and water quality sampling in November 1990.

(ii) As there has not been a detailed and comprehensive on-site survey of the Central catchment, any assessment of pollution sources is a matter of opinion rather than fact. As above, the consultants' opinion is that 75% results from overflows and known cross-connections from the sewers to the stormwater drains. In my opinion the major portion of pollution is more likely to be from a multitude of small diameter mis-connections within buildings, in private sewers in rear lanes and throughout the system. I have no evidence to suggest the existance of an extensive system of purpose built high-level overflows which are at present discharging 45% of the pollution load into the stormwater drains due to high sewage levels in the sewers. With regard to the nine "Known" connections suggested by the consultants: one is an interconnection between two sewers to balance the flows; one has not existed for some time; three are blocked off with permanently closed penstocks and plates (although two may have minor leakage); one is a broken sewer pipe crossing through a stormwater culvert however it is in a catchment outside the study area and evidence of the existance of one cannot be found. The remaining two are small diameter foul sewers which have broken pipes at crossings through stormwater culverts. These nine "known" connections are therefore responsible for only a small proportion of the overall pollution of the storm drains and the 30% figure cannot be supported.

The assessment of pollution sources is only an estimate based upon a judgement of the condition of the system. It was a fact that about half of the sewage generated within the Central area in November 1990 did not reach the screening plant. How this sewage got into the stormwater system is not, however, precisely known.

EPD has just recently commissioned the SMP consultants to do an extension study. Its purpose is to conduct a detailed on-site survey of the Central stormwater catchments to determine the source of the pollution and design of mitigation measures. This study will comprise manhole inspections, water sampling, and CCTV works.

Responses to the specific comments are given in section (b) below.

(iii) The Report also proposes to relay certain undercapacity sewers in order to lower the level of surcharging in adjacent pipes and therefore reduce the pollution load entering the storm system. Again, this presupposes that there is an extensive system of high level overflows which are operating at present and I have no evidence to support this view. Although I would not question the need to increase the capacity of these sewers I would doubt that this measure, by itself, would result in an automatic reduction in pollution.

The SMP study found that the flow hydrograph (in November 1990) at the Central Screening Plant was affected by sea water suggesting that cross-connections within storm system are present.

For the hydrograph to be so affected by seawater indicates a considerable number of connections within the Central Sewage system. Only a few of these connections are detailed but others must exist. Therefore improving the capacity of the sewers will lower the hydraulic grade line and should therefore reduce overflows into the storm system through these connections.

(iv) Of the measures which the Report proposes be implemented immediately, the following are possible:

<u>Lowering of electrodes at Central Screening Plant</u>

Although not agreeing that this will have any measurable effect in reducing pollution, the electrode levels will be lowered by the end of September 1992.

Responses to the comments are given in section (b) below.

Desilting the trunk sewer along Connaught Road Central

This sewer has been and will continue to be desilted as part of an on-going preventive maintenance programme. The sewer was last desilted in June 1992 and will be inspected and, if necessary, desilted in September 1992. The level of silt will continue to be monitored and, if necessary, silt will be removed on a 3 to 4 monthly basis.

Removal of known cross-connections

The minor leaks in the penstock and plate blocking off two connections can be repaired. Measures are already in hand to repair one of the broken sewers passing through a storm culvert. Works should be complete by end December 1992. The other broken pipe within the catchment is located at the Queens Road Central/Pedder Street junction and traffic problems would have a significant influence on repair works. If sewer relaying is undertaken in this area perhaps the repairs should be undertaken at that time.

(b) Detailed Comments on Report Sections

(i)	2.1.3 (f), final para: only the sewers along Jubilee Street will be upgraded, therefore delete "Gilman Street and".	Noted.
(ii)	2.2.1, 3rd para: as the General Comments, I have no evidence to support the view that there is at present in operation an extensive system of purpose built cross-connections and overflows. Of the nine stated by the connsultant as "known", only three exist as purpose built connections and these are permanently closed off with penstocks or a plate. The two sentences from "These cross-connections ..." to "... diversion of all the flow." should be deleted.	The comments were based upon the findings of the SMP. The draft phase 1 report, Volume 1 details expedient connections in their study area. In addition the flow hydrograph at the Central Screening plant does not show a peaked flow suggesting that sea water is entering the foul sewer system via cross connections from the surface water drains during high tide. This condition can only be caused by an extensive system of cross-connections.
(iii)	2.2.1, 6th para, final sentence: replace "expedient connection" by "high-level overflow". This cross-connection between the sewer and storm drain is 1.50m above the 300mm dia. sewer.	Noted.
(iv)	2.2.1, 7th para: replace "300mm diameter expedient connection" by "225mm diameter broken sewer pipe discharging to a storm drain".	Noted.

(v) 2.2.3 (a): As the above General Comments, I am not able to support the view that lowering the electrodes will be effective in reducing pollution. However, apart from a possible slight increase in electricity consumption it is unlikely to have any adverse effect on the operation of the screening plant and the measure will be put into effect by end September 1992.

This measure was based upon the SMP draft phase 1 report, Volume 1 section 4.5.

A temporary lowering of the electrodes by 300mm was observed to double the volume of grit removed.

(vi) 2.2.3 (b): The trunk sewer is not at present "heavily silted" and as the General Comments I have no evidence to suggest that there are numerous overflows at present discharging into the storm system due to high sewage levels. I therefore cannot support the view on pollution reduction expressed in this paragraph. However I wold confirm that there is and will continue to be an on-going preventive maintenance programme to monitor silt levels and to desilt as necessary.

The silt levels in the Connaught Road trunk sewer were based upon the SMP fabric survey reports. This survey was conducted in November 1990 and measured silt levels of over 200mm and up to 350mm in places.

(vii) 2.2.3 (d), 2nd and 3rd paras: There are not three known "expedient" connections discharging sewage into the storm catchment CD. As (iv) above, there is a 225mm dia broken sewer pipe at the Hollywood Road/Cochrane Street (not Pottinger Street) junction and this will shortly be repaired. The two cross-connections mentioned at Gilman Street and Jubilee Street are blocked off by penstocks which are kept permanently closed. The Gilman Street penstock has minor leaks and requires repair, however at the time of inspection it was stormwater leaking into the foul sewer rather than the other way round. Although repair of the Hollywood Road sewer will reduce the pollution I would doubt that it would make any significant difference to the overall pollution loading in catchment CD.

The broken sewer pipe at Hollywood Road/ Cochrane Street was discovered during the Hillside Escalator works and will be rectified shortly. This was discussed in the last paragraph of section 2.2.1. The SMP fabric survey found on overflow on the corner of Hollywood Road and Pottinger Street.

The overflows in Gilman Street and Jubilee Street were based on DSD record drawings which now appear to be out-dated; reference to these will be removed from the text.

(viii) 2.2.3 (d), paras 4 and 5: I would not question the need to relay these sewers but would doubt that this measure would automatically result in any reduction of pollution.

Relaying and upgrading sewers improves the hydraulic capacity, lowers the hydraulic grade line and therefore reduces the overflows to the storm system. It is impossible to quantify with certainty the effect this will have on reducing pollution until a detailed assessment is made, but some improvement must ensue.

The SMP study did however conclude that four "black spot" resewering works could remove 37% of the pollution loading in four catchments.

(ix)	2.2.3 (e), paras 1 and 2: There are not four known "expedient" connections discharging sewage into the storm system. The 225mm dia pipe at Queens Road Central/Pottinger Street connects two foul sewers in order to balance the flows. The Douglas Street/Connaught Road Central pipe was removed some years ago. I have no evidence to confirm the existance of a connection at QRC/Ice House Street. The only place where it is known that sewage is discharging is at QRC/Pedder Street. This is a broken pipe on a 225 dia sewer where it crosses through a storm culvert. Repairs would probably involve excavating at this busy road junction and this requires further consideration. It is doubted however that the repair of this pipe would result in any significant reduction in the pollution loading in catchment F.	Reference to the overflow in Queens Road Central/Pottinger Street and Douglas Street/ Connaught Road C was based on SMP findings and will be deleted from the text. The connection at QRC Ice House Street was discovered by the SMP fabric survey.
(x)	2.2.3 (e), paras 3 and 4: The need for sewer relaying is not questioned however, again it is doubted that there would be any automatic reduction in pollution.	Refer response to comment viii)
(xi)	2.2.3 (f), paras 2 and 3: The "expedient" connection at Murray Road/CRC is blocked off by a steel plate. This plate has minor leaks which will be repaired. The Cotton Tree Drive/CRC connection is not in catchment J1. Pollution reduction in J1 will therefore be only by repairing minor leaks at the steel plate and the reduction is unlikely to be significant.	The SMP fabric survey observed in November 1990 that the connection was in operation and that the sewer flow was bypassed into the culvert. If since this time the connection has been blocked then the pollution loading has been considerably lowered to that assumed in the EIA report.
(xii)	2.2.3 (f), paras 4 and 5: Relaying of the Harcourt Road sewer is fully supported however I have no reason to believe that this will automatically result in pollution reduction in catchment J1.	Refer response to comment viii)
(xiii)	2.2.3 (g), 1st para: 1st sentence replace "which can be made to the stormwater culvert." by "which have been considered." 3rd sentence replace "If correctly implemented..." by "If practical to implement ...".	Noted.
(xiv)	Table 2.2: This Table has not included the Jubilee Street sewer reconstruction which will effect Catchment D. (see section 2.2.1). As above comments, I am unable to support the figures given for % reduction in pollution or for the estimated costs of the "immediate" works.	The catchment D works have not been included in the table as these were assumed to be completed prior to reclamation works.

(xv) 3.1.5: As above comments, I could not support the pollution load reduction figures given in this section.	The pollution load figures are estimates based upon the findings of the SMP study. The draft phase 1 report, Volume 1, section 8 details interim measures and the likely BOD reductions which can result. These guidelines were followed for the measures recommended in the EIA. EPD has commissioned consultants to prepare a detailed assessment of the stormwater catchments affected by the reclamation and the results should be known in November 1992.

Environmental Protection Department (ref: (30) in EP2/H4/071V)

Comments:	**Responses:**
(a) <u>Drainage</u>	
(i) Section 2.2.3 (c) - Stormwater Catchment B	
We have pointed out previously that there will still be adverse impacts on the water quality adjacent to the embayment area after the diversion of the outfall. This issue was not adequately addressed in this report. Given the close proximity of the bund to the HK-Macau Ferry Terminal, it is doubtful whether there will be flushing similar to the existing condition. It seems that further extension of the outfall will be necessary. It is also apparent that the proposed outfall diversion is permanent, the water quality problems will therefore persist until full implementation of the recommendations in the Central, Western and Wan Chai West Sewerage Master Plan Study (SMP).	The modelling results do not suggest that water quality will deteriorate significantly in this area.
(ii) Section 2.2.3	
Would the Consultants advise the source of information concerning the location and types of expedient connection ?	As stated on p2-6, section 2.2.3, para 3, the source of the information detailing the expedient connections was DSD record drawings (1:500 series) and the fabric survey conducted in November 1990 for the SMP.
(iii) Section 2.2.1 - penultimate paragraph	
Would the Consultants please justify the 50% reduction in pollution (BOD loading) from storm culvert D.	The reduction in pollution loading was based upon the SMP, phase 1 report, Volume 1, section 8. This section identified an interim measure in Jubilee Street (storm culvert D) which has a high BOD.

(iv) Section 3.1.4 (b) - Water Quality Effects

Would the Consultants advise why no modelling stations are set up near the east of the western reclamation bund to predict the effect on water quality arising from the sewage discharge from culverts C and D ? These discharges would have a significant water quality impact before they are extended out of the embayment area.

The effects of the discharge from culverts C and D are shown by the contour plots (see Figures 3.19-21 in the main report and Figures A2.1-A2.30 in the annex). It was expected that the worst conditions would occur in the eastern end of the embayment, hence the modelling station was sited to the east. It should be pointed out that all of the area shown is modelled; the modelling sations only provide the added information of time history plots.

(v) Appendix 18 - Improvements to Existing Sewerage System

Would the Consultants clarify why the sewer up-grading works for storm catchments C & D are not shown ?

These are shown in the Figure included in specification Appendix 18.

(b) Water Quality

Our Water Policy Group has detailed concerns that require more time for review. It is intended that comments on water quality will be forwarded to you by noon of 2.9.92.

Noted.

(c) Marine Mud

(i) Section 3.2.3

Figures 3.2 and 3.1 referred to in Sections 3.2.3 and 3.2.4 respectively should both be Figure 3.2.3.

Noted. Text will be amended.

(ii) Section 3.2.4

It seems to imply that all marine mud which is classified as contaminated be totally dredged and disposed of at designated sites. Please note that consideration should be given to leaving the material in site subject to satisfactory provisions for testing and/or treatment if necessary.

Noted. The marine mud will be left *in situ* where this will not affect the integrity of the reclamation.

(c) Section 2.2, last paragraph

Throughout the whole communication process with the reclamation consultants or TDD, they are fully aware that the proposed extended work under CW3 only covers catchments C and D. They have been claiming that by diverting drains at B and F, the degree of water circulation should be similar before and after the two bunds. It is only when the Draft Report was issued that they claimed the only area to be looked at should be around catchment F from their model which is not accepted by WPG. As such, only the works mentioned in (v) are included in the scope of the extension study of CW3, NOT (iv). The latter should be included in the reclamation job itself.

It is appreciated that only catchments C and D are presently included in the scope of the CW3 extension study. It is a recommendation of this study, however, that catchments F and J1 are also included, even though the funding for these may come from elsewhere. It was not proposed that implementation of the works in catchments F and J1 should be carried out under the SMP extension study, only that investigation of the effectiveness of such works should be included. The text has been revised to clarify this point.

(d) Paragraph 13

It should be noted that the mitigation measures at catchments F and J1 are only programmed to be complete around 1997. Again the last sentence "... similar work on catchment F should follow" implies that it will be under CW3 which is wrong. This must be pointed out.

This comment appears to relate to EPD's Draft EPCOM paper rather than the Executive Summary, and it is not therefore for the consultants to respond.

(e) General

I know the urgency of the project but unless it has been decided that it is a departmental line to accept the proposed works even though there is no evidence (and confusion as stated in (a) above) that they would work, I cannot accept the Executive Summary.

This comment appears to relate to EPD's Draft EPCOM paper rather than the Executive Summary, and it is not therefore for the consultants to respond.

Environmental Protection Department
ref ( ) in 2/H4/07

Comments:		**Responses:**
1	In Figs 3.19 to 3.21 (the modelling results), the red spots indicate the discharge points. However, there is no trace of outfalls F, G, H & I. Even with the consultant's explanation of sucking-in action by cooling water intake, why did the new outfall location of F (which is not far from the original F location) still show a red spot in Fig A.12 in Appendix A? Moreover, with similar loadings for A, H and I, red spots similar to A should be shown for H and I if the loadings were included in the model.	Appearance of a "hotspot" on the contour diagrams is influenced by the cooling water intake and discharge arrangements. These change between the partial and complete reclamation, in that all cooling water is discharged outside the reclamation after its completion, with a large discharge of 5523 l/sec being discharged near culvert F. This is thought to be responsible for the hotspot at F for the full reclamation scenario. Outfalls H and I discharge close to a relatively large intake and discharge of 1120 l/sec whereas the discharge near outfall A is only 510 l/sec.
2	If the modelling results were based on the more stringent measures (i.e. 60% reduction loading), there seems to be no reason to relax the standard to 30% reduction as stated in the recommended in item 3.1.5 (a).	The relative benefit of implementing a 60% load reduction as opposed to a 30% load reduction in culvert J1 has to be weighed against the disbenefit of implementing the sewer regrading, which would itself cause considerable disruption and impact. It was considered that in view of the relatively minor improvement predicted in water quality resulting from the 60% load reduction as compared to the "no mitigation" case, (the only significant benefit being a reduction in *E. coli* at Station C from 6 x 10^4 to 4 x 10^4/100 ml) the benefits associated with the sewer regrading were not worthwhile. These works were not therefore recommended. Remediation of known cross connections was recommended and remains a recommendation after further consultation with DSD. The Consultants response to EPD's previous comment (3) on Section 3.1.5 (a) refers. We would be grateful if EPD would advise on the acceptability of the approach proposed in the last para of that response.

3	We do not accept the consultants' reply to our queries on Appendix 1, 4 para and Annex : P.2, 6th para. The small difference quoted in their reply contradicts our previous modelling results for the Metroplan Study, in which the same modelling sub-consultant was involved.	The estimated percentage change in flow was based on the results of previous modelling exercises HWR have undertaken. HWR's fax to EPD ref HWR/P/49 dated 13 July refers. HWR were not involved in the Metroplan Study, which we understand was an internal study carried out by Government. Boundary conditions were discussed at length with EPD before the modelling for this study commenced, and subsequent to these discussions, EPD raised no objection to the modelling proceeding. CES fax to EPD ref 95060/F5757 dated 15 July refers (see attached). As indicated in the previous discussions on boundary conditions with EPD, and in the Consultants responses to EPD's previous comment (3), on the basis of the data available to us it is considered that the boundary conditions used were sufficiently accurate to evaluate local water movements and local dispersion of stormwater discharges around the reclamation bunds.
4	The consultants' response to WPG's query no. 13 contains no evidence to support their explanation of upwelling from the lower layer. There is explanation of why the case only applies to ammonia, and not to other parameters as well.	Fig A.7 in Appendix A showed quite clearly that at position D, E & F, the tidal averaged concentrations of ammonia at the bed layer were above 0.1 mg/l while at the surface, they were less than 0.1 mg/l. With the water getting shallower towards the shore, the higher concentrations indicated by the contour plots were quite obviously due to upwelling. This is not observed for BOD, oxidised nitrogen and *E. coli* because the difference in concentrations between the surface and bottom were much smaller.
5	In the meeting held earlier this month, the consultants were asked whether they had regenerated the boundary in the big WAHMO in order to take into account the extra loading diverted from the embayment through mitigation measures. No reply has been given. The impact should be quantified.	Using BOD loading as the indicator, the total load diverted from the model area was about 2.0 tonne/day. The general water quality in Victoria Harbour is determined by the sewage loads discharged from the main outfalls. The loadings from Central, Wanchai West and East, Northwest Kowloon, Kowloon South, Kowloon East, Kwun Tong and North Point outfalls were about 227.0 tonne/day, so the diverted load represented less than 1% of the total loading that determined that boundary conditions for the local model. It was therefore considered unnecessary to regenerate the boundary conditions to cater for the diverted loading.
6	Concerning sections 2.1.3 (f) and 2.2.1 lines 16-18: the improved works along Gilman Street and Jubilee Street are still not given (the scope is more extensive than the interim measures proposed under the Central SMP which covers only Jubilee Street). Information obtained from DSD shows that works will only be carried out in Jubilee Street, not in Gilman Street. Will the latter works be undertaken by DSD for completion by end 92	The reference to improvement works in Gilman Street is incorrect and will be revised in the text. The scope is similar to that proposed by the SMP.

7	Regarding section 2.2.1 (penultimate para); the SMP Phase I Report never mentioned that there would be a 50% reduction in pollution. The consultants should justify the estimated reduction.	The SMP draft phase 1 report actually mentions a possible 100% reduction in BOD (Table 8.2 of the SMP report refers). This was considered too high and revised to 50% after discussions with the SMP consultants. It should be noted that no load reduction was assumed for catchment D in the modelled scenarios.

Environmental Protection Department (ref: (31) in EP2/H4/071V)

Comments:

(a) Modelling Requirements/Scenarios

(1) Appendix 1, 6th para

The brief specifies that the scenarios during construction and on completion of the Phase 1 (Stage 1) reclamation shall be modelled. Why only 1 scenario (completion of the Stage 1 reclamation) has been modelled ?

Responses:

As advised verbally to EAPG prior to submission of the Draft Report, the additional flow and water quality modelling required to simulate effects of the completed Phase 1 reclamation could not be completed within the tight timescale of the project and were thus tabled in draft form at the meeting on 3 September.

Comments:

(2) 3.1.3 - p3-3 of Main Report and Section 2 of Annex Report

The main report specifies three modelling scenarios which are different from the modelling scenarios in the HR report. The 3 scenarios stated in the main report are:

existing conditions (I interpret this to be the basecase condition of 1996 as agreed in previous meetings between the consultants and EPD).

reclamation bunds with load reduction due to storm diversions and other measures.

Responses:

There is no discrepancy between the two descriptions; they describe different aspects of the modelled scenarios. The main report describes the infrastructure differences between the scenarios, while the annex, which covers the modelling procedures and results in more detail, describes the model input parameters and assumptions on pollution loads etc. These descriptions will be amalgamated in the Final report for clarity, as follows;

(1) Existing Conditions Scenario. Tidal flows were based on boundary conditions taken from a previous WAHMO model simulation with the 1987 coastline while water quality boundary conditions were taken from a previous WAHMO simulation of 1996 conditions. Effluent loads local to the Central reclamation were based on observations and measurements made under the Central Western and Wan Chai West Sewerage Master Plan Study in 1990.

	reclamation bunds with the above and additional mitigation measures. The 3 scenarios stated in the annex report are: o existing conditions o reclamation bunds with 1996 loading based on increase in population, resulting in 10% increase in loading o reclamation bunds with mitigation measures	(2)	Intermediate Reclamation Scenario. Tidal flows with the reclamation bunds in place and culverts B and F and cooling water discharges from Harbour Building, Wing On Centre, St George Building, Exchange Square, Landmark, Jardine House and General Post Office diverted outside the embayment; water quality boundary conditions were taken from the simulation of 1996 conditions in the WAHMO 250m model which also included the large PADS reclamations of West Kowloon, Container Terminals 8 and 9 and the full Central and Wanchai Reclamation. Local effluent loads modelled were increased by 10% compared with the simulation carried out for existing conditions ((1) above) to account for nominal population increase.
	Please explain the discrepancies and state which scenarios were actually modelled.	(3)	Intermediate Reclamation with Mitigation Scenario. The simulation described in (2) was repeated but with reduced effluent loads from outfalls F and J1 (Table attached) to reflect effect of mitigation measures, comprising rectification of cross connections and sewer regrading within catchments F and J1.
(3)	3.1.5 (a) - p3-7 Since the modelling scenario (iii) of section 3.1.3 does not correspond to the set of mitigation measures recommended by the consultants here, it is subjective to state that "effects of implementation would be expected to be similar to or marginally less than those shown in simulation (iii)". In particular, the load reduction at J1 will be 30% instead of 60%, which is a significant change in loading. Based on the loading and the contour plots, outfall F does not seem to be the controlling influence.		Noted. However, while culvert J1 has a higher load than culvert F, the contour plots shown, for example, in Figures A2.21, A2.24 for *E. coli* and A2.11 for ammoniacal nitrogen, show a deterioration in water quality near the discharge point of culvert F, immediately adjacent to the eastern reclamation bund, but a lesser deterioration around outfall J1 which shows up as a localised red "hotspot" on both the baseline and test contour plots. Similarly, the contour plots for *E. coli* appear to be more affected by the discharge from culvert F than culvert J1. It would therefore appear that a reduction in loading in culvert F, dispersion of the discharge from which is restricted, would be more beneficial than in J1 where dispersion is greater.

Since the percentage reductions in pollution loading relating to particular mitigation measures are, of necessity, subjective, the mitigation modelling results have to be regarding as broadly indicative. They do suggest however, that remediation of storm sewer contamination with foul sewage in catchments discharging near Star Ferry would be beneficial. Mitigation measures which could be implemented within catchment F are the rectification of two cross-connections known by the Consultants and DSD in Queens Road Central/Ice House Street and Queens Road Central/Pedder Street. The percentage reduction in pollution loading from rectification of these can be speculated but not confirmed unless sampling is carried out.

Further to discussion with DSD, a large cross-connection in catchment J1, which was observed during the fabric survey for the Central Western and Wan Chai West Sewerage Master Plan Study, has now been corrected. This will mean that the pollutant load from culvert J1 will in practice be lower than modelled for scenario (ii). Other works presently being carried out by DSD in catchment D, i.e. rectification of the cross-connection at Jubilee Street, and at Hollywood Road under the Hillside Escalator Scheme, will effectively reduce the load being discharged into the embayment, although again, the percentage reduction can only be speculated.

As a detailed survey of the study area will be carried out for EPD later this year, under which investigations will be made into possible cross-connections, it would seem appropriate to review possible additional mitigation measures once the results of the survey are available.

In summary, it is recommended that all known cross-connections in catchment F are corrected and the effects monitored by reference to the water quality monitoring programme. If further measures are deemed necessary on the basis of model predictions or subsequently on the basis of the monitoring results, these should be determined from the results of the SMP extension study to be carried out for EPD later this year.

(b) Pollution Loading

(4) 2.2.1 and Table 2.1

Why have loadings from Outfalls E, G, H, I been omitted for Stage I reclamation ? According to Table 2.1, pollution loadings at G, H&I do not seem to be low or negligible. The H&I combined loading is in fact similar to that of A.

Outfall E serves only a small hard-standing area and has no pollutant load. It was therefore omitted. Loadings from outfalls G, H, I were included in model input parameters. Reference to the footnotes to Table 2.1 shows that loads for these catchments were estimated on the basis of catchment population, on the worst case assumption that 70% of the foul load generated from this population would be discharged through the storm sewer system. This 70/30 split was identified as a result of the sampling survey carried out under the Central Western and Wan Chai West Sewerage Master Plan (SMP).

During the field survey for the Central Western and Wan Chai West Sewerage Master Plan Study, samples of all dry weather flow or contaminated flow in the main storm sewers in this area were taken. All of the main storm sewers were inspected visually in order to identify those which should be sampled. In 1990, when the field survey was carried out, the sewers serving outfalls G, H, I were recorded as have either no flow or no contaminated flow, and were not therefore included in the subsequent sampling programme.

Nevertheless, for the purposes of this study, it was considered prudent to assume as a worst case that these outfalls could now (2 years later) be carrying a proportion of foul flow, thus the above estimates were made of their potential pollutant load. The modelling results are therefore likely to be conservative.

(5) Section 2.2 and Table 2.2

Which of the improvement measures are also recommended in the Central, Western and Wan Chai West SMP ? Which mitigation measures are proposed by the consultants for the first time in this study ? Please indicate more specifically which mitigation measures have been included in the modelling scenarios. How have the consultants determined the % reduction in loading of each mitigation measure in Table 2.2 ?

The SMP recommended the following short-term measures;

- lower electrodes at Central Plant on a trial basis
- desilt the trunk sewer
- remove known cross-connections (specific connections were not detailed for action)
- regrade hydraulically inadequate sewers where feasible (specific sewers were not detailed for action)

No mitigation measures are proposed that are not discussed in the SMP.

The modelling scenario (iii) included rectifying all the cross-connections and sewer regarding in catchments F and J1 as detailed in Section 2.2. Desilting and lowering the electrodes was also recommended although these were not included in the modelling scenario.

The amount of reduction of pollution was based upon the findings of the SMP. More specifically the SMP Draft Phase 1 report, section 8 details indicative reductions in pollution loading which can be expected after mitigation measures are made.

(c) <u>3-D Flow Model</u>

(6) Annex : p3, last para, line 5-6

"The ebb currents ... observed tide
Explain more clearly the reason of the disagreement.

It should be noted that Wanchai Position 4 has been compared with field observations at the WAHMO data collection Station 6 which is outside the model area (as shown in Figure 1 of the Annex). In addition, the observed tide and simulated tide were not the same with the main difference being that the modelled tide had longer flood and shorter ebb durations than the one observed as described in section 3.1 of the Annex. Because of the different tidal amplitudes and durations of flood and ebb tides, it is expected that the magnitudes of the simulated and observed water speeds would be different. The comparison has been shown only to examine the general characteristics of the flow patterns. At WAHMO Position 8 which did lie within the modelled area and could be compared more directly with a modelled point, the modelled and observed water velocities are closer although differences due to the different tidal conditions must still be expected.

(7) Annex : Fig 9

Why is there a salinity difference of 2-5 ppt in the model predictions and observation ?

As with the tidal velocities, some differences in salinity should be expected because the modelled and observed tides were not the same. In the calibration of the 250m WAHMO model, the features of special interest when examining the salinity calibration were the degree of vertical stratification and its variation over the tide and the horizontal salinity gradients all of which affect the flow. These features will also vary from tide to tide and the model results could only be compared in broad terms with the observations. In the draft report, Figure 9 was not correct and the wrong values from the WAHMO 250m model had been plotted. The final report will contain the corrected Figure which shows that the salinities from the 250m and 25m models agree well.

(8) Annex : p5, 1st line

Why is there no thermal discharge during calibration and verification exercise ?

The calibration and verification exercise was, to a large extent, designed to compare the large scale water movements with the WAHMO 250m model which did not include thermal discharges. The magnitude of the thermal discharges is relatively small and, as shown in the later simulations, were confined to the top layer of the water column in the near coastal zone. The thermal discharges would have no noticeable impact on the larger scale water movements. Having completed the validation exercise, the thermal discharges were then inserted into the model which was run for the pre-reclamation situation.

(9) Annex : p2, 3rd para and Appendix 1, 3rd page, 2nd para

Does the model HEATFOW-3D simulate salinity ? Is water density also depended on salinity ? Note that a salinity difference of 1 ppt produces a density difference of about 0.75 kg/m^3 at such ambient condition whereas 1°C only produces 0.25 kg/m^3 density difference, and a salinity difference of 2-4 ppt exists in observation and model prediction.

The Annex presented details of the equations used for the thermal and water movement aspects of the model only (HEATFLOW). In fact, the complete model used includes a simulation of salt movement which is carried out interactively with the flow and heat transport simulations. As noted in the comment, the salinity often has a dominating influence on the density and the model includes the salt concentration in the density calculation. The annex only described the contribution to the variation in density from the temperature. Examination of the time history plots of the water speeds for wet and dry season tides (eg Figs 29 and 33) show the important impact of the simulated salinity gradients in the wet season. For example, in the dry season, the water speeds in each layer are very similar with only a small reduction in speed between the surface and bed layer; in the wet season, the water speeds in each layer show larger differences and there is increased directional shear. An additional paragraph will be added to the report containing more details.

(10) Appendix 1, 4th para and Annex : p2, 6th para

The brief states that the boundary conditions should reflect the change in flow field due to the reclamation. Have the WAHMO runs used to supply these boundary conditions incorporated the effect of the reclamation ?	The tidal flow model obtained boundary conditions from the WAHMO 250m model which had been run without the Central reclamation. It was considered, however, that the model boundaries were sufficiently far removed from the Central reclamation to be unaffected by the reclamation - this was confirmed by examination of the flow model results which did not show perturbations in the water velocities at the model boundaries following the introduction of the reclamation. Previous studies had shown that the introduction of the West Kowloon reclamation would reduce peak neap tide flows through Victoria Harbour by approximately 3% while the full Central and Wanchai reclamation would further reduce peak flows by less than 1%. The impact the partial reclamation would have on total tidal discharges was not thought sufficiently important to warrant more detailed large scale modelling (with attendant increase in study cost). The water quality model used boundary conditions from a previous WAHMO model simulation which included planned reclamations such as Central & Wanchai and West Kowloon. Within the accuracy of the simulations possible, it was considered that the boundary conditions used were sufficiently accurate and would not impact on any conclusions about local water movements and dispersion of effluent locally.

(d) <u>Water Quality Model</u>

(11)	Can the consultants provide the parameters used in their water quality model runs for our review ?	Copies of the WAHMO model parameter files are attached.
(12)	Please submit for our review the loading data used in the water quality model ? Please indicate in the loading table details of the outfalls, discharges, loads of modelled parameters, temperature and salinity, etc.	Loading data are attached. Please see response to comment 2 above. The WAHMO water quality model does not simulate salinity and temperature dynamically and the values assigned to the effluent discharges were taken from the WAHMO model boundary file.

(13) Annex : Fig A2.10-2.12 (Ammoniacal nitrogen, wet season)

Why is there local concentration of the pollutant at the northeastern section of the modelled area? This is not observed in the dry season case and the plottings for all the other parameters.

Conditions in the wet and dry season are different. Because of the discrete nature of the colour banding against concentration range, it is thought that the area of higher concentration described may be the result of a small increase in concentration which has just crossed the contour interval. In the wet season, lower layer concentrations of Ammoniacal Nitrogen are higher than surface layer concentrations whereas, in the dry season, concentrations are almost uniform over the depth (cf Figs A.2 and A.7). This area of higher concentration in the wet season is most likely be the result of upwelling of higher concentrations from the lower layer to the surface layer which would not be visible in the dry season because of the more uniform vertical concentration gradients.

(e) <u>Other Comments</u>

(14) 3.1.4 (c) - p3-6

Have the consultants assessed the cumulative effects of dredging inside the basin created by the reclamation bunds ? Will water quality be much worsened (e.g. DO depletion) with the increase in levels of pollutants due to dredging of contaminated mud ?

Cumulative effects of dredging inside the embayment have not been assessed by modelling, as indicated in the meeting on 3.9.93, as this was not a requirement of Appendix 1 of the Brief.

Water quality, in terms of DO depletion is likely to be exacerbated by dredging but accurate quantification is difficult because;

(a) the losses to the water column from dredging with a sealed grab, as specified in the Contract, are not well documented, if at all;

(b) losses depend on the operation of the dredging equipment, for example more sediment is likely to be dispersed if the grab impacts on the bottom than if it is placed with care; or if material is spilled from barges during filling by overfilling or opening the grab at height;

(c) the exertion of BOD/COD will vary depending on the nature of the mud and the time period over which it is in suspension.

A section can be included in the Final Report describing qualitatively the possible cumulative impacts that may arise.

Central Reclamation, Phase I - Engineering Works - Focused Environmental Impact Assessment Study

Marine Department (ref: (9) in PA/S 492/41(38))

Comments:	Responses:
(1) It appears that Annex 1, Clause 14, S.Appx.26/6 needs to be clarified as it is in direct conflict with our general condition that upon completion of project, the grantee shall restore the seabed to its original levels, or to such other levels as may be specified by the Director of Marine.	The conditions for use of the marine borrow area for this project were produced by Fill Management Committee and conveyed to us by UADO. We assume FMC had discussed these conditions with you prior to issue.
(2) In view of the recent problems of short/illegal dumping (Ma Wan and Deep Bay), it is suggested that a condition should be included in the contract (with appropriate wording and forming part of the EPD requirements) to prevent such occurrence and to require the contractor to take remedial action or compensate government should they be caught dumping short.	Regarding your paragraph 2, we would advise that the contract specification limits dumping to three defined areas: Ninepins and Cheung Chau dumping grounds and to be contaminated mud dumping ground north of Chek Lap Kok. The contractor is required to obtain appropriate licences from EPD.

Civil Engineering Department (( ) in PWO 59/3702/87 Pt.22)

Comments:	Responses:
No comments on the draft report.	Noted.

(d) Air Quality

(i) Section 3.3.4 and Figure 3.24 (receivers)

The Exchange Square and General Post Office should be included as analysis points in the air quality impact assessment.

Exchange Square and the General Post Office are unlikely to be affected by dust, these being air conditioned buildings. Modelling indicates that ground level dust concentrations may reach 620 μgm^{-3} under worst case conditions at the Post Office. However, meteorological statistics show that the conditions leading to this level occur for only 9 hours per year. The probability of these conditions coinciding with periods of maximum activity would be very low.

(ii) Section 2.1.3 (a)

Should off-site construction impacts, such as those at the pre-casting yard for seawall blocks in Siu Sai Wan, also be addressed in this assessment ?

This does not form part of the focussed EIA. We would note, however, that the potential use of the Sui Sai Wan site was discussed at length at the time of circulation of the Draft Engineering Conditions for the site by BLD. EPD withdrew their opposition to pre-casting and concrete-batching activities when the considerable separation from sensitive receivers was confirmed.

(iii) Section 3.3.5 (last sentence)

Would the Consultants please confirm whether or not there is any concrete batching activity and has this been included in the air quality assessment ?

On-site concrete batching is not envisaged.

(iv) Section 3.3.6

The recommended monitoring frequency of at least once every six days at both locations is supported.

Noted.

(v) Table 3.8

Please note that hourly 500 $\mu g/m^3$ TSP guideline might be exceeded when background dust level is taken into consideration. Would the Consultants comment on this ?

Dust generation and dispersion will be dependent on levels and types of activity, and meteorological conditions. This makes predictions indicative only. It is possible that under unfavourable conditions, dust from the site in combination with background dust could cause exceedance of the 500 μgm^{-3} TSP guideline. It is essential that the contract requirements for dust suppression are adopted and enforced to prevent nuisance in the area. The dust monitoring programme requires the Contractor to take action when levels are considered by the Engineer to be significantly in excess of background levels.

(vi) Appendix 2, page S.Appx 5/3, Clause 3

As there is unlikely any rock crushing activities, I suggest to incorporate a "No Crushing Activities" clause into the contract document, and delete Clause 3 and "or crushing plant" in Clause 2(5) and Section 3.3.5 (last sentence).

Listing all activities not required during the construction period would unnecessarily complicate contract documentation. Rock crushing is not envisaged as a construction activity in Central, therefore amending the clauses is not considered necessary.

(vii) Appendix 2, page S.Appx 5/5, Clause 5(1), (5) and (7)

Should it be the "Contractor" who will provide qualified staff instead of the "Engineer" to carry out dust monitoring ?

The Engineer will carry out the dust monitoring programme. If the Contractor had to carry out this work there would be additional cost to Government and increased supervision requirements.

(e) <u>Noise Impacts</u>

(i) Section 3.4.1 (a)

The application of the daytime general construction noise limit of 75 dB(A) should not be limited to construction planning and contract tender assessment stages. The noise limit should also be applied during the contract implementation stage.

Noted. Text will be amended.

The applicability of the maximum daytime noise level would not depend upon existing noise levels. We would not accept a noise limit that could vary with the ambient noise level for the control of daytime construction noise during the implementation stage. It is practically impossible to compare the construction noise with the instantaneous prevailing ambient noise level during the construction stage. We recommend to revise the last sentence of the first para. as " ...... to Construction Noise Permits. Nevertheless, the limit of 75 dB(A) will be used throughout the contract implementation stage. Appropriate noise mitigation measures should be considered once this limit is exceeded."

Noted. Text will be amended. Please see also response to comment (e))vii) below.

The "Corrected Noise Level (CNL)" in para.2 should be "Acceptable Noise Level (ANL)".

Noted. Text will be amended.

In table 3.9, the column for "Evening" should also be applicable to the daytime on general holidays. Also, the descriptor for the noise limits should be $L_{Aeq\ (5\ mins)}$.

Noted. Text will be amended.

(ii) Section 3.4.1 (b)

In Table 3.10, "windows" should be revised as "windows or other openings"; the column for "Night" should also be applicable to general holidays; the remark should also include "other NSRs which are considered by the Authority to be particularly sensitive to noise".

Noted. Text will be amended.

(iv) Section 3.4.2

We would not get any sensible idea on the existing traffic noise levels from the "approx. 86dB(A) at the facades of the buildings". Assessment details shall be provided to give a complete picture on the existing traffic noise levels.

The traffic figures were taken from the Annual Traffic Census 1990, Transport Department. Traffic counts on Connaught Road, Central were used and seven percent of this daily traffic flow was taken to represent a peak hour flow. The percentage of heavy goods vehicles was calculated from the vehicle classification data for Core Station 1001. Calculations were carried out using the UK Department of Transport 'Calculation of Road Traffic Noise', 1988 (CRTN).

Vehicles per hour 1990	=	84,010
7% (peak hour flow)	=	5,880
Basic noise level	=	79.8dB(A)
(correction for speed (80 km/h) + % HGVs (15.8)	=	+3.5dB(A)
Facade effect	=	+2.5
Corrected Noise Level	=	85.8

This assumes a distance of 4 m or less to the sensitive receivers. There are sensitive receivers on Connaught Road and an addition correction for distance is not considered necessary.

The above traffic noise calculation was undertaken to indicate the presence of major noise sources in the area.

(v) Section 3.4.3

The formula for distance attenuation and the term "notional source position" should only be applicable to general construction work. A separate para. to describe the assessment methodology for percussive piling should be added.

In Table 3.13, the correction factor given cannot be deduced from the formula quoted. Please revise.

Table 3.13 actually shows correction factors based on regression analysis of the data provided in Table 4 (Correction Factors to obtain the Predicted Noise Level from the Total Sound Power Level at Given Distances) of Technical Memorandum on Noise from Percussive Piling. These were used to obtain the Predicted Noise Level from the Total Sound Power Level of Percussive Piling operation at given distances 301 to 425 m. However the text is not clear in this respect and will be redrafted as requested, with a separate section on the assessment methodology for percussive piling.

(vi) Section 3.4.4

Since general construction work and percussive piling have different definition on "NSR", different noise sensitive buildings such as Harbour Building, Exchange Square, etc. should be used for the assessment of noise from percussive piling. In respect of the NSRs identified, for general construction work, the address of the third noise sensitive building appears wrong. Please clarify. Also, Victoria Hotel and City Hall, due to their proximity to the site, should be included for assessment.	Noted. The address of NSR3 should read Connaught Road Central. Victoria Hotel and City Hall will be included as additional NSRs for general construction work.
Figure 3.3 has no concern with the "location of the noise sensitive receivers". Please amend.	Typographical error. Figure 3.3 should read Figure 3.24.
NSR3, Victoria Hotel and City Hall are not all directly affected by the traffic noise of Connaught Road Central. For general construction noise assessment propose, an Area Sensitive Rating "B" should be assigned to them.	NSR3 will represent a noise sensitive receiver only on Sunday. However, traffic flow on Connaught Road will become an influencing factor to the NSR3 even though the traffic flow is less on Sunday than on weekdays.
In Table 3.14, the "maximum noise levels" at the NSRs, should be 75, 85, 80 and 78 dB(A) only.	Noted. Text will be amended.
For NSR1 and NSR3, it is not appropriate to predict whether there would be a nuisance by comparing the maximum construction noise level with the L_{10} (peak hour) traffic noise level. Firstly, L_{eq} should not be compared with L_{10} in this manner. Secondly, the maximum noise from these two sources would take place in different hours.	Noted. Nonetheless the magnitude of traffic flows on Connaught Road and the fact that in most cases, the road lies between the NSR and the construction site, and closer to the NSR than the construction site, has to be taken into consideration.
For NSR2, the "overestimate" should be quantified by calculation.	For NSR2, the worst case situation was evaluated in which all the plant on site is assumed to be located at notional source position in direct line of sight of the NSR. In practice, the plant will move around the site during construction phase and some PME may be shielded by adjacent buildings. As the location of the plant cannot be predicted accurately, the 'overestimate' cannot be quantified by calculation in the report.
For NSR4, the report should describe the balcony structures of the hotel in detail so as to substantiate the self protection effect. Also, it should be noted that the noise limit for general construction work would remain the same no matter central air-conditioning is provided or not.	Reference to balconies and air conditioning at the Mandarin Hotel was not intended to justify limit relaxation, but was an observation that a degree of attenuation due to building design will occur.
For percussive piling, it is not clear which NSRs are the "closest receivers". A table containing all assessment details should be provided.	Text will be amended.

	Comment	Response
	Please amend the last para. as " ...... restriction. It should be noted that percussive piling is prohibited between 7 p.m. and 7 a.m. and on general holidays."	Text will be amended.
(vii)	Section 3.4.5	
	The reasons to exclude the 75 dB(A) limit are not justified. The ambient noise level would not be always exceeding 75 dB(A). Moreover, the 75 dB(A) limit is only intended to be used for initiation of adequate noise mitigation measures. Should the consultants believe that this criterion cannot be met, detailed assessment should be provided to see the impact. The third reason given is irrelevant. It can be dealt with by careful drafting of contract document easily.	Please refer to response to comment below.
	As the consultants have agreed that it would be beneficial to adopt the 75 dB(A) limit, the consultants should pursue for this criterion. As discussed under our second comment on section 3.4.1(a), the limit of 5 dB(A) above background is not acceptable.	Further to discussion at the meeting with EPD on 3 September, it was agreed that the 75 dB(A) limit would be retained, but with the proviso that the Engineer interpret the monitoring results in the light of potential influencing factors such as road traffic.
(viii)	Section 3.4.6	
	The monitoring frequency should preferably be two 3 consecutive 5-minute L_{eq} measurements per week.	Noted. Text will be amended.
	The limit of 75 dB(A) should be adopted.	Noted. Text will be amended.
(ix)	Appendix 5, Clause 7(2)	
	The first sentence should be revised as (" ...... or acoustic sheds or screens to avoid disturbance to any nearby noise sensitive receivers. The measured sound levels during any 5-minute periods from 0700 to 1900 hours on any day not being a general holiday at 1 m from the closest external facade of the nearby noise sensitive receivers shall not exceed an equivalent sound level (L_{eq}) of 75 dB(A) otherwise the construction operations, causing the excess shall be regarded as causing serious noise pollution impacts.") As the hand-held breakers and portable compressors would be controlled under the Noise Control (Hand Held Percussive Breakers) Regulations and Noise Control (Air compressors) Regulations, the second sentence should be revised accordingly.	Noted. Further to the response to comment (vii), it is recommended that the phrase ", if deemed by the Engineer to be" is inserted after "otherwise the construction operations" and that a comma is inserted after the word "excess", such that the phrase reads " otherwise the construction operations, if deemed by the Engineer to be causing the excess, shall be regarded as causing serious noise pollution impacts." The second sentence will be amended to read "In particular, hand-held breakers and portable compressors shall comply with the requirements laid down in the Noise Control (Hand Held Percussive Breakers) Regulations and Noise Control (Air Compressors) Regulations.

		In view of the concern over DO depletion it may be advisable to include alarm (3 mg/l^{-1} DO) and action (2 mgl^{-1}) levels for DO in Figure 1 of Specification Clause 4.08 (b) and to include two additional monitoring points inside the embayment.
(15)	Section 2.2.3	
	Whole section refers to pollution loading reduction in %. Shouldn't these be % reduction in flow volume as suggested in Table 2.2.	A constant concentration over time is assumed, thus % load is taken to be proportional to % flow.
(16)	Fig 2.9	
	Culvert F is not shown to discharge outside the embayed area.	Noted. Figure will be amended.
(17)	3.1.6 - p3-7	
	Fig 3.1 does not show any monitoring stations.	Typographical error; Figure 3.1 should read Figure 3.22. Text will be amended.
(18)	3.1.4 (b) - p3-5	
	There are typo errors on ammonia-nitrogen concentrations at Station B.	Noted. Text will be amended to read 0.08 mg/l and 0.14 mg/l.
(19)	Fig 3.9 to Fig 3.18	
	How do the lines correspond to the 3 modelling scenarios ((i), (ii) and (iii)) ?	The lines in the figures are : Short Dotted : Existing conditions Long Dashed : Partial reclamation with full effluent loads Solid : Partial Reclamation with reduced loads after mitigation measures
(f)	<u>Contract Specification Provisions - Appendix 2</u>	
(20)	Clause 4.01 (a)	
	The second sentence should read "In particular, he shall arrange his method of working to minimise the effects on the water quality within the Site, adjacent to the Site, on the transport routes and at the loading, dredging and dumping areas".	We do not believe that rewriting the clause would serve any purpose, because the areas described by EPD are parts of the area defined in the clause.

(21) Clause 4.02 (ii)

The definition of "contaminated marine mud" shall be "designated dredged material to be removed from the reclamation areas containing sufficient micro-pollutants to require particular handling and disposal procedures.

We believe that the decision on what is to be classified as contaminated should not be open to interpretation by the contractor. Contaminated material to be dredged is defined on drawing 1106, and disposal location defined in Appendix 9, we do not therefore believe that there is any need to change the present clause.

(22) Clause 4.02 (iv)

The second sentence should read "The material is to be disposed of at designated spoil dumping grounds".

The material envisaged in this clause was topsoil, builders debris, vegetation etc. We suggest that it would be inappropriate to dispose of this at marine spoil grounds.

(23) Clause 4.04 (b) (i)

The sensor cable should be not less than 25m. The last sentence should read "After calibration, turbidity measurements shall be taken as a rough field-indication of levels of suspended solids before lab test results are available".

The change in cable length will be instructed at the beginning of the contract.

If the words "rough field indication" are used, the contractor would argue that the turbidity meter is inaccurate and therefore its results cannot be used as a basis for controlling works. Would you please indicate how you envisage turbidity and suspended solids controls to work. Can action be taken on the basis of either, or both ? See also 4.004 (b) (iii) last sentence.

(24) Clause 4.04 (c)

Calibration should be done at bi-monthly intervals.

Please confirm that the additional requirement is necessary. If so it could be presented to short-listed tenderers. Note additional cost implication.

(25) Clause 4.05 (c) (ii)

During the course of Works, monitoring shall be done on 3 working days a week.

Ditto.

(26) Clause 4.08

We have received no response on our previous comments on this clause. We previously asked the consultants to justify the basis of setting the alarm and action levels for suspended solids, and to explain "persistently greater" (block 4 of Fig 1) in more clear and precise terms.

We had believed that all previous comments were responded to. The action level we originally based on information received from MTRC.

The specification has been circulated to pumphouse owners who have not objected to these levels. "Persistently greater" could be defined as being in excess of the action level on more than three successive monitoring days. If you agree, we can put this to shortlisted tenderers.

(27) Clause 4.10

The last sentence should read "contaminated mud disposal shall be in accordance with provisions of Clause 4.11".

If the clause is to be altered, we believe that the reference should be to Clauses 4.09, 4.11 and Appendix 9. Please advise, for discussion with shortlisted tenderers.

(28) Clause 4.11 (iii)

This clause should read "discharge from split barges shall take place within a radius of 100 meters of the centre of the area allocated for the disposal of designated contaminated marine mud".

We do not believe that it is necessary to limit the area of disposal to any smaller than the areas shown on the drawings.

In any case there would be insufficient capacity for the material requiring to be dumped if such a proposal were to be adopted.

A change to the specification in this respect would be expected to lead to a significant claim.

Hong Kong Government
Territory Development Department
Urban Area Development Office

Central and Wan Chai Reclamation Development

Central Reclamation, Phase 1
Focussed Environmental Impact Assessment Study

Supplementary Document to the Final Report

March 1993

Maunsell Consultants Asia Ltd

in association with

Balfours International Asia Consulting Engineers Ltd

CES Consultants in Environmental Services (Asia) Ltd

Hydralics and Water Research (Asia) Ltd

PREFACE

The Focussed EIA Study was carried out on behalf of the Project Manager, Urban Area Development Office, Territory Development Department by CES Consultants in Environmental Sciences (Asia) Ltd. The objective of EIA was to ensure that environmental mitigation measures specified in the contract documents for the Central Reclamation Phase 1 are adequate to maintain acceptable environmental quality, particularly water quality, during the process of reclamation. The functional output of the EIA took the form of recommendations on additional mitigation measures, where necessary, for inclusion in the works contract.

The Focussed EIA Study enabled water quality modelling plus a review of air, noise, waste and construction matters to be carried out. Pollution reduction measures were identified and recommended by the Study to ameliorate the effects of the new reclamation and its embayments, although the effective extent of pollution reduction will need to be quantified by subsequent investigation and monitoring. Certain amendments to the construction specification were found necessary and were incorporated into the contract. As a result, this study has enabled construction impacts of the reclamation to be minimised. The Final Report of the Study was issued on 7th October 1992.

In the Final Report, a maximum sound power level from construction plant of 132 dB(A) was calculated for the two worst case months (May and June 1995). The maximum noise level at noise sensitive (NSR 2) was predicted to reach 85 dB(A) which exceeded the day-time requirement by 10 dB(A). This calculation did not, however, take into account that the noise would be arising from contracts in two separate areas. Upon further review, EPD requested an additional assessment to evaluate in more detail the noise impact at NSR2 (United Building) within the critical months by considering the construction schedule and any mitigation required to satisfy the day-time construction noise limit of 75 dB(A). This assessment was carried in November 1992 and took into account the different site areas available to each contract. The "Addendum on Noise Assessment" was issued on 27th November 1992.

Further discussion on some minor points continued with EPD, who subsequently requested that a supplementary document to the Final Report be produced to incorporate the Addendum on Noise Assessment, further comments and responses, and Post-Final Report correspondence. A sticker was also requested for the present copies of the Final Report, advising readers that it was to be read in conjunction with the Final Report.

Contents

Addendum on Noise Assessment

Further Comments and Responses

Post Final Report Correspondence

Hong Kong Government
Territory Development Department
Urban Area Development Office

Central and Wan Chai Reclamation Development

Central Reclamation, Phase 1
Focussed Environmental Impact Assessment Study

Final Report
Addendum on Noise Assessment

November 1992

Maunsell Consultants Asia Ltd

in association with

Balfours International Asia Consulting Engineers Ltd

CES Consultants in Environmental Sciences (Asia) Ltd

Hydraulics and Water Research (Asia) Ltd

Addendum on Noise Assessment

CENTRAL RECLAMATION, PHASE 1
Noise Assessment for NSR2 (United Building)

1 Introduction

In the Final Report on the Focussed EIA Study of Central Reclamation Phase 1, a maximum sound power level from construction plant of 132 dB(A) was calculated for the worst case months of May and June 1995 (refer to Apppendices I and II). The maximum noise level at NSR2 was predicted to reach 85 dB(A) which exceeds the day-time requirement by 10 dB(A). This calculation did not, however, take into account that the noise would be arising from two separate contracts.

The objective of this additional assessment was to evaluate in more detail the noise impact at NSR2 (United Building) within the critical months by considering the construction schedule and any mitigation required to satisfy the day-time construction noise limit of 75 dB(A). This assessment takes into account the different site areas available to each contract.

2 Construction Programme

Central Reclamation, Phase 1, Engineering Works Contract, will be carried out in two construction stages. During the first stage, two bunds will be constructed to the new seawall along the eastern and western boundaries of the reclamation. The ferry piers, access roads, cooling water pumping stations and some culvert extensions will be constructed during this stage. Once these facilities are fully operational, the existing piers and pumping stations will be abandoned and the second stage of reclamation, i.e. filling in the embankment between the bunds, will commence. As one of the first tasks in the second stage, the existing ferry piers will be demolished and the precast piles extracted or cut off at seabed level. The existing piers will be removed during the period June - August 1994. Two further piers and perimeter roads will be constructed in this stage. Detailed construction schedule and the location of each section is shown in Appendices III & IV respectively.

The Hong Kong Station and Tunnel Contract will commence soon after the start of the second stage of the Engineering Works Contract - when sufficient land is formed, in late 1994. After this time, noise will be produced from the Station Contract and the now more distant Engineering Works Contract.

3 Noise Assessment

For the period March - June 1995, construction for the Engineering Works Contract will be mainly at the pier and between the road and seawall. The distance from the Notional Source Position (NSP) of construction plant in each area to the NSR2 and the resulting noise attenuation are given in Table 3.1.

Table 3.1 Distance Attenuation from NSPs to NSR2

Area	Distance, m	Attenuation, dB(A)
Pier	420	60
Between Road & Seawall	360	59

Plant will be engaged in pier construction and the resulting noise level at NSR2 is shown in Table 3.2.

Table 3.2 **Calculation of Noise Level Generated from Pier Construction**

Plant	No. of Plant Item	SWL, dB(A)	Total SWL, dB(A)
Mobile Crane	4	112	124
Track Crane	4	112	
Ready-mix Truck	6	109	
Concrete Pump	3	109	
Tug Boat	2	110	
Barge	8	104	
Lighter	4	104	
Distance Attenuation			(60)
Sound Pressure Level at NSR2			**67**

Plant will be engaged on work between road and seawall and the resulting noise level at NSR2 is shown in Table 3.3.

Table 3.3 Calculation of Noise Level Generated from Between Road and Seawall

Plant	No. of Plant Item	SWL, dB(A)	Total SWL, dB(A)
Dump Truck	10	117	128
Lorry	4	112	
Compressor	5	109	
Generator	5	108	
Distance Attenuation			(59)
Sound Pressure Level at NSR2			**72**

For the period March - June 1995, construction work for the Hong Kong Station and Tunnel Contract will be mainly at S2, S3, S5 and S6 (Figure 1). The distances from the NSP of plant in each area to the NSR2 and the resulting noise attenuation are given in Table 3.4.

Table 3.4 Distance Attenuation from NSPs to NSR2

Area	Distance, m	Attenuation, dB(A)
S2	460	61
S3	240	56
S5 & S6	150	52

Plant will be engaged in S2 construction and the resulting noise level at NSR2 is shown in Table 3.5.

Table 3.5 Calculation of Noise Level Generated from S2 Construction

Plant	No. of Plant Item	SWL, dB(A)	Total SWL, dB(A)
Bored Piling Oscillator	2	115	118
Bentonite Filtering Plant	2	105	
Diaphragm Wall Extractor	2	90	
Distance Attenuation			(61)
Sound Pressure Level at NSR2			**60**

Plant will be engaged in S3 construction and the resulting noise level at NSR2 is shown in Table 3.6. As S3 construction work will be totally screened by the Southland Building, a 10 dB(A) negative correction has therefore been applied.

Table 3.6 Calculation of Noise Level Generated from S3 Construction

Plant	No. of Plant Item	SWL, dB(A)	Total SWL, dB(A)
Tug Boat	2	110	121
Barge	2	104	
Grab Dredger	2	112	
Bored Piling Oscillator	2	115	
Bentonite Filtering Plant	2	105	
Diaphragm Wall Extractor	2	90	
Distance Attenuation			(56)
Barrier Correction			(10)
Sound Pressure Level at NSR2			**58**

Plant will be engaged in S5 and S6 construction and the resulting noise level at NSR2 is shown in Table 3.7. Works on S5 and S6 were assumed be undertaken at the same time, and the NSP for these areas is partially screened by the Southland Building. Therefore, a 5 dB(A) negative correction has be applied.

Table 3.7 Calculation of Noise Level Generated from S5 & S6 Construction

Plant	No. of Plant Item	SWL, dB(A)	Total SWL, dB(A)
Mobile Crane	4	112	128
Ready-mix Truck	6	109	
Concrete Pump	3	109	
Dump Truck	4	117	
Dozer	3	115	
Backhoe	2	112	
Lorry	3	112	
Bored Piling Oscillator	1	115	
Bentonite Filtering Plant	1	105	
Diaphragm Wall Extractor	1	90	
Compressor	5	109	
Generator	5	108	
Distance Attenuation			(52)
Partial Screen			(5)
Sound Pressure Level at NSR2			74

The total sound pressure level is therefore calculated as shown in Table 3.8.

Table 3.8 Calculation of Sound Pressure Level at the Facade of NSR2

Area	Sound Pressure Level, dB(A)	Overall Sound Pressure Level, dB(A)
Pier	67	77
Between Road & Seawall	72	
S2	60	
S3	58	
S5 & S6	74	

The total noise level is equal to 77 dB(A) which is still 2 dB(A) higher than the day-time requirement. Mitigation is therefore required. In terms of noise sources, 19% of the noise is predicted to come from the Engineering Works Contract and 81% to come from the Hong Kong Station and Tunnel Contract.

4 Mitigation

One way of reducing the noise level would be to erect a noise barrier along the shore near the Vehicular Ferry Pier after the demolition of the pier. The barrier should be long enough to shield the angle of view from the NSR2 to the site area and high enough to block the line of sight from the NSR2 to the notional source position.

NSR2 is only a seven to eight storey building which is estimated to be 22m high. The notional source position is 50m away from the shore and therefore the dimension of the barrier required would be at least 6.5m high and 120m long. An overall reduction of up to 5 dB(A) could easily be achieved by using 18mm plywood board for constructing the barrier.

Alternatively, diversion of all dump trucks from going through the exposed area in S5 and S6 (except the operation of one dump truck at a time for dumping purposes), and provision of noise baffles to the noise generating parts of the bored piling oscillator operated inside these areas, may be a more appropriate method for obtaining the required 2 dB(A) reduction.

Either of the methods above could be used to comply with the daytime noise limit, however, it is up to contractors to select the mitigation measures to be applied. However it will be the responsibility of the Station Contractor rather than the Engineering Works Contractor to achieve this mitigation since the majority of the noise will be generated by the Station Contract plant. Any mitigation measures adopted should be developed in parallel with the detailed design and should be coherent with the construction programme.

Table 3.17 Sound Power Levels [dB(A)] for Central Reclamation Phase 1 Engineering Works Plant Schedule No. 1

Closest Area	Equipment	1992			1993											
		10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
	Material Handling															
Pier	Mobile Crane	115	115	115	115	115	115	115	115	121	121	121	121	121	121	118
	Track Crane										118	118	118	118	118	118
	Concreting															
Pier	Ready-mix Truck		113	116	116	116	116	116	116	116	116	116	116	116	116	116
	Concrete Pump		113	113	113	113	113	113	113	113	113	113	113	113	113	113
	Excavation and Filling															
Between Road & Seawall	Dump Truck										127	127	127	127		
	Dozer										121	121	121	121		
	Backhoe	112	112	112												118
	Lorry	115	115	115	115	115	115	115	115	118	118	118	118	118	118	118
	Marine															
Pier	Tug Boat	110	113	113	113	113	113	113	113	113	113	113	110			
	Barge	110	113	113	113	113	113	113	113	113	113	113	110			
	Grab Dredger	118	119	119	119											
	Lighter	107	107	107	107	110	110	110	110	110	110	110	110	110	110	110
	Piling															
—	Bored Piling Oscillator									118	118	118	118	118	118	
	Bentonite Filtering Plant									105	105	105	105	105	105	
	Diaphragm Wall Extractor									96	96	96	96	96	96	
	Auxiliary															
Between Road & Seawall	Compressor	112	112	115	115	116	116	115	115	115	115	115	115	115	115	115
	Generators	111	115	114	114	115	115	114	114	114	114	114	114	114	114	114
	Hydraulic Impact Breaker			114	114	114	114									
	Total Sound Power Level	123	125	126	126	125	125	124	124	127	131	131	130	130	127	126

Equipment	1994											
	1	2	3	4	5	6	7	8	9	10	11	12
Material Handling												
Mobile Crane	118	118	118	118	118	115	115	115	115	115	115	115
Track Crane	118	118	118	118	118	115	115	115	115	115	115	115
Concreting												
Ready-mix Truck	116	116	116	116	116	116	116	116	116	116	116	116
Concrete Pump	113	113	113	113	113	113	113	113	113	113	113	113
Excavation and Filling												
Dump Truck												
Dozer												
Backhoe	118	118	118	118	118							
Lorry	118	118	118	118	118	118	115	115	115	115	115	115
Marine												
Tug Boat						110	113	113	113	113	113	113
Barge						110	113	113	113	113	113	113
Grab Dredger						118	119	119	119	119		
Lighter	110	110	110	110	110	110	107	107	110	110	110	110
Piling												
Bored Piling Oscillator												
Bentonite Filtering Plant												
Diaphragm Wall Extractor												
Auxiliary												
Compressor	115	115	115	115	115	115	115	115	115	115	115	115
Generators	114	114	114	114	114	114	114	114	114	114	114	114
Hydraulic Impact Breaker						117	117	117	117			
Total Sound Power Level	126	126	126	126	126	126	126	126	126	126	125	125

Equipment	1995											
	1	2	3	4	5	6	7	8	9	10	11	12
Material Handling												
Mobile Crane	115	115	115	115	118	118	118	118	118	118	118	118
Track Crane	115	115	115	115	118	118	118	118	118	118	118	118
Concreting												
Ready-mix Truck	116	116	116	116	116	116	116	116	116	116	116	116
Concrete Pump	113	113	113	113	113	113	113	113	113	113	113	113
Excavation and Filling												
Dump Truck			127	127	127	127						
Dozer												
Backhoe												
Lorry	115	115	115	115	115	118	118	118	118	118	118	118
Marine												
Tug Boat	13	113	113	113	113	113	110					
Barge	113	113	113	113	113	113	110					
Grab Dredger												
Lighter	110	110	110	110	110	110	110	110	110	110	110	110
Piling												
Bored Piling Oscillator							118	118	118	118	118	118
Bentonite Filtering Plant												
Diaphragm Wall Extractor												
Auxiliary												
Compressor	115	115	115	115	115	115	115	115	115	115	115	115
Generators	114	114	114	114	114	114	114	114	114	114	114	114
Hydraulic Impact Breaker												
Total Sound Power Level	125	125	129	129	129	129	126	126	126	126	126	126

Equipment	1996											
	1	2	3	4	5	6	7	8	9	10	11	12
Material Handling												
Mobile Crane	118	118	118	115	115	115	115	115	115	115		
Track Crane	118	118	118	115	115	115	115	115	115	115		
Concreting												
Ready-mix Truck	113	113	113	113	113	113	113	113	113	113		
Concrete Pump	113	113	113									
Excavation and Filling												
Dump Truck												
Dozer												
Backhoe			118	118	118	118	115	115	115	115		
Lorry	118	118	118	118	118	118	115	115	115	115		
Marine												
Tug Boat												
Barge												
Grab Dredger												
Lighter	110	110	110	110	110	104	104	104	104			
Piling												
Bored Piling Oscillator												
Bentonite Filtering Plant												
Diaphragm Wall Extractor												
Auxiliary												
Compressor	115	115	115	115	115	115	112	112	112	112		
Generators	114	114	114	114	114	114	111	111	111	111		
Hydraulic Impact Breaker								110	110	110		
Total Sound Power Level	125	125	126	125	125	125	123	123	123	123		

Notes:

1. Area is for sectional area closest to NSR2 in which PME from this contract may operate, because of contract site boundaries, in the months March-June 1995.

2. Between March and June 1995, all PME shown in the table will be engaged in pier construction (i.e. beyond the S12 seawall) except for Excavation and Filling, and Anxiliary which will only operate between the road and seawalls.

Table 3.18 Sound Power Levels [dB(A)] for Hong Kong Station and Tunnel Contract Plant Schedule No. 2

Closest Area	Equipment	1994			1995											
		10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
	Material Handling															
S5	Tower Crane															
S6	Mobile Crane	115	115	115	118	118	118	118	118	118	118	118	118	118	118	118
	Track Crane															
	Concreting															
S5	Ready-mix Truck		114	117	117	117	117	117	117	117	117	117	117	117	117	117
S6	Concrete Pump		109	109	114	114	114	114	114	114	114	114	114	114	114	114
	Excavation and Filling															
S5	Dump Truck	120	120	120	123	123	123	123	123	123	123	123	123	123	123	123
S6	Dozer		118	118	120	120	120	120	120	120	120	120	120	120	120	120
	Backhoe	112	115	115	115	115	115	115	115	115	115	115	115	115	115	115
	Lorry	115	115	115	117	117	117	117	117	117	117	117	117	117	117	117
West	**Marine**															
of	Tug Boat	113	113	113	113	113	113	113	113	113	113	113	113	113	113	113
S3	Barge	107	107	107	107	107	107	107	107	107	107	107	107	107	107	107
	Grab Dredger	115	115	115	115	115	115	115	115	115						
S2	**Piling**															
S3	Bored Piling Oscillator	118	121	121	121	121	121	121	121	121	121	121	121	121	121	121
S5	Bentonite Filtering Plant	108	112	112	112	112	112	112	112	112	112	112	112	112	112	112
S6	Diaphragm Wall Extractor	93	97	97	97	97	97	97	97	97	97	97	97	97	97	97
	Auxiliary															
S5	Compressor	112	115	115	116	116	116	116	116	116	116	116	116	116	116	116
	Generators	111	114	114	115	115	115	115	115	115	115	115	115	115	115	115
S6	Hydraulic Impact Breaker	110	113	113	113											
	Total Sound Power Level	125	127	128	129	129	129	129	129	129	129	129	129	129	129	129

Closest Area	Equipment	1996												1997											
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
	Material Handling																								
S5	Tower Crane	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
S6	Mobile Crane	118	118	1 8	118	118	115	115	115	115	115	115	115	115	115	115	115	115	115	112	112	112	112	112	112
	Track Crane	117	117	117	117	117	117	112	112	112	112														
	Concreting																								
S5	Ready-mix Truck	117	117	117	117	117	117	117	117	117	117	117	117	117	117	117	117	117	117	116	116	116	116	116	116
S6	Concrete Pump	114	114	114	114	114	114	114	114	114	114	114	114	114	114	114	114	114	114	112	112	112	112	112	112
	Excavation and Filling																								
S5	Dump Truck	117	117	117	117	117	117	117	117	117	117	117	117	117	117	117	117	117	117						
S6	Dozer	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115						
	Backhoe	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115	112	112	112	112	112	112
	Lorry	117	117	117	117	117	117	117	117	117	117	117	117	117	117	117	117	117	117	115	115	115	115	115	115
West	**Marine**																								
of	Tug Boat																								
S3	Barge																								
	Grab Dredger																								
S2	**Piling**																								
S3	Bored Piling Oscillator																								
S5	Bentonite Filtering Plant																								
S6	Diaphragm Wall Extractor																								
	Auxiliary																								
S5	Compressor	116	116	116	116	116	116	116	116	116	116	116	116	116	116	116	116	116	116	114	114	114	114	114	114
	Generators	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115	113	113	113	113	113	113
S6	Hydraulic Impact Breaker																								
	Total Sound Power Level	126	126	126	126	126	126	125	125	125	125	125	125	125	125	125	125	125	125	122	122	122	122	2	122

Closest Area	Equipment	1998											
		1	2	3	4	5	6	7	8	9	10	11	12
	Material Handling												
S5	Tower Crane	100	100	100	100	100	100	100	100	100	100	100	100
S6	Mobile Crane	112	112	112	112	112	112	112	112	112	112	112	112
	Track Crane												
	Concreting												
S5	Ready-mix Truck	116	116	116	116	116	116	116	116	116	116	116	116
S6	Concrete Pump	112	112	112	112	112	112	112	112	112	112	112	112
	Excavation and Filling												
S5	Dump Truck												
S6	Dozer												
	Backhoe	112	112	112	112	112	112	112	112	112	112	112	112
	Lorry	115	115	115	115	115	115	115	115	115	115	115	115
West	**Marine**												
of	Tug Boat												
S3	Barge												
	Grab Dredger												
S2	**Piling**												
S3	Bored Piling Oscillator												
S5	Bentonite Filtering Plant												
S6	Diaphragm Wall Extractor												
	Auxiliary												
S5	Compressor	114	114	114	114	114	114	114	114	114	114	114	114
	Generators	113	113	113	113	113	113	113	113	113	113	113	113
S6	Hydraulic Impact Breaker												
	Total Sound Power Level	122	122	122	122	122	122	122	122	122	122	122	122

Notes: 1. See notes on Table 3.17
2. Piling: An estimated 80% of piling works will be in Areas S2 & S3, the remainder will be in Areas S5 and S6.

Appendix III

91590/20/74

Central Reclamation, Phase 1 Engineering Works
<u>Section Completion Dates</u>

Section	Completion		Completion Date for Commencement	
	Days	Cal Months *	on 3.10.1992	
1 *	570	18.7	25 Apr. 1994	
2 *	766	25.2	7 Nov. 1994	
3 *	872	28.6	21 Feb. 1995	
4	450	14.8	26 Dec. 1993	
5 *	802	26.3	13 Dec. 1994	
6 *	837	27.5	17 Jan. 1995	
7	837	27.5	17 Jan. 1995	
8	1065	35.0	2 Sept. 1995	
9	1000	32.9	29 June 1995	
10 *	907	29.8	28 Mar. 1995	
11	1306	42.9	30 Apr. 1996	
12 *	1350	44.4	13 June 1996	
13	1400	46.0	2 Aug. 1996	
14	1825	60.0	1 Oct. 1997	
15	120	3.9	30 Jan. 1993	
16	1460	48.0	1 Oct. 1996	
17	1700	55.9	29 May 1997	
18	2150	70.7	22 Aug. 1998	
19	1220	40.1	4 Feb. 1996	
20	90	3.0	31 Dec. 1992	
21	1184	38.9	30 Dec. 1995	
22	1184	38.9	30 Dec. 1995	
23	636	20.9	30 June 1994	

Note: 1. Section 1 relates to Sectional Area S1 etc.
2. Sections marked * will be handed to MTRC's Station Contract after the Completion Date.

Contract UA 11/91
Central Reclamation
Sectional Areas

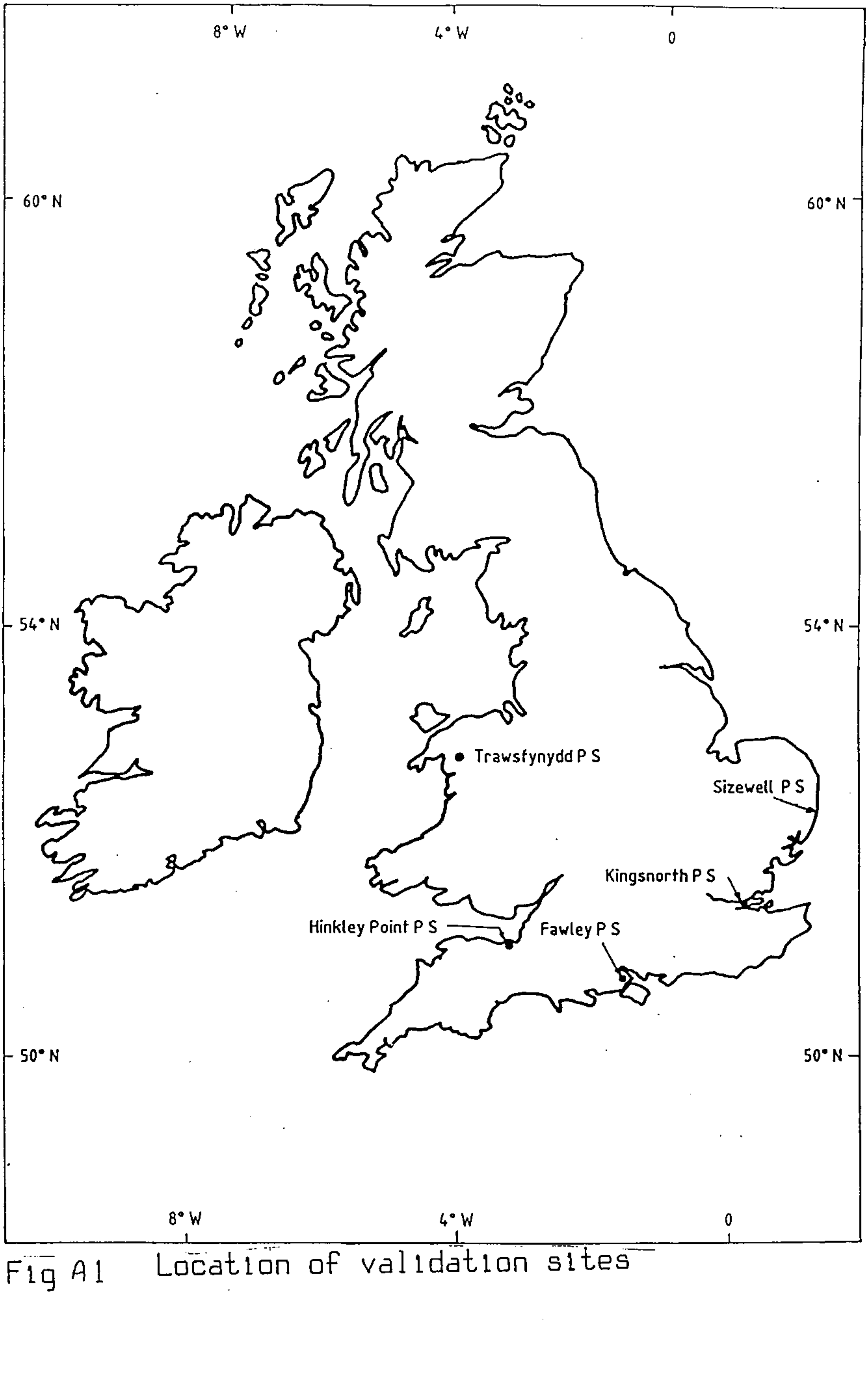


Fig A1 Location of validation sites

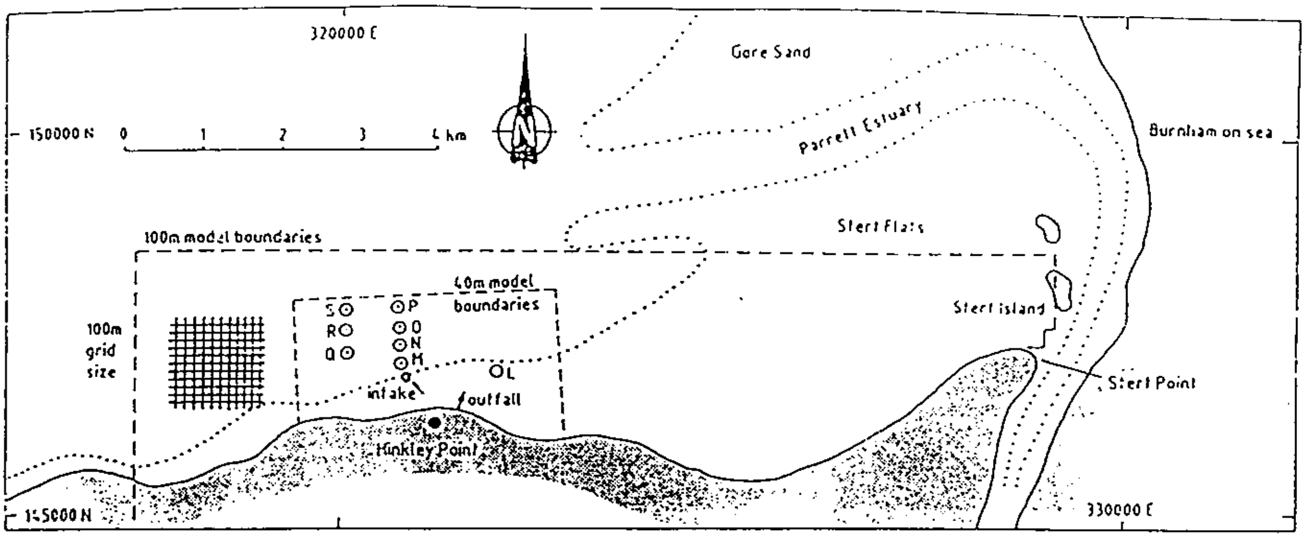


Fig A2 Layout of Hinkley model

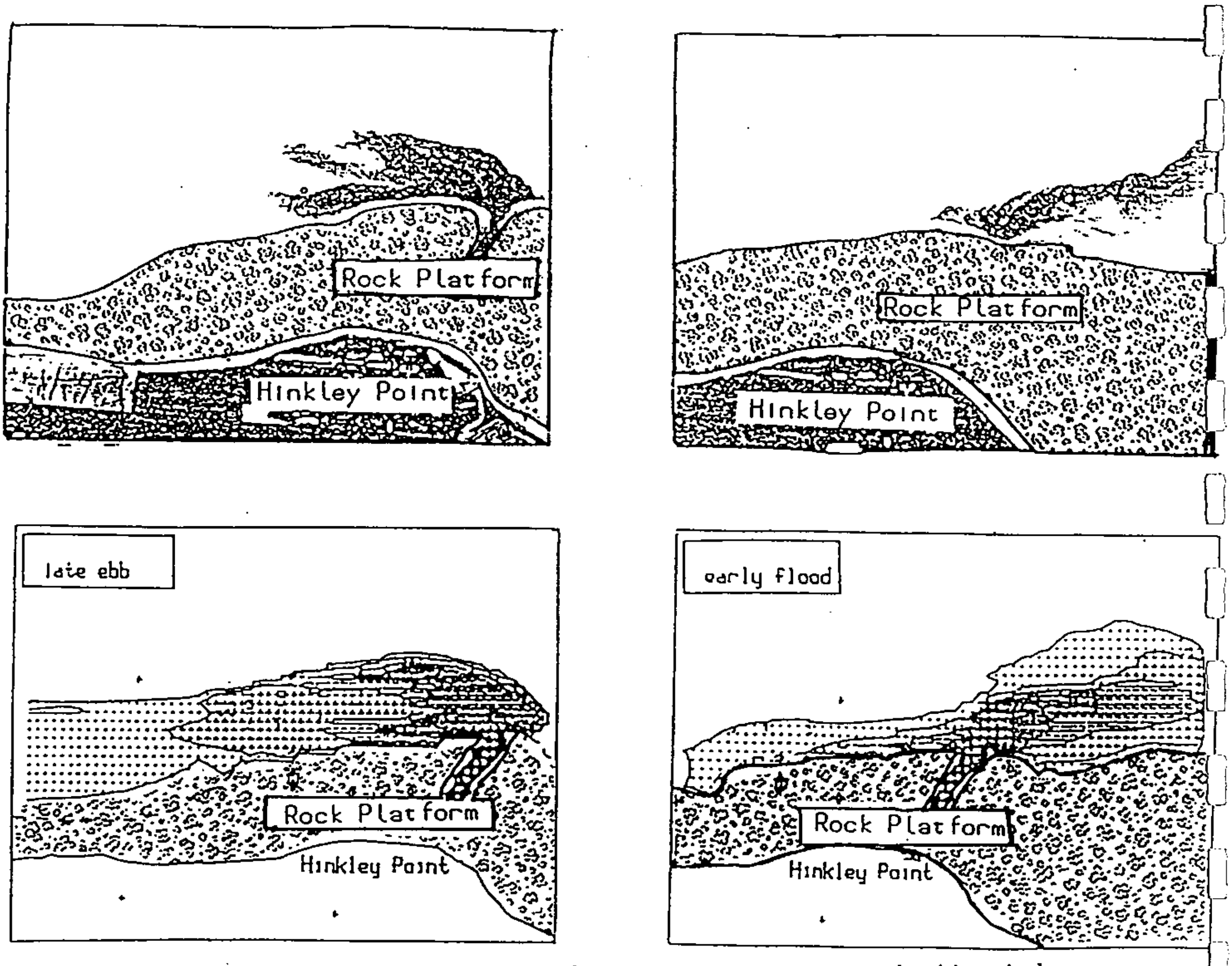


Fig A3 Model top layer temperatures at Hinkley compared with infra-red images of plume

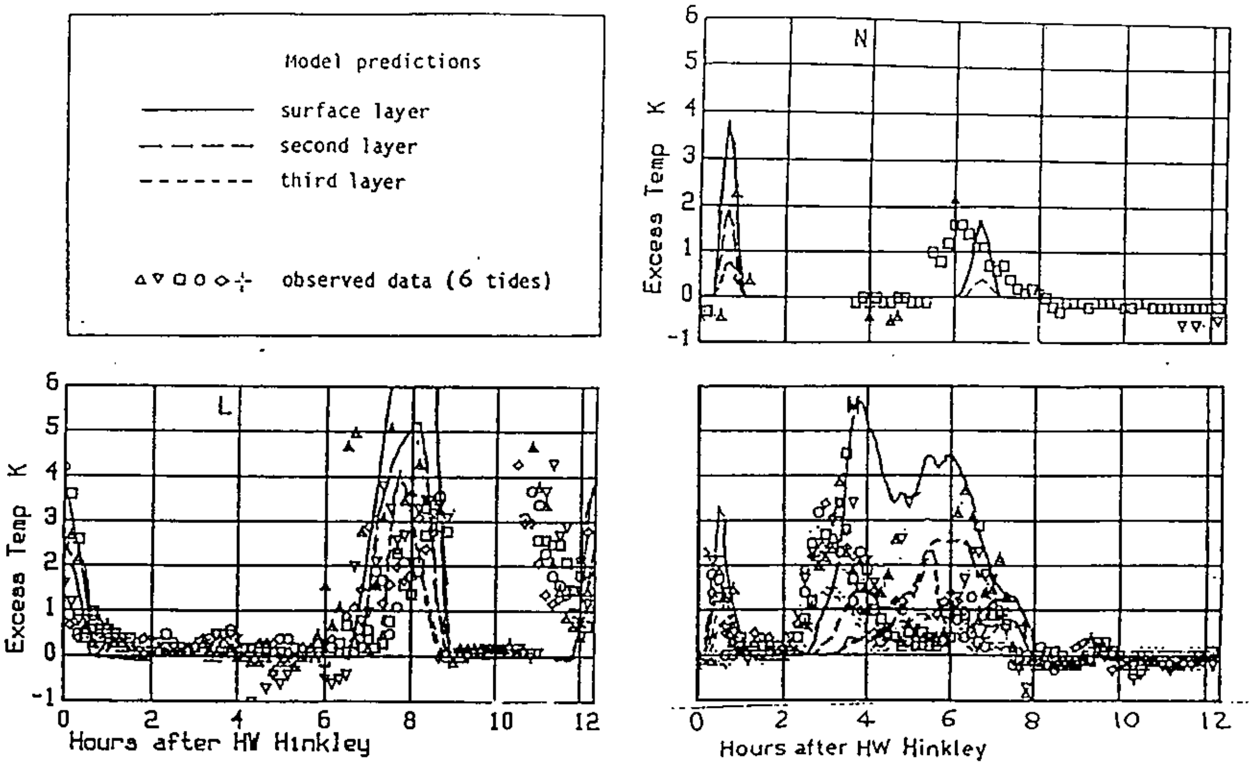


Fig A4 Temperature variations at Hinkley

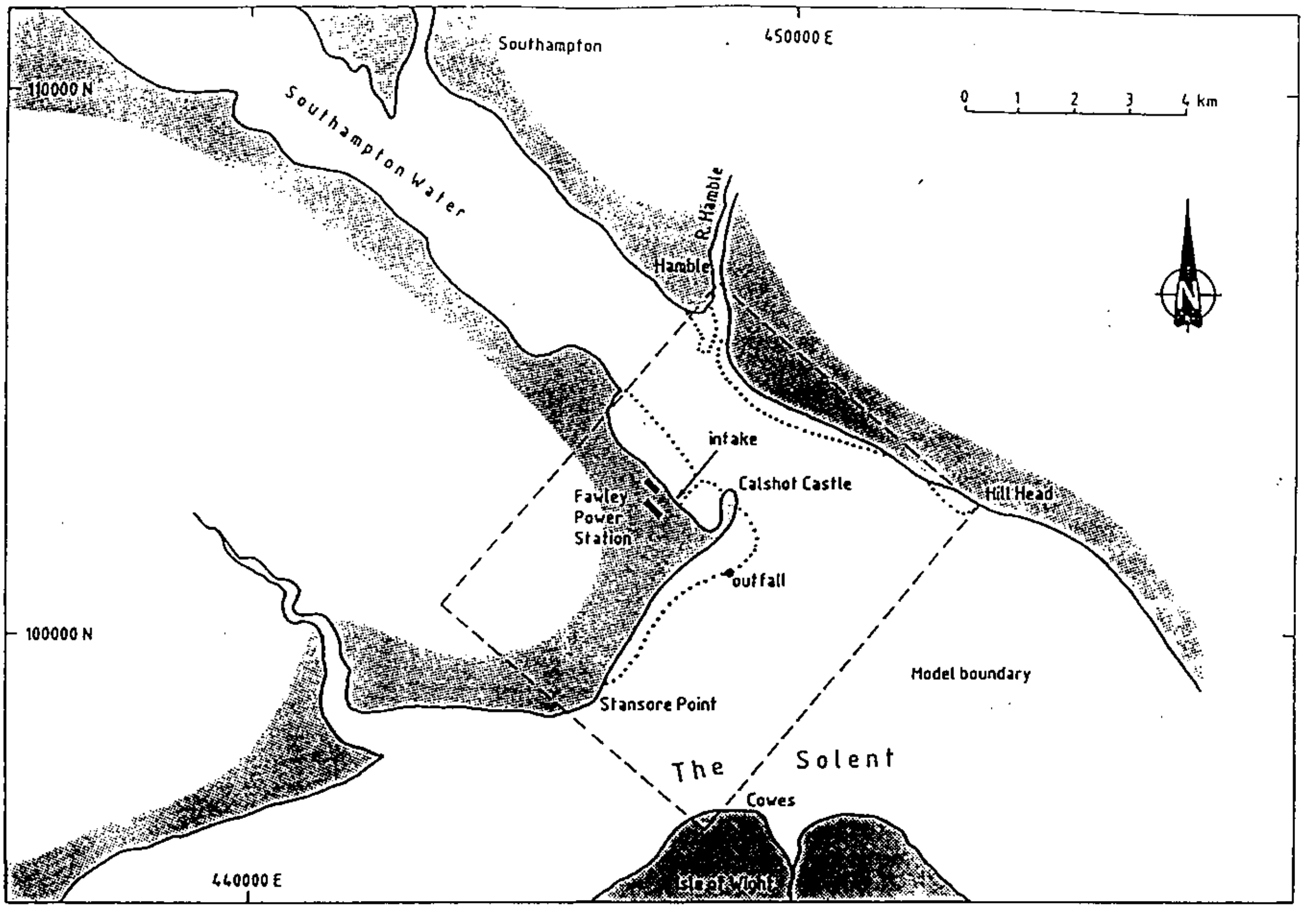


Fig A5 Layout of Fawley model

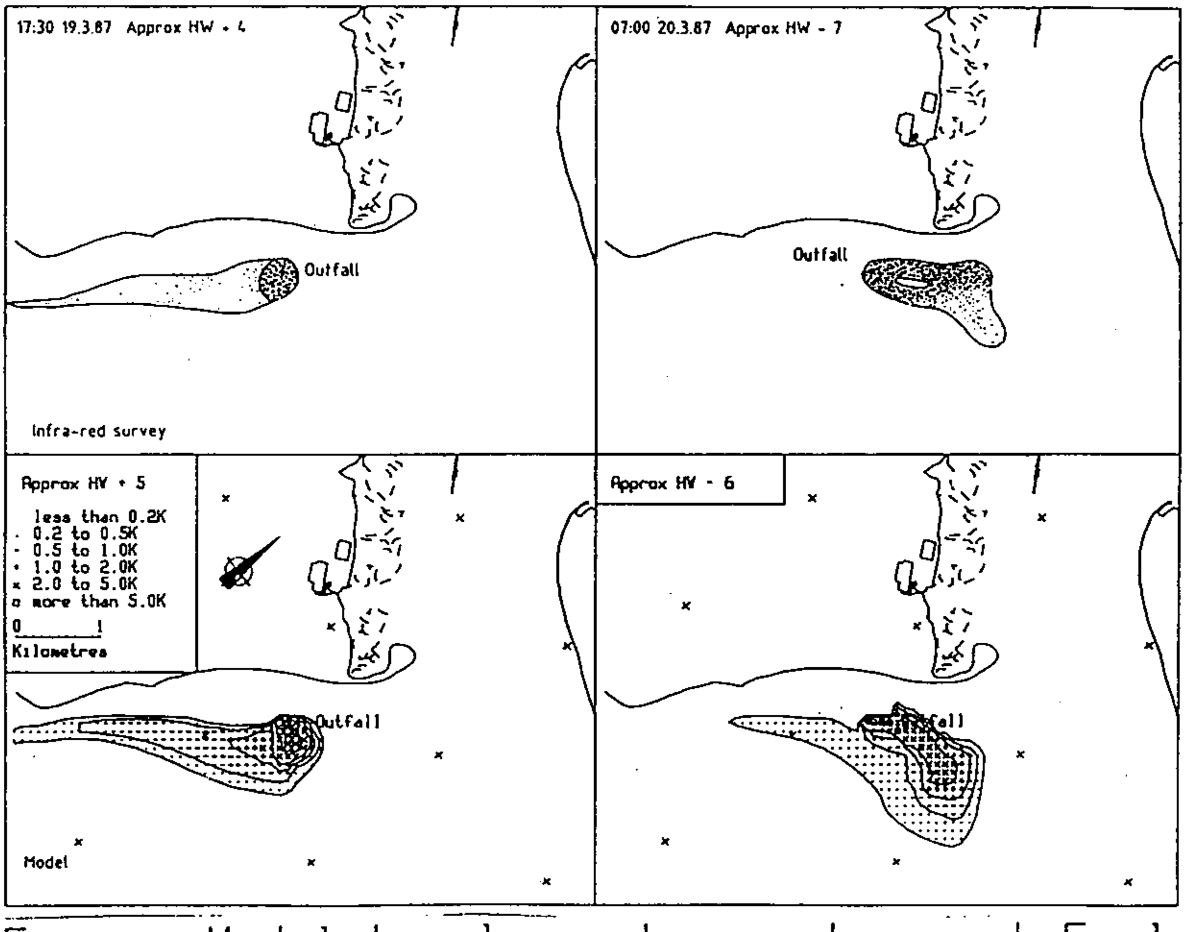
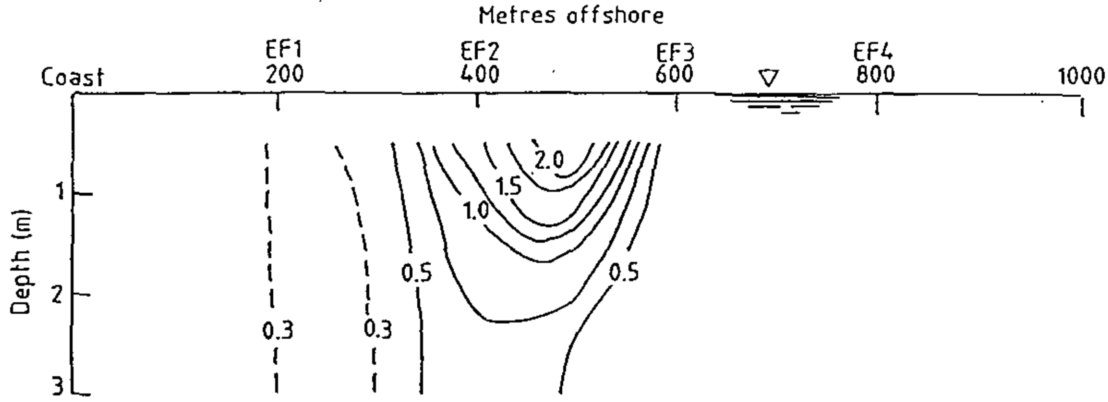
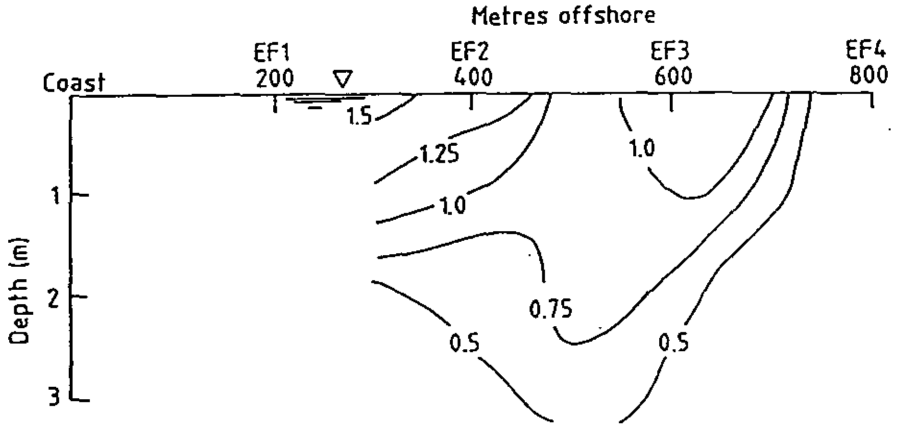


Fig A6 Model top layer temperatures at Fawley compared with infra-red images of plume



Model results High water +2.00



Observations 07:15 GMT, 19 June 1987

Fig A7 Temperature cross-sections at Fawley

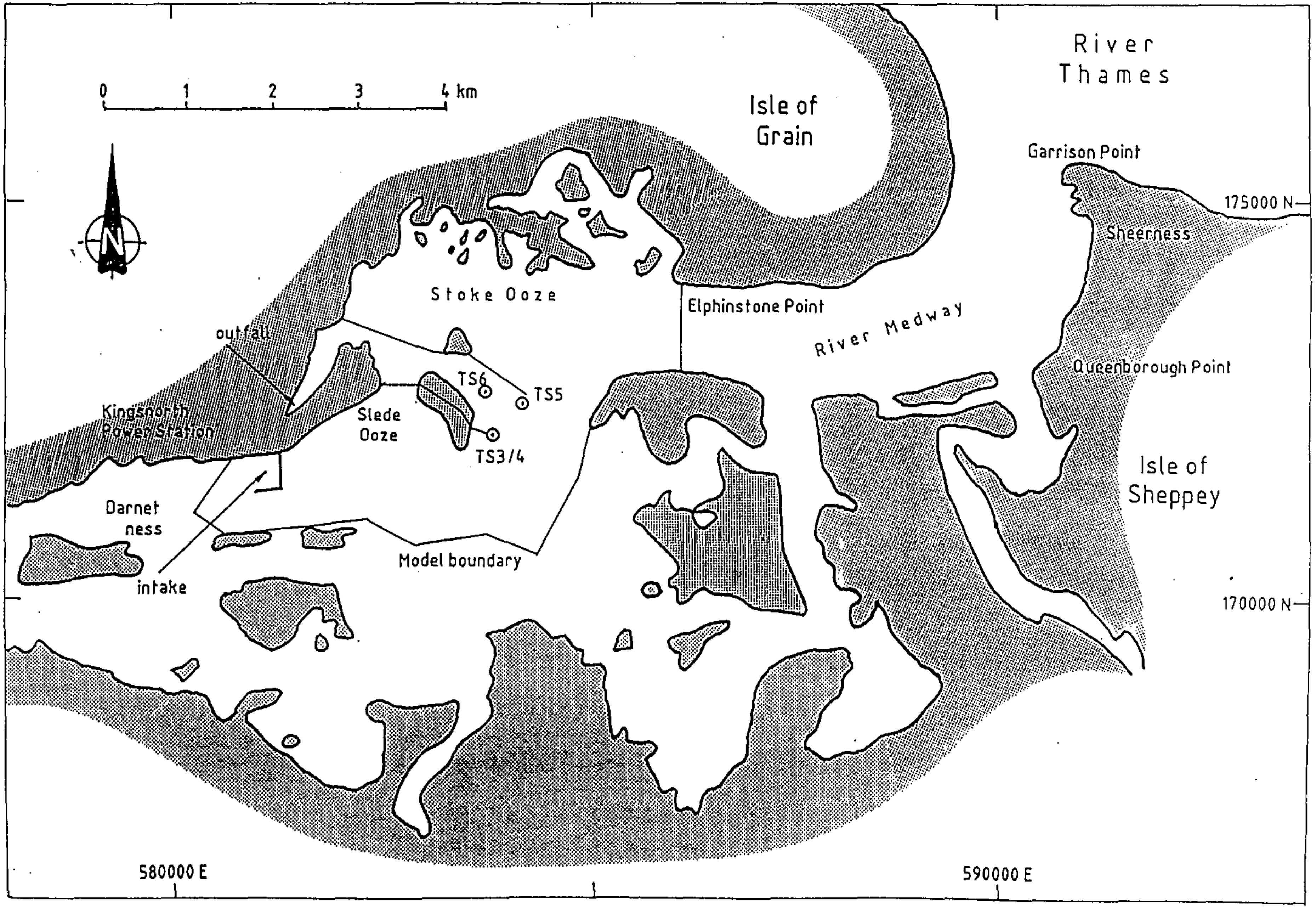


Fig A8 Layout of Kingsnorth model

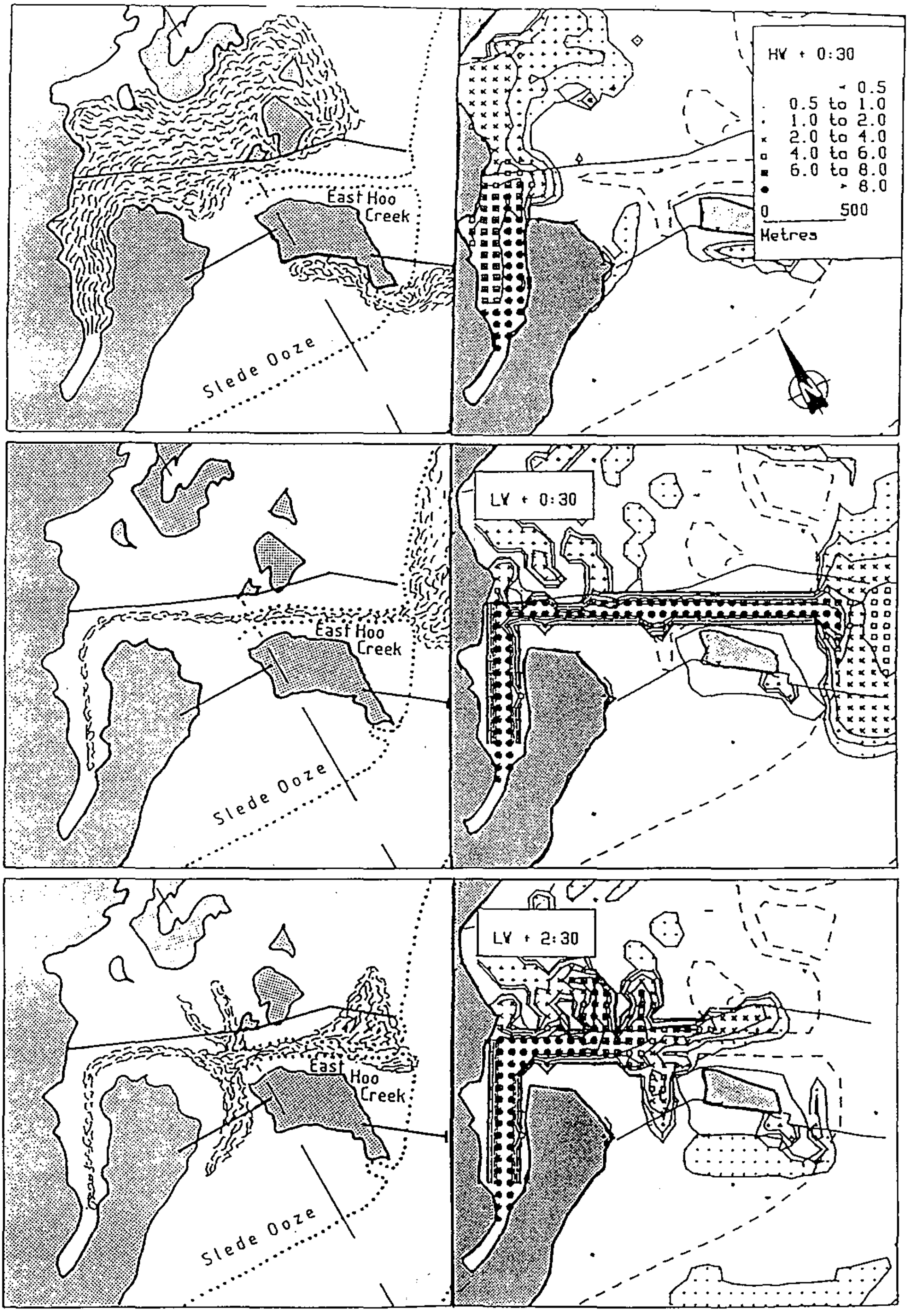
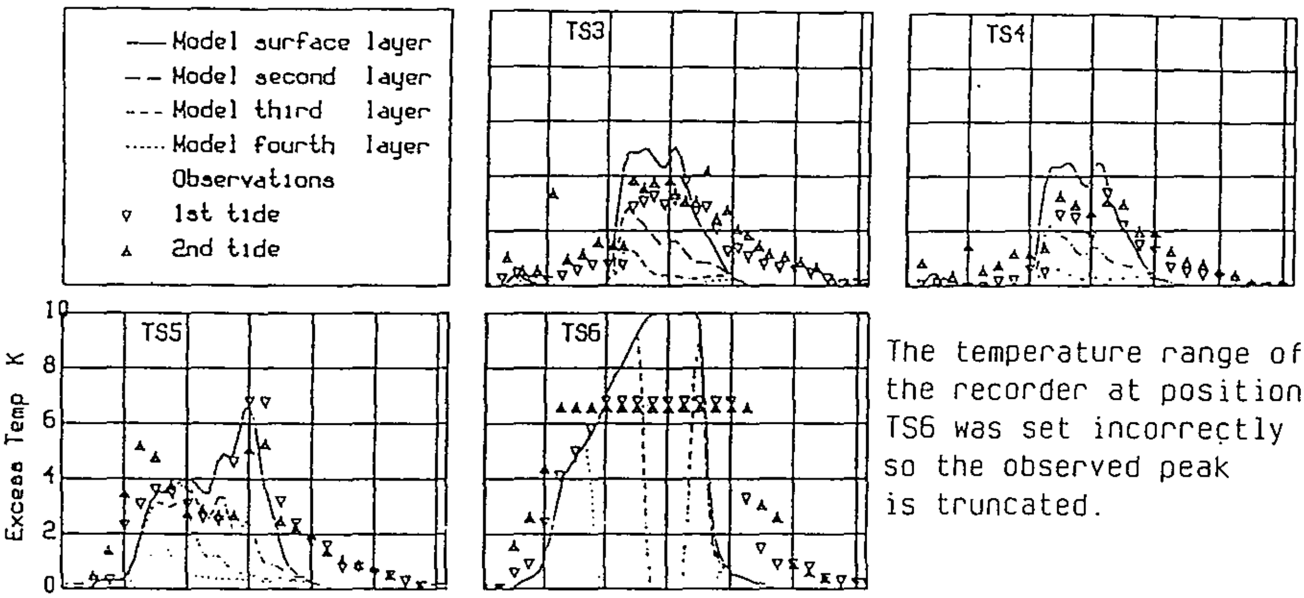


Fig A9 Model top layer temperatures at Kingsnorth compared with infra-red images of plume



The temperature range of the recorder at position TS6 was set incorrectly so the observed peak is truncated.

Fig A10 Temperature Variations at Kingsnorth

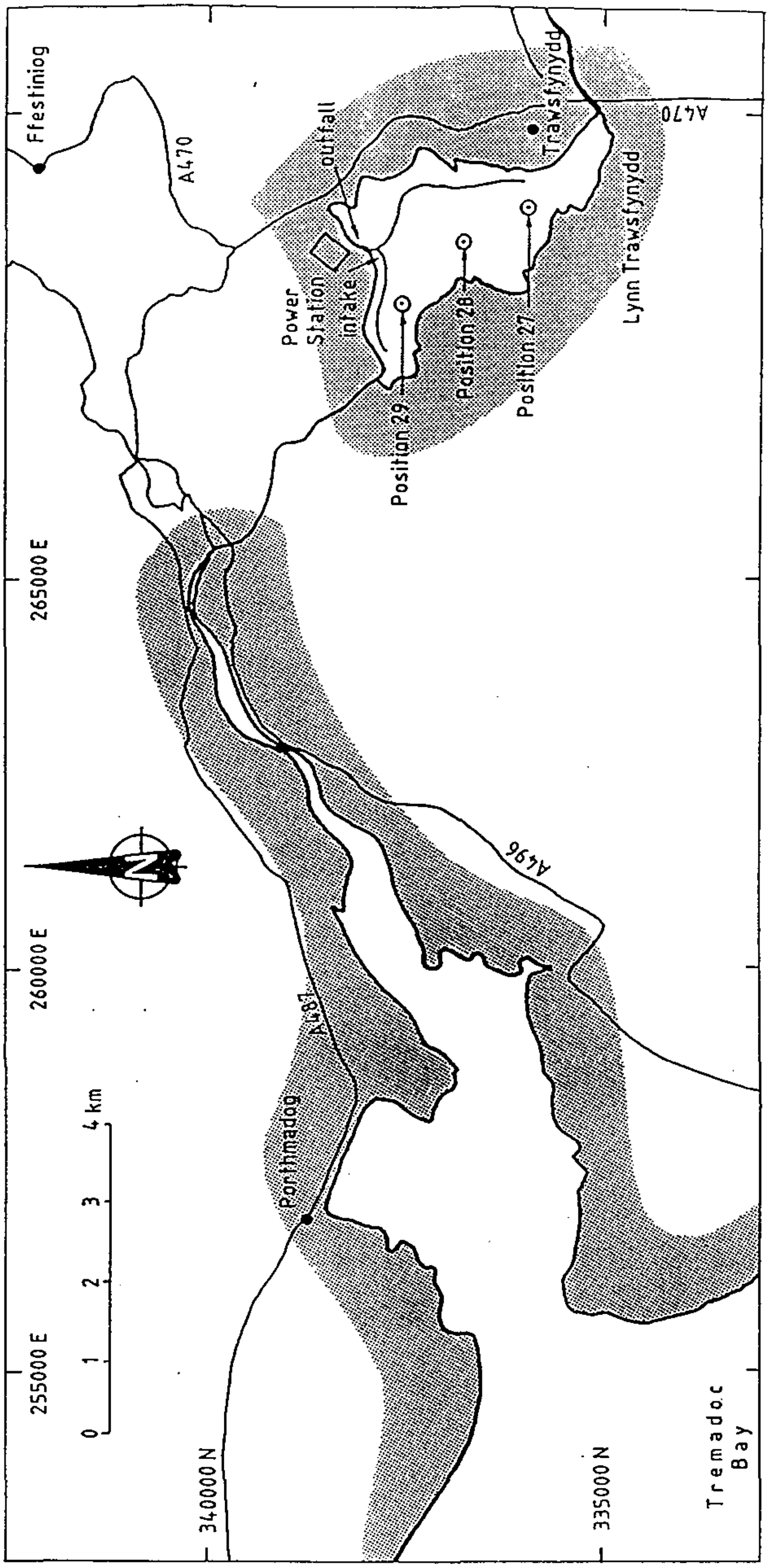


Fig A11 Layout of Trawsfynydd model

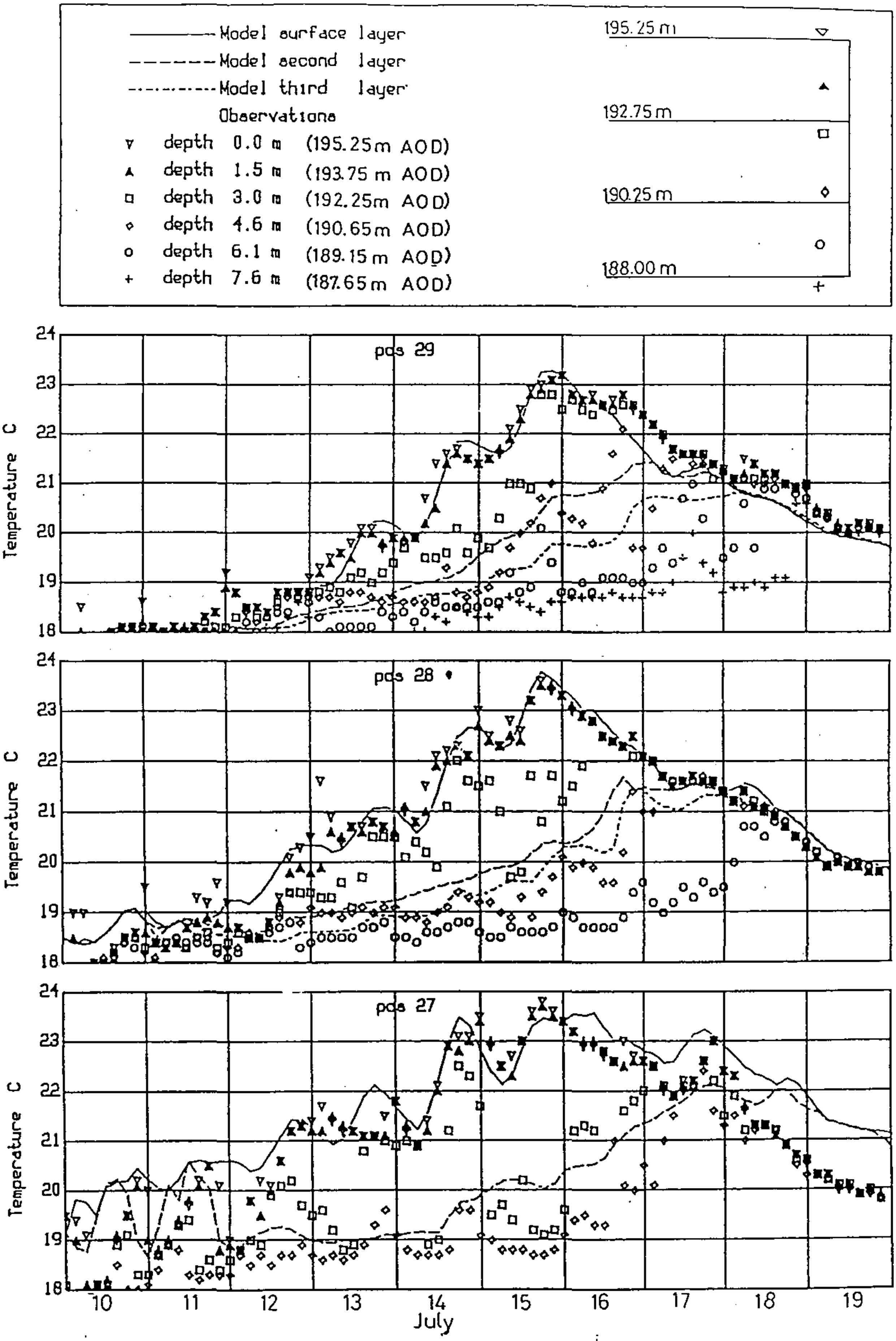


Fig A12 Temperature variations at Trawsfynydd

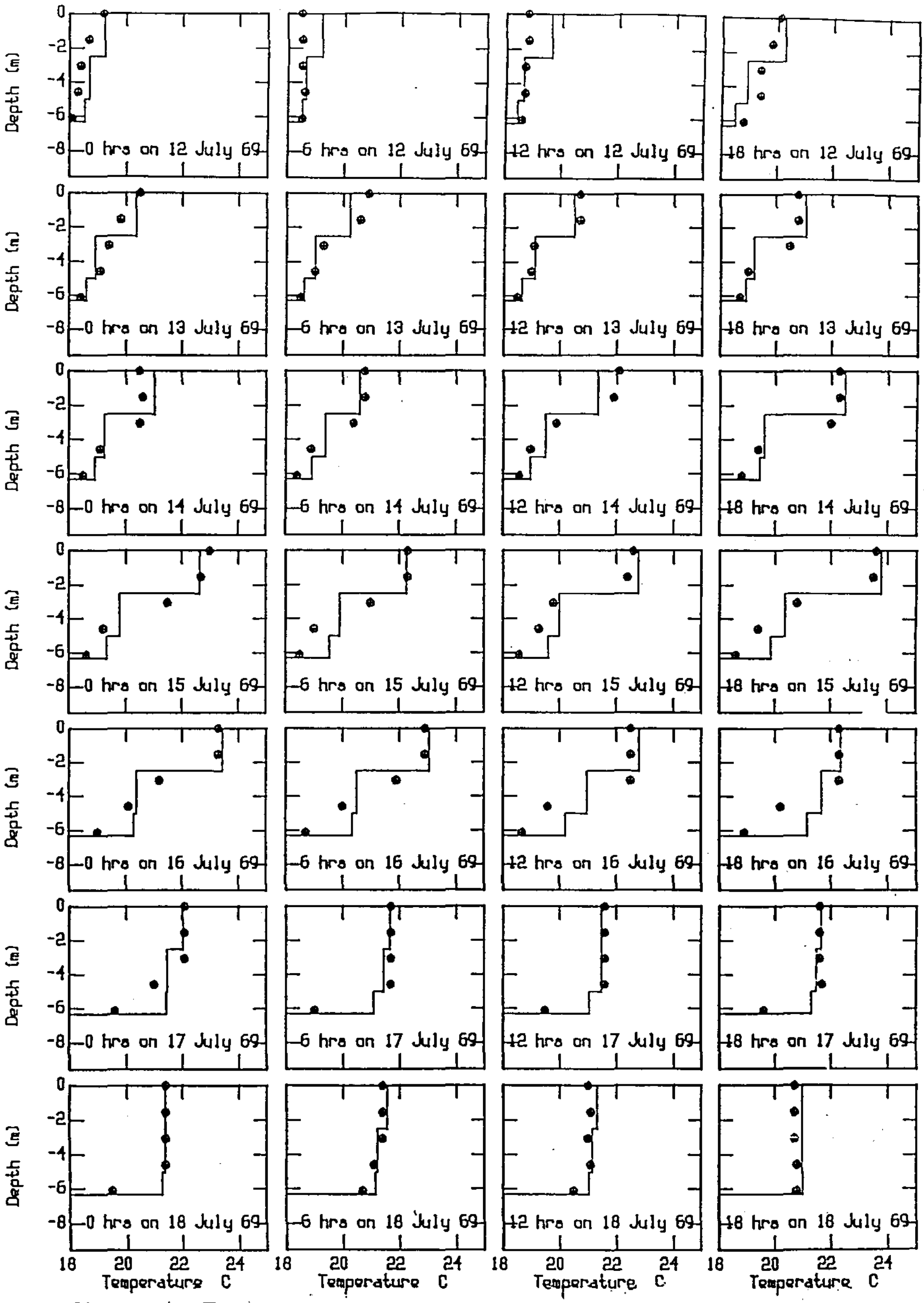


Fig A13 Temperature profiles at Trawsynydd

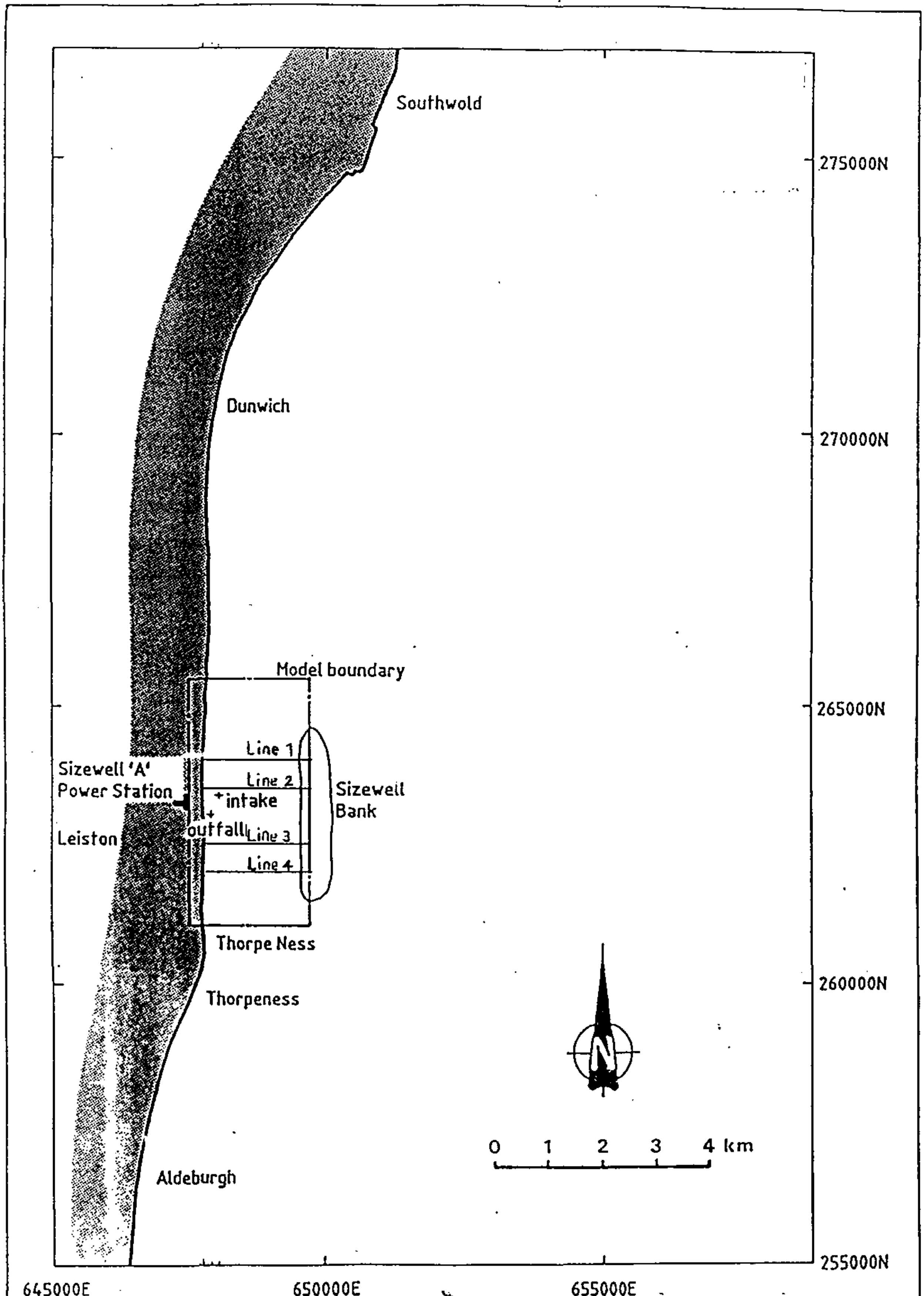
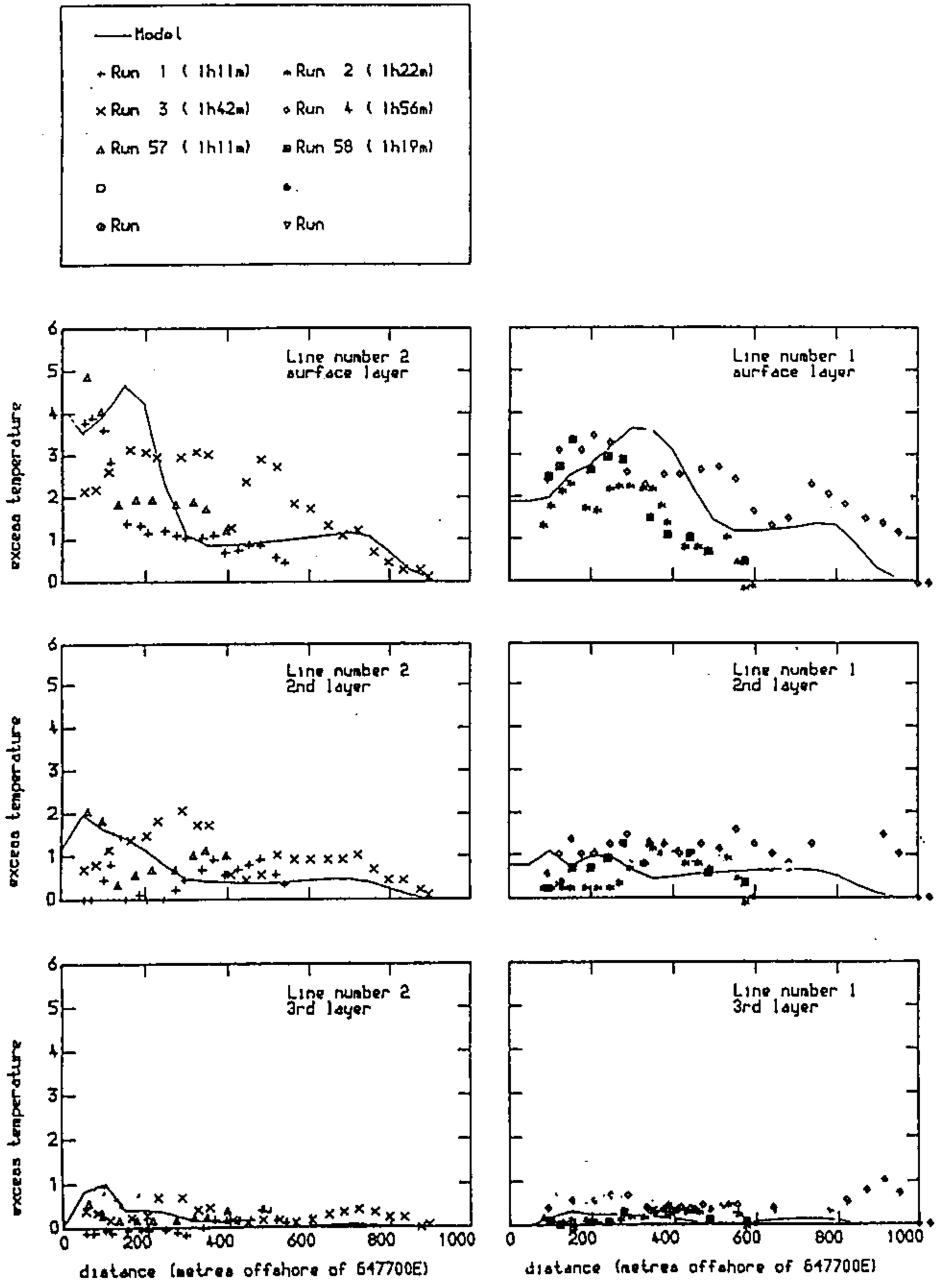
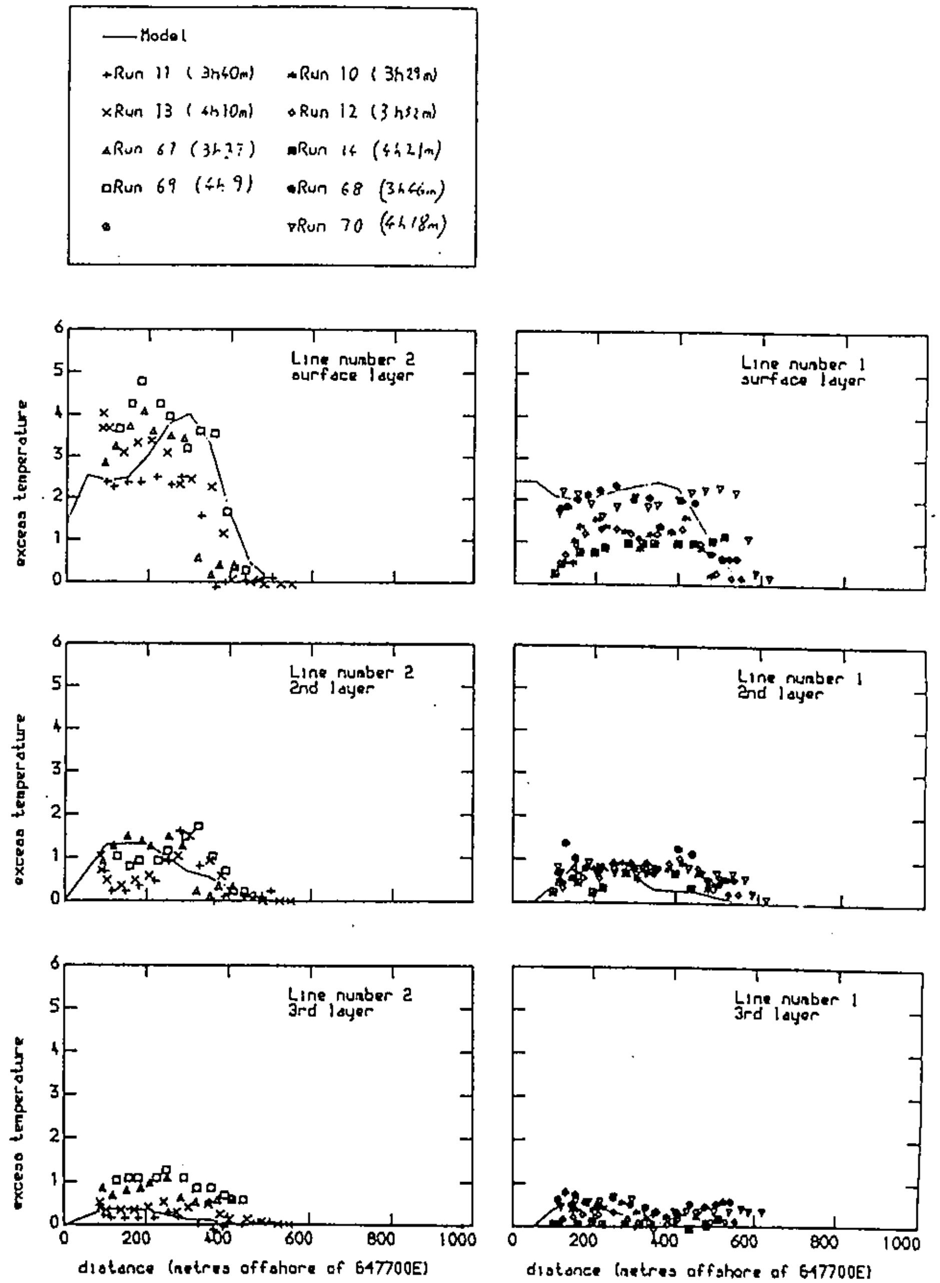


Fig A14 Layout of Sizewell model

Fig A15 Observed and model plume transects at Sizewell, ebb tide

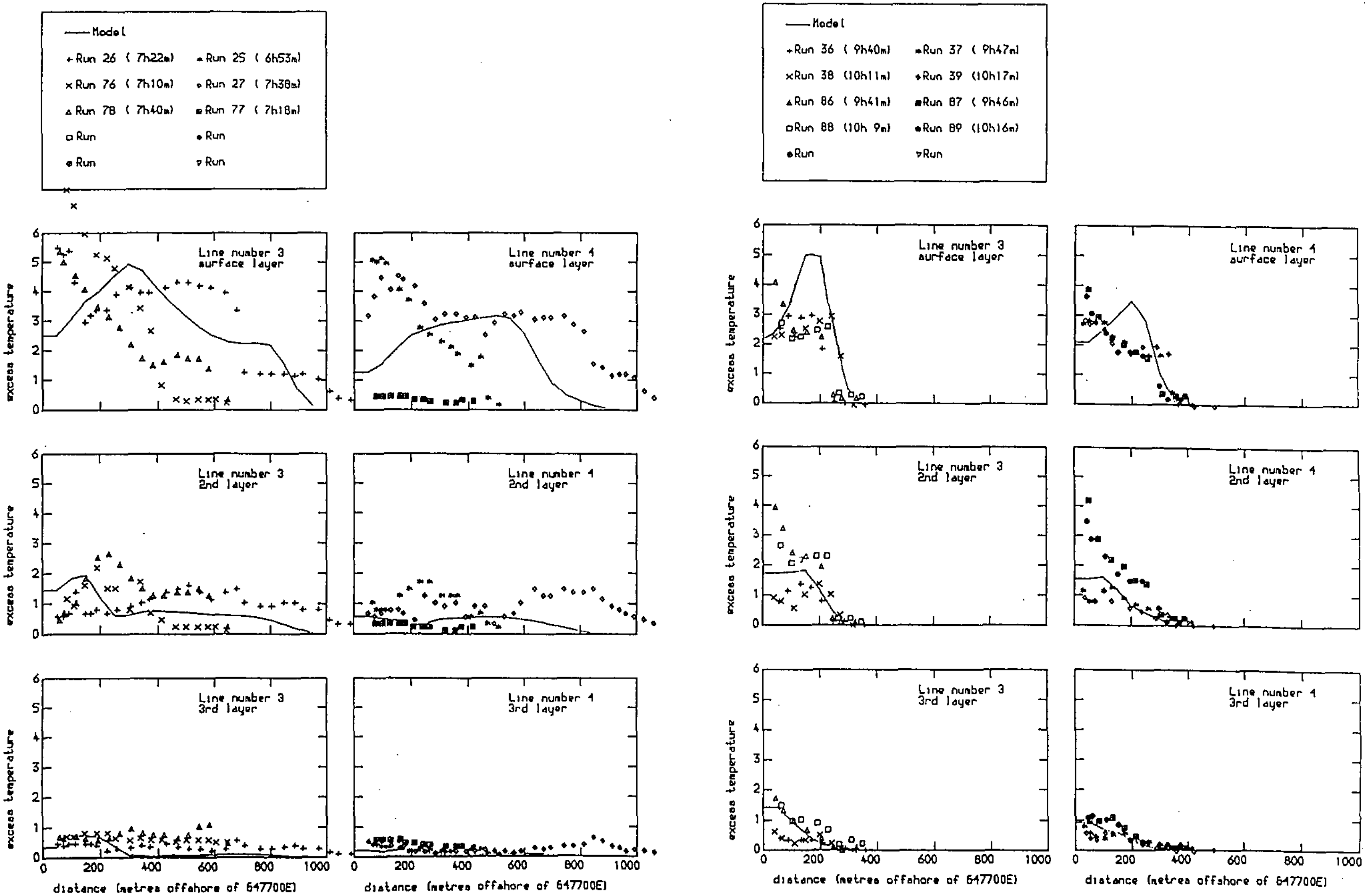


a) Plume transects 1.5 hours after HW slack



b) Plume transects 4 hours after HW slack

Fig A16 Observed and model plume transects at Sizewell, flood tide



a) Plume transects 7h 20mins after HW slack

b) Plume transects 10 hours after HW slack

Further Comments and Responses

1. EPD NPG ( ) in EP 2/H4/07

2. EPD ( ) in EP 2/H4/07

Environmental Protection Department
Noise Policy Group (ref ( ) in EP2/H4/07)

	Comments:	Responses:
3.4.2	The calculated "existing" traffic noise level is probably very much on the high side. During the peak hour, it would be impossible for the vehicles to travel at 80 km/h. Also, most NSRs are much more than 4 m away from Connaught Road Central. To give a better picture, noise survey should be conducted at representative NSRs, for example, at bottom floor and top floor of NSR3 and NSR5.	As stated in previous telephone discussions, there is insufficient time to undertake noise monitoring prior to submission of the Final Report on 2 or 6 October. The calculated traffic noise level has been revised to include a speed range from 40-80 km/h, and a sentence added noting that noise levels will be lower at the upper floors of sensitive receivers.
Table 3.13	Your regression analysis deviates slightly from our in-house data. Please revise the table as follows, Distance (m) — Correction (dB(A)) 301 to 317 — 63 318 to 351 — 64 352 to 387 — 65 388 to 427 — 66	We note that there is a minor difference between our regression analysis and your in-house data. Our regression analysis approximately follows the equation [Correction = 23.33 logD + 5.11007] and your in-house data appears from back-calculation to follow the equation [Correction = 23.33 logD + 5.1142]. There is only a difference of 0.0043 in the constant term which is quite insignificant. Nevertheless, the text has been amended as per your request.
3.4.4	NSR1 should be located in Connaught Road Central instead of Connaught Road West.	Text amended.
	NSR2, NSR5 and NSR6 are not all directly affected by the traffic noise of Connaught Road Central. Some facades of these NSRs have no direct line of sight to Connaught Road Central and an Area Sensitive Rating "B" should be assigned to these facades.	Previous comments on this point received from EPD in writing and by telephone queried the classification of NSR3, not NSR2. NSR5 has already been classified as an ASR "B" in the original text. Reference to NSR3 was amended to a "B/C" as discussed by telephone. The classification of NSR2 was not previously queried.
	For NSR2, the predicted maximum noise level of 85 dB(A) is alarming. The suggested overestimate should be quantified by calculation otherwise concrete noise reduction measures should be recommended.	Please refer to response to original comment on this issue, where the reasons why the overestimate cannot be calculated were stated.
	High quality glazing and central air-conditioning cannot attenuate <u>external</u> noise. Please amend the relevant statement.	Text clarified.
3.4.6	"Clause 7.9" in the second paragraph should be revised as "Clause 7".	Text amended.

Liquid Projects Group

2(a) There is <u>NO</u> way I can advise you whether we accept the mitigation measures proposed - the improvement numbering is different to previously submitted ones and no diagrams are provided to show which is which. The cost estimates are also all different to those on the draft report. I just cannot compare Table 2 in the Executive Summary and Table 2.2 in the Draft Report.

Subsequent to submission of the Draft Final Report, we understand that DSD undertook manhole inspections to investigate a number of the cross-connections identified. Confirmation of these and agreement on which could be rectified was received from DSD on 1 October. The report text was revised and a draft executive summary sent out for comment on the evening of 1 October. A figure to show the locations of the revised mitigation measures could not be prepared within this short timescale for circulation with the draft summary, but was completed for inclusion in the Executive Summary (and Final Report) which was printed and submitted to SPEL on 6 October, after the bank holiday.

While we appreciate the difficulties in reviewing material without adequate illustration, the time constraints involved in meeting SPEL's deadline for the EPCOM meeting (then set on 13 October) precluded the provision of a diagram and the possibility of a normal review period.

(b) <u>Page 2, 2nd paragraph last sentence</u>

I have at least pointed out four times before that <u>NO</u> information on the possible reduction from any measures has been provided in the Central SMP (CW3). It only gives the current pollution situation. This last sentence again gives the impression that the reduction is obtained from CW3. It is pointless for me to give the same comments time and time again without getting any satisfactory response until such time when the project is so advance or urgent that I am forced to make a decision whether to accept any unexplained assumptions (and invariably to accept them).

Section 8 of the Central Western and Wan Chai West SMP Draft Final Report discusses the potential reductions in polluting load which might result from various mitigation measures in terms of X kg BOD/d (see Table 8.2) and suggests that it may be possible to achieve an overall reduction of 27% of the total pollution load observed in the field survey by implementing certain remedial measures. A similar approach was taken in the Draft Final Report to estimating the potential pollution load reductions which could be achieved by various mitigation measures. While it was necessary to assume percentage reductions based on our experience from the SMP Study in order to carry out the requirements of the Study Brief, it is acknowledged that these are only estimates and that the effectiveness of any mitigation measures recommended would need to be evaluated by further field investigations. The text has been revised in the Final Report to delete references to percentage load reductions, except where these had to be assumed for the purposes of modelling. It has also been recommended that the efficacy of the measures proposed are investigated as far as possible under the CW3 extension survey, which at present only covers catchments C and D. The revised Final Report and Executive Summary now recommend that other catchments, notably F and J1, be included in the survey, so that the practicality and value (in terms of pollution reduction) of the measures proposed can be determined before they are implemented.

The positions of the model boundaries and the dimensions of the model area were given to EPD before the model study began. While it is always preferable to model as large an area as possible, constraints are imposed by the fine model grid required to resolve local features and the scope of work possible within the project deadlines. At the beginning of the study, it was our opinion that the modelled area was sufficiently large and the boundaries sufficiently far removed from the local discharge points of interest to allow a successful simulation of local impacts. Having completed the simulations, the results from the flow and thermal model indicated that the main plumes were contained within the modelled area and it was confirmed that the location of the model boundaries would not have an undue impact on the model results.

We think there has been a misunderstanding. HWR did not claim that 25 m grids had been used in Hong Kong before, only that 25 m grids are not uncommon in three-dimensional models. The 25 m grid is being used in the Rambler Channel model following discussions with EPD and this current model study was mentioned simply to indicate that EPD have accepted the use of 25 m grid models. It was not intended to suggest that this study had been completed.

3(c) The stratified temperature zones predicted by the 3-D hydraulic model seems to have no effect on the DO, chlorophyll growth nor the *E. coli* die off rate, and should have been evaluated further.

The model results indicated that the significant temperature increases were confined to the surface layers of the water column in the three-dimensional model and that the lower layers experienced a much smaller temperature increase. The water quality model was a two-layer model and so these surface increases would have been averaged over the much thicker top layer of the two-layer model giving a much lower average increase in water temperature than was predicted in the surface layer of the three-dimensional model. The heated water is flushed by the tidal flows and so the water affected by the higher temperature is constantly changing and is subjected to the higher temperature for a limited period only.

The impact of temperature on bacteria mortality rates was considered during a study of the impact of a power station cooling water discharge on the local receiving waters in Hong Kong. It was reported that the temperature dependence of the night time mortality rate could be expressed as $T_{90} = 960/T$ where T is the water temperature in °C. Considering the uncertainty in mortality rates caused by, for example, changes in salinity and turbidity and the large variation in mortality rate between bright sunlight during the day and nighttime, for the typical water temperature in Hong Kong, an increase in water temperature of the order of 1°C cannot be meaningful within the accuracy of any simulations possible.

In assessing the simulations, in the absence of detailed field data for comparison, it is most important to compare the predictions for the present situation with those following the introduction of the reclamations. The warmer water distributions are not the same for both situations and, in assessing the impact of the different water temperatures on water chemistry and mortality rates, it should be the differences in water temperatures between the two situations which should be considered rather than the differences in water temperature between each situation and the far field background temperature. On the whole, over most of the area affected, the difference in temperature between the existing situation and that following the reclamation must be smaller than between either situation and the far field background temperature. As a result, in this study, the temperature effect on water chemistry and mortality rates must be considered a secondary effect beyond the resolution of present knowledge.

Section 3.1.4

(c) The dredging impact assessment was done assuming a dredging rate of 8,000 m^3/day and 5% "losses to the water column on dredging". The dredging method which corresponds to these rates was not specified. Section 3.2.5 recommends a closed grab dredging method. Is removal of 8,000 m^3/day realistic for this type of dredger ?

The rate of removal of marine mud is determined primarily by the size and number of dredgers, not the type of plant. The type of plant and the way in which it is operated determine the proportion of the removed material which is lost to suspension. Use of sealed grabs had already been specified in the Contract Specifications for Central Reclamation prior to the Focussed EIA being carried out, thus use of this type of plant was an inherent assumption. As stated in the text, the assumption of 5% losses with a sealed grab dredger is considered to be conservative and will tend to overestimate the potential polluting loads.

The pollutant loading was based on sediment results from VS6. However, sediment results are also available at station VS5 which is closer to the site. These VS5 results should have been included in the load assessment.

Sediment data provided by EPD on another study were used for the assessment. VM5 was not used as it does not appear to be included in the 1987-91 EPD data set. Early 1987 data for VM5 indicate very similar characteristics to VM6 for 1991 in terms of specific gravity, dry weight ratio and COD concentration. Within the accuracy of the sampling and analytical methods, and temporal variations, use of the VM6 data is considered to be reasonably representative.

Section 4.4 of the study brief also asked for an assessment of impacts from the placement of fill and the potential for release of metals and sulphides. This area does not appear to have been addressed.

Section 4.4 of the Brief requires, *inter alia*, an assessment of the potential increase in turbidity. The potential increase in suspended solids loading has been quantified and the effects of this summarised qualitatively in Table 3.7. Translation of sediment loads into steady state suspended solids concentrations in the water column would require modelling, which was not specified in the Brief. Increases in turbidity from fill placement will be low in comparison to dredging, since marine sand with a low fines content will be used and settlement will be more rapid due to the larger particle size. Any controls required on the basis of dredging should therefore also be appropriate for controlling turbidity generation from fill placement.

The potential for release of metals was considered briefly in Section 3.2.4 on Marine Muds. However, since the Contract Specification already includes the requirement for a sealed grab, which is specified by EPD as being suitable for removal of Class C contaminated mud, it is inferred that the potential for release of metals will be low and within acceptable limits (ref Section 3.2.5).

Release of other compounds will also be lower using this dredging method than other methods which cause greater solids suspension.

Sulphides are of concern in that their release from anaerobic sediments could imply a change in speciation and release of metals present in sediments as insoluble sulphides. However, no data are available on sulphide levels in sediments in this area since this parameter is not included in EPD's routine sediment monitoring programme nor to our knowledge, in any other field studies carried out in the area.

Para 4 Dredging is predicted to double the pollutant loads, however, the resultant impacts on the embayed area have not been identified. Nor has the cumulative effect of dredging and sewage impact to the water bodies been assessed. [5 ton/day of COD from dredging is more than 7 times the sewage loading at culvert F]. In view of this fact other mitigation measures are needed in addition to the monitoring controls and working methods in the contract specification.

Impacts from dredging have been summarised qualitatively in Table 3.7 and the cumulative impacts from dredging and stormwater discharges discussed in Section 3.1.5 (a) para 4. Quantitative assessment would require modelling, but neither this nor evaluation of cumulative impacts was explicit in the Brief.

The value of extensive modelling of dredging impacts based on limited input data is perhaps questionable in the context of EPD's concern over the existing modelling exercise; it is possible to say that there will be a period of 2.5 months when dredging impacts are likely to exacerbate water quality locally at points with the embayment. Dredging impacts will be minimised by both the methods specification and the performance specification included in the Contract; should the Contractor exceed the performance specification he is required to amend his working methods or deploy appropriate mitigation measures, which could include the use of silt screens. If EPD consider that the performance specification is inadequate, this can be revised on advice .

Table 3.7

The fact that floating refuse may choke up the cooling water intakes of ships and may cause damages to engines has not been mentioned.

Noted.

Environmental Protection Department (ref: in EP/H4/07)

Comments:		**Responses:**
	Section 3.1.3	
(a)	From the model results' contour plots, it is doubtful whether the loading of culvert F has been included in the model, especially for ammonia (an indication of raw sewage discharge) in Figures 3.39 to 3.46. Culvert F is not shown as a discharge point (i.e. a high concentration point) in figures showing the partial reclamations. However, culvert F is shown as a discharge point the ammonia loading at F is comparable to the loadings at A, C or D. As well as the discharge points, A, C and D, F should be shown.	In all previous modelling exercises using WAHMO, discharges from the outfalls (storm or sewage) were just applied to the water quality as a loading to the model cells, no flow discharges were included in the flow model. In the present study, the flow model simulations included the effects of cooling water intakes and discharges, which effectively carried flow from or into inactive dry cells. The existing WAHMO water quality models would only be able to cater for these by applying additional source/sink effects upon the water quality model cells to maintain the flow continuity. Two approaches could be used: a) Assume both water and pollutants were removed at the cooling water intakes and added to the model at the cooling water discharges, as a result lower pollution levels would appear at the intakes while higher concentrations would appear at the discharge points; or b) Assume that only water would be extracted and discharged, so pollutants would be maintained at the cells where the cooling water intakes were located and had a dilution effect at the discharge point, such that higher concentrations would result at the intakes and lower levels at the discharges. It was expected that adopting either approach would produce different results in only local areas around the intakes or discharges. In the present study, the first approach was employed. The red spots shown at outfall F for the case with the completed Phase 1 reclamation were due to the effects of the large cooling water discharge of 5523 l/sec which was previously located elsewhere for the basecase and the partial reclamation.

(b) As stated in section 10 of our EPCOM issues paper, the pier obstruction of tidal flows at the Macau Ferry and Star Ferry and the resultant eddies, have been omitted. It is accepted that with obstructions there will be a small increase in local current velocities. However, this increase in velocity will reduce the total volume of bulk water flows, with a consequent decrease in the flushing capacity. Without the modelling of the effects of the piers, the local water quality impact might have been underestimated.

The model boundaries were set too near to the concerned area, and hence the simulations will be distorted by these preset boundary conditions.

The Rambler Channel model runs are being set up at the present time. Hence contrary to HWR's claim, the Central Reclamation was the first to have used a 25 m grid WAHMO model in HK waters.

Furthermore, the results at station C serve as an indicator as to whether discharges from outfall F, G and H were included. From Table 3.4 and Figures 3.11 to 3.30, the effects of the discharge from culvert F on station C, if it had not been included, would not have given the noticeable difference between the cases with and without the mitigation measures, as only the loads from outfall F and J1 had been reduced. Also, greater difference in the water quality between the cases of partial and completed reclamation would have resulted if outfall F had not been included in the former case. Therefore, there should not be any doubt as to whether the loading from culvert F was included.

It was assumed in the studies that the small obstruction to flows presented by the ferry piers would make little difference to total bulk water movements. Water speeds, and so friction losses, under the piers are low and it was assumed that, for example, a 15% reduction in flow area caused by the piers would be compensated by a similar increase in water speed so, to within the accuracy of the simulation, the total bulk water movement could be assumed to be unaffected. It is to be expected that there will be some reduction in total flows but these could not be resolved accurately by the model. A more detailed study requiring detailed field data would be required if it was thought necessary to resolve the expected impact of the piers on water movements and water quality.

Once the reclamations are in place, the nearshore water speeds in the vicinity of, for example, this Star and Macau Ferry piers will be much reduced (c.f. Points 12 and 15 in Figs 20 and 38 and 24 and 42 of Appendix 2 of the Final Report). Any small impact of the piers will then be greatly reduced also. As a result, while the model may possibly have overestimated the tidal flushing for existing conditions, it is likely that, for the simulations of the reclamation layouts, any very small overestimation in total flows would be much reduced. Consequently, when comparing the changes in pollutant concentrations between existing conditions and those following the uncertainty in the absolute concentrations of the pollutants modelled as a result of uncertainties in the loadings and boundary conditions used and the modelling procedure, it is thought that the relative changes in pollutant concentrations predicted by the models should not be underestimated.

Post Final Report Correspondence

Correspondence	Date	Reference Number
MCAL to UADO	7.10.92	91590/20/47
CES to EPD (NPG)	8.10.92	95060/F6494
CES to EPD (EAPG)	9.10.92	95060/F6510
HWR to CES	7.10.92	C&W
UADO to MCAL	16.10.92	(127) in 2/4/101 XIV
EPD to CES	21.10.92	(94) in EP 2/H4/07 IV
EPD to CES	22.10.92	( ) in EP 2/H4/07
Secretary for Planning Environment and Land Environment Division to DEP	27.10.92	(35) in PELB(E) 55/10/277 (92)
CES to EPD (EAPG)	30.10.92	95060/F 6713
CES to EPD (WPG)	9.11.92	95060/F6741
MCAL to UADO	2.11.92	91590/20/47
MCAL to UADO	3.11.92	91590/20/47
CES to EPD	9.11.92	95060/F6741
EPD to CES	10.11.92	( ) in EP 2/H4/07IV
EPD to CES	10.11.92	EP 72/W8/9
MCAL to EPD	10.11.92	91590/20/47
MCAL to UADO	12.11.92	JDB:EC:91590/20/47
UADO to EPD	26.11.92	UAH 2/4/101 XVII
MCAL to UADO	27.11.92	91590/20/47
EPD to CES	30.11.92	EP 60/G1/12-26
MCAL to SPEL	9.12.92	91590/20/47
UADO to Distribution	14.12.92	(36) in UAH 2/4/101 XVIII
EPD to MCAL	18.12.92	EP 2/H4/07VI
UADO to Distribution	29.12.92	(79) in UAH 2/4/101 XVIII
MCAL to UADO	7.1.93	91590/20/17 & 47
Balfours to UADO	7.1.93	7230/69/F8507
MCAL to UADO	7.1.93	91590/20/47
EPD to MCAL	18.1.93	EP/20/108/6S
MCAL to EPD	20.1.93	91590/20/47
UADO to MCAL	20.1.93	(16) in UAH 2/4/101 XIX
MCAL to UADO	26.1.93	91590/20/47
PMUA to CHE/HK	12.2.93	(19) in UAH 2/4/101
UADO to MCAL to EPD	25.2.93	(33) in UAH 2/4/101 XX
UADO to DSD	1.3.93	(3) in UAH 2/4/102 N

At UADO's request, correspondence relating to EPCOM and DB meetings has been omitted.

MEMO

From: Director, NAPCO	To: Project Manager (Urban Area) (Attn: Mr M.T. Wong)
Ref: in: NAP/T 3/10/13	
Tel. No: 829-6707 FAX:	Your Ref: (78) in UAH 2/4/101.XVI
Date: 9 December 1992	Dated: 12th November 1992

Central Reclamation, Phase I - Engineering Works
Focussed EIA Study
Programme of Construction for Mitigation Measures

We refer to your memo dated 12th November 1992 regarding the above and confirm that we have no adverse comments.

(J.P. Bovis)
for Director, NAPCO

Distribution

EPD	(Attn:	Mr. W.J. Farrell)
CE/HK&I, DSD	(Attn:	Mr K.R. Murells)
MTRC	(Attn:	Mr G. Turnbull)
DO/C&W	(Attn:	Mr H. Cho)
DLO/HKW	(Attn:	Miss Anita Lam)
CES/NA(Urban)	(Attn:	Miss Trevina Kung)
PTDB, TD	(Attn:	Mrs Irene Chung)
CHE/HK	(Attn:	Mr F.S. Tam)
CTE/HK, TD	(Attn:	Mr H. W. Chan)

cc. SPEL	(Attn:	Mr W. Hui)
MCAL	(Attn:	Mr J. Berry)

S6/CWR 2

香港地下鐵路公司

Mass Transit Railway Corporation

GPO Box 9916 Hong Kong

Our Ref. C/CM1/UA11/C2000
Please quote reference in all replies

Your Ref.

Date 23rd November, 1992.

BY FAX & BY POST

Project Manager/Urban Area
Territory Development Department, HK,
Urban Area Development Office,
12/Fl., Leighton Centre,
77, Leighton Road,
Hong Kong.

Attn.: Mr. M.T. Wong

Dear Sirs,

Central Reclamation, Phase I - Engineering Works
Focussed EIA Study
Programme of Construction for Mitigation Measures

We refer to your memo of 12 November 1992 requesting comments on the draft implementation programme for mitigation measures 7 to 18 proposed in MCAL's letter of 3 November 1992.

Measures Nos. 8, 9 and 12 have already been included in Contract UA11/91 as Portions Subject to Incorporation, and these have to be ordered within 26 weeks of commencement. As Maunsell correctly say some of the mitigation measures extend outside the current site area and negotiations with the contractor would be necessary.

We have no objection in principle to the draft programme. However, instruction to proceed should be given at the earliest possible time so that negotiations with the contractor can commence and to enable the contractor to properly plan and programme the works. We would add that contractually the time for completion of mitigation works currently contained in the contract is 1065 days (Section 8) and the imposition of the draft implementation programme would constitute a variation. It may be of course that the contractor could accommodate the programme without cost effect, but this would be subject to negotiation.

Yours faithfully,
for MASS TRANSIT RAILWAY CORPORATION

G.U. Turnbull
Construction Manager (1)

GUT/BR/ww

Proposed Arrangements for Implementation of Recommended Mitigation Measures

Improvement No.	Description	Source of Funding	Agency	Proposed Construction Programme	Cost HK$	Remarks
1	Lower Electrodes	DSD	DSD	Completed	–	
2	Desilting Trunk Sewer	DSD	DSD	on a regular basis	–	See Note 1
3	Sewer Upgrading	DSD	DSD	Sep 92 – Jan 93	–	See Note 1
4	Repair of Pipe	DSD	DSD	to be advised by DSD	–	See Note 1
5	Realignment of Culvert B	TDD+	UADO	Sep 94 – Sep 96	1,300,000	To be constructed under MTRC Contract 501
6	Expedient Connection	DSD	DSD	to be advised by DSD	–	See Note 1
7	Sewer Upgrading	EPD	DSD	Feb 95 – Jan 96	5,000,000	See Note 4
8	Sewer Upgrading	TDD+	UADO	Jun 93 – Sep 93	600,000	See Note 2
9	Sewer Upgrading	TDD+	UADO	Jul 93 – Jan 94	1,900,000	See Note 2
10	Expedient Connection	EPD	DSD*	Apr 96 – Jun 96	15,000	To be carried out in conjunction with No.17
11	Expedient Connection	EPD	DSD*	May 93 – Jul 93	15,000	To be carried out in conjunction with No.16
12	Sewer Upgrading	TDD+	UADO	Jun 93 – Oct 93	1,400,000	See Note 2
13	Sewer Upgrading	EPD	DSD*	May 93 – Jul 93	100,000	
14	Sewer Upgrading	EPD	DSD	Apr 96 – Jun 96	800,000	See Note 4
15	Sewer Upgrading	EPD	DSD*	Jun 93 – Oct 93	800,000	
16	Sewer Upgrading	EPD	DSD*	May 93 – Jul 93	150,000	
17	Sewer Upgrading	EPD	DSD	Apr 96 – Jun 96	760,000	See Note 4; Further investigation is suggested by DSD
18	Sewer Upgrading	EPD	DSD*	Jun 93 – Sep 93	290,000	

+ To be funded under item 2386CL

* To be entrusted to UA Dev O as suggested by DSD

Notes : 1. DSD works which are either about to commence or are on–going

2. These improvements have been incorporated in the Tender Document of Contract No. UA 11/91 as provisional items

3. Only Improvements No. 3,5,6 and 9 are totally within the site boundary of Contract No. UA 11/91

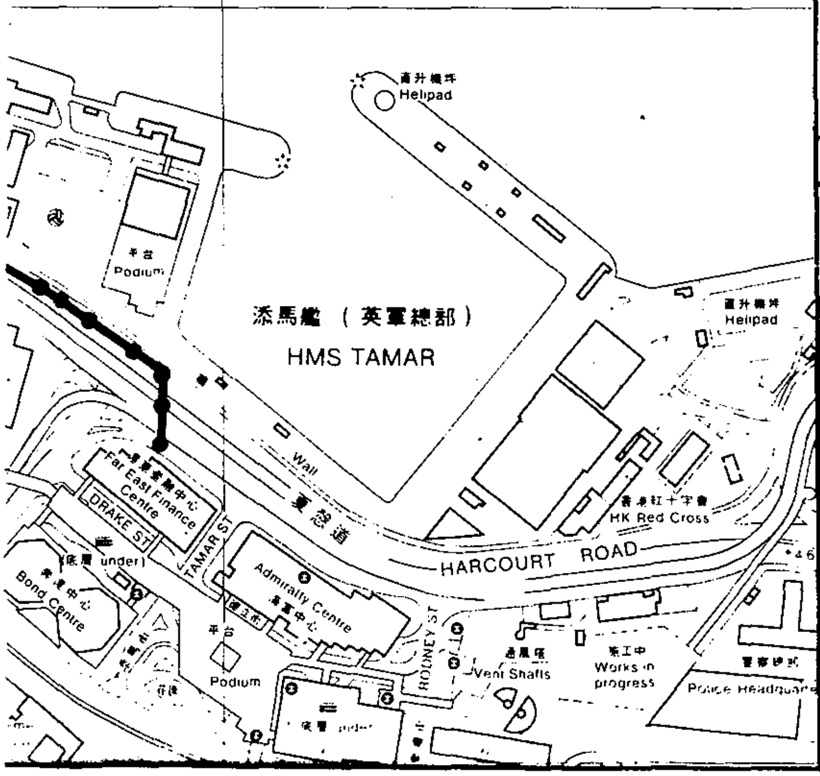
4. Due to road opening restrictions, these improvements can only be stated in 95/96. As such, DSD could carry out the works themselves

te boundary of Contract No. UA 11/91

only be stated in 95/96. As such, DSD could carry out the works themselves

LEGEND :

① Mitigation Meausre Number



	Name	Date
Drawn	W. F. Hui	10 Dec 92
Checked	K. F. Tang	10 Dec 92
Approved by		

Drg. Title :

Central Reclamation, Phase 1
Focussed EIA Study
Proposed Arrangements for
Implementation of Recommended
Mitigation Measures

Drg. No. :	Scale :
UA 358	1:5000

Office :

URBAN AREA
DEVELOPMENT OFFICE

TERRITORY
DEVELOPMENT
DEPARTMENT
HONG KONG

來函 YOUR REF: EP60/G1/12
本署檔號 OUR REF:
電話 TEL. NO.: 755 6162
圖文傳真 FAX NO.: 305 0453

Hong Kong Government
Environmental Protection Department
Branch Office
9th Floor, Tower 1, World Trade Square,
123 Hoi Bun Road,
Kwun Tong, Kowloon,
Hong Kong.

環境保護署分處
香港九龍
觀塘海濱道
一百廿三號
環貿商業中心
第一座九樓

16 July 1992

CES Consultants (Asia) Ltd.,
9/F., Parkview Commercial Building,
9-11 Shelter Street,
Causeway Bay,
Hong Kong.

(Attn.: Linden Coppell)

Dear Sir,

Central & Wanchai Reclamation
Package 1 Phase 1
Disposal of Dredged Mud

I refer to your fax ref. 94475/F5471 dated 9.6.92 and subsequent discussions between your Dr. T. Rudd and our Dr. M.M. Lau and Mr. P.H. Yuen.

In view of the higher cost of disposing contaminated mud and inadequate dumping capacity for contaminated mud, only the portion of mud classified as contaminated should be disposed of at the East Sha Chau pit and the remaining uncontaminated mud should be disposed of at gazetted spoil grounds.

Please determine the contour of contaminated mud using the attached guideline and prepare dredging profiles for the contaminated and uncontaminated mud for EPD's agreement.

My apology for this belated reply.

Yours faithfully,

(P.H. Yuen)
Ag. Senior Environmental Protection Officer
for Director of Environmental Protection

Encl.

b.c.c. S(WM)3
S(EA)5
S(WP)4
E(EA)11

Guideline on Drawing Contour of Contaminated Mud

- Similar to plotting a map

  1. Consider the contamination level in each depth by referring to the results of the testing. When the level of one metal exceeds the criteria, the mud is considered as contaminated.

  2. Plot the contour line which delineates the area of uncontaminated and contaminated mud based on the testing results by interpolation if necessary.

  3. Repeat the steps 1 and 2 until the contour line for the lowest depth of contaminated mud is drawn.

- Others to be considered in drawing the contour lines.

  1. It is expected that contamination near the outfall is more severe.

  2. For practical reasons, the dredging profile for contaminated mud may be different from the contour lines defining the volume of the contaminated mud. The dredging profile may be modified to suit the dredging operation.

Notes : It is the responsibility of the project offices to define and calculate the volume of contaminated mud for EPD's agreement based on the guideline in the Work Branch Technical Circular on Marine Disposal of Dredged Mud.

b:\mud\contour

MEMO

From CE/HK & I

Ref. 5(6) in D(HK)15/1/11 XV

Tel. No. 594 7195

Date 23.11.1992

To PM/UA

Your Ref. 78 in UAH 2/4/101 XVI

dated 12.11.1992

Central Reclamation Phase I - Engineering Works
Focused EIA Study
Programme of Construction for Mitigation Measures

With reference to your above memo, please find my following comments:

1. Improvement No. 7: The waiving of road opening restriction is fully supported.

2. Improvement No. 8: Your consultants are advised to check with the Hillside Escalator Drainage and Sewerage Review Report concerning proposed pipe sizes.

3. Improvement Nos. 10 & 17: Please refer to my memo to you dated 5.11.1992 in this series (copy attached). The upgrading works need be extended down Ice House Street to Connaught Road Central.

4. Your consultants are advised that in drawing up the detailed proposals of the improvement works they should take into account the findings and proposals contained in other consultants' studies such as Central, Western and Wanchai West SMP, LDC Drainage and Sewerage Review Report, and the Hillside Escalator Drainage and Sewerage Review Report.

(David Leung)
for Chief Engineer/Hong Kong & Islands
Drainage Services Department

dl.431

MEMO

From CE/HK & I	To PM/UA
Ref. in D(HK)15/1/11	
Tel. No. 594 7195	Your Ref. in
Date 5.11.1992	dated

Reconstruction of Carriageway and Footways
Ice House Street section between
<u>Chater Road and Des Voeux Road Central</u>

CHE/HK circulated in September an impending roadwork notice on the re-construction of carriageway and footways in Ice House Street section between Chater Road and Des Voeux Road Central. A copy of his circulation and my reply were copied to you for information.

2. Now that CHE/HK, in his attached memo, asks for a programme of the sewer upgrading works at Ice House Street, and as the programme is being drawn up by your Consultants, I should be grateful if you would inform CHE/HK on the information he requested.

3. In this connection, I would refer to the sealing up of a sewer overflow to stormwater drain in Queen's Road Central and Ice House Street recommended in the Focused EIA. A trial seal was carried out but unfortunately overflowing of sewage was observed in the sewer along Queen's Road Central the next day. This indicates that the upgrading of sewer along Ice House Street mentioned in the Focused EIA is essential and imminent. The Consultants have been told during a meeting with us that there is a big watermain through a foul manhole at junction of Ice House Street and Connaught Road Central, which need to be rectified.

HK&I. DIVISION
- 6 NOV 1992
DES

(David Leung)
for Chief Engineer/Hong Kong & Islands
Drainage Services Department

cc.
CHE/HK - HH 1 1 (U) (MC)

MAUNSELL
CONSULTANTS ASIA LTD.
CONSULTING ENGINEERS
茂盛工程顧問有限公司

1 KOWLOON PARK DRIVE, HONG KONG
TELEPHONE: 376 2299
FAX: 376 2070

YOUR REF.:
OUR REF.: JDB:EC:91590/20/47

PM/UA
Urban Area Development Office
12/F, Leighton Centre
77 Leighton Road
Causeway Bay
Hong Kong

12th November, 1992.

BY FAX

Attn: Mr. Y.L. Chung

Dear Sir,

Central Reclamation, Phase 1 - Engineering Works
Focussed EIA Study

As you will recall, we had a meeting with EPD on 30th October 1992 to tidy up any matters arising from the issue of the Final Report from this Study. Information was requested on two water quality matters and a response was sent on 9th November 1992. Minutes of the meeting were sent on 10th November 1992.

We have now received on 11th November 1992 two further separate letters requesting in one case further work outside the brief and in the other, comments on the Final Report, a draft of which EPD had had the opportunity of commenting upon before printing.

We attach responses to the two letters but would note that we believe that the remaining issues now under discussion are of such a minor nature as to be of no appreciable effect on the environmental condition of the Central Area. We therefore request your guidance upon the extent of further work required under this project.

Yours faithfully
for MAUNSELL CONSULTANTS ASIA LTD.

J Berry

(J.D. Berry)

cc: EPD (Mr. W. Farrell))
CES (Dr. T. Rudd)) w/encl. BY FAX

Central Reclamation, Phase 1 - Engineering Works
Focussed EIA Study
Comments on EPD letter of 10th November 1992 ref.
EP 72/W8/9 (copy attached)

Para. 1 Note that EPD have "no special comment".

The Fianl Report has already been printed, however a written response has been sent to the comment.

Para. 2 Should the RE report exceedences of alarm and action levels, the three suggested mitigation measures can be considered.

Para. 3 This is outside the scope of the brief.

Para. 4 Note that EPD do not require further monitoring stations.

12.11.1992

[illegible]
[illegible] DOWNER [illegible]
F S Y BONG Managing Director
R C T HO
R J GARRETT
R K GRIEVE
P C N YIM
A HAMILTON
R J DOUTHWAITE
G N GILLOTT
R D TAYLOR

ASSOCIATES
A CAMERON-SMITH
L S LEE
P K YUNG
K OLDFIELD
A S POON
M K C LAI
K M TSANG
K Y WONG
C R GOODWIN
D C S LEE
S A ROBINSON
T C K SHUM

FILE

MAUNSELL
CONSULTANTS ASIA LTD.
CONSULTING ENGINEERS

1 KOWLOON PARK DRIVE, HONG KONG

TELEPHONE 376 2299
FAX 376 2070

茂盛工程顧問有限公司

YOUR REF.:
OUR REF.: JDB:EC:91590/20/47

Environmental Protection Department,
28/F, Southorn Centre,
130 Hennessy Road,
Wanchai,
Hong Kong.

10th November, 1992.

BY FAX

Attn: Mr. W. Farrell

Dear Sir,

Central Reclamation, Phase 1 - Engineering Works
Focussed EIA Study
Notes of Meeting 30th October 1992

We are pleased to enclose a copy of the notes of our 30.10.92 meeting.

We also note that CES has already sent on 9th November 1992 responses on the issues raised in notes 2.2(e) and (f). May we assume that you have no further comments on noise issues?

Yours faithfully,
for MAUNSELL CONSULTANTS ASIA LTD.

p.p. (J.D. Berry)

Encl.

cc: UADO (Mr. Y.L. Chung)) w/encl. BY FAX
CES (Dr. T. Rudd))

bcc: DFD w/e

91590/20/47

Central Reclamation, Phase 1 - Engineering Works
Focussed EIA Study
Notes of Meeting 30th October 1992

Present:

UADO	- Mr. Y.L. Chung	
	- Mr. M.T. Wong	
EPD	- Mr. W. Farrell	
	- Mr. W.K. Tsui	
	- Mr. W. To	
	- Mr. Gordon Wan	
	- Mr. C.C. Chiu	
CES	- Dr. T. Rudd	
HWRA	- Mr. D. Choi	
Balfours	- Mr. G. Ward	
MCAL	- Mr. J. Berry	

Notes: Action

1. Noise Matters

1.1 CES' revised calculations: "Noise Assessment for NSR2 (United Building)" were tabled. This took into account the fact that there were two contracts with exclusive areas. Thus there would be separate noise source locations and differing attenuations. The calculations showed that the worst noise at NSR2 was 77dBA, 2dBA above acceptable levels, and that 19% of this was from the Engineering (reclamation) works and 81% from the Station works.

1.2 One possible mitigation measure discussed was the erection of a 6.5m x 120m noise barrier but this has considered impractical in terms of the relatively small reductions in noise levels required. Mr. Farrell said that on other projects where noise levels were predicted to be <80dB(A); it had been left up to the contractor to decide what mitigation should be employed to reduce the level to <75dB(A). As most of the noise would emanate from the Station works, and because its equipment and construction methods were yet to be specified (so there was scope for other means of noise protection within that contract), it was agreed that such noise protection works should be a part of the Station Contract.

1.3 The calculation and assessment appeared to be satisfactory. EPD would confirm this to CES after further checking of the paper. EPD

2. WATER QUALITY

2.1 CES referred to their fax dated 30th October 1992 with responses to comments on the final report.

Action

2.2 Notes on particular comments and responses

(a) Comment on Section 3.1.3:
EPD accept CES/HWR explanation

(b) Comment on pier obstruction:
HWR advised that their assumptions were not considered to have produced conservative results. Mr. Farrell said that the result was not critical to the report. Dr. Rudd said that the 15% area reduction was of little relevance, as it applied to both base and reclamation cases and the purpose of the assessment was comparative. She also noted that while agreement in general had been received from EPD on modelling methodology, there had not been time in the short period available to define and receive agreement on all details.

(c) Comment on stratified temperature zones:
EPD stated that 3D modelling should have been used for water quality as well as for tidal flow, Mr. D. Choi stated that the benefits of 3-D modelling of water quality were small. Dr. Rudd pointed out that the Brief from WPG on the mathematical modelling specifically required the use of a 2D water quality model. Mr. Farrell said that EPD's comment was really "Just a comment on the art of modelling".

(d) Comment on Section 3.1.4: Dredging rate
MCAL confirmed that the dredging rate assumed $8000m^3$/day was realistic.

(e) Comment on use of station VS6 rather than VS5
Dr. Rudd said that VS6 data was used because VS5 data was not included in EPD's 1987-91 data set while that for VS6 was.

Mr. W. To will give VS5 data to CES and ask that any significant effects arising from any deviation from VS6 data be advised. Mr. Farrell said that dealing with this matter by correspondence alone would be sufficient. EPD, CES

(f) Comment on Section 4.4, metals and sulphides:
Mr. Farrell accepted CES' written response regarding metals release. Dr. Rudd said that the sealed grab was the EPD accepted method. No sulphide data were believed to be available. Mr. Farrell said that sulphide data were now available. Dr. Rudd suggested that calculations on the effects of sulphides could be carried out by assuming that they were proportional to sediment. Mr. To said that EPD could do such a calculation in-house. CES

Action

Mr. To said that it was possible that the dredging impact was much greater than that of the sewage load. Dr. Rudd said that this was not so, firstly because the 5% loss assumed was conservative, and secondly that even if 5% was lost and all the COD was exerted, which would not happen in practice, then the impact from that would be about equal to the sewage load.

(g) Comment on monitoring controls

Dr. Rudd said that ENPO had suggested for West Kowloon Reclamation (WKR) that dredging caused high turbidity but not necessarily reduced DO, and the main adverse impacts in that area had arisen from sewage discharge. Mr. Farrell said that for WKR this situation may worsen as embayments are formed. However EPD accepts CES' response in general. EPD will monitor the contract performance.

3. <u>GENERAL</u>

3.1 EPD want to be able to endorse the paper by the end of next week.

3.2 EPD is writing the EPCOM paper, and asked for a layman's terms explanation from Balfours of each mitigation measure proposed. — Balfours

3.3 Mr. Ward said that

- items 1 to 4 and 6 were funded by DSD;
- item 5 would be funded by TDD in the station contract;
- for items 7, 10, 11, 13 to 18, funds were not available;
- items 8, 9, 12 were covered in TDD's contract UA 11/91.

3.4 Mr. Farrell summarised by saying that CES had one action on noise (following receipt of any further comments from NPG) and two on water quality issues. EPD will write endorsing the report. — CES

OUR REF:
來函檔號 EP 72/W8/9
YOUR REF:
電話
TEL. NO.: 8351154
圖文傳真
FAX NO.: 8349960

Environmental Protection Department
Headquarters
28th Floor, Southorn Centre,
130 Hennessy Road,
Wan Chai, Hong Kong.

香港灣仔
軒尼詩道
一百三十號
修頓中心廿八樓

CES Consultants
Room 1201,
Tai Yau Building
181 Johnston Road
Wanchai, Hong Kong.

(Attn.: Dr. Topsy Rudd)

12 NOV 92
12-11-92
91590/20/47

fax circulated

10 November 1992

Dear Madam,

Central Reclamation - Dredging

Your faxed dated 9/11/92 received with thanks.

I have no special comment to the sediment analysis between VS5 and VS6. However, I would like to include this in the appendix or response to comment section of the final report.

At the moment, once the monitoring location reached the alarm/action levels, the Resident Engineer will instruct (or formulate with) the contractor proper mitigation measures to minimise the adverse impact. Besides sealed grab, the three other mitigation measures suggested in your letter would be quite appropriate for the RE to follow:

(1) using a slower work pace

(2) working in a closed compartment (silt curtain skirt around the dredger)

(3) working with a safety margin to prevent overloading the transport vessels.

By copy of this letter, would you please produce some guidelines for resident staff in dealing with these problems so that UADO can include these options in the RE instruction note. Therefore, the resident staff can have some solid guidelines to follow when the monitored data reached alarm/action levels.

I would not insist of putting more monitoring stations at this stage as previous agreed with you and UADO and would not object any increase of the number of stations or sampling frequency if the resident staff required more.

Yours faithfully,

(Wynn To)
Environmental Protection Officer
for Director of Environmental Protection

c.c. CE/Central & Wanchai Reclm., UADO (Attn: Mr. M. T. Wong)
Manusell Consultant (Attn: Mr. John Berry)
P(EA)

page 3-14 last paragraph, page 3-15 2nd paragraph and Section 4.2.1 last paragraph, the same wrong assumption is made on the scope of the SMP extended survey.

(4) <u>Page 2-7, line 6 & Table 3.8</u>

Presumably the estimated costs still do <u>not</u> include design fee, supervision cost and pre-commencement detailed survey (if required).

(5) <u>Page 2-7, 2nd paragraph lines 2 & 5</u>

The statement "... will not affect water quality in the embayed areas ..." is rather misleading. It seems that there is no reason why the outfall location is controlled by the seawater pumping station and Custom and Excise building.

(6) <u>Page 2-8, 2.2.3 (d) line 3</u>

The length of existing sewer having negative gradient is only about 60m as identified under SMP. The figure of 570m is not understood. The section that the consultant said to be replaced is probably not the same section recommended under SMP - the latter only recommends the section downstream of CES's one.

(7) <u>Section 2.2.4 (b)</u>

Please elaborate on (i) the required heads of the proposed extension and of the further extended option; (ii) what additional cost is involved for the further extension; (iii) whether the option is feasible technically; (iv) whether the required diversion in the next phase of reclamation can be abandoned.

(8) <u>Section 2.2.4 (c)</u>

Please provide a sketch showing the clash between ARL tunnel and proposed further extension of F and elaborate on the amount of <u>additional</u> headloss caused by the further extension over the recommended extension. If these two reasons are valid, why will the proposed further extension of C & D after final reclamation not have the same problem (if this is still the recommendation)?

(9) <u>Table 2.2 & Table 3.8</u>

The cost estimate for Improvement No. 12 is not included in Table 2.2.

(10) Table 3.3

Should NH3-N load be 55kg/d in Scenario (2), (3) and (4)?

(11) Page 3-4, footnote 4 and Section 3.1.3 (b) (3) 2nd paragraph

The assumed percentages reduction are far too high. Note that DSD have similar view.

(12) Section 3.1.5, 5 paragraph, line 4

What is the measure recently implemented by DSD at F or J1?

(13) Section 4.1.1

Similar comment as (5) above, "... are likely to deteriorate slightly ..." should be accompanied by a statement that the model and hence the results are not yet agreed by EPD.

(14) General

It should be noted that any (new) mitigation measures recommended under the SMP's extended survey are not yet included in the budget.

Original copy NOT sent/~~to be sent separately~~
Total no. of pages including this page: 4

Environmental Protection Department

環境保護署

FROM: W.K. Tsui

OUR REF.: (EP2/H4/07IV

TEL NO. 835-1150

TO: CES (Attn Dr. T. Rudd)

YOUR REF.: ( ) in

YOUR FAX NO.: 891-0305

DATE: 10 November 1992

OUR FAX NO.: 838-2155

Central Reclamation Phase 1
Focused EIA Study

Subsequent to our meeting on 30 October and our telephone conversation yesterday, please find attached our comments on the Final Report and the Noise Assessment for NSR2 for your necessary action and response.

(TSUI Wai-kit)
for Director of Environmental Protection

cc Maunsell (Attn Mr. J.D. Berry) Fax 376-2070
UADO (Attn Mr. M.T. Wong) Fax 577-5040

Noise
(Comments on Noise Assessment for NSR2 (United Building)

Section 3 - Noise Assessment

While the application of a general 5 dB(A) negative correction as mentioned in the last paragraph is considered oversimplified, our in-house assessment on the worst scenario also obtains an overall sound pressure level of 77dB(A) at the facade of NSR2 when individual screening effect and silenced compressor and generator as specified in the relevant contract specification are taken into consideration. Mitigation is still required. Dump trucks and bored piling oscillator, when exposed to the line of sight from NSR2, are the dominant noise sources. If they are screened, the daytime noise limit of 75 dB(A) can be complied with.

Section 4 - Mitigation

The recommended 6.5m high 120m long barrier may not be the most appropriate measures to reduce noise from the dump trucks and bored piling oscillator. To divert all dump truck from going through the exposed areas in S5 and S7 (except the operation of one dump tuck for dumping purpose) and provide noise baffles to the noise generating parts of the bored piling oscillator operated inside these areas may be more effective and suitable for the required 2 dB reduction application.

Sewerage

(1) The disagreement over the percentages reduction should be mentioned in the Executive Summary and recommendation section of the Final Report. This issue is to be looked in greater detail during the detailed design stage.

(2) If it is decided that the extended investigation works for catchments F & J1 is to be carried out by the SMP consultants, it should be noted that additional funding must be provided and more time should be allowed.

(3) Section 1.2, line 4-6

It seems that the consultant is confused as to the scope of the extended survey to be carried out by the SMP consultants. At present only the two catchments draining to outfalls C & D are included. Again, on

CES CONSULTANTS IN ENVIRONMENTAL SCIENCES (ASIA) LTD

Room 1201, Tai Yau Building, 181 Johnston Road, Wanchai, HONG KONG

Telephone: 8931551 Facsimile: 8910305 Dialcom: 8808:HKA129

FAX TRANSMISSION FORM

To (Company)	:	EPD (WPG)	**Fax No.**	:	834 9960
Attention	:	Mr Wynn To	**Date**	:	9.11.92
From	:	Dr T Rudd	**No. of pages**	:	3
Subject	:	Central Reclamation	**Job/Ref No.**	:	95060/F6741

c.c. EPD (EAPG) (591 0558) - Attn : Mr Bill Farrell ☐
MCAL (#05) - Attn : Mr John Berry ☐
UADO (577 5040) - Attn : Mr M T Wong ☐

If you do not receive all the pages, please contact us immediately. **The original will not be sent by post.**

Wynn

Revision of the dredging calculation using 1991 data for VS5 instead of VS6 gives higher loads of 390 t/d SS, 8 t/d COD and 4 t/d BOD, but lower loads of 0.3 t/d TKN and 0.02 t/d NH_3-N. Using a mean value for VS5 of 130 mgS/kg for the years 1987-1989 (no 1991 data recorded), the potential loss of sulphide on dredging is 0.05 t/d. This includes both soluble and particulate; a proportion of the latter would be expected to redeposit on the bed. The potential for metal release as a result of sulphide solubilisation will be minimised by use of a sealed grab.

I also recalculated the pollutant loads using 'S' factors for sediment losses from sealed grabs with no silt screens, given in the Contaminated Spoil Study. These factors take sediment settlement into account as well, and are possibly more realistic than the 5% assumed previously which (as stated in the EIA report) is probably an overestimate for grab dredgers.

Assuming that the unit for the 'S' factors "kg/m^3" refers to dry weight of mud lost per bank volume dredged, the loads using data for VS5 and VS6 are as follows;

'S' factor for small-large grab dredgers with no silt screen:	11-20 kg/m^3
taking 20 kg/m^3 as a conservative estimate:	8000 m^3/d x 20 kg/m^3 = 160 t/d sediment lost to water column

associated pollutant loads in t/d:

	SS	COD	TKN	NH_3-N	S
VS5	160	3.2	0.14	0.008	0.02
VS6	160	2.9	0.29	0.028	0.02

As you can see from this table, the pollutant load calculations are very much dependent on the amount of sediment that is assumed to be lost during dredging: this is probably a more influential factor than the particular set of sediment data used.

As we discussed at the meeting, predicting the impacts from dredging cannot be very precise because of the lack of consistent data on losses reported in the literature and because it depends very much on how the dredgers are operated at the time. The report already notes that dredging could cause a similar amount of pollution as the contaminated stormwater, which suggests that the impacts from both should be mitigated.

In terms of increased mitigation of dredging impacts, we have already specified a sealed grab, which is recommended in the publication "Aquatic Pollution and Dredging in the European Community" (1990) as being the best method for minimising pollutant release. Other mitigation measures suggested are;

* using a slower work pace
* working in a closed compartment
* working with a safety margin to prevent overloading the transport vessels.

The first option you suggested in the meeting, and could be pursued further. The second option is already effected by the reclamation bunds, which should mean that plumes are mostly contained inside the embayment. This does not of course prevent the problem which you and Amy mentioned in relation to the Tamar Basin development, about complaints from people directly overlooking the reclamation area in office blocks. Localised containment has been achieved elsewhere by using a square or semi-circular framework fixed to the side of the dredger with silt curtains suspended from it and weighted at the bottom. The grab then works entirely inside this framework except when swinging out over the loading barge. This could be a measure to consider if the works start to cause problems.

The third option is already effectively incorporated in the contract documentation under Clause 4.03, but could be worded more directly to restrict the barge loading to e.g. 80% capacity. Any restrictions of this sort will obviously have a cost and programming implication, though.

In practical terms, plume generation inside the reclamation area would only be a problem as far as the cooling water intakes are concerned and protection of these is already well covered in the contract. Fish can move out of the area during dredging and the benthic fauna are unlikely to be of special ecological value because of the existing levels of pollution from the storm sewers. The main residual concern therefore appears to be complaints from the public over the visual impacts and their perception of its effect on water quality.

If you feel that this still has not been adequately guarded against, I would suggest that we put 2 or 3 more monitoring stations inside the embayment and reduce the alarm and action levels for suspended solids still further. If the monitoring results are unacceptable, reducing the rate of dredging and/or deploying silt curtain containment around the working area of the grab may need to be considered by the Contractor as potential remedial measures which he is required to take according to the Action Plan in Clause 4.08 of the Contract.

Please advise whether you wish the monitoring stations and alarm/action levels to be further amended in the Contract Specification.

Regards

Improvement N^{o}1; Lower Electrodes
Location: Central Screening Plant, Sheung Wan

Lowering water level indicator electrodes at the plant will cause the pumps to operate more frequently which will lower the water level in the pipes. This in turn will allow more sewage to flow through the pipes, reducing blockages and overflows.

Improvement N^{o}2; Desilting Trunk Sewer
Location: Connaught Road, Central and Sheung Wan

The main sewer pipe in Central/Sheung Wan has 200 to 300 mm of silt in the bottom. Removing this silt will allow more sewage to flow through the pipe. This will reduce overflows.

Improvement N^{o}3; Sewer Upgrading
Location: Jubilee Street, Central

The sewer pipe under this road is too small. Digging up this pipe and replacing it with a larger one will reduce overflows.

Improvement N^{o}4; Repair of Pipe
Location: Cochrane Street, Central

A broken sewer pipe was found to be allowing sewage to enter a stormwater pipe. Repair of this pipe will prevent the sewage entering the stormwater system.

Improvement N^{o}5; Realignment of Culvert B
Location: Future Central Reclamation

The stormwater pipes in this area have a high amount of sewage in them. Having the last pipe at the northern seawall of the Central Reclamation will allow the sewage to be flushed away by the tides.

Improvement N^{o}6; Expedient Connection
Location: Des Voeux Road, Central

The sewer pipe under this road has an opening into a stormwater pipe. Blocking this opening will stop the sewage from going into the stormwater pipe.

Improvement N^{o}7; Sewer Upgrading
Location: Harcourt Road, Wan Chai

The sewer pipe under this road is too small and laid unevenly. Digging up this pipe and replacing it with a larger one will reduce overflows.

Improvement N^{o}8; Sewer Upgrading
Location: Queen's Road Central

The sewer pipe under this road is too small. Digging up this pipe and replacing it with a larger one will reduce overflows.

Improvement N^{o}9; Sewer Upgrading
Location: Des Voeux Road, Central

The sewer pipe under this road is too small. Digging up this pipe and replacing it with a larger one will reduce overflows.

Improvement N°10; Expedient Connection
Location: Queen's Road Central

The sewer pipe under this road has an opening into a stormwater pipe. Blocking this opening will stop the sewage from going into the stormwater pipe.

Improvement N°11; Expedient Connection
Location: Queen's Road Central

The sewer pipe under this road is broken and the sewage is going into a stormwater pipe. Repair of the sewer pipe will stop this.

Improvement N°12; Sewer Upgrading
Location: Des Voeux Road Central

The sewer pipe under this road is too small. Digging up this pipe and replacing it with a larger one will reduce overflows.

Improvement N°13; Sewer Upgrading
Location: Des Voeux Road Central

The sewer pipe under this road is too small. Digging up this pipe and replacing it with a larger one will reduce overflows.

Improvement N°14; Sewer Upgrading
Location: Des Voeux Road Central

The sewer pipe under this road is too small. Digging up this pipe and replacing it with a larger one will reduce overflows.

Improvement N°15; Sewer Upgrading
Location: Des Voeux Road Central

The sewer pipe under this road is too small. Digging up this pipe and replacing it with a larger one will reduce overflows.

Improvement N°16; Sewer Upgrading
Location: Queen's Road Central

The sewer pipe under this road is too small. Digging up this pipe and replacing it with a larger one will reduce overflows.

Improvement N°17; Sewer Upgrading
Location: Queen's Road Central

The sewer pipe under this road is too small. Digging up this pipe and replacing it with a larger one will reduce overflows.

Improvement N°18; Sewer Upgrading
Location: Queen's Road Central

The sewer pipe under this road is too small. Digging up this pipe and replacing it with a larger one will reduce overflows.

MAUNSELL
CONSULTANTS ASIA LTD.
1 KOWLOON PARK DRIVE, HONG KONG

FAX (GP3) : 376 2070
TELEPHONE : 376 2299

FACSIMILE MESSAGE

DATE	FROM	TO	DESTINATION
2-11-92	John Berry	Mr Y.L. Chung Mr M.T. Wong	UADC

OUR REF.	PROJECT	FAX REF. NO.:	SHEET
91590/20/47	Central Reclamation - EIA.		1 OF 1

MESSAGE SENT

Leslie, M.T.,

Please see attached notes prepared by Balfours and sent to EPD for their use in writing the EXCOM paper.

Regards

John.

Balfours International (Asia) Consulting Engineers Ltd.
10th Floor, 1 Kowloon Park Drive, Kowloon, Hong Kong.
Telephone : 3175933 Fax : 3175920

FAX TRANSMISSION FORM

CALLING FAX No. : 591 0558 REF No. : 7230/69/F8081 SHEET 1 OF 3

FROM : Geoff Ward

TO (COMPANY) : EPD

FOR ATTN OF : Kit Tsiu

C.C. : T. Rudd - CES, J. Berry - K/O

DATE : 02.11.1992

SUBJECT :

Central & Wan Chai Reclamation
Focussed EIA

As requested last Friday, 30 October, I enclose plain English descriptions of the eighteen (18) improvement measures as shown in Table 2 of the Executive Summary.

Regards,

Geoff Ward

GRW/vc

Encl.

-2 NOV
PROJ.ENG. J. Berry
RJG
KKC
PY
AH
RJD
GNG
RDT
OTHERS DFD
COPIED TO UADO - YC Chung, MT Wong
REPLIED
FILE 91590/20 /47

URGENT BY FAX

MEMO

From Project Manager/Urban Area	To Distribution
Ref.(79) in UAH 2/4/101 XVIII	
Tel. No 882 7204	Your Ref. ... in ...
Date 29 December 1992	dated ...

Central Reclamation, Phase 1 - Engineering Works
Focussed EIA Study
Implementation of Mitigation Measures

I refer to my earlier memo ref. (36) in even series dated 14.12.1992 and write to confirm that the meeting originally scheduled for 18.12.1992 is now to be held on Wednesday, 6 January 1993, 2:30 p.m. in UADO's conference room on 12/Fl., Leighton Centre. The revised agenda for the meeting is as follows -

(1) Proposed arrangements for implementation of mitigation measures as shown on drawing No. UA 358

(2) Impact of possible traffic diversion on the proposed implementation programme

(3) Progress of current extension study/survey for Catchments C and D

(4) Progress and arrangements for proposed extension study/survey for Catchments F and J1

(5) A.O.B.

29 DEC 1992
JWD PROJ. ENG. FSYB J. Berry
RGTH OTHERS
RJG DEO - Dave Plsuthard
HKG
PY
AH
RJD COPIED TO
GNG Balfours (GW) (PMG) ... attend
RDT JDB, DEO
REPLIED
FILE 91590/20/4 7

(M T Wong)
for Project Manager/Urban Area

Encl.

G.F. 73A

Distribution

EPD	(Attn: Mr. W.J. Farrell & Mr. W.K. Tsui)
CE/HK&I, DSD	(Attn.: Mr. K.R. Murrells & Mr. David Leung)
MTRC	(Attn: Mr. G. Turnbull)
NAPCO	(Attn: Mr. J.P. Bovis)
CHE/HK	(Attn: Mr. Albert W.B. Lee)
CTE/HK, TD	(Attn: Mr. H.W. Chan)
DLO/HKW	(Attn: Miss Anita Lam)
CES/NA(Urban)	(Attn: Miss Trevina Kung)
PTDB, TD	(Attn: Mr. Tommy L.S. Ng)
DO/C&W	(Attn: Mr. H. Cho)
CP (DD/Traffic)	
MCAL	(Attn: Mr. J. Berry)

c.c. SPEL (Attn: Mr. W. Hui) - (you may wish to be represented at the meeting)

MTW/lky

本署檔號 OUR REF: ( ) in EP2/H4/07 VI
來函檔號 YOUR REF:
電話 TEL. NO.: 594 6557
圖文傳真 FAX NO.: 802 4511

Hong Kong Government
Environmental Protection Department
Branch Office
33/F, Wanchai Tower III,
5 Gloucester Road,
Wan Chai, Hong Kong.

環境保護署分處
香港
告士打道五號
灣仔政府綜合大樓
第三座三十三樓

18 December 1992

Maunsell Consultants Asia Ltd.
1 Kowloon Park Drive
Kowloon.

(Attn : Mr. J.D. Berry)

Dear Mr. Berry,

Central Reclamation, Phase 1 - Engineering Works
Focussed EIA Study
Final Report
Addendum on Noise Assessment

I refer to your letter ref. JDB:EC:91590/20/47 dated 27.11.92 addressed to UADO copied to us concerning the captioned addendum.

In the third para. of section 4 of this addendum, I believe that "S6" should read "S7" for the noise mitigation measures recommended, as suggested in our previous comment. S6 lies in an area screened by the Southland Building and justification for noise mitigation measures are not well supported. On the other hand, S7 is closer than S5 and a portion of S7 is exposed to the line of sight from the NSR2. When noise assessment finds that certain noise mitigation measures would be necessary for S5, such measures should be extended to S7.

Apart from the above comment, the addendum is acceptable to us.

Yours faithfully,

(C.C. CHIU)
Environmental Protection Officer
for Director of Environmental Protection

c.c. UADO (Attn : Mr M.T. WONG)
CES (Attn : Mr. Y.T. TANG)

Balfours International (Asia) Consulting Engineers Ltd.
10th Floor, 1 Kowloon Park Drive, Kowloon, Hong Kong.
Telephone : 3175933 Fax : 3175920

FAX TRANSMISSION FORM

CALLING FAX No. :	577 5040 REF No. : 7230/69/F8/10 SHEET 1 OF 1
FROM :	Geoff Ward
TO (COMPANY) :	UADO
FOR ATTN OF :	Mr. M.T. Wong
C.C. :	J.D. Berry (MCAL/KO)
DATE :	7/1/93
SUBJECT :	Central and Wan Chai Reclamation - Focussed EIA

I refer to the meeting yesterday at your offices and advise that the estimated cost of improvement no. 17 includes the works along Ice House St down to Connaught Road.

It assumes the water main obstruction (mentioned by DSD yesterday) can be avoided without having to relocate it.

noted in minutes of meeting

Regards,

Geoff Ward

Geoff Ward

GRW/em

- 7 JAN 1993
JWD FSYS RCTH RJG RKG PY AH RJD GNG RDT
PROJ. ENG. JDB
OTHERS
COPIED TO
REPLIED
FILE 91590/20/47

MAUNSELL
CONSULTANTS ASIA LTD.
CONSULTING ENGINEERS
茂盛工程顧問有限公司

1 KOWLOON PARK DRIVE, HONG KONG
TELEPHONE 376 2299
FAX 376 2070

FILE

YOUR REF.:
OUR REF.: JDB:EC:91590/20/47

PMUA
Urban Area Development Office
12/F, Leighton Centre
77 Leighton Road
Causeway Bay
Hong Kong

7th January 1993

Attn: Mr. Y.L. Chung

Dear Sir,

Central Reclamation, Phase 1 - Engineering Works
Focussed EIA Study
Implementation of Mitigation Measures

We enclose notes of our meeting of 2:30pm on Wednesday 6th January 1993 at your offices.

Yours faithfully
for MAUNSELL CONSULTANTS ASIA LTD.

(J.D. Berry)

Encl.

cc: EPD - Mr. Gordon Wan/C.F. Lam)
DSD - Mr. D. Leung)
RHKP (CP (DDT)) - Mr. K.T. Wong)
HyD (HKR) - Mr. K.M. Hung)
RHKP (SSO T HKI) - Mr. C.C. Au Yeung) w/encl.
TD (TE/HK) - Mr. H.W. Chan))
CNTA DO(C&W) - Ms Mary Tsang))
NAPCO - Mr. J. Bovis)

bcc: Balfours (G.Ward)) w/encl.
DFD)
91590/20/41 w/o encl.

91590/20/47

Central Reclamation, Phase 1 - Engineering Works
Focussed EIA
Implementation of Mitigation Measures

Location : UADO

Date : 6th January 1993

Time : 2:30pm

Present :		
	Ms. Mary F.Y. Tsang	CNTA (DO(C&W))
	Mr. K.M. Hung	HyD (HKR)
	Mr. K.T. Wong	RHKP CP (DDT)
	Mr. C.C. Au Yeung	RHKP SSO (THKI)
	Mr. D. Leung	DSD (E HK3)
	Mr. H.W. Chan	TD (TE/HK)
	Mr. J. Bovis	NAPCO
	Mr. G. Wan	EPD
	Mr. C.F. Lam	EPD
	Mr. Y.L. Chung	UADO
	Mr. M.T. Wong	UADO
	Mr. G. Ward	Balfours
	Mr. J.D. Berry	MCAL

1. Introduction — Action

Mr. Chung described the background to this work and described in general the mitigation measures shown on Drawing UA 358.

2. Proposed Arrangements for Mitigation (Refer UADO Drawing UA358)

2.1 Measure 1 - Lowering of electrodes

Mr. D. Leung (DSD) said that this measure had been carried out. The electricity usage was being monitored, and no firm information on silt deposition was yet available.

2.2 Measure 2 - Desilting of Trunk Sewer

Mr. Leung said that desilting was now at 3 monthly intervals. DSD will consider more frequent desilting depending on observation.

2.3 Measure 3 - Jubilee Street Sewer Upgrading

Mr. Leung said that this was substantially complete.

2.4 Measure 4 - Repair of Broken Pipe : Hillside Escalator

HyD may hand this work back to DSD. May be slippage in this repair work (may start at mid 1993) in order to avoid claims.

2.5 Measure 5 - Realignment of Culvert B | Action

Will be constructed in Station Contract.

2.6 Measures 6 - Expedient Connection

Expedient connection already rectified by DSD.

2.7 Measure 7 - Sewer upgrading (near Furama)

DSD is concerned about a repeat of the flooding of Urban Council Chambers experienced about four years ago.

Mr. Ward said that the flow is eastwards.

Mr. Leung said that EPD was concerned about funding, and also about Note 4 to the table (road opening restrictions). The meeting agreed that there was strong justification for this measure.

Mr. Hung (HyD) said that Harcourt Road widening could be considered as minor works and therefore not needing to be gazetted.

Mr. Au Yeung (RHKP) noted that HKE was putting a new HV electricity main up this road. The sewer works should take account of this, and if possible trenchless technology should be used. Decking over during daytime will be required by RHKP. MCAL

Mr. M.T. Wong said that when consultants are instructed to prepare full drawings, they also prepare road diversion plans. Mr. Y.L. Chung said neighbouring works should be grouped. There would be a need to go to Road Opening Coordination Committee (ROCC). Mr. Ward said that detailed design would determine whether the existing pipe would need to be removed. Mr. Hung (HyD) said that HyD would not approve the road opening until circulated to TD, Police, DO etc. Cannot therefore agree to road opening at this stage. Main point is whether the road diversions will work.

Mr. Berry noted that this sequence and time of approvals would make it very difficult to include this work in the Tamar Basin Reclamation contract, however the work in that contract could be phased to permit Measure 7 works to proceed ASAP. In particular, the construction of an extra lane at the Harcourt Road/Garden Road intersection could be completed early.

Mr. Wan said that the efficacy of the mitigation measure was not yet proven. EPD had not yet decided whether to extend the SMP Study to catchments F and J1 to, inter alia, prove this efficacy.

Funding: Mr. Chung said that money should not be spent until after the efficacy has been determined. The programme of the SMP extension to catchments I and J should not be delayed and brought forward as much as possible.

Action

2.8 Measure 8

No problems seen with the implementation of this measure.

2.9 Measure 9

No problems seen with the implementation of this measure.

2.10 Measure 10 - Expedient Connection in Ice House Street

DSD has carried out a trial seal of this connection. This confirms that overflow work must remain until Measure No. 17 is complete. UADO therefore becomes works agency for Measure No. 17.

DSD has also advised that Measure No. 17 must include the extension from Queens Road Central to Connaught Road. These measures must therefore be linked. Mr. Wong was concerned with the cost implication. Mr. Leung said the cost estimates appeared to include for this. Mr. Ward would not recall whether the Ice House Street works had been included, and will check. — Balfours

[Post Meeting Note: The cost estimate includes the Ice House Street works]

Traffic: Miss Tsang thought that chaos may ensue if diversions are not properly planned, Daytime trench covers were likely to be included. No road opening restrictions affect this area. Mr. Chung asked if the SMP Extension investigation covered this area. Mr. Ward said the works were already shown to be essential.

The meeting supported the need for the works.

2.11 Measure 11

Mr. Leung said that DSD had already carried this work out.

2.12 Measure 12

Provisional in UA 11/91.

2.13 Measure 13 - Sewer Upgrading in Des Voeux Road

Not a road opening restriction area. A two lane carriageway. Mr. Leung said that this work was first identified in this Focussed EIA.

2.14 Measure 14 - Sewer Upgrading

Mr. Hung said that UADO have to discuss with HyD if it is intended that the road is opened before April 1996.

The meeting supported the need for these works.

2.15 Measure No. 15

Subject to CW3 SMP Extension Study.

2.15 Measure No. 15

Subject to CW3 SMP Extension Study.

2.16 Measure No. 16

Subject to CW3 SMP Extension Study.

2.17 Measure No. 17

Discussed with Measure 10 above. Subject to CW3 SMP Extension Study.

2.18 Measure No. 18

Subject to CW3 SMP Extension Study

3. <u>General</u>

3.1 Road Opening / Traffic Diversion

Mr. Hung said that HyD should be consulted ASAP with firm proposals for each of the measures.

3.2 Consultation with District Board

Miss Tsang said that both the Focussed EIA Study, and improvement must go to District Board for consultations. The DB has an EWC Committee.

Timing - meeting is every two months. When have a firm proposal and programme, should go to DB. Whole process may take 3-6 months. Next meeting: 28th January.

Mr. Wan said that EPD would attend the DB meeting and give its support.

3.3 Consultation with NAPCO

Will be carried out by UADO.

4. <u>Impact of Possible Traffic Diversion on the Proposed Implementation Programmes</u>

Mr. H.W. Chan (TD) lamented the lack of proposals on traffic diversions to date.

Mr. Chung said that this would be carried out after the consultants were instructed.

5. <u>Progress of Current Extension Study/Survey for Catchments C & D</u>

Mr. Wan said that the report available about Chinese New Year.

Work is almost finished now. Detailed design for any improvement will be carried out within about a month after.

Mr. Chung asked EPD whether the CW3 SMP Extension Study would determine which flat/building was wrongly connected. Mr. Wan said that this was not being done, such work was in the province of BLD. EPD's powers were limited to requesting owners to rectify expedient connections. EPD's aim is to identify the source where possible. If this identified an individual building then BLD may be alerted. Mr. Chung said that this should be the intention of the study.

Mr. Wan said that the sum of $15M was estimated by its consultants for all possible remedial measures in catchments C&D. EPD will give a full and detailed account of proposals to UADO.

Balfours agreed with Mr. Wan's statement, and gave a description of some of the erroneous pipework. Many offending terminal manholes have yet to identified.

Mr. Leung asked that DSD be made aware of proposals. Balfours has been giving some information to DSD.

6. <u>Progress and Arrangements for Proposed Extended Study/Survey for Catchments F and J1</u>

Mr. Wan said the EPD have not received funding and so have not confirmed plans or consultants yet. Will talk to consultants shortly.

Funding: Mr. Chung asked EPD to give a drawing showing area covered. EPD

Mr. Ward said that for Catchments C&D study was limited to uphill from about Des Voeux Road to Hollywood Road and it was likely that catchment F and J1 would be similar.

7. <u>Any Other Business</u>

Mr. Chung said that another meeting would be called if required.

7.1.1993

本署檔號
OUR REF: EP 20/08/65
來函檔號
YOUR REF: JDB:EC:91590/20/47 dd 7.1.93
電話
TEL. NO.: 8351330
圖文傳真
FAX NO.: 5910636

Hong Kong Government
Environmental Protection Department
Headquarters
28th Floor, Southorn Centre,
130 Hennessy Road,
Wan Chai, Hong Kong.

環境保護署總部
香港灣仔
軒尼詩道
一百三十號
修頓中心廿八樓

18 January 1993

Maunsell Consultants Asia Ltd
1 Kowloon Park Drive
Hong Kong

(Attn: Mr J D Berry) (Tel: 3762299)
(Fax: 376 2070)

18	
JWD FSYS RCTH RJG KKG PY AH RJD GNG PDT	PROJ ENG. J. Berry
	OTHERS DFD
	COPIED TO Balfours, GK
REPLIED 19-1-93	
FILE 91590/20/47	

Dear Sirs,

Central Reclamation, Phase I - Engineering Works
Focussed EIA Study
Implementation of Mitigation Measures

I refer to your letter quoted above.

My comments on the notes of meeting of 6.1.93 are as follows :

(a) Section 2.7, Para 8
"... not yet proven" should read "... not yet proven, which should be further addressed by Maunsell in the course of their works."
"EPD had not yet ... prove this efficacy" should be replaced by "EPD had not yet been asked by UADO to approach the SMP consultants to undertake the extended survey/detailed design of catchments F & J1."

(b) Section 2.7, Para 9
Should "... I & J ..." read "... F & J1 ..." ?

(c) Section 5, Para 2
"Mr Wan said that this was not being done ..." should be replaced by "Mr Wan said that the source of pollution would be identified up to the terminal manholes if necessary and beyond these manholes, the individual polluting sources would not be identified, which should be under the remit of BLD."

(d) Section 5, Para 3
"Mr Wan said that the sum of $ 15 M was estimated ..." should be replaced by "Mr Wan said that a very preliminary sum of $15M was estimated ...

... Cont'd

(e) <u>General (in particular to Section 2.7, Para 9, 1st sentence)</u>
It has been stressed in the meeting that since the effectiveness of all these measures may be very difficult to establish, we should aim at undertaking as much these proposed mitigation works as possible and as early as possible. I am particularly concerned with the programme of improvement no. 7, which could be a very major one in terms of pollution removal.

Yours faithfully,

(Gordon Wan)
for Director of Environmental Protection

c.c.

PM/UA, TDD	(Attn : Mr Y L Chung)	(Fax: 5775040)
CE/HK&I, DSD	(Attn : Mr D Leung)	
RHKP (CP (DDT))	(Attn : Mr K T Wong)	
HyD (HKR)	(Attn : Mr K M Hung)	
RHKP (SSO T HKI)	(Attn : Mr C C Au Yeung)	
TD (TE/HK)	(Attn : Mr H W Chan)	
CNTA DO(C&W)	(Attn : Ms Mary Tsang)	
NAPCO	(Attn : Mr J Bovis)	

FILE

MAUNSELL
CONSULTANTS ASIA LTD.
CONSULTING ENGINEERS

1 KOWLOON PARK DRIVE, HONG KONG

TELEPHONE 376 2299
FAX 376 2070

茂盛工程顧問有限公司

YOUR REF.:
OUR REF.: JDB:EC:91590/20/47

Environmental Protection Department
24-28 Southorn Centre
130 Hennessy Road
Wanchai
Hong Kong

20th January 1993

Attn: Mr. Gordon Wan

Dear Sir,

Central Reclamation, Phase 1 - Engineering Works
Focussed EIA Study

Your letter of 18th January 1993 refer.

We do not agree with your comment (a) on Section 7 Para 8 of our notes of the meeting of 6th January 1993. Maunsell did not undertake to further address the efficacy of the mitigation measure No. 7, because it is not presently briefed to carry out the necessary surveys.

Comment (b) is agreed.

Comment (c) : this appears to have the same meaning.

Comment (d) : noted.

Comment (e) : noted.

Yours faithfully,
for MAUNSELL CONSULTANTS ASIA LTD.

J Berry

(J.D. Berry)

cc: UADO (Mr. M.T. Wong)

bcc: Balfours (G.Ward)
DFD

BY FAX AND POST

拓展署
Territory Development
Department, Hong Kong

市區拓展處
URBAN AREA DEVELOPMENT OFFICE

來函檔號 Your Reference	
本署檔號 Our Reference	(16) in UAH 2/4/101XIX
電話 Telephone	882 7204
傳真 Fax 577 5040	
日期 Date	20 January 1993

21 1
JWD
FSYS JDB
RCT
RJG
HKG
PY
AH
RJD [G. Bradley]
GNG
RDT
REPLIED 26-1-93
FILE 91590/20/47

Maunsell Consultants Asia Ltd
14/F Bank of Tokyo Building
1 Kowloon Park Drive
Tsim Sha Tsui
Kowloon

(Attn : Mr John Berry)

Dear Sirs,

Central Reclamation, Phase 1 - Engineering Works
Focussed EIA Study

I refer to my previous memo ref. (57) in UAH 2/4/101 XVII of 26.11.1992 sent to EPD with a copy to you concerning the focussed EIA study, and enclose herewith for your reference a copy of EPD's memo ref. EP 2/H4/07 dated 13.1.1993 giving their responses to my memo of 26.11.92.

I should be grateful for your early responses to EPD's comments. In particular, it would be useful if you would give clearer indication on the conditions under which one or more of those mitigation measures mentioned in para. (4) of my memo of 26.11.1992 should be considered for implementation by the Contractor/Engineer for Contract No. UA 11/91.

Your earliest response will be appreciated.

Yours faithfully,

(M T Wong)
for Project Manager/Urban Area

Encl.

MTW/ks

MEMO

From DEP
Ref. ( ) in EP 2/H4/07
Tel. No. 835 1118 Fax. No. 591 0558
Date 13 January 1993

To PM/UA
(Attn.: Mr. M.T. Wong)
Your Ref. (57) in UAH 2/4/101 XVII
dated

RECEIVED
18 JAN 1993
URBAN AREA DEVELOPMENT OFFICE, T.D.D.

Central Reclamation, Phase 1 - Engineering Works
Focussed EIA Study

I refer to your memo under reference.

2. We note that your consutlant has responded to our comments on the report and that the EIA study findings have been presented to EPCOM. However, we have no idea whether the responses to comments and the reassessment works on water quality and noise aspects would be included in an addendum to the final report. As you are aware there was some measure of disagreement on the multiple sets of responses to comments and whilst we accept that the Final Report text cannot be amended, the text needs to be reviewed in the context of our entire comments and opinions. Subject to the resolution of the above, the report can be endorsed.

3. As regards paragraph 4 of your memo, the mitigation measures that should be implemented when the monitored data reach the alarm/action levels were proposed by your consultant. We consider that your consultant should also indicate more clearly under what conditions should one or more of these mitigation measures be considered for implementation by the Contractor/Engineer. This could form a set of guidelines to assist the resident site staff in dealing with deteriorating water quality. We therefore do not agree with you that "it is clearly outside the current scope of the study brief". Should you not wish to pursue this matter further, then your resident site staff will need to seek advice from the independent environmental monitoring & audit team on a more frequent basis.

(G.D.E. Sanvicens)
for Director of Environmental Protection

19.1.93

Pl. ask for memo response.

G.F. 73A

FILE

MAUNSELL
CONSULTANTS ASIA LTD.
CONSULTING ENGINEERS

1 KOWLOON PARK DRIVE, HONG KONG

TELEPHONE 376 2299
FAX 376 2070

茂盛工程顧問有限公司

YOUR REF.:

OUR REF.: JDB:EC:91590/20/47

Urban Area Development Office
12/F Leighton Centre
77 Leighton Road
Causeway Bay
Hong Kong

26th January 1993

Attn: Mr. Y.L. Chung / M.T. Wong

Dear Sir,

Central Reclamation, Phase 1 - Engineering Works
Focussed EIA Study

We refer to your letter of 20th January 1993 enclosing DEP's memo of 13th January ref. () in EP 2/H4/07.

It is not clear exactly how DEP wishes the Final Report text to be reviewed when he accepts that it will not be amended. Some post-report correspondence has taken place, and where there are any differences later correspondence would normally take precedence over earlier correspondence. We note that there is a Comments and Responses section in the Final Report, and also that an addendum on noise assessment was issued in November 1992. We believe that the report, the comments and responses, the addendum and the post-report correspondence has adequately covered all of the subjects in the brief.

Regarding guidelines for resident site staff dealing with deteriorating water quality, we believe that the Action Plan in clause 4.08 of Appendix 4 to the Specification (Final Report Appendix 3) provides clear guidelines on when action is to be taken. The contractor is required to abide by this performance specification and, as such, the onus for proposing mitigation measures and achieving the required levels remains his. His proposals may include but would not be restricted to any or all of those mentioned in your memo of 26th November 1992. The site staff will have access to the consultants (which will include an independent environmental consultant) to discuss contractor's proposals.

Yours faithfully
for MAUNSELL CONSULTANTS ASIA LTD.

(J.D. Berry)

cc: EPD (Mr. W. Farrell)
CES (Mr. G. Bradley)

PLEASE QUOTE OUR
MEMO REFERENCE IN REPLY

From Highways/Hong Kong Region	To PM/UA (Attn.: M. T. WONG)
Ref. (9) in HH 710/95 (3) VI (DP)	
Tel. No. 895 8449 圖文傳真 FAX NO. 576 6244	Your Ref. (78) in UAH 2/4/101 XVI
Date 25 November 1992	dated 12.11.92

Central Reclamation Phase 1 - Engineering Works
Focussed EIA Study
Programme of Construction for Mitigation Measures

I refer to your above-quoted memo and have the following comments on the draft implementation programme of the mitigation measures nos. 7 to 18 inclusive for sewer upgrading and/or expedient connection.

2. The proposed dates for implementation/construction of mitigation measures nos. 7, 10, 14 & 17 will be affected by road opening restrictions at respective locations:-

Mitigation measures No.	Road Opening Restrictions
7	Des Voeux Road Central, Harcourt Road, part of Murray Road & Edinburgh Place (due to expire in Feb. 1995)
10 & 17 (not in Queen's Road Central)	Queen's Road Central J/W Ice House Street
	(i) northern half (due to expire in May, 1993)
	(ii) southern half (due to expire in April, 1996)
14	Des Voeux Road Central
	(i) Westbound (due to expire in April, 1996)
	(ii) Eastbound (due to expire in April, 1997)

I have no comment on the implementation programme for the remaining mitigation measures.

.../2.

3. Please would you instruct MCAL to revise the above implementation programme of the mitigation measures affected by the road opening restrictions. Otherwise, strong justification for waiving these road opening restrictions is required.

(Albert W. B. LEE)
for Chief Highway Engineer/Hong Kong

c.c.	EPD	(Attn.: Mr. W. J. Farrell)
	CE/HK&I, DSD	(Attn.: Mr. K. R. Murrells)
	MTRC	(Attn.: Mr. G. Turnbull)
	NAPCO	(Attn.: Mr. J. P. Bovis)
	DO/C&W	(Attn.: Mr. H. CHO)
	DLO/HKW	(Attn.: Miss Anita LAM)
	CES/NA (Urban)	(Attn.: Miss Trevina KUNG)
	PTDB, TD	(Attn.: Mrs. Irene CHUNG)
	CTE/HK, TD	(Attn.: Mr. H. W. CHAN)

WBL/mn

TOTAL P.03

2/4/101

MEMO

From Secretary for Planning, Environment and Lands (Environment Division)	**To** PM/UA (Attn. : Mr. Y.L. Chung)
Ref. (46) in PELB(E)55/10/277(92)	
Tel. No. 848 2551 (Fax : 845 3489)	**Your Ref.** (78) in UAH 2/4/101 XVI
Date 23 November 1992	**dated** 12.11.1992

Central Reclamation, Phase 1 - Engineering Works
Focused EIA Study
Programme of Construction for Mitigation Measures

I refer to your MUR and the EPCOM meeting on 18 Nov 1992 when the Central Reclamation Phase I Focused EIA was discussed. You may recall that EPCOM members were particularly concerned about the water quality issue and strongly urged that all the mitigating measures recommended in the EIA report should be implemented. The meeting also noted that funding for some of the recommendations, which totalled $13.13 million, was not yet available. Upon EPCOM's request, you kindly agreed to co-ordinate a working group to sort out the funding arrangements. The Members also requested that they be kept informed of progress.

2. I note from your MUR that you have already started the ball rolling and would be pleased to receive a sitrep by early January 1993 so that I can report back to EPCOM at its next meeting which is scheduled for 18 January 1993.

RECEIVED 25 NOV 1992 URBAN AREA DEVELOPMENT OFFICE, T.D.B.

(William C.W. Hui)
for Secretary
for Planning, Environment and Lands

c.c. EPD (Attn. : Mr. W.J. Farrell)
CE/HK&I, DSD (Attn. : Mr. K.R. Murrells)
MTRC (Attn. : Mr. G. Turnbull)
NAPCO (Attn. : Mr. J.P. Bovis)
DO/C&W (Attn. : Mr H. Cho)
DLO/HKW (Attn. : Miss Anita Lam)
CES/NA (Urban) (Attn. : Miss Trevina Kung)
PTDB, TD (Attn. : Mrs. Irene Chung)
CEH/HK (Attn. : Mr. F.S. Tam)
CTE/HK, TD (Attn. : Mr. H.W. Chan)
MCAL (Attn. : Mr. J. Berry)
PELB(E)25/41/67(92)XXX

PM

For information please.

Time of sitrep

URGENT

MEMO

From: TE Div./HK, Transport Department	To: PM/UA
Ref. (125) in HR 182/80-9 II	(Attn: Mr. M.T. WONG)
Tel. No. 829 5428	Your Ref. (78) in UAH 2/4/101 XVI
Date 23 November, 1992	dated 12.10.1992

Central Reclamation, Phase 1 - Engineering Works
Focussed EIA Study
Programme of Construction for Mitigation Measures

I am concerned that the Final Report of the EIA Study has been issued without prior circulation to this Department for comments. In fact, the Consultant has totally ignored the importance of satisfactory traffic arrangements in assessing the proposed migitation measures.

2. I have briefly reviewed the implementation programme and Figures No. 2.11 to 2.25 in the Report. I opine that major traffic disruption will be caused by your proposed works, which are located at critical roads links/junctions in Central District. I also notice that the improvement work at each location could last for a period between 2 months and 1 year and up to 9 locations could be under construction simultaneously.

3. The traffic conditions will be further aggravated by the likely trench/hoarding works which are expected to be occurred simultaneously in the vicinity. These include, inter alia, the following:

(a) Utility works/hoarding of the ongoing building developments, notably LDC sites H6 & H3.

(b) HEC's proposed 275KV cable laying from Kennedy Road to Sheung Wan.

(c) Road reconstruction works under Hillside Escalator Link project.

(e) Stormwater/Sewer Drainage works under Central Reclamation Project (designed by Balfours).

(f) Improvement Works No. 1 to 5, as shown on Figures 2.11 & 2.12.

4. Even if night time works were proposed the problems will not completely be resolved as there will be road safety implications in plating over the trenches in daytime.

5. In this connection, the Consultant is required to submit detailed traffic diversion proposals for this Department's agreement, as well as that of the Police. To conclude I regret that I cannot agree to the proposed migitation measures and the implementation programme at this stage.

(H.W. CHAN)
for Assistant Commissioner for
Transport/Urban

c.c. CHE/HK
CP(DD/Traffic))
CP(SSO/T/HK1)) - w/addressee's memos, MCAL's letter, fig 2-11 to 2.25 - please forward your comments if any, to PM/UA.

HWC/ml

MEMO

From AC/PTD, TD
Ref. (66) in PT 116/161-7 XII
Tel. No. 8295307
Date 1 December 1992

Urgent By Fax

To PM/UA
(Attn. : Mr. M. T. Wong)
Your Ref. 78 in UAH 2/4/101 XVI
dated 12 November 1992

Central Reclamation, Phase 1 - Engineering Works
Focussed EIA Study
Programme of Construction for Mitigation Measures

I refer to MCAL's letter ref. JOB:EC:91590/20/47 dated 3.11.92 and offer no comments on the proposed implementation programme for the mitigation measures No. 7 to 18.

(Tommy L. S. NG)
for Assistant Commissioner for Transport/
Public Transport Development

G.F. 734

FAX 577-5040

MEMO

From DEP

Ref. ( ) in EP 2/H4/07

Tel. No. 835 1150 Fax. No. 591 0558

Date 2 December 1992

To PM/UA (Attn.: Mr. M.T. Wong)

Your Ref. (78) in UAH 2/4/101 XVI

dated 12 November 1992

Central Reclamation, Phase 1 - Engineering Works
focussed EIA Study
Programme of Construction for Mitigation Measures

I refer to your memo under reference.

2. Please make allowance in the programme for the excution of the findings of the SMP Extension Study for catchments C and D and the potential findings for catchments F and J1.

3. According to the tentative programme, the additional survey and preliminary design under the CW3 Extension Study will be completed around Chinese New Year.

(TSUI Wai-kit)
for Director of Environmental Protection

OUR REF: 來函檔號 EP 72/W8/9
YOUR REF:
電話 TEL. NO.: 8351154
圖文傳真 FAX NO.: 8349960

Environmental Protection Department
Headquarters
28th Floor, Southern Centre,
130 Hennessy Road,
Wan Chai, Hong Kong.

香港灣仔
軒尼詩道
一百三十號
修頓中心廿八樓

11 NOV

CES Consultants
Room 1201,
Tai Yau Building
181 Johnston Road
Wanchai, Hong Kong.

(Attn.: Dr. Topsy Rudd)

JDTS
DFD

10 November 1992 91590/20/47

Dear Madam,

Central Reclamation - Dredging

Your faxed dated 9/11/92 received with thanks.

I have no special comment to the sediment analysis between VS5 and VS6. However, I would like to include this in the appendix or response to comment section of the final report.

At the moment, once the monitoring location reached the alarm/action levels, the Resident Engineer will instruct (or formulate with) the contractor proper mitigation measures to minimise the adverse impact. Besides sealed grab, the three other mitigation measures suggested in your letter would be quite appropriate for the RE to follow:

(1) using a slower work pace

(2) working in a closed compartment (silt curtain skirt around the dredger)

(3) working with a safety margin to prevent overloading the transport vessels.

By copy of this letter, would you please produce some guidelines for resident staff in dealing with these problems so that UADO can include these options in the RE instruction note. Therefore, the resident staff can have some solid guidelines to follow when the monitored data reached alarm/action levels.

I would not insist of putting more monitoring stations at this stage as previous agreed with you and UADO and would not object any increase of the number of stations or sampling frequency if the resident staff required more.

Yours faithfully,

/o

(Wynn To)
Environmental Protection Officer
for Director of Environmental Protection

c.c. CE/Central & Wanchai Reclm., UADO (Attn: Mr. M. T. Wong)
Manusell Consultant (Attn: Mr. John Berry)
P(EA)

Balfours International (Asia) Consulting Engineers Ltd.
10th Floor, 1 Kowloon Park Drive, Kowloon, Hong Kong.
Telephone : 3175933 Fax : 3175920

URGENT

FAX TRANSMISSION FORM

CALLING FAX No. : 891 0305 REF No. : 7230/69/F 8178 SHEET 1 OF 5

FROM : Geoff Ward

TO (COMPANY) : CES

FOR ATTN OF : Dr. T. Rudd

C.C. : J. Berry (KO)

DATE : 11/11/92

SUBJECT : Central and Wan Chai Reclamation - Focussed EIA

12-11-92 J. Berry

AH
RJD
GKG
PDT
REPLIED
FILE

I refer to your fax dated 11/11/92, ref. F6782, and reply to EPD's letter to the sewerage comments as follows;

Comment

(1) The disagreement over the percentages reduction should be mentioned in the Executive Summary and recommendation section of the Final Report. This issue is to be looked in greater detail during the detailed design stage.

Response

(1) The percentage reduction figures are not discussed in the Final Report except in Section 3.1.3 which stated the figures for the purposes of modelling only. The figures are subjective but are broadly indicative and will be confirmed by the SMP extension study and the following detailed design. It is the view of DSD that the percentage reduction figures are too high however they have not suggested any alternatives.

\- - - - -

Comment

(2) If it is decided that the extended investigation works for catchments F & J1 is to be carried out by the SMP consultants, it should be noted that additional funding must be provided and more time should be allowed.

Response

(2) Irrespective of whom completes the investigation works for catchments F & J1 additional funding must be provided. Whether more time is necessary can only be determined by Government and the way the works are completed. It is feasible, for example, to complete the investigation in parallel with the SMP extension study.

\- - - - -

Comment

(3) Section 1.2, line 4-6

It seems that the consultant is confused as to the scope of the extended survey to be carried out by the SMP consultants. At present only the two catchments drainage to outfalls C & D are included. Again, on page 3-14 last paragraph, page 3-15 2nd paragraph and Section 4.2.1 last paragraph, the same wrong assumption is made on the scope of the SMP extended survey.

Response

(3) Noted. We ask you discuss this matter with your Mr. Gordan Wan. He has been made aware of this discrepancy, a Balfour's letter dated 25/9/92, ref. 7230/07/06/6917 refers.

- - - - -

Comment

(4) Page 2-7, line 6 & Table 3.8

Presumably the estimated costs still do not include design fee, supervision cost and pre-commencement detailed survey (if required).

Response

(4) Correct.

- - - - -

Comment

(5) Page 2-7, 2nd paragraph lines 2 & 5

The statement "... will not affect water quality in the embayed areas ..." is rather misleading. It seems that there is no reason why the outfall location is controlled by the seawater pumping station and Custom and Excise building.

Response

(5) The statement is quite correct. The pipe will outfall on the western seawall and therefore it is impossible for it to have any affect on the water quality in the embayed area.

- - - - -

Comment

(6) Page 2-8, 2.2.3 (d) line 3

The length of existing sewer having negative gradient is only about 60m as identified under SMP. The figure of 570m is not understood. The section that the consultant said to be replaced is probably not the consultant said to be replaced is probably not the same section recommended under SMP - the latter only recommends the section downstream of CES's one.

Response

(6) The distance of 570m was agreed with DSD based upon recent operational experiences. In fact two sections of the sewer have a negative gradient.

- - - - -

Comment

(7) Section 2.2.4 (b)

Please elaborate on (i) the required heads of the proposed extension and of the further extended option; (ii) what additional cost is involved for the further extension; (iii) whether the option is feasible technically; (iv) whether the required diversion in the next phase of reclamation can be abandoned.

Response

(7) The option of submarine stormwater outfalls was rejected primary because it will increase the potential for flooding in Central. This potential flooding is detailed in the "Surface Water Drainage Systems Investigation, Central Catchment, Final Report R1" completed for the Central and Wan Chai Reclamation Development. This report is available from your Mr. Lawrence K.K. Ngo. For your information a submarine outfall is feasible and would cost upwards from $40,000 per metre length depending on the diameter.

- - - - -

Comment

(8) Section 2.2.4 (c)

Please provide a sketch showing the clash between ARL tunnel and proposed further extension of F and elaborate on the amount of additional headloss caused by the further extension over the recommended extension. If these two reasons are valid, why will the proposed further extension of C & D after final reclamation not have the same problem (if this is still the recommendation)?

Response

(8) The Final Report mentioned in the response to comment (7) above details this clash, what the additional headloss is and why other culverts do not have the same problem.

- - - - -

Comment

(9) Table 2.2 & Table 3.8

The cost estimate for Improvement No. 12 is not included in Table 2.2.

Response

(9) The cost for Improvement No. 12 is included in Table 2.2 in the estimated cost of $4,300,000 for sewer upgrading in storm catchment F.

\- - - - -

Comment

(10) Table 3.3

Should NH_3-N load be 55kg/d in Scenario (2), (3) and (4)?

Response

(10) Correct, this was a typographical error, which is regretted.

\- - - - -

Comment

(11) Page 3-4, footnote 4 and Section 3.1.3 (b) (3) 2nd paragraph

The assumed percentages reduction are far too high. Note that DSD have similar view.

Response

(11) Refer response to comment (1).

\- - - - -

Comment

(12) Section 3.1.5. 5 paragraph, line 4

What is the measure recently implemented by DSD at F or J1?

Response

(12) The measure is the major expedient connection in catchment J1, refer page 2-5 para 6, line 1 and 2.

\- - - - -

Comment

(13) Section 4.1.1

Similar comment as (5) above, "... are likely to deteriorate slightly ..." should be accompanied by a statement that the model and hence the results are not yet agreed by EPD.

Response

(13) The report, in principle, has been accepted by EPD with some reservations on the modelling results. It is the consultants belief that a slight deterioration can be expected.

- - - - -

Comment

(14) General

It should be noted that any (new) mitigation measures recommended under the SMP's survey are not yet included in the budget.

Response

(14) It is impossible to cost recommendations of the SMP extension study when data collection has not even been completed.

Regards,

Geoff Ward

GRW/em

MEMO

From Project Manager/Urban Area

Ref. ( ) in UAH 2/4/101 XVII

Tel. No. 882 7204

Date 26 November 1992

To EPD (Attn : Mr. W. Farrell)

27 NOV 1992

Your Ref. .... in .... JDB

dated .... DF

Central Reclamation, Phase 1 - Engineering Works
Focussed EIA Study

CES (C Branch)

I refer to MCAL's letter ref. JDB:EC:91590/20/47 dated 10.11.1992 sent to me with a copy to you concerning the captioned EIA Study. 91590/20/47

2. Following our successful presentation of the EIA study to EPCOM on 18 November 1992, it is apparent that the study should now be taken as complete. All additional minor comments recently raised by your staff have all been responded in writing by the consultants. These seem to be adequate as the Final Report and Executive Summary have all been printed and distributed.

3. In view of the above, I would request your formal endorsement of the report as suggested by you at the meeting on 30.10.1992 (para. 3.4 of the notes of meeting sent with MCAL's letter ref. JDB:EC:91590/20/47 dated 10.11.1992 refers) so that the fees for the study can be finalised.

4. As regards your staff's request to the consultants for additional guidelines for resident site staff in dealing with deteriorating water quality when monitored data reached alarm/action levels, it is clearly outside the current scope of the study brief. Notwithstanding the above, some mitigation measures such as (i) using a slower work pace, (ii) using silt curtain skirt and (iii) working with a safety margin to prevent overloading the transport vessels have already been proposed. They seem to be sufficient as far as the EIA Study is concerned, given that it is the Contractor's responsibility to propose suitable mitigation measures to the satisfaction of the Engineer in the event of deteriorating water quality.

5. Regarding the proposed extended investigation works for catchments F&J1 to be carried out by your SMP consultants, it seems that funding, and may be timing as well, for this work have yet to be resolved. I suggest this to be addressed when you comment on the draft implementation programme of the mitigation measures No. 7 to 18 circulated vide my previous memo in even series dated 12.11.1992.

(M.T. Wong)
for Project Manager/Urban Area

c.c. MCAL (Attn: Mr. J. Berry)

MTW/clt

FILE

MAUNSELL
CONSULTANTS ASIA LTD.
CONSULTING ENGINEERS

1 KOWLOON PARK DRIVE, HONG KONG

TELEPHONE 376 2299
FAX 376 2070

茂盛工程顧問有限公司

YOUR REF.: () in UAH 2/4/101 XIII
OUR REF.: JDB:EC:91590/20/47

PM/UA
Urban Area Development Office
12/F, Leighton Centre
77 Leighton Road
Causeway Bay
Hong Kong

27th November, 1992.

Attn: Mr. M.T. Wong

Dear Sir,

Central Reclamation, Phase 1 - Engineering Works
Focussed EIA Study
Final Report
Addendum on Noise Assessment

Further to our issue of the Final Report for this study, our discussions at our meeting with EPD on 30th October 1992, and EPD's letter ref. EP/H4/07 dated 22nd October 1992, we have revised the noise assessment for Noise Sensitive Receiver NSR-2 (United Building).

We enclose 30 copies of the "Addendum on Noise Assessment" as requested.

Yours faithfully,
for MAUNSELL CONSULTANTS ASIA LTD.

(J.D. Berry)

Encl.

cc: EPD (Mr. W. Farrell) w/2 copies

bcc: CES (G. Bradley) w/2 copies
HWR (J. Rodger))
Balfours (G. Ward)) w/o encl.
DFD)
JDB)
KO Library) w/encl.

CES CONSULTANTS IN ENVIRONMENTAL SCIENCES (ASIA) LTD

Room 1201, Tai Yau Building, 181 Johnston Road, Wanchai, HONG KONG

Telephone: 8931551 Facsimile: 8910305 Dialcom: 8808:HKA129

12/10/92

FAX TRANSMISSION FORM

To (Company)	:	EPD (EAPG)	**Fax No.**	:	591 0558
Attention	:	Mr Gaspar Sanvicens	**Date**	:	9.10.92
From	:	Dr T Rudd	**No. of pages**	:	6
Subject	:	Central Reclamation Focussed EIA	**Job/Ref No.**	:	95060/F6510

c.c. UADO Attn: Mr M T Wong ☐
MCAL Attn: Mr J Berry ☐

If you do not receive all the pages, please contact us immediately. **The original will not be sent by post.**

Gaspar

Please see attached responses to comments from NPG and LPG. I appreciate that the LPG comments were internal, but have provided responses where further clarification seemed warranted.

7.10.92

I have also attached, for your information, a copy of a fax from HWR with some observations on Items 10 and 13 from your draft EPCOM paper. These may be useful in any discussions on these items with EPCOM members. One salient point is that the ferry piers were not modelled as solid but were simulated on a 15% solid basis as advised by MCAL. We presume that Item 13 referred to the whole Central and Wanchai Reclamation rather than just the Central Phase 1 Reclamation; Jim's response has been drafted on that basis.

Regards

Environmental Protection Department
Noise Policy Group (ref ( ) in EP2/H4/07)

Comments: / **Responses:**

3.4.2 The calculated "existing" traffic noise level is probably very much on the high side. During the peak hour, it would be impossible for the vehicles to travel at 80 km/h. Also, most NSRs are much more than 4 m away from Connaught Road Central. To give a better picture, noise survey should be conducted at representative NSRs, for example, at bottom floor and top floor of NSR3 and NSR5.

Response: As stated in previous telephone discussions, there is insufficient time to undertake noise monitoring prior to submission of the Final Report on 2 or 6 October. The calculated traffic noise level has been revised to include a speed range from 40-80 km/h, and a sentence added noting that noise levels will be lower at the upper floors of sensitive receivers.

Table 3.13 Your regression analysis deviates slightly from our in-house data. Please revise the table as follows,

Distance (m)	Correction (dB(A))
301 to 317	63
318 to 351	64
352 to 387	65
388 to 427	66

Response: We note that there is a minor difference between our regression analysis and your in-house data. Our regression analysis approximately follows the equation [Correction = 23.33 logD + 5.11007] and your in-house data appears from back-calculation to follow the equation [Correction = 23.33 logD + 5.1142]. There is only a difference of 0.0043 in the constant term which is quite insignificant. Nevertheless, the text has been amended as per your request.

3.4.4 NSR1 should be located in Connaught Road Central instead of Connaught Road West.

Response: Text amended.

NSR2, NSR5 and NSR6 are not all directly affected by the traffic noise of Connaught Road Central. Some facades of these NSRs have no direct line of sight to Connaught Road Central and an Area Sensitive Rating "B" should be assigned to these facades.

Response: Previous comments on this point received from EPD in writing and by telephone queried the classification of NSR3, not NSR2. NSR5 has already been classified as an ASR "B" in the original text. Reference to NSR3 was amended to a "B/C" as discussed by telephone. The classification of NSR2 was not previously queried.

For NSR2, the predicted maximum noise level of 85 dB(A) is alarming. The suggested overestimate should be quantified by calculation otherwise concrete noise reduction measures should be recommended.

Response: Please refer to response to original comment on this issue, where the reasons why the overestimate cannot be calculated were stated.

High quality glazing and central air-conditioning cannot attenuate <u>external</u> noise. Please amend the relevant statement.

Response: Text clarified.

3.4.6 "Clause 7.9" in the second paragraph should be revised as "Clause 7".

Response: Text amended.

Liquid Projects Group

2(a) There is NO way I can advise you whether we accept the mitigation measures proposed - the improvement numbering is different to previously submitted ones and no diagrams are provided to show which is which. The cost estimates are also all different to those on the draft report. I just cannot compare Table 2 in the Executive Summary and Table 2.2 in the Draft Report.

Subsequent to submission of the Draft Final Report, we understand that DSD undertook manhole inspections to investigate a number of the cross-connections identified. Confirmation of these and agreement on which could be rectified was received from DSD on 1 October. The report text was revised and a draft executive summary sent out for comment on the evening of 1 October. A figure to show the locations of the revised mitigation measures could not be prepared within this short timescale for circulation with the draft summary, but was completed for inclusion in the Executive Summary (and Final Report) which was printed and submitted to SPEL on 6 October, after the bank holiday.

While we appreciate the difficulties in reviewing material without adequate illustration, the time constraints involved in meeting SPEL's deadline for the EPCOM meeting (then set on 13 October) precluded the provision of a diagram and the possibility of a normal review period.

(b) Page 2, 2nd paragraph last sentence

I have at least pointed out four times before that NO information on the possible reduction from any measures has been provided in the Central SMP (CW3). It only gives the current pollution situation. This last sentence again gives the impression that the reduction is obtained from CW3. It is pointless for me to give the same comments time and time again without getting any satisfactory response until such time when the project is so advance or urgent that I am forced to make a decision whether to accept any unexplained assumptions (and invariably to accept them).

Section 8 of the Central Western and Wan Chai West SMP Draft Final Report discusses the potential reductions in polluting load which might result from various mitigation measures in terms of X kg BOD/d (see Table 8.2) and suggests that it may be possible to achieve an overall reduction of 27% of the total pollution load observed in the field survey by implementing certain remedial measures. A similar approach was taken in the Draft Final Report to estimating the potential pollution load reductions which could be achieved by various mitigation measures. While it was necessary to assume percentage reductions based on our experience from the SMP Study in order to carry out the requirements of the Study Brief, it is acknowledged that these are only estimates and that the effectiveness of any mitigation measures recommended would need to be evaluated by further field investigations. The text has been revised in the Final Report to delete references to percentage load reductions, except where these had to be assumed for the purposes of modelling. It has also been recommended that the efficacy of the measures proposed are investigated as far as possible under the CW3 extension survey, which at present only covers catchments C and D. The revised Final Report and Executive Summary now recommend that other catchments, notably F and J1, be included in the survey, so that the practicality and value (in terms of pollution reduction) of the measures proposed can be determined before they are implemented.

(c) Section 2.2, last paragraph

Throughout the whole communication process with the reclamation consultants or TDD, they are fully aware that the proposed extended work under CW3 only covers catchments C and D. They have been claiming that by diverting drains at B and F, the degree of water circulation should be similar before and after the two bunds. It is only when the Draft Report was issued that they claimed the only area to be looked at should be around catchment F from their model which is not accepted by WPG. As such, only the works mentioned in (v) are included in the scope of the extension study of CW3, NOT (iv). The latter should be included in the reclamation job itself.

It is appreciated that only catchments C and D are presently included in the scope of the CW3 extension study. It is a recommendation of this study, however, that catchments F and J1 are also included, even though the funding for these may come from elsewhere. It was not proposed that implementation of the works in catchments F and J1 should be carried out under the SMP extension study, only that investigation of the effectiveness of such works should be included. The text has been revised to clarify this point.

(d) Paragraph 13

It should be noted that the mitigation measures at catchments F and J1 are only programmed to be complete around 1997. Again the last sentence "... similar work on catchment F should follow" implies that it will be under CW3 which is wrong. This must be pointed out.

This comment appears to relate to EPD's Draft EPCOM paper rather than the Executive Summary, and it is not therefore for the consultants to respond.

Environmental Protection Department (ref: in EP/H4/07)

Comments:		**Responses:**
	Section 3.1.3	
(a)	From the model results' contour plots, it is doubtful whether the loading of culvert F has been included in the model, especially for ammonia (an indication of raw sewage discharge) in Figures 3.39 to 3.46. Culvert F is not shown as a discharge point (i.e. a high concentration point) in figures showing the partial reclamations. However, culvert F is shown as a discharge point the ammonia loading at F is comparable to the loadings at A, C or D. As well as the discharge points, A, C and D, F should be shown.	In all previous modelling exercises using WAHMO, discharges from the outfalls (storm or sewage) were just applied to the water quality as a loading to the model cells, no flow discharges were included in the flow model. In the present study, the flow model simulations included the effects of cooling water intakes and discharges, which effectively carried flow from or into inactive dry cells. The existing WAHMO water quality models would only be able to cater for these by applying additional source/sink effects upon the water quality model cells to maintain the flow continuity. Two approaches could be used: a) Assume both water and pollutants were removed at the cooling water intakes and added to the model at the cooling water discharges, as a result lower pollution levels would appear at the intakes while higher concentrations would appear at the discharge points; or b) Assume that only water would be extracted and discharged, so pollutants would be maintained at the cells where the cooling water intakes were located and had a dilution effect at the discharge point, such that higher concentrations would result at the intakes and lower levels at the discharges. It was expected that adopting either approach would produce different results in only local areas around the intakes or discharges. In the present study, the first approach was employed. The red spots shown at outfall F for the case with the completed Phase 1 reclamation were due to the effects of the large cooling water discharge of 5523 l/sec which was previously located elsewhere for the basecase and the partial reclamation.

Furthermore, the results at station C serve as an indicator as to whether discharges from outfall F, G and H were included. From Table 3.4 and Figures 3.11 to 3.30, the effects of the discharge from culvert F on station C, if it had not been included, would not have given the noticeable difference between the cases with and without the mitigation measures, as only the loads from outfall F and J1 had been reduced. Also, greater difference in the water quality between the cases of partial and completed reclamation would have resulted if outfall F had not been included in the former case. Therefore, there should not be any doubt as to whether the loading from culvert F was included.

(b) As stated in section 10 of our EPCOM issues paper, the pier obstruction of tidal flows at the Macau Ferry and Star Ferry and the resultant eddies, have been omitted. It is accepted that with obstructions there will be a small increase in local current velocities. However, this increase in velocity will reduce the total volume of bulk water flows, with a consequent decrease in the flushing capacity. Without the modelling of the effects of the piers, the local water quality impact might have been underestimated.

The model boundaries were set too near to the concerned area, and hence the simulations will be distorted by these preset boundary conditions.

The Rambler Channel model runs are being set up at the present time. Hence contrary to HWR's claim, the Central Reclamation was the first to have used a 25 m grid WAHMO model in HK waters.

It was assumed in the studies that the small obstruction to flows presented by the ferry piers would make little difference to total bulk water movements. Water speeds, and so friction losses, under the piers are low and it was assumed that, for example, a 15% reduction in flow area caused by the piers would be compensated by a similar increase in water speed so, to within the accuracy of the simulation, the total bulk water movement could be assumed to be unaffected. It is to be expected that there will be some reduction in total flows but these could not be resolved accurately by the model. A more detailed study requiring detailed field data would be required if it was thought necessary to resolve the expected impact of the piers on water movements and water quality.

Once the reclamations are in place, the nearshore water speeds in the vicinity of, for example, this Star and Macau Ferry piers will be much reduced (c.f. Points 12 and 15 in Figs 20 and 38 and 24 and 42 of Appendix 2 of the Final Report). Any small impact of the piers will then be greatly reduced also. As a result, while the model may possibly have overestimated the tidal flushing for existing conditions, it is likely that, for the simulations of the reclamation layouts, any very small overestimation in total flows would be much reduced. Consequently, when comparing the changes in pollutant concentrations between existing conditions and those following the uncertainty in the absolute concentrations of the pollutants modelled as a result of uncertainties in the loadings and boundary conditions used and the modelling procedure, it is thought that the relative changes in pollutant concentrations predicted by the models should not be underestimated.

The positions of the model boundaries and the dimensions of the model area were given to EPD before the model study began. While it is always preferable to model as large an area as possible, constraints are imposed by the fine model grid required to resolve local features and the scope of work possible within the project deadlines. At the beginning of the study, it was our opinion that the modelled area was sufficiently large and the boundaries sufficiently far removed from the local discharge points of interest to allow a successful simulation of local impacts. Having completed the simulations, the results from the flow and thermal model indicated that the main plumes were contained within the modelled area and it was confirmed that the location of the model boundaries would not have an undue impact on the model results.

We think there has been a misunderstanding. HWR did not claim that 25 m grids had been used in Hong Kong before, only that 25 m grids are not uncommon in three-dimensional models. The 25 m grid is being used in the Rambler Channel model following discussions with EPD and this current model study was mentioned simply to indicate that EPD have accepted the use of 25 m grid models. It was not intended to suggest that this study had been completed.

3(c) The stratified temperature zones predicted by the 3-D hydraulic model seems to have no effect on the DO, chlorophyll growth nor the *E. coli* die off rate, and should have been evaluated further.

The model results indicated that the significant temperature increases were confined to the surface layers of the water column in the three-dimensional model and that the lower layers experienced a much smaller temperature increase. The water quality model was a two-layer model and so these surface increases would have been averaged over the much thicker top layer of the two-layer model giving a much lower average increase in water temperature than was predicted in the surface layer of the three-dimensional model. The heated water is flushed by the tidal flows and so the water affected by the higher temperature is constantly changing and is subjected to the higher temperature for a limited period only.

The impact of temperature on bacteria mortality rates was considered during a study of the impact of a power station cooling water discharge on the local receiving waters in Hong Kong. It was reported that the temperature dependence of the night time mortality rate could be expressed as $T_{90} = 960/T$ where T is the water temperature in °C. Considering the uncertainty in mortality rates caused by, for example, changes in salinity and turbidity and the large variation in mortality rate between bright sunlight during the day and nighttime, for the typical water temperature in Hong Kong, an increase in water temperature of the order of 1°C cannot be meaningful within the accuracy of any simulations possible.

In assessing the simulations, in the absence of detailed field data for comparison, it is most important to compare the predictions for the present situation with those following the introduction of the reclamations. The warmer water distributions are not the same for both situations and, in assessing the impact of the different water temperatures on water chemistry and mortality rates, it should be the differences in water temperatures between the two situations which should be considered rather than the differences in water temperature between each situation and the far field background temperature. On the whole, over most of the area affected, the difference in temperature between the existing situation and that following the reclamation must be smaller than between either situation and the far field background temperature. As a result, in this study, the temperature effect on water chemistry and mortality rates must be considered a secondary effect beyond the resolution of present knowledge.

Section 3.1.4

(c) The dredging impact assessment was done assuming a dredging rate of 8,000 m^3/day and 5% "losses to the water column on dredging". The dredging method which corresponds to these rates was not specified. Section 3.2.5 recommends a closed grab dredging method. Is removal of 8,000 m^3/day realistic for this type of dredger ?

The rate of removal of marine mud is determined primarily by the size and number of dredgers, not the type of plant. The type of plant and the way in which it is operated determine the proportion of the removed material which is lost to suspension. Use of sealed grabs had already been specified in the Contract Specifications for Central Reclamation prior to the Focussed EIA being carried out, thus use of this type of plant was an inherent assumption. As stated in the text, the assumption of 5% losses with a sealed grab dredger is considered to be conservative and will tend to overestimate the potential polluting loads.

The pollutant loading was based on sediment results from VS6. However, sediment results are also available at station VS5 which is closer to the site. These VS5 results should have been included in the load assessment.

Sediment data provided by EPD on another study were used for the assessment. VM5 was not used as it does not appear to be included in the 1987-91 EPD data set. Early 1987 data for VM5 indicate very similar characteristics to VM6 for 1991 in terms of specific gravity, dry weight ratio and COD concentration. Within the accuracy of the sampling and analytical methods, and temporal variations, use of the VM6 data is considered to be reasonably representative.

Section 4.4 of the study brief also asked for an assessment of impacts from the placement of fill and the potential for release of metals and sulphides. This area does not appear to have been addressed.

Section 4.4 of the Brief requires, *inter alia*, an assessment of the potential increase in turbidity. The potential increase in suspended solids loading has been quantified and the effects of this summarised qualitatively in Table 3.7. Translation of sediment loads into steady state suspended solids concentrations in the water column would require modelling, which was not specified in the Brief. Increases in turbidity from fill placement will be low in comparison to dredging, since marine sand with a low fines content will be used and settlement will be more rapid due to the larger particle size. Any controls required on the basis of dredging should therefore also be appropriate for controlling turbidity generation from fill placement.

The potential for release of metals was considered briefly in Section 3.2.4 on Marine Muds. However, since the Contract Specification already includes the requirement for a sealed grab, which is specified by EPD as being suitable for removal of Class C contaminated mud, it is inferred that the potential for release of metals will be low and within acceptable limits (ref Section 3.2.5).

Release of other compounds will also be lower using this dredging method than other methods which cause greater solids suspension.

Sulphides are of concern in that their release from anaerobic sediments could imply a change in speciation and release of metals present in sediments as insoluble sulphides. However, no data are available on sulphide levels in sediments in this area since this parameter is not included in EPD's routine sediment monitoring programme nor to our knowledge, in any other field studies carried out in the area.

Para 4 Dredging is predicted to double the pollutant loads, however, the resultant impacts on the embayed area have not been identified. Nor has the cumulative effect of dredging and sewage impact to the water bodies been assessed. [5 ton/day of COD from dredging is more than 7 times the sewage loading at culvert F]. In view of this fact other mitigation measures are needed in addition to the monitoring controls and working methods in the contract specification.

Impacts from dredging have been summarised qualitatively in Table 3.7 and the cumulative impacts from dredging and stormwater discharges discussed in Section 3.1.5 (a) para 4. Quantitative assessment would require modelling, but neither this nor evaluation of cumulative impacts was explicit in the Brief.

The value of extensive modelling of dredging impacts based on limited input data is perhaps questionable in the context of EPD's concern over the existing modelling exercise; it is possible to say that there will be a period of 2.5 months when dredging impacts are likely to exacerbate water quality locally at points with the embayment. Dredging impacts will be minimised by both the methods specification and the performance specification included in the Contract; should the Contractor exceed the performance specification he is required to amend his working methods or deploy appropriate mitigation measures, which could include the use of silt screens. If EPD consider that the performance specification is inadequate, this can be revised on advice .

Table 3.7

The fact that floating refuse may choke up the cooling water intakes of ships and may cause damages to engines has not been mentioned.

Noted.

Hydraulics and Water Research (Asia) Ltd

DATE 7.10.92
ACTION/REPLY/COMMENT

COPY

CALLING FAX NO	: 8910305
TO (COMPANY)	: CONSULTANTS IN ENVIRONMENTAL SCIENCES
ATTENTION	: Dr T RUDD
FROM	: JIM RODGER
DATE	: 7 October 1992
SUBJECT	: CENTRAL & WANCHAI
No OF PAGES	: 2 (including cover page)
OUR FAX No.	: 5763590

Our Ref: HWR/F/49

Topsy,

Thank you for your fax; responses follow.

Issues

(10) The model boundary conditions were taken from previous WAHMO model simulations which must be regarded as reasonable approximations to the conditions which would be experienced for the existing coastline and the overall effluent load EPD specified should be used. There will be unknowns and uncertainties associated with the effluent loading and, when simulating absolute water quality conditions, these will have a more important impact on the model results than any uncertainties in the boundary conditions caused by the works.

The model grid size used (25m) is not uncommon when examining local effects and small thermal discharges and finer grid sizes are used (down to 10m). A 25m grid has also been selected for another model of the impact of bridge piers on water movements in the Rambler Channel. The tidal flow model was a three-dimensional model which can better represent the important physical processes governing stratified tidal flows and is considered the most accurate approach for this local study and more appropriate than the WAHMO two-dimensional models.

The data provided suggested that the reduction in flow area caused by the ferry piers would be less than 15% and the expected reduction in water movements would be less because the water would accelerate through the reduced area available. At the low water velocities in this area, the small increase in water speed would have little impact on friction losses and so it was assumed that the effects of the piers on local discharges could be neglected.

The eddies which the model is able to represent will be restricted to those greater than approximately 150m for the grid size chosen. As a result, the water movements in the slack water areas on either side of the reclamation should have been well represented. A finer grid size would be required to model smaller eddies.

A Joint Venture Company of HR Wallingford Ltd, EGS Ltd and WRc plc
12th Floor, Park Commercial Centre, 2-12 Shelter Street, Causeway Bay, Hong Kong Tel: 8948622 Telex 65269 EGS HK Fax: 5763590

(13) The impact of the completed reclamation on tidal flushing has been the subject of previous computer and physical model studies. While this must be of concern to EPD. it was not the subject of this focused EIA and the problem was not addressed. We would be pleased to carry out additional studies to EPD's instructions.

It is agreed that a conservative assessment of the model results should be made. Any model will contain some approximations and must rely on best estimates of input parameters such as effluent loadings. It is also not possible to model every condition which might be experienced and so usually worst case conditions are estimated and modelled. In the time available and with the resources available, the models used are considered to be the most appropriate tools with which the relative impact of the proposed works could have been assessed. Water quality will be reduced after the construction of the works and the model results should be taken as an indication of the possible degree and extent of the worsening which might be expected.

I hope this helps.

Regards

Jim

12/10/92
91590/20/07

CES CONSULTANTS IN ENVIRONMENTAL SCIENCES (ASIA) LTD

Room 1201, Tai Yau Building, 181 Johnston Road, Wanchai, HONG KONG

Telephone: 8931551 Facsimile: 8910305 Dialcom: 8808:HKA129

FAX TRANSMISSION FORM

To (Company)	:	EPD (Noise Policy Group)	**Fax No.**	:	838 2155
Attention	:	Mr S Wong	**Date**	:	8.10.92
From	:	Dr T Rudd	**No. of pages**	:	2
Subject	:	Central Reclamation Focussed EIA	**Job/Ref No.**	:	95060/F6494

c.c. UADO (577 5040) - Attn : Mr M T Wong
MCAL (810 1056) - Attn : Mr J Berry
EAPG (591 0558) - Attn : G Sanvicens

If you do not receive all the pages, please contact us immediately. **The original will not be sent by post.**

Mr Wong

Further to your fax ref ( ) in EP 2/H4/07 dated 2 October, we have the following responses to your comments;

1) Noted. Text amended.

2) We discussed with Mr Chiu by telephone his suggested further revisions to the revised main report text (submitted to NPG on 23 September) and agreed to take these into account where possible. One of them, monitoring noise levels along Connaught Road Central, was not possible within the timescale of submission of the report. We understood that we were generally in agreement over the major issues but that some minor text changes were still required.

However, the substance of your comments on road noise, contained in the first paragraph on page 2 of your fax, appears to contradict what had previously been agreed with NPG in the meeting at EPD's offices on 3 September, and subsequently reiterated in our written responses to comments. As stated in our previous fax ref 95060/F6432 dated 2 October, the issue of dominant road noise and the provision for the Engineer to determine whether or not it constitutes an influential factor during monitoring of construction noise, was not raised in EPD's comments on our responses, and we thus assumed that the amendment to the contract specification which we had recommended in respect of this issue was accepted.

While we appreciate the need to avoid undue public alarm with respect to the contents of the EPCOM paper and have accordingly amended the text in response to your comments, it would have assisted in the preparation of the final documents if these comments could have been provided earlier than 11.15 am and 6.15 pm respectively on the day on which the Final Report and Executive Summary were due to be submitted.

3) For your information, a copy of the revised Final Report text was passed to EAPG on 2 October. The Final Report and Executive Summary were submitted on 6 October, following the bank holiday. In view of the tight timescale to meet the deadline for EPCOM, EAPG agreed that any further minor issues arising from the revised Final Report text could be resolved by correspondence after submission of the report.

Regards

pp Rudd

MAUNSELL
CONSULTANTS ASIA LTD.
CONSULTING ENGINEERS

1 KOWLOON PARK DRIVE, HONG KONG

TELEPHONE 376 2299
FAX 376 2070

茂盛工程顧問有限公司

YOUR REF.: () in UAH 2/4/101 XIII
OUR REF.: JDB:EC:91590/20/47

7th October, 1992.

URGENT BY HAND

PMUA
Urban Area Development Office
12/F, Leighton Centre
77 Leighton Road
Causeway Bay
Hong Kong

Attn: Mr. M.T. Wong

Dear Sir,

Central Reclamation, Phase 1 - Engineering Works
Focussed EIA Study

Your letter of 17th September and our subsequent conversation (Wong/Berry) refers.

As instructed, we have produced 80 copies of the Executive Summary and 30 copies of the Final Report for this study. 50 copies of the Executive Summary have been sent to SPEL direct on 6th October 1992 (attention Mr. William Hui), 27 and 3 copies given to you and EPD on the same day.

We note that the presentation to EPCOM has been delayed.

We now enclose 2 copies of the final report and have sent 5 and 3 to SPEL and EPD separately today. The remaining copies will be sent to you shortly.

Yours faithfully
for MAUNSELL CONSULTANTS ASIA LTD.

(J.D. Berry)

Encl.

cc: EPD (Mr. W. Farrell) w/3 copies)
SPEL (Mr. William Hui) w/5 copies) BY HAND

bcc: CES (Dr. T. Rudd) w/2 copies)
HWR (Mr. J. Rodger)))
Balfours (Mr. G. Ward))) Please be prepared for the
DFD) w/1 copy) EPCOM presentation when it
JDB)) comes.
KO Library))

By Fax & Post

Please quote this reference
in future correspondence

拓展署
Territory Development
Department, Hong Kong

市區拓展處
URBAN AREA DEVELOPMENT OFFICE

來函檔號 Your Reference
本署檔號 Our Reference (12) in UAH 2/4/101 XIV
電話 Telephone 882 7204
傳真 Fax 577 5040
日期 Date 16 October 1992

Maunsell Consultants Asia Ltd
8/F Baskerville House
22 Ice House Street
Central
Hong Kong

(Attn: Mr John Berry)

Dear Sir,

Contract No. UA 11/91
Central Reclamation, Phase 1 - Engineering Works
Focussed EIA Study

I refer to the Table 4.1 - Recommended Mitigation Measures in the Final Report for the Focussed EIA Study.

Please draft an implementation programme for mitigation measures Nos 7 to 18, based on the assumption that the SMP extention study will confirm the effectiveness of these mitigation measures. Sufficient time should be allowed in the programme for the undertaking of the detailed design and preparation of necessary documents/drawings for construction. This draft programme will form the basis for further discussion with departments concerned for the implementation of the recommended mitigation measures

Yours faithfully,

(M.T. WONG)
for Project Manager/Urban Area

c.c. EPD (Attn: Mr W Farrell)
CE/HK&I, BLD (Attn: Mr K R Murrells)
Balfours (Attn: Mr Geoff Ward)
CES (Attn: Dr T Rudd)
MTRC (Attn: Mr G Turnbull)

DL/MTW/af

本署檔號
OUR REF: (94) in EP 2/H4/07 IV
來函檔號
YOUR REF:
電話
TEL. NO.: 835 1303
圖文傳真
FAX NO.: 838 2155

Hong Kong Government
Environmental Protection Department
Headquarters
28th Floor, Southorn Centre,
130 Hennessy Road,
Wan Chai, Hong Kong.

環境保護署總部
香港灣仔
軒尼詩道
一百三十號
修頓中心廿八樓

21 October 1992

CES Consultants in Environmental
Sciences (Asia) Ltd.,
Room 1201, Tai Yau Building,
181 Johnston Road,
Wanchai,
Hong Kong.

(Attn.: Dr. T. Rudd)

Dear Dr. Rudd,

Central Reclamation, Phase 1
Engineering Works - Focused EIA Study

I refer to the Executive Summary and Final Report for the captioned study submitted by MCAL on 6.10.92 and 7.10.92 respectively and your responses to our comments subsequently received.

After careful review I would like to draw your attention to our following remarks on the Executive Summary and Final Report on the noise sections:

Executive Summary

It would be preferable to revise the second last sentence in Section 4 as "..... daytime noise limit of 75 dB(A)".

Final Report

Section 3.4.2 We consider the best way to find out existing noise environment on Connaught Road Central is by measurement due to non-free flowing traffic. The predictions given in this section overestimate the existing traffic noise levels. From our past surveys, facade noise levels during peak hours at 4m from Connaught Road Central are in the order of 78 dB(A) Leq. The predication should therefore be used with care.

Section 3.4.5 For NSR2, it is noted that a maximum noise level of 85 dB(A) may be reached. To be useful to the Reclamation Engineer, the report should recommend concrete noise reduction measures to reduce the potential noise problem. For example, one of the ways available to reduce the noise impact is by positioning of site offices at critical position acting as screens for NSR2. The EIA study will be more user-friendly if concrete measures are provided.

..... 2

Section 4.1.6 This section is the same as the superseded draft Executive Summary which has been found to be inappropriate. It has overemphasized on the effect from traffic noise and gives a wrong impression that this study is not concerned about the impact from construction noise. I would consider prudent to revise this section in accordance with the line taken in the agreed Executive Summary.

Section 4.2 Recommendation to reduce construction noise impact on NSR2 with concrete measures as discussed under Section 3.4.5 should be included in this section.

Yours faithfully,

(C.C. CHIU)
Environmental Protection Officer
for Director of Environmental Protection

c.c. SPEL (Attn.: Mr. William HUI)
UADO (Attn.: Mr. M.T. Wong)
MCAL (Attn.: Mr. John Berry)

Environmental Protection Department

環境保護署

[illegible]

Original copy NOT sent/to be ~~sent~~ separately

Total no. of pages including this page: 2.

FROM: G.D.E. Sanvicens

TO: CES
(Attn.: Dr. T. Rudd)

OUR REF.: ( ) in EP/H4/07

TEL NO.: 835-1118

YOUR REF.: ( ) in

DATE: 22 October 1992

YOUR FAX NO.: 891 0305

OUR FAX NO.: 591-0558

Central Reclamation, Phase I
Focussed EIA Study - Final Report

Since the postponement of the EPCOM meeting to discuss the captioned item, and the review of the Final Report, we are now in a position to discuss outstanding issues which were identified in our EPCOM issues paper. Our aim is resolve these issues and revise the paper.

2. I have noted that our Noise Policy Group has sent you a letter, dated 21 October 1992. In the main this letter does not recognise that you have produced the final versions of the Executive Summary and Final Report. However, there are some items which need to be addressed. In particular, mitigation methods need to be specified in contract documents for reducing the construction noise level from the predicted 85 dB(A).

3. In addition, there are several water quality issues that need resolution, as follows:

Section 3.1.3:

(a) From the model results' contour plots, it is doubtful whether the loading of culvert F has been included in the model, especially for ammonia (an indication of raw sewage discharge) in Figures 3.39 to 3.46. Culvert F is not shown as a discharge point (i.e. a high concentration point) in figures showing the partial reclamations. However, culvert F is shown as a discharge point in the figures for the full reclamation. Table 3.3 shows that the ammonia loading at F is comparable to the loadings at A,C or D. As well as the discharge points A,C and D, F should be shown.

(b) As stated in section 10 of our EPCOM issues paper, the pier obstruction of tidal flows at the Macau Ferry and Star Ferry and the resultant eddies, have been omitted. It is accepted that with obstructions there will be a small increase in local current velocities. However, this increase in velocity will reduce the total volume of bulk water flows, with a consequent decrease in the flushing capacity. Without the modelling of the effects of the piers, the local water quality impact might have been underestimated.
The model boundaries were set too near to the concerned area, and hence the simulations will be distorted by these preset boundary conditions.

The Rambler Channel model runs are being set up at the present time. Hence contrary to HWR's claim, the Central Reclamation was the first to have used a 25m grid WAHMO model in HK waters.

(c) The stratified temperature zones predicted by the 3-D hydraulic model seems to have no effect on the DO, chlorophyll growth nor the E.Coli die off rate, and should have been evaluated further.

Section 3.1.4 (c) - The dredging impact assessment was done assuming a dredging rate of 8000 m^3/day and 5% "losses to the water column on dredging". The dredging method which corresponds to these rates was not specified. Section 3.2.5 recommends a closed grab dredging method. Is removal of 8000 m^3/day realistic for this type of dredger? The pollutant loading was based on sediment results from VS6. However, sediment results are also available at station VS5 which is closer to the site. These VS5 results should have been included in the load assessment.
Section 4.4 of the study brief also asked for an assessment of impacts from the placement of fill and the potential for release of metals and sulphides. This area does not appear to have been addressed.

Section 3.1.4 (c), para. 4 - Dredging is predicted to double the pollutant loads, however, the resultant impacts on the embayed area have not been identified. Nor has the cumulative effect of dredging and sewage impact to the water bodies been assessed. [5 ton/day of COD from dredging is more than 7 times the sewage loading at culvert F]. In view of this fact other mitigation measures are needed in addition to the monitoring controls and working methods in the contract specification.

Table 3.7- The fact that floating refuse may choke up the cooling water intakes of ships and may cause damages to engines has not been mentioned.

4. Please advise how you wish to resolve these matters.

(G.D.E. Sanvicens)
for Director of Environmental Protection

cc: PM/UA	(Attn: Mr. Y.L.Chung)	Fax: 577 5040
SPEL	(Attn: Mr. William Hui)	845 3489
MCAL	(Attn: Mr. J. Berry)	376 2070

SEA5OC:\WP51\PADS\FAX.92\CRECLEIA.022

MEMO

FAX

From Secretary for Planning, Environment and Lands (Environment Division)

To DEP (Attn. : Mr. Bill Farrell) 591 0558

Ref. (35) in PELB(E)55/10/277(92)

Your Ref. ____ **in** ____

Tel. No. 848 2551 (Fax : 845 3489)

Date 27 October 1992

dated ____

Central Reclamation, Phase I
Focussed EIA Study - Final Report

At our meeting with PM/UA this afternoon, we agreed that EPD would discuss with CES and the consultants on the points raised in our memo of above reference with a view to resolving them and considering the possibility of endorsing the EIA report.

2. As regards the draft EPCOM paper, I for one got the impression by reading through it that EPD considers the modelling predictions of the study not adequate and that there are more reliable prediction tools for water quality assessment (para. 12). But you pointed out to me at the meeting that the predictive model use in the study was in fact the best model available. In view of this, perhaps you can have a second look at paras. 10 - 12 of the draft paper and see whether this point could be brought out more clearly.

3. We also agreed that a section on the mitigation measures as recommended in the study should be included in the text of the paper with a more detailed description of the various measures (in layman terms). Hopefully this will give the paper a more balanced approach.

4. I should be grateful if a revised draft could be sent to me by 4 November 1992. By copy of this memo, PM/UA is requested to send me any comment that they may have.

(William C.W. Hui)
for Secretary
for Planning, Environment and Lands

c.c. PM/UA (Attn. : Mr. Y.L Chung) 577 5040
CES (Dr. T. Rudd) 891 0305

CES CONSULTANTS IN ENVIRONMENTAL SCIENCES (ASIA) LTD

Room 1201, Tai Yau Building, 181 Johnston Road, Wanchai, HONG KONG

Telephone: 8931551 Facsimile: 8910305 Dialcom: 8808:HKA129

FAX TRANSMISSION FORM

To (Company) :	EPD (EAPG)	**Fax No.** :	591 0558
Attention :	Gaspar Sanvicens/Kit Tsui	**Date** :	30/10/92
From :	Dr T Rudd	**No. of pages** :	7
Subject :	Central Reclamation	**Job/Ref No.** :	95060/F6713

c.c. UADO - Mr M T Wong ☑
MCAL - Mr J Berry ☑
EPD (WPG) - Mr W To ☑

If you do not receive all the pages, please contact us immediately. **The original will not be sent by post.**

Gaspar

With reference to your fax ref () in EP/H4/07 dated 22 Oct, we attach responses to comments on the Central Reclamation Focussed EIA Final Report and Executive Summary.

An additional assessment of mitigation measures for daytime construction noise in relation to the United Building is being carried out and will be presented at this afternoon's meeting.

Regards,

30 OCT 1992
PROJ.ENG. J. Berry
RJG
RKC
PY
AH
RJD
GNG
RDT
COPIED TO
REPLIED
FILE 9/590/20/4 7

R J GARRETT
R K GRIEVE
P C N YIM
A HAMILTON
R J DOUTHWAITE
G N GILLOTT
R C TAYLOR

ASSOCIATES
A CAMERON-SMITH
C S LEE
P K YUNG
K OLDFIELD
A S POON
M K C LAI
K M TSANG
K Y WONG
C R GOODWIN
D C S LEE
S A ROBINSON
T C K SHUM

FILE

MAUNSELL
CONSULTANTS ASIA LTD.
CONSULTING ENGINEERS

1 KOWLOON PARK DRIVE, HONG KONG

TELEPHONE 376 2299
FAX 376 2070

茂盛工程顧問有限公司

YOUR REF.: (127) in UAH 2/4/101 XIV
OUR REF.: JDB:EC:91590/20/47
20/60

PM/UA
Urban Area Development Office
12/F, Leighton Centre
77 Leighton Road
Causeway Bay
Hong Kong

3rd November, 1992.

Dear Sir,

Central Reclamation, Phase 1 - Engineering Works
Focussed EIA Study
<u>Programme of Construction for Mitigation Measures</u>

We refer to your letter dated 16th October 1992 for an implementation programme. Find attached a programme of implementation for mitigation measures No. 7 to 18 inclusive.

Most of the detail design period will involve the approval of traffic diversion schemes and confirmation of existing utilities. The implementation/construction period in the programme is shown to commence immediately the design is completed as in general, these measures have been included in the contract. We should however remind you that after detailed design it may be that the works extend outside the site boundaries and so negotiation will be required with the contractor. The programme may therefore extend.

Due to the closeness of these measures to each other in Central the traffic diversion schemes may clash thus requiring the construction period to be modified or extended.

Mitigation measures 10 and 11 can be designed now as they are independent of the SMP study.

Yours faithfully
for MAUNSELL CONSULTANTS ASIA LTD.

J Berry

(J.D. Berry)

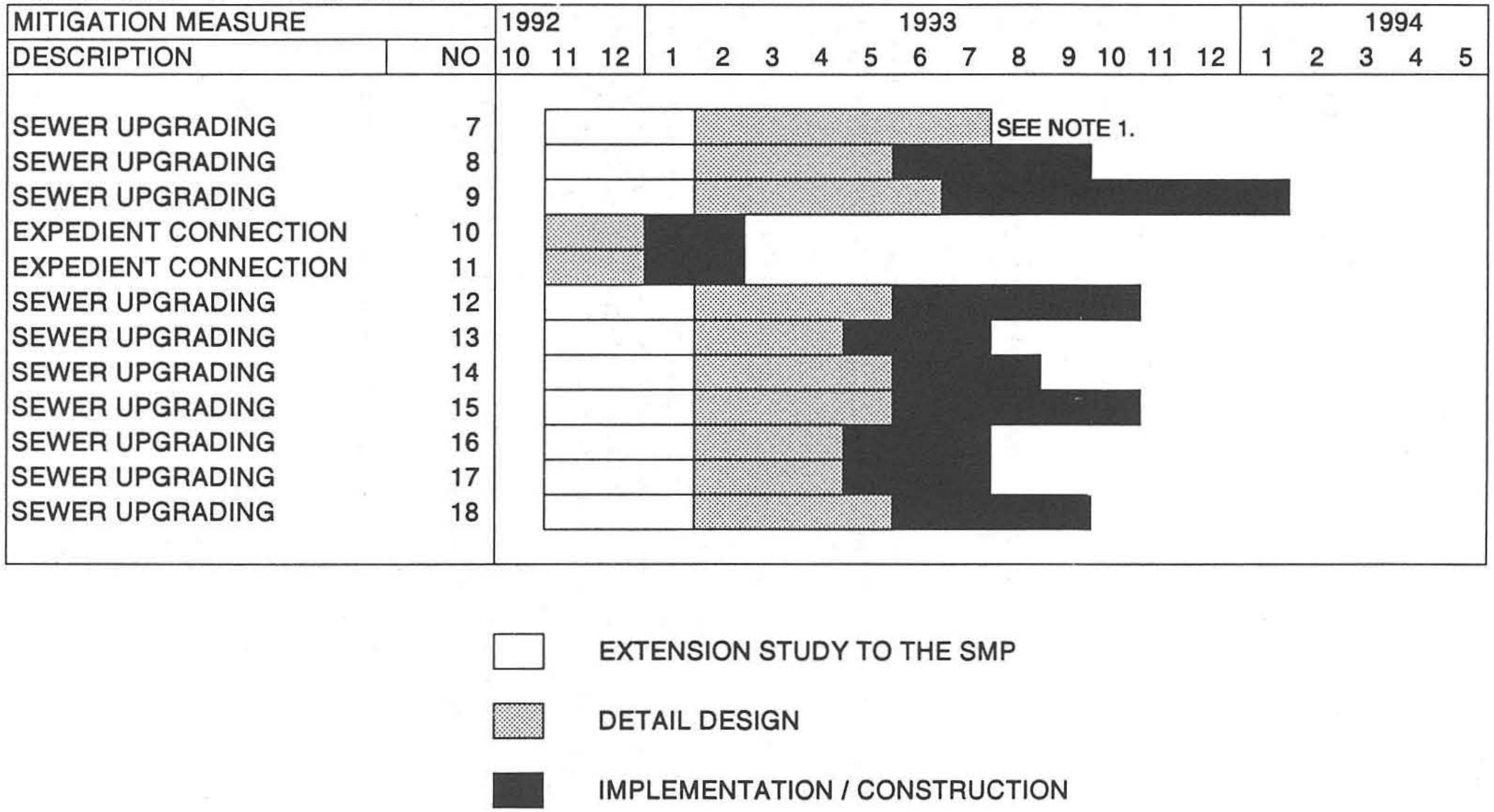
Encl.

bcc: Balfours)
JDB) w/encl.
DFD)

OFFICES: SINGAPORE, KUALA LUMPUR, TOKYO, BANGKOK, JAKARTA
IN THE UNITED KINGDOM – G. MAUNSELL & PARTNERS
IN AUSTRALIA – MAUNSELL PTY. LTD.

FOCUSSED EIA STUDY

PROGRAMME OF IMPLEMENTATION



NOTES :
1. THIS MEASURE CANNOT BE IMPLEMENTED UNTIL FEB 1995 DUE TO HyD RESTRICTIONS AND WILL TAKE APPROX 12 MONTHS TO COMPLETE.
2. ASSUMES THE WORK WILL BE COMPLETED BY THE CONTRACTOR FOR UA11/91.
3. IMPROVEMENTS 7 TO 9 AND 12 TO 18 ARE SUBJECT TO THEIR EFFECTIVENESS BEING CONFIRMED BY THE SMP EXTENSION STUDY. IT IS ASSUMED THAT THE EXTENSION STUDY HAS ADEQUATE SCOPE TO INCLUDE THESE IMPROVEMENTS.
4. THE ADDITIONAL SURVEY AND PRELIMNIARY DESIGN CARRIED OUT UNDER THE SMP STUDY IS COMPLETED BY MID JAN 1993.
5. IMPROVEMENT 10 WILL REQUIRE A MONITORING PERIOD TO ASSESS IT'S EFFECTIVENESS. IT IS ASSUMED NO FURTHER WORKS WILL BE REQUIRED.
6. WORK FOR DETAIL DESIGN OF IMPROVEMENTS 10 & 11 COMMENCES EARLY NOVEMBER 1992.
7. THE EARLIEST DATE FOR COMPLETION OF THE BUNDS ON UA11/91 IS SEPTEMBER 1993.

本署檔號
OUR REF: EP 60/G1/12-26
來函檔號
YOUR REF: 95060/F6767
電話
TEL. NO.: 755 6162
圖文傳真
FAX NO.: 305 0453

Hong Kong Government
Environmental Protection Department
Branch Office

9th Floor, Tower 1, World Trade Square,
123 Hoi Bun Road,
Kwun Tong, Kowloon,
Hong Kong.

環境保護署分處
香港九龍
觀塘海濱道
一百廿三號
環貿商業中心
第一座九樓

30 November 1992

CES Consultants (Asia) Ltd.,
9/F., Parkview Commercial Building,
9-11 Shelter Street
Causeway Bay,
Hong Kong.
(Attn.: Ms. Linden Coppell)

Spoke to L. Coppel 8/12
Drg. has been sent.

- 8 DEC 1992
JWD FSYB RCTH RJG RKG PY AH RJD GNG RDT
PROJ. ENG. TDB
OTHERS
COPIED TO
REPLIED
FILE 91590/20/20 20/47

Dear Madam,

Central and Wanchai Reclamation
Package 1 Phase 1
Disposal of Dredged Mud

I refer to your facsimile Ref. No. 95060/F6767 dated 9.11.92 and the subsequent telephone conversation on 30.11.92.

In accordance with the enclosed Environmental Protection Department Technical Circular No. (TC) No 1-1-92-Classification of Dredged Sediments for Marine Disposal, V22 is classified as seriously contaminated with exceedances of both copper and zinc for both depths and that V23 and V24 are classified as uncontaminated. Since the coverage of the Site Investigation Plan (Drg. No. 53790/W/1001) does not include the addition vibrocores V20, V21, V22, V23 and V24, I would be grateful if you could submit to us an up-dated SI Plan.

With reference to the enclosed letter Ref. No. EP 60/G1/12 dated 16.7.92 to CES Consultants, you may wish to note that we are still awaiting for your delineation of the contour of contaminated and uncontaminated mud and the proposed dredging profiles.

Yours faithfully,

(H.C. CHAN)
for Director of Environmental Protection

Encl.

c.c. S/FMC, GEO, CED (Attn.: Mr. Mark Foley)
MTRC (Attn.: S.K. Kong)
MCAL (Attn.: John Berry)

Ref : EP 100/C10/16

Environmental Protection Department
28/F., Southorn Centre
130 Hennessy Road
Wanchai, Hong Kong.

9 November 1992

ENVIRONMENTAL PROTECTION DEPARTMENT

TECHNICAL CIRCULAR NO. (TC) NO 1-1-92

Classification of Dredged Sediments for Marine Disposal

In fulfilment of my responsibility as the designated officer under paragraph 2(1) in Schedule I of the Dumping at Sea Act 1974 (Overseas Territories) Order 1975, I wish to notify you that dredged sediments will be classified as indicated below for the purpose of issuing licences under the Act. This circular should be read in conjunction with the Works Branch Technical Circular No. 22/92 - Marine Disposal of Dredged Mud which outlines the procedures to be followed in all works, whether public or private, which involve the marine disposal of dredged sediments.

2. Sediments will be classified according to their level of contamination by toxic metals. The classes are defined as follows :

Class A — Uncontaminated material, for which no special dredging, transport or disposal methods are required beyond those which would normally be applied for the purpose of ensuring compliance with EPD's Water Quality Objectives, or for protection of sensitive receptors near the dredging or disposal areas.

Class B — Moderately contaminated material, which requires special care during dredging and transport, and which must be disposed of in a manner which minimizes the loss of pollutants either into solution or by resuspension.

Class C — Seriously contaminated material, which must be dredged and transported with great care, which cannot be dumped in the gazetted marine disposal grounds and which must be effectively isolated from the environment upon final disposal.

....../3.

3. The classification criteria for contamination levels are laid down in Table A. It should be noted that it is necessary for the concentration of only one metallic element to be exceeded for sediments to be identified as falling within a particular class.

Table A - Classification of Sediments by Metal Content (mg/kg dry weight)

	Cd	Cr	Cu	Hg	Ni	Pb	Zn
Class A	0.0-0.9	0-49	0-54	0.0-0.7	0-34	0-64	0-140
Class B	1.0-1.4	50-79	55-64	0.8-0.9	35-39	65-74	150-190
Class C	1.5 or more	80 or more	65 or more	1.0 or more	40 or more	75 or more	200 or more

Note: Tests results should be rounded off to two significant figures before comparing with the table, e.g. Cd to the nearest 0.1mg/kg, Cr to the nearest 1 mg/kg, and Zn to the nearest 10 mg/kg, etc.

(Stuart B. Reed)
Director of Environmental Protection

Please quote our reference in future correspondence

URGENT BY HAND

MEMO

From Project Manager/Urban Area

Ref. (36) in UAH 2/4/101 XVIII

Tel. No. 882 7204

Date 14 December 1992

To Distribution

Your Ref. .... in ....

dated ....

15 DEC 1992

Central Reclamation, Phase 1 - Engineering Works
Focussed EIA Study
Implementation of Mitigation Measures

I refer to my previous circulation, ref. (78) in even series dated 12.11.1992 and your comments on the proposed construction programme for the mitigation measures recommended under the focussed EIA Study. A copy of each of the comments from SPEL, EPD, DSD, MTRC, NAPCO, TD & HyD are enclosed for your reference.

2. Please find enclosed for your further comments a copy of drawing No. UA 358 outlining the proposed arrangements for the implementation of the above mitigation measures including source of funding and agency. This proposal has taken into account your previous comments. The proposed source of funding is suggested on the basis that those proposals originally recommended under the Central, Western and Wan Chai West Sewerage Master Plan Study are supposed to be funded by EPD with the exception of those items already provided under the Central Reclamation project.

3. In order to enable TDD to report back to SPEL in early January 1993 as requested, I invite you to attend a meeting to be held on Friday, 18 December 1992, 10:00 a.m. in UADO's conference room on 12/Fl., Leighton Centre to discuss the captioned issue. The agenda for the meeting is as follows: -

(1) Proposed arrangements for implementation of mitigation measures as shown on drawing No. UA 358.

(2) Progress of current extension study/survey for Catchments C and D.

(3) Progress and arrangements for proposed extension study/survey for Catchments F and J1.

(M T Wong)
for Project Manager/Urban Area

Encl.

G.F. 73A

Distribution

EPD (Attn: Mr. W.J. Farrell & Mr. W.K. Tsui)
CE/HK&I, DSD (Attn.: Mr. K.R. Murrells & Mr. David Leung)
MTRC (Attn: Mr. G. Turnbull)
NAPCO (Attn: Mr. J.P. Bovis)
CHE/HK (Attn: Mr. Albert W.B. Lee)
CTE/HK, TD (Attn: Mr. H.W. Chan)
DLO/HKW (Attn: Miss Anita Lam)
CES/NA(Urban) (Attn: Miss Trevina Kung)
PTDB, TD (Attn: Mr. Tommy L.S. Ng)
DO/C&W (Attn: Mr. H. Cho)
CP (DD/Traffic)
MCAL (Attn: Mr. J. Berry)

c.c. SPEL (Attn: Mr. W. Hui) - w/encl (you may wish to be represented at the meeting on 18.12.92)

MTW/clt

MEMO

From Project Manager/Urban Area	To CHE/HK
Ref. (19) in UAH 2/4/101 XX	
Tel. No. 882 7204	Your Ref. (9) in HH710/95(3)VI(DP)
Date 12 February 1993	dated 25.11.92

Central Reclamation, Phase 1 - Engineering Works
Application for Waiving of Road Opening
Restrictions for Implementation of mitigation
measures on Harcourt Road and
<u>Des Voeux Road Central</u>

I refer to your above-quoted memo and the subsequent meeting held on 6.1.1993 concerning the implementation of mitigation measures recommended by the Focussed EIA Study which has been endorsed by EPCOM in November 1992.

2. It is generally agreed that all recommended mitigation measures should best be carried out in a programme which ties in with the reclamation work so that the water quality impacts due to the formation of the two reclamation bunds would be minimised at the outset as far as possible. Any deferment of the implementation of these improvement works would be extremely undesirable as the deteriorated water quality in the vicinity of the reclamation would then have to be tolerated for an unnecessarily prolonged period, which would be subject to public criticism.

3. It has been clarified with your staff that only improvement measure Nos. 7 and 14 as shown on the attached figures 2.14 and 2.21 are currently subject to road opening restrictions, expiry of which are due in Feb 1995 and April 1996 respectively.

4. For reasons given above, implementation of improvement measure Nos. 7 and 14 after the expiry of the road opening restrictions should be avoided as far as practicable. To this end, I write to seek your approval to waive the road opening restriction for the section of Harcourt Road and Des Voeux Road Central as coloured pink on the attached figures 2.14 and 2.21 to enable the improvement works to be carried out in good time in conjunction with the reclamation contract which is due to start subject to availability of funds.

5. Your earliest attention to the issue will be appreciated.

15 FEB 1993
JWD
FS B
RCTH
RJG
RKG
PY
AY
RJD
GNG
RDT
PROJ. ENG.
OTHERS
COPIED TO
REPLIED
FILED

(M T Wong)
for Project Manager/Urban Area

Encl

c.c. EPD
CE/HK&I CSD) w/o encl
MCAL

91590/20/47

By Fax and Post

MEMO

From Project Manager/Urban Area

Ref. (33) in UAH 2/ /101 XX

Tel. No. 882 7204

Date 25 February 1993

To EPD
(Attn : Mr G.D.E. Sanvicens)

Your Ref. in EP 2/H4/07

dated 13.1.1993

Central Reclamation, Phase I - Engineering Works
Focussed EIA Study

I refer to your above quoted memo, MCAL's letter ref. JDB:EC:91590/20/47 of 26.1.1993 and our subsequent telecon (Sanvicens/Wong) earlier today regarding the finalisation of the focussed EIA study.

2. I accepted your suggestion that all post-report correspondence, the addendum on noise assessment issued in November 1992 and relevant comments and responses are to be compiled to form a single document which will be issued to all recipients of the Final Report as a supplementary document to the Final Report. In addition, appropriately worded stickers will be provided as requested for sticking over the Final Report advising readers that the Final Report is to be read in conjunction with the supplementary document.

3. Regarding the guidelines for resident site staff dealing with deteriorating water quality, the consultants advised in their letter of 26.1.93 that the current specification of the contract provides clear guidelines on when action is to be taken. It is also important to note that the onus for proposing mitigation measures and achieving the required levels remains the Contractor's. Our telcon. confirmed that you had no further comments on the issue.

4. By copy of this memo, would MCAL please take necessary action in respect of the supplementary document referred to in para 2 above. Please provide 25 sets of the document and the sticker. It has been suggested that the document is to be printed on both sides.

5. Subject to the issuance of the supplementary document, the Focussed EIA Study is deemed to be fully completed and endorsed by EPD.

25 FEB 1993	
JWD	PROJ. ENG.
FSYB	JDB
RCTH	OTHERS
RJG	
RKG	
PY	
AH	
AJD	COPIED TO
GNG	CES(GB) by fax
RDT	JDB
REPLIED	

91590/20/47

(M T Wong)
for Project Manager/Urban Area

c.c. MCAL (Attn : Mr J. Berry)

MTW/lky

Urgent By FAX

拓展署
Territory Development
Department, Hong Kong

市區拓展處
URBAN AREA DEVELOPMENT OFFICE

來函檔號 Your Reference
本署檔號 Our Reference (3) in UAH 2/4/102N
電話 Telephone 882 7202
傳真 Fax 577 5040
日期 Date 1 March 1993

-2 MAR 1993
JWD
FSYB
RCTH
RJG
RKG
PY
AH
RJD
GNG
RDT
PROJ ENG JDB
OTHERS
COPIED TO
REPLIED
FILE 95792/42
91590/.20/47

Maunsell Consultants Asia Ltd
1 Kowloon Park Drive,
Hong Kong.
(Attn : Mr J.D. Berry)

Dear Sir,

Tamar Basin Reclamation
Project Design Statement
Reponses to D.S.D. Comments

I refer to CE/HK&I's memo Ref. D(HK) 15/1/17 dated 18.2.1993 addressed to me and copied to you.

Regarding the sewerage works in Harcourt Road recommended by the FEIA for the Phase I reclamation (vide paragraph 3(a) of CE/HK&I's memo), I should be grateful if you would advise me, from the contract point of view, the best arrangement for incorporating the implementation of such works into either Contract NO. UA 11/91 Central Reclamation, Phase 1 - Engineering Works or Contract No. UA 17/93 Tamar Basin Reclamation - Engineering Works.

Yours faithfully,

Discussed 2/3/93
AH/JB, YLC/JB.

(H.H. Yeung)
for Project Manager/Urban Area

HHY/lky

By Fax

MEMO

From Project Manager/Urban Area	To Distribution
Ref. (49) in UAH 2/4/101 XX	
Tel. No. 882 7204	Your Ref. in
Date 9 March 1993	dated

Central Reclamation, Phase 1
Focused EIA Study
<u>Presentation to C&W DB Environment and Works Committee</u>

Further to my (115) in even series dated 18.1.1993, please be advised that the originally proposed presentation to C&W DB Environment and Works Committee on 25.3.1993 is now postponed following NAPCO's advice vide their memo ref. NAP/T3/10/13 dated 4.3.1993, copy attached.

2. I shall keep you informed of the development of the issue.

(M T Wong)
for Project Manager/Urban Area

Distribution (w/encl)

CHE/HK&I, DSD	(Attn : Mr David Leung)
EPD	(Attn : Mr Gordon Wan & Mr W.K. Tsui)
DO/C&W, CNTA	(Attn : Ms Mary Tsang)
MCAL	(Attn : Mr J. Berry)
c.c. D/NAPCO	(Attn : Mr Paul Tang & Mr J.P. Bovis) - w/o encl.

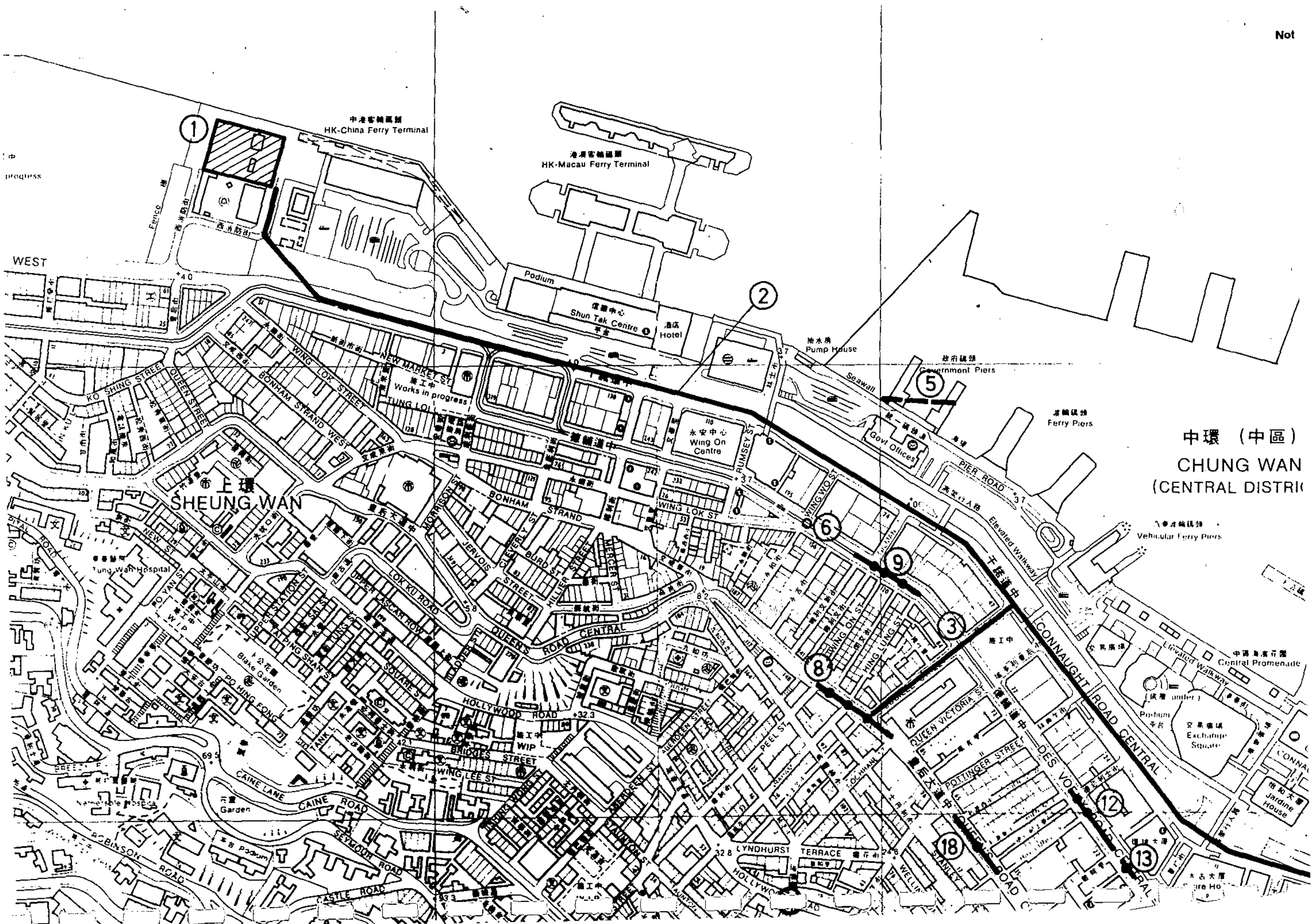
MTW/lky

MAR
JWD
FSYB
RCTH
RJG
RKG
PY
GH
RJD
CMG
PST
PROJ ENG.
OTHERS
COPIED TO
CES

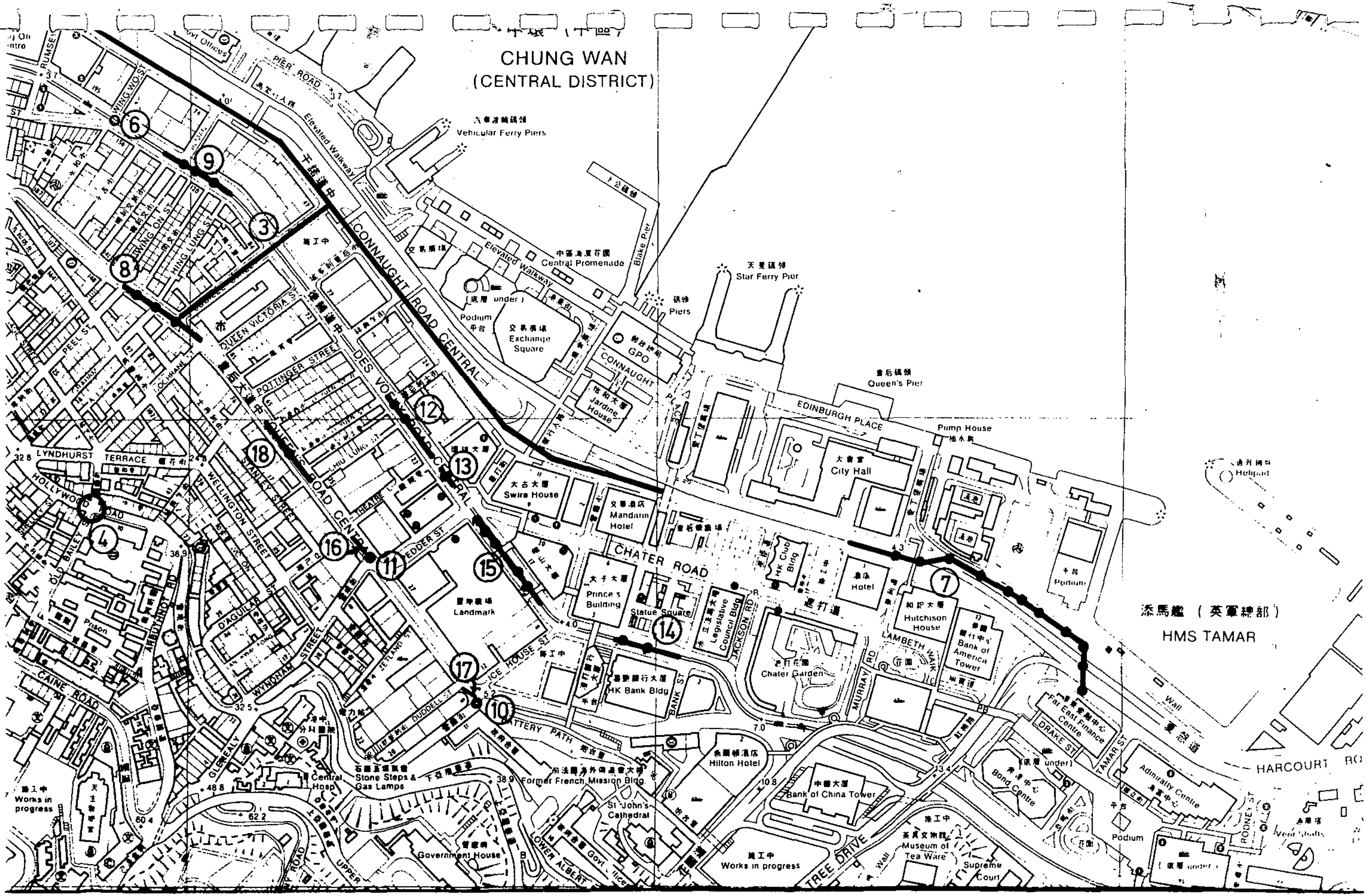
91590/20/4 7

G.F. 73A

Not



中港客輪碼頭
HK-China Ferry Terminal
港澳客輪碼頭
HK-Macau Ferry Terminal
Podium
信德中心
Shun Tak Centre
Hotel
抽水房
Pump House
Seawall
政府碼頭
Government Piers
渡輪碼頭
Ferry Piers
中環 (中區)
CHUNG WAN
(CENTRAL DISTRIC
Govt Offices
PIER ROAD
Elevated Walkway
Vehicular Ferry Piers
Central Promenade
Exchange Square
Jardine House
CONNAUGHT ROAD CENTRAL
永安中心
Wing On Centre
RUMSEY ST
WING WO ST
WING LOK ST
NEW MARKET ST
Works in progress
TUNG LOI
WEST
Fence
KO SHING STREET
QUEEN STREET
WING LOK STREET
BONHAM STRAND WEST
BONHAM
STRAND
上環
SHEUNG WAN
Tung Wah Hospital
NEW ST
PO YAN ST
UPPER STATION ST
LOK KU ROAD
JERVOIS
STREET
MORRISON ST
CLEVERLY ST
BURD ST
HILLIER STREET
MERCER ST
QUEEN'S ROAD CENTRAL
UPPER LASCAR ROW
Blake Garden
PO HING FONG
TAI PING SHAN ST
SQUARE ST
HOLLYWOOD ROAD
WIP
BRIDGES STREET
WING LEE ST
CAINE LANE
CAINE ROAD
Garden
SEYMOUR ROAD
ROBINSON ROAD
CASTLE ROAD
ABERDEEN ST
STAUNTON ST
PEEL ST
COCHRANE
LYNDHURST TERRACE
WING ON ST
HING LUNG ST
QUEEN VICTORIA ST
POTTINGER STREET
DES VOEUX ROAD
STANLEY
QUEEN'S ROAD
1
2
3
5
6
8
9
12
13
18



CHUNG WAN
(CENTRAL DISTRICT)
Vehicular Ferry Piers
Pier Road
Elevated Walkway
Connaught Road Central
Central Promenade
Blake Pier
Star Ferry Pier
Piers
Podium
Exchange Square
GPO
Connaught
Jardine House
Queen's Pier
Edinburgh Place
Pump House
City Hall
Heliport
Swire House
Mandarin Hotel
Chater Road
HK Club Bldg
Hotel
Hutchison House
Bank of America Tower
Lambeth Walk
Prince's Building
Statue Square
Legislative Council Bldg
Jackson Rd
Chater Garden
Murray Rd
HMS TAMAR
Wall
Far East Finance Centre
Drake St
Tamar St
Harcourt Ro
Admiralty Centre
Rodney St
Vent Shafts
Bond Centre
Podium
HK Bank Bldg
Bank St
Hilton Hotel
Bank of China Tower
Museum of Tea Ware
Supreme Court
Works in progress
St John's Cathedral
Former French Mission Bldg.
Battery Path
Lower Albert
Government House
Upper
Central Hosp
Stone Steps & Gas Lamps
Duddell St
Ice House St
Landmark
Pedder St
Theatre
Des Voeux Road Central
Queen's Road Central
Queen Victoria St
Pottinger Street
Stanley Street
Wellington Street
D'Aguilar
Wyndham Street
Zetland St
Lyndhurst Terrace
Hollywood Road
Old Bailey St
Prison
Arbuthnot Rd
Caine Road
Glenealy
Wing Wo St
Wing On St
Hing Lung St
Peel St
Cochrane
Rumsey
Works in progress