Hong Kong Government
Architectural Services Department

Stonecutters' Island South Shore Naval Facilities Environmental Impact Assessment

Agreement No. CAO B18

Mott MacDonald Hong Kong Ltd.
in association with
EBC Hassell

FINAL REPORT

CONFIDENTIAL downgraded

July 1994

STONECUTTERS' ISLAND SOUTH SHORE NAVAL FACILITIES

ENVIRONMENTAL IMPACT ASSESSMENT

AGREEMENT NO. CAO B18

PROJECT NO. T361

FINAL REPORT

CONFIDENTIAL

	Prepared by Project Manager		Approved by Project Director
Name	Laura Wong	Name	S V Jones
Signature	[signature]	Signature	[signature]
Date	15/7/94	Date	15/7/94

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1. INTRODUCTION

1.1 Background

This project is to conduct an Environmental Impact Assessment (EIA) of the construction and operation phases of the Naval facilities which are proposed to be located on the south shore of Stonecutters' Island. It is understood that these facilities will replace the existing HMS Tamar Naval Base on Hong Kong Island. The proposed facilities will be built for an intended handover to the People's Republic of China (PRC) at the end of the British occupancy of the Territory mid 1997.

At this present moment it is assumed that the proposed facilities will be similar to the existing facilities at HMS Tamar and where appropriate the proposed facilities will be assessed according to the current operation practices and requirements at HMS Tamar. The need for this assumption is necessary due to the difficulty in determining the nature and practices of the future PRC Naval Facilities.

The Naval Base will be an operating base with restricted repair capability for ships of a range of sizes. There will be slipping capability for vessels up to 45 tonnes. The Chinese Navy ships will undertake the role of search and rescue whereas the Government Dockyard will continue to carry the responsibility for maintenance of the Government vessels which include police, fire, pollution, immigration, port health, harbour mooring, and aids to navigation boats. It is unlikely that the Basin will be used as a typhoon shelter.

Container Terminal 8 (CT8) has been constructed off the west and northwest coasts of the island and Stonecutters Island is now linked to the Kowloon peninsula. Figures 1.1 and 1.2 show the study area.

The Phase I relocation of the Government Dockyard to the East Basin is at a stage where most of the reclamation contractor's work is complete and the building contract has just started. This dockyard comprises administration, workshop and stores, ship and buoy repair, and service facilities.

In addition to these developments the reclamation for the construction of the new Drainage Services Department sewage treatment plant was completed in early 1993 and has been on line since then.

It is understood that the layout discussed in this document has largely been agreed by both the PRC and British Authorities. Some minor details are still under review but these are unlikely to affect the findings of this report.

Table 1.1 Summary of the proposed facilities (Cont'd)

Facilities	Area
oil depot and working room	$3000m^2$
signal tower	$180m^2$
naval basin	$160{,}000m^2$
workshop	$5600m^2$
inflammable store	$4000m^2$
ammunition store	$4000m^2$

The only occupants of the area during the operation phase will be the PRC Navy. There will be no other land users and thus no sensitive receivers to be taken account of during the operation phase for the assessment of noise and air quality impacts. The key issues of this project during operation are therefore water quality and ecological impacts.

In terms of the construction phase impacts, however, air and noise quality could cause impacts on the identified sensitive receivers. The duration of land based construction activities has been assumed to be continuous over a period of 15 months. The details of the construction activities and their individual working duration are outlined in the noise and air quality assessment sections. Detailed construction programmes are not yet available so estimated durations have been assumed. Piling and infrastructure will be constructed first followed by the building construction and finishing.

1.4.2 Naval Base Marine Works

The reclamation zones for the new Naval Facility are shown in Figures 1.2 (The Study Site). The Civil Engineering Department (CED) has prepared an estimated construction programme, the details of which will be used for the purposes of the environmental impact assessment. The original construction period as shown in Figure 1.4 prepared by CED incorporates evening (restricted period) construction works finishing at 2300 hours.

As dredging is on the critical path for the marine works programme, a reduction in the working period for the purpose of preventing nuisance in connection with elevated noise levels to the sensitive receivers could have programme implications. The Contractor may need to consider deploying an additional dredger, hopper barge and tug boat or dredgers with bigger grabs in order to complete the works on time if the working hours are reduced to 0700-1900. With regard to the reclamation activities, the pumping rate can be increased by deploying on additional pump. Therefore, the reclamation activities working hours can also be reduced to operate between 0700-1900 hours only.

An alternative construction programme set out in Figure 1.5 shows the duration of the activities taking into account the reduction in the working hours. In the noise and dust impact Chapters both the original programme (with works finishing at 2300 hours) and the revised programme (with works finishing at 1900 hours) will be assessed to present the impacts arising from each construction programme. The Contractor will be required to apply for a Construction Noise Permit and as Government is unlikely to grant a relaxation of the standards the works will most likely need to stop at 1900 hours according to Programme B.

Further to the above discussion it should be noted that works in the evening will be subject to review after the contract is awarded and there will be nothing to stop the Contractor applying for a Construction Noise Permit if he believes that he can work within the noise levels promulgated under the Noise Control Ordinance.

1.4.3 Construction Programme A

The reclamation and marine works construction programme and activities for programme A are as follows. Standard working hours without a Construction Noise Permit are 0700 - 1900 on all days except public and general holidays:

- ***Dredging***

Dredging the existing sea-bed will be carried out for the foundation of the reclamation, seawall and breakwater, and for the navigation of vessels inside the basin and between the fairway.

Working Period	:	(dredging sea-bed) December 1994 - November 1995 (dredging basin and approach) November 1996 - February 1997	
Working Hours	:	0700 - 2300, 6 days/week	
Location	:	South Shore of Stonecutters Island	
Equipment	:	Grab Dredgers	2
		Hopper Barges	3
		Tugs	2
		Launch	1

Marine mud will be dredged completely from under the reclamation, seawall and breakwater areas. Dredging will also be carried out on the basin area and the approach areas to the fairway for navigational purposes. The dredging will be carried out by grab dredgers and the dredged mud will be taken away by hoppers barges to the designated dumping ground. The estimated quantity of marine mud is 2.35M m^3.

- ***Reclamation***

This will be carried out for the site formation for the Naval Base.

Working Period	:	April 1995 - August 1995
Working Hour	:	0700 - 2300 6 days/week
Location	:	Area adjacent to the coastline of south shore of Stonecutters Island

Equipment	:	Suction Dredger	1
		Marine Sand Pump	1
		Dozer	2
		Tug	1

Marine sand will be dredged by suction dredger and pumped through a floating pipeline to fill the area behind the seawall from the dredged level to +4.mPD. The estimated quantity of marine sand is 1.72M m^3.

- *Vertical Seawall and Breakwater/Armour Seawall*

There will be a vertical seawall along the northern eastern and southern inner face of the basin. An armour seawall will be constructed on the western breakwater and the outer faces of the other sides of the basin. The total length of the seawall will be approximately 1,500m.

Working Period	:	January 1995 - December 1996	
Working Hours	:	0700 - 1900 6 days/week	
Location	:	South shore of Stonecutters Island	
Equipment	:	<u>Place sand in dredged trench</u> (April 95 - February 96)	
		Suction Dredger	1
		Marine Sand Pump (on dredger)	1
		Dozer	2
		Tug	1
		<u>Place Rock Fill</u> (April 1995 - September 1996)	
		Derrick Barges	3
		Tug	1
		Launch	1
		<u>Set Concrete Seawall Blocks</u> (July 1995 - October 1996)	
		Derrick Barges	2
		Tug	1

CED has assumed that marine sand will be deposited by pumping from a suction dredger to the dredged seawall/breakwater trenches immediately after the removal of marine mud from the seawall/breakwater foundation. Rock fill and armour rock will then be placed by grab from derrick barges. The setting of concrete seawall blocks will be carried out by derrick barges. The estimated quantities of sand fill, rock fill, and armour rock are 0.5Mcu.m, 1.07M cu.m and 0.185M cu.m respectively.

- *Concrete Coping*

Working Period	:	November 1995 and December 1996 - January 1997	
Working Hour	:	0700 - 1900, days/week	
Location	:	In the vicinity of the seawall	
Equipment	:	Concrete Barge	2
		Crane	1
		Concrete Pumps	2
		Vibrators	8

- *General Earthworks*

Working Period	:	July 1995 - December 1996	
Working Hour	:	0700 - 1900, days/week	
Location	:	Area of the reclamation	
Equipment	:	Trucks	4
		Dozers	3
		Compactors	3

The construction programme as detailed above is summarised in Figure 1.4.

1.4.4 Construction Programme B

The reclamation and marine works construction programme for programme B are as follows (note that the activities remain unchanged from Programme A unless otherwise stated also the 6 day working week are public and general holidays except):

- *Dredging*

Working Period	:	(dredging sea-bed)	
		February 1995 - April 1996	
		(dredging basin and approach)	
		October 1996 - February 1997	
Working Hours	:	0700 - 1900, 6 days/week	
Equipment	:	Grab Dredgers	3
		Hopper Barges	4
		Tugs	3
		Launch	1

- *Reclamation*

Working Period	:	June 1995 - April 1996	
Working Hour	:	0700 - 1900 6 days/week	
Equipment	:	Suction Dredger	1
		Marine Sand Pump	
		(on dredger)	2
		Dozer	2
		Tug	1

- *Vertical Seawall and Breakwater/Armour Seawall*

Working Period	:	January 1995 - December 1996
Working Hours	:	0700 - 1900 6 days/week
Equipment	:	Place sand in dredged trench
		(April 95 - April 96)
		Place Rock Fill
		(May 1995 - September 1996)
		Set Concrete Seawall Blocks
		(July 1995 - October 1996)

- *Concrete Coping*

Working Period	:	September 19956 - January 1997
Working Hour	:	0700 - 1900, 6 days/week

- *General Earthworks*

Working Period	:	June 1995 - April 1996
Working Hour	:	0700 - 1900, 6 days/week

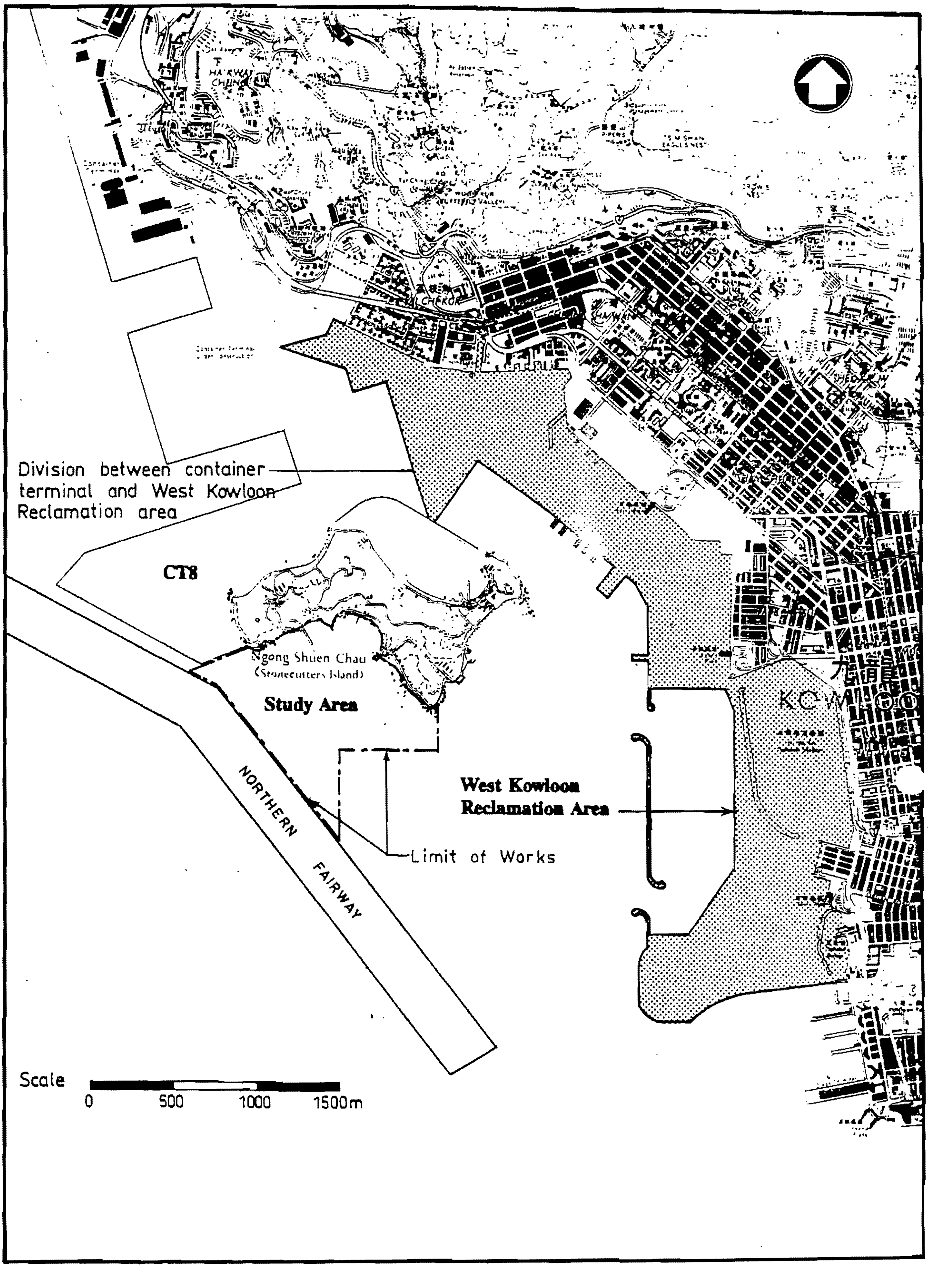
The construction programme as detailed above is summarised in Figure 1.5.

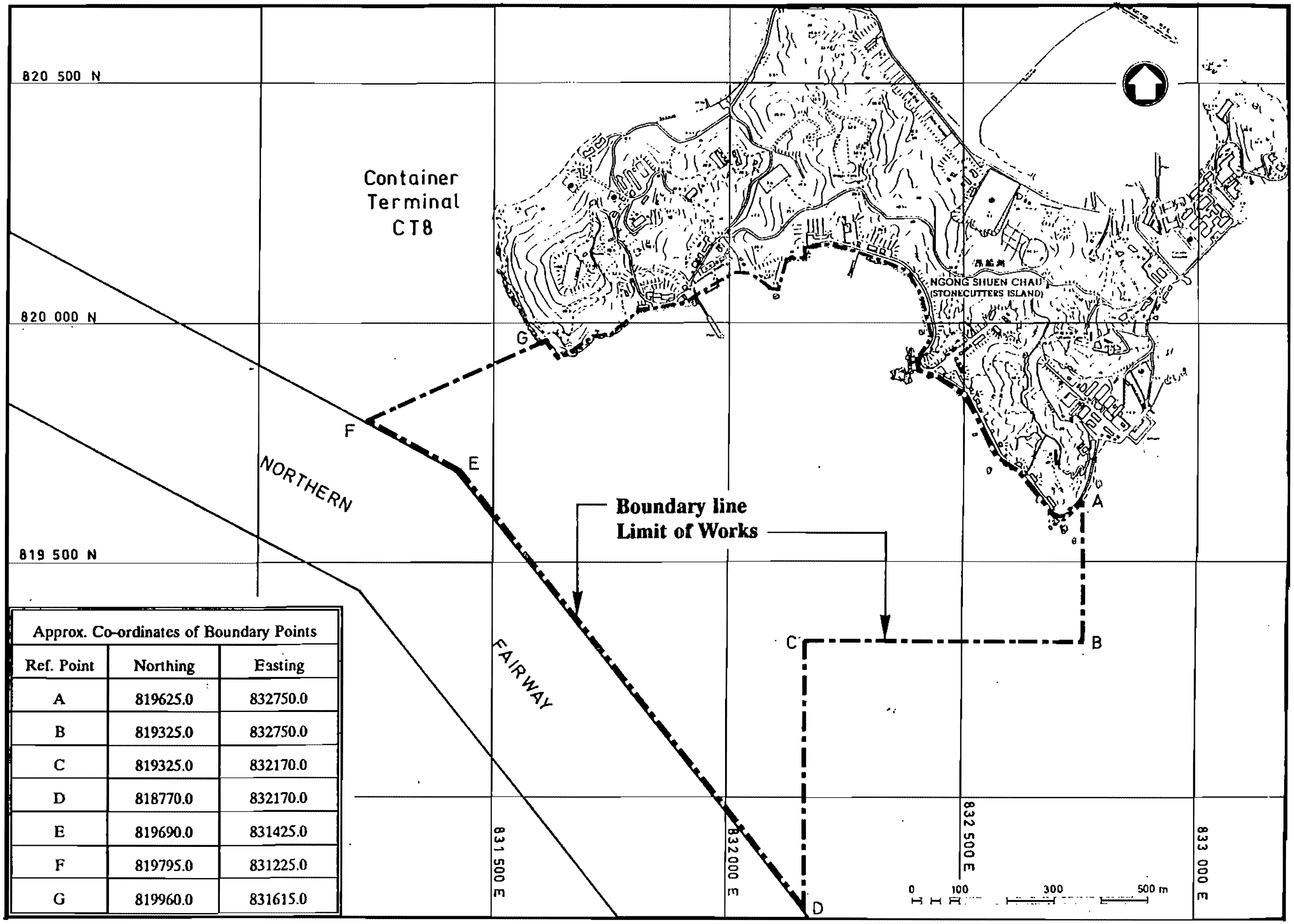
1.5 Ecology

This study has focused on the intertidal ecology of the southern shoreline of the island. Attention has also been given to the sublittoral ecology, water quality and relevant aspects of the terrestrial ecology. Construction and operation impacts and their attendant mitigation dimensions have been addressed. Most of the southern shore of Stonecutters Island will, in fact, vanish when the Proposed Naval Facilities has been built.

This report describes the existing intertidal (littoral) ecology as fully as possible. Mitigation measures are proposed which should enhance the nature, scope and quality of the development.

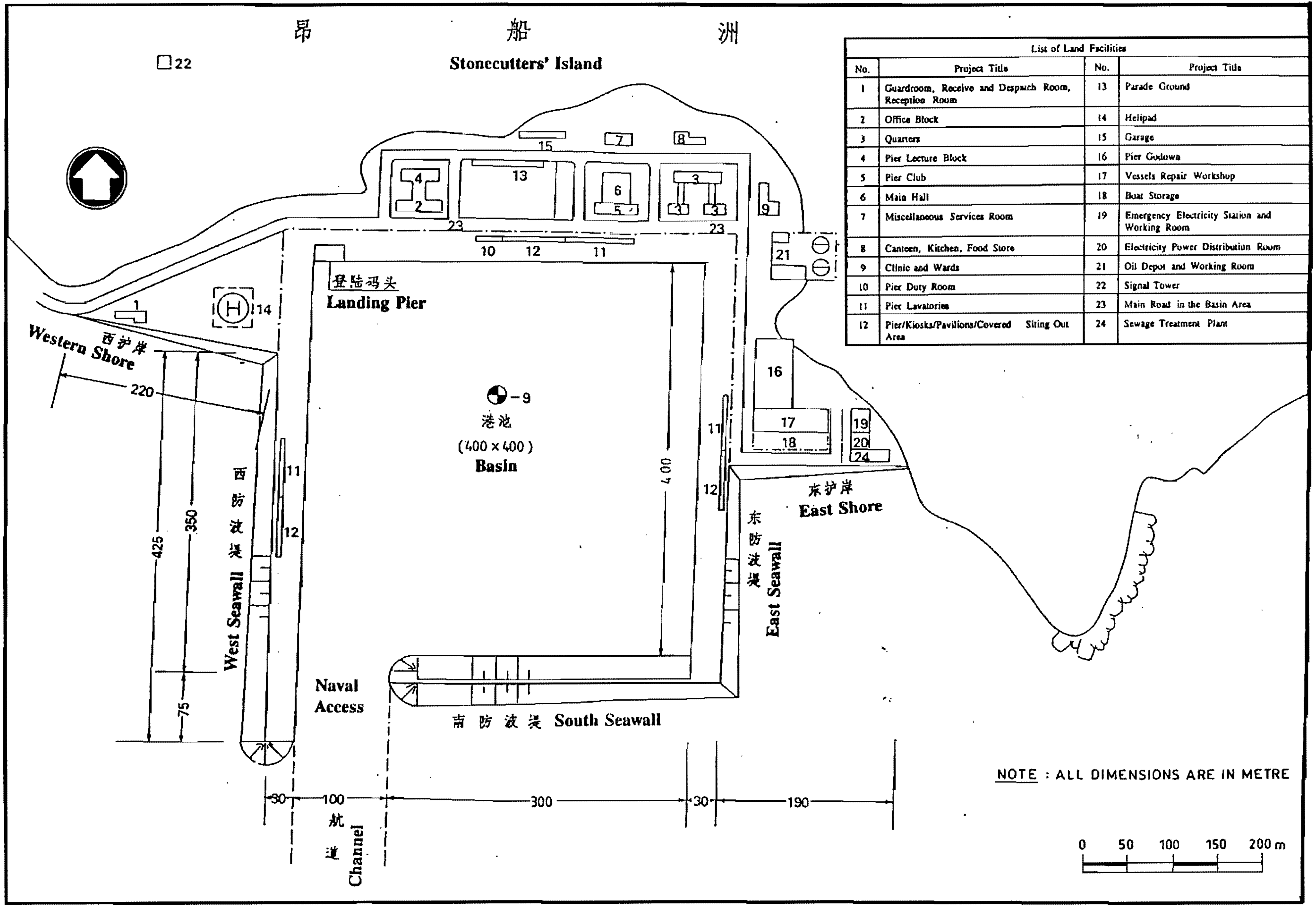
Figure 1.1
Study Area, Location of CT8 and WKR





Approx. Co-ordinates of Boundary Points		
Ref. Point	Northing	Easting
A	819625.0	832750.0
B	819325.0	832750.0
C	819325.0	832170.0
D	818770.0	832170.0
E	819690.0	831425.0
F	819795.0	831225.0
G	819960.0	831615.0

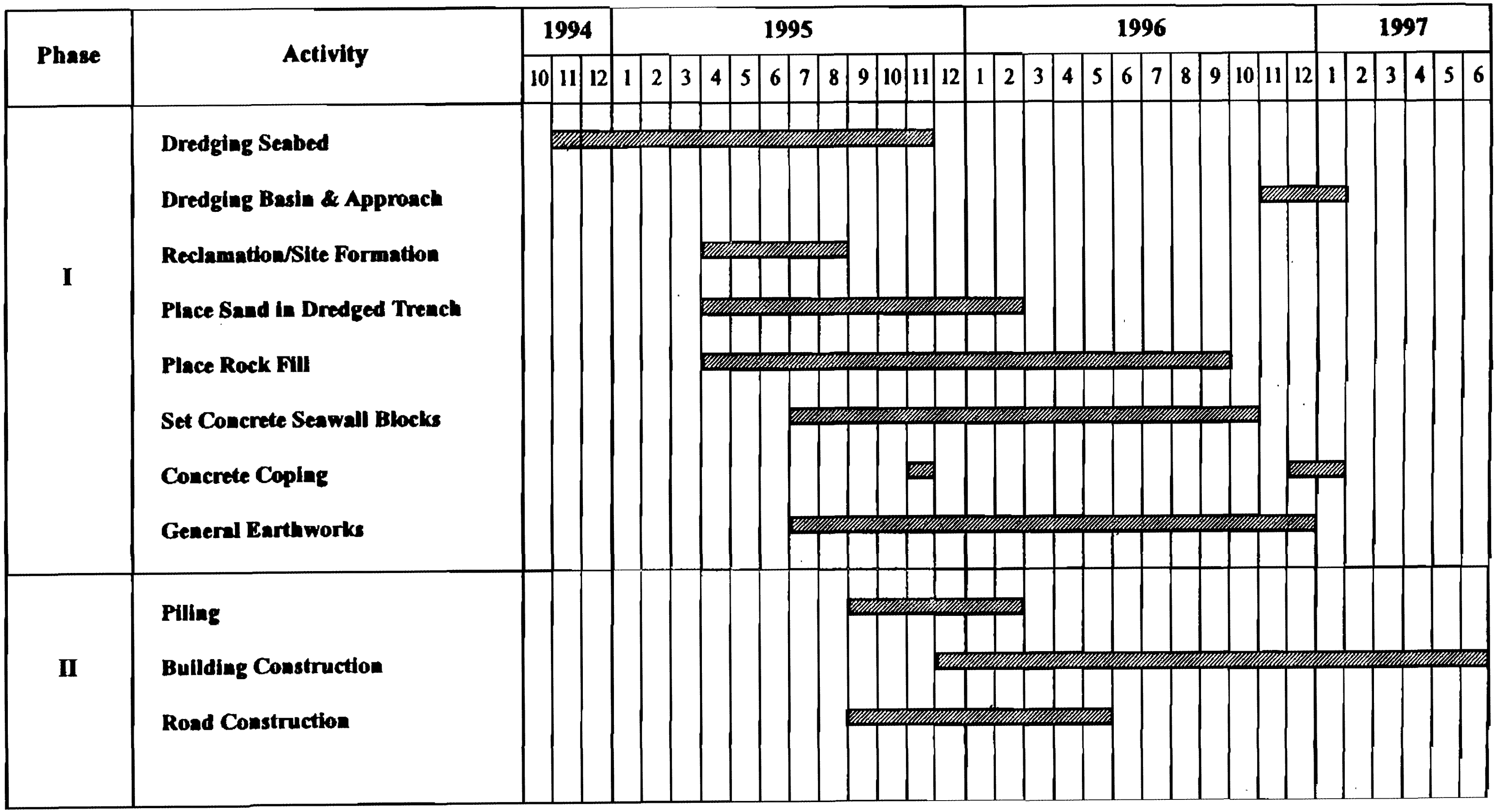
Figure 1.2
The Study Area



List of Land Facilities			
No.	Project Title	No.	Project Title
1	Guardroom, Receive and Despatch Room, Reception Room	13	Parade Ground
2	Office Block	14	Helipad
3	Quarters	15	Garage
4	Pier Lecture Block	16	Pier Godown
5	Pier Club	17	Vessels Repair Workshop
6	Main Hall	18	Boat Storage
7	Miscellaneous Services Room	19	Emergency Electricity Station and Working Room
8	Canteen, Kitchen, Food Store	20	Electricity Power Distribution Room
9	Clinic and Wards	21	Oil Depot and Working Room
10	Pier Duty Room	22	Signal Tower
11	Pier Lavatories	23	Main Road in the Basin Area
12	Pier/Kiosks/Pavilions/Covered Siting Out Area	24	Sewage Treatment Plant

Figure 1.3
Proposed Development (Base Facilities) Scheme L

Figure 1.4
Construction Programme (with restricted hours work 0700 - 2300hrs)



2. THE STUDY AREA

2.1 General Characteristics

Stonecutters' Island is 77 hectares in area and located 2.1km west of Kowloon Peninsula. It comprises mainly hilly terrain rising to a maximum height of about 60mPD in the west with most of the natural slopes covered with dense and mature vegetation. An additional area of flat land has recently been reclaimed on the north east side of the island to accommodate the North West Kowloon sewage treatment plant.

The island is a restricted area with no access available to the general public. It is mostly held by the UK Secretary of State for Defence for the use of Ministry of Defence (MOD), with the exception of the private lot held by Du Pont (HK) Ltd., for the manufacture of water gel explosives. The military uses include the HMS Tamar Naval Base, support facilities for the Hong Kong Military Service Corps, Army firing ranges, the British Military and Hong Kong Government Explosives Depots and a military club and leave facilities. There are also a number of military married quarters and a recreational area on the Island. These have all been identified as sensitive receivers. The British military facilities are expected to remain on the island until June 1997.

To the north west and west is Container Terminal 8 (CT8) Development and to the north and north east is the West Kowloon Reclamation (WKR). (see Figure 1.1)

Stonecutters' Island was garrisoned as a military post around 1860. It has served continually since then as a munitions storage and production site and as a training facility. There are currently about 600 Naval and Army personnel stationed on the island. Housing and other high-use facilities are concentrated at lower elevations at the east side of north bay, the southeast arm, and the west arm of the island. The central area of the island away from the shoreline is higher in elevation, has a low density of buildings, and is a low-use area. The munitions magazine area is also a low-use area, as most of the structures and human activity are underground.

In 1992 Stonecutters' Island was joined to the Kowloon peninsula by land reclamation associated with the CT8 and WKR projects. This resulted in the loss of 800m of natural shoreline on the north shore and a further 700m of rubble mound seawall which originally surrounded the DSD reclamation site. The Kowloon primary sewage treatment works had caused the loss of 600m of natural shoreline in the now defunct north bay. These facilities were completed in 1993 and are now in full use.

In 1993, reclamation work started for the construction of a new Hong Kong Government Dockyard within the north basin already occupied by the HMS Tamar Naval Base. Construction of the buildings for the Dockyard started in January 1994 and is expected to be completed in early 1995.

2.2 Navigational Features

A number of radio masts stand on the central and eastern part of the island, some attaining an elevation of 109m and most being marked by air obstruction lights.

A disused light beacon is situated on the southwest side of the island, adjacent to the proposed site of the naval facilities. If the Naval Base development goes ahead, it may be necessary to remove the beacon. A red and white tank, marked by an air obstruction light is situated about 140m north of the beacon, and a light for the use of aircraft is occasionally exhibited at a lower elevation 50m further west northwest. A large water tower stands 270m northeast of the red and white tank mentioned above.

2.5 Water Quality

2.5.1 Existing Circulation Patterns

Results of mathematical modelling studies conducted within the Study Area were provided by Government for use in this EIA. These data have been used to assess the impact of both construction and operation of the Naval Facilities, and are discussed in Section 4.

Seasonal variations in the circulation patterns in Hong Kongs' coastal waters are best illustrated by the residual flows, which vary extensively between summer and winter, as illustrated in Figure 2.1. Freshwater inflow from the Pearl River plays a significant role in the overall variations in temporal and spatial conditions in the wet season in terms of salinity gradients and transport of pollutants. In the dry season conditions are generally well mixed.

The proposed Naval Facilities will be located within a sheltered embayment which is generally separated from the mainstream flows by a distance of 200m. Local water circulation patterns vary quite extensively in this area and the implication of this is discussed in Section 4.

2.5.2 Existing Water Quality

In the vicinity of the Study Area, some dramatic physical changes have occurred over the past two or three years with a consequential impact on local water quality. Not only has the channel between Northern Stonecutters Island and West Kowloon been closed but extensive marine works have also been, and are still being, carried out within the area. For the purposes of this EIA, recourse has been made to the results of water quality monitoring collected by the West Kowloon Environmental Project Office (ENPO) with the stations referred to as W4 and C2. A summary of the results of routine marine water quality monitoring carried out by ENPO between the period September 1992 and February 1994 are included as Table 2.1.

Table 2.1 Summary of Selected Water Quality Monitoring Data

Period	Parameter								
	DO (mg/l)			SS (mg/l)			Turbidity (NTU)		
	mean	min	max	mean	min	max	mean	min	max
<u>Station C2</u> Sept 1992 - Aug 1993	4.3	2.5	7.4	17.6	1.9	73.5	14	2	61
Sept 1993 - Feb 1994	4.2	2.4	7.0	14.2	2.9	33.3	12	3	33
<u>Station W4</u> Sept 1992 - Aug 1993	4.3	2.0	6.8	20.6	2.3	136.4	18	2	116
Sept 1993 - Feb 1994	4.1	2.4	6.7	22.3	4.8	59.3	19	5	56

2.5.3 Sediment Transport and Quality

Both seasonal and diurnal factors need to be taken into account when considering sediment transport and deposition rates. The seasonal effects are well documented and recent data collected under a Geotechnical Engineering Office programme confirmed the dominant effect of oceanic waters in preventing the ingress of suspended sediments from the Pearl River to Hong Kong's coastal waters on the flood tide. The same study has confirmed that on the ebb tide sediment deposition takes place in the Western Harbour. This deposition is temporary as material is known to be reworked by wave and tidal action in this area.

The dominant influence of the Pearl River in Victoria Harbour is further demonstrated by the high percentage of fine silt content in the bottom sediments. Through extensive laboratory testing carried out for other projects, it has been concluded that in the area between south Stonecutters Island and Green Island about 60% of sediments are < 63 μm with approximately 90% of the sediments having a particle size < 200μm). Review of data collected from various sources indicates a high organic content in the sediment samples in the western Victoria Harbour, which also reflect their source.

2.5.4 Future Environment

Factors over which this Project has little control which will affect future conditions within the study area, include alterations to circulation rates or changes in sediment transport and deposition patterns as a consequence of major reclamation and dredging projects together with external sources of pollution.

The single factor most likely to influence future water quality is the SSDS Stage I Outfall. The Stage I Scheme of the SSDS will provide many benefits in that it will collect point sources of pollution from West Kowloon and part of Hong Kong Island and will provide a higher level of treatment than presently exists, resulting in a general improvement in water quality within Victoria Harbour. In the context of the present Study, effluent discharges from the diffuser of the outfall are a major issue to be addressed as a part of the pollution load could be conveyed, at certain stages of the tide, into the Naval Basin.

In the very long term marine water quality in Hong Kong will be influenced by the phasing and timing of the massive development proposals both in Hong Kong and in the hinterland of the Pearl River Delta.

2.6 Visual Impacts/Landscape

The study area for the visual impact and landscape study has been established as the southern shoreline, between the western edge of the island and the bay to the east of the proposed facility. This includes the area occupied by the Du Pont (HK) Ltd. water gel explosives manufacturing plant. The existing coastline between these two points will be affected in two ways;

- the proposed ground level of the landfill will be approximately 4.5mPD. This will affect some of the trees located in close proximity to the pier and the existing swimming pools/leave bungalows.

- the works area for the reclamation will require fencing off and this proposed boundary fence will be in close proximity to the trees located along the shoreline.

The final fenceline alignment should take into consideration the position of the trees to be retained, to either exclude them from the works site, or if this is impracticable, to provide protective fencing enclosing an area at least to the edge of the canopy spread. As the trees lie some distance inshore, and there has been no discussion suggesting a need for the reclamation boundary to move inland of the existing site boundary, the trees should be protected.

2.7 Solid Waste

The Waste Disposal Ordinance 1980 (Cap. 354) applies to the management and disposal of all wastes including construction materials in Hong Kong.

2.8 Sensitive Receivers

2.8.1 Noise and Air Sensitive Receivers

The Noise Sensitive Receivers (NSRs) and Air Sensitive Receivers (ASRs) are identified as follows:

ASR/NSR1	Married Quarters These quarters are occupied full time and are equipped to standard military married quarters scale with no secondary glazing and there are air conditioning only in bedrooms.
ASR/NSR2	Rosia Cottage - leave Bungalow. This leave bungalow is occupied for approximately 60% of the year predominantly in summer time. This cottage has no secondary glazing and there is air conditioning only in bed rooms.
ASR/NSR3	Leave quarters (Group of 5 Bungalows) These are occupied for around 60% of the time, predominantly in summer time.
ASR/NSR4-6	Married Quarters These are occupied full time
ASR7	Lido Area This area comprises the NAFFI family shop, swimming pool, barbecue area, snack bar, salt water pump room, squash court and store rooms. Note that this is not to be considered as a noise sensitive receiver.

ASR/NSRs 1,2 and 3 will be practically on the site boundary. Figure 2.3 shows the locations of these sensitive receivers and Table 2.2 indicates the coordinates of these receivers.

Table 2.2 Co-ordinates of Sensitive Receivers

Sensitive Receiver	Description	Co-ordinates	
		Northing	Easting
1	Married Quarters	820055	831855
2	Leave Bungalow (Rosia Cottage)	820035	831815
3	(i)Leave Quarters (Group of 5)	820155	832015
4	Married Quarters	820210	831805
5	Married Quarters	820258	831920
6	Married Quarters	820340	831983
7	(ii)Lido Area	820110	831965

(i) The closest bungalow to the site boundary has been used as the measuring point.

(ii) The swimming pool has been used as the measuring point

EPD have confirmed that the Lido Area is not to be considered as a Noise Sensitive Receiver unless the premises associated with this receiver are residential or educational in nature. Therefore, this report will not include an assessment of the noise impact at this receiver.

2.8.2 Water Quality Sensitive Receivers

Sensitive receivers within the area of influence are mainly confined to seawater/cooling water intakes during the construction period. Seawater intakes are located near the ferry jetty on the south shore of Stonecutters Island. The south shore pumping station provides firefighting and flushing water to all the facilities in the south shore area and draws water from beside the jetty. No work can be permitted to begin on the reclamation area until satisfactory arrangements to supply salt water of acceptable quality are re-provided.

It should be noted that Victoria Harbour will be gazetted shortly as a Water Control Zone and will be ascribed Water Quality Objectives for Beneficial Use 3 as a habitat for marine life and a resource for human exploitation. The protection of the marine waters is a primary concern both during and following construction of the proposed Naval Facilities.

Figure 2.1a
Residual Flows in Winter

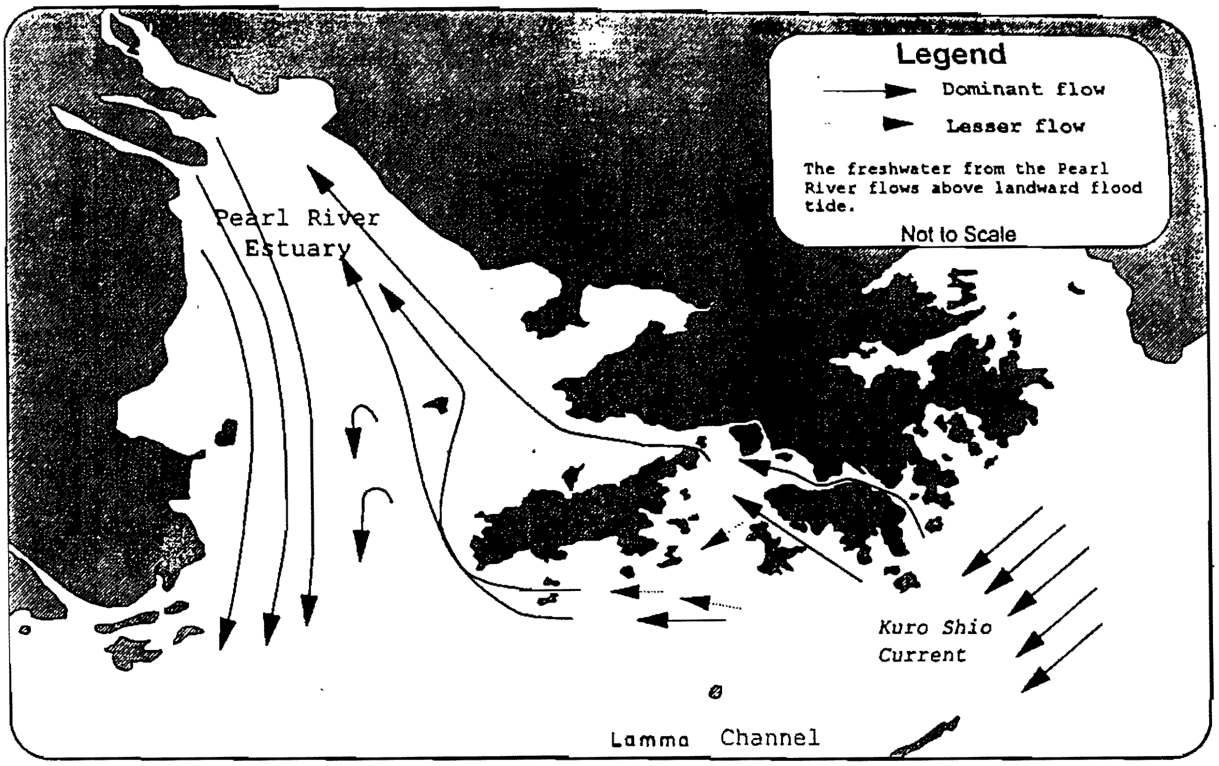


Figure 2.1b
Residual Flows in Summer

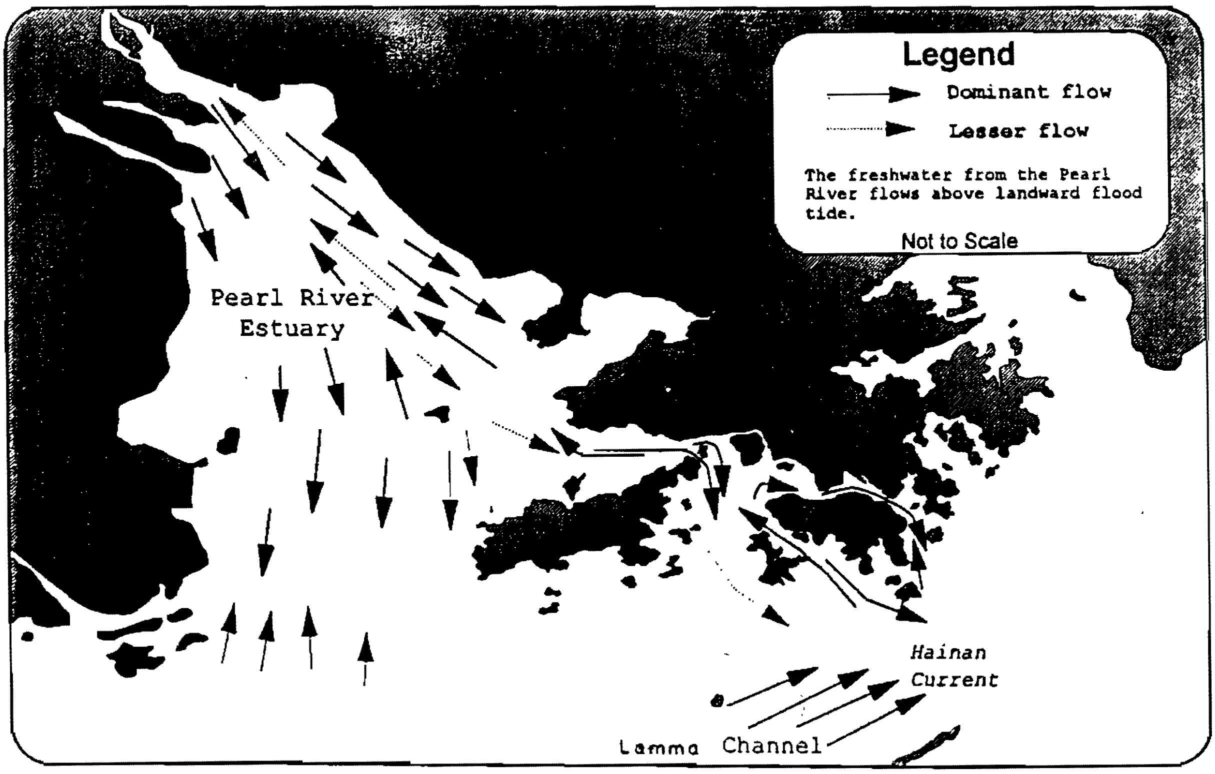
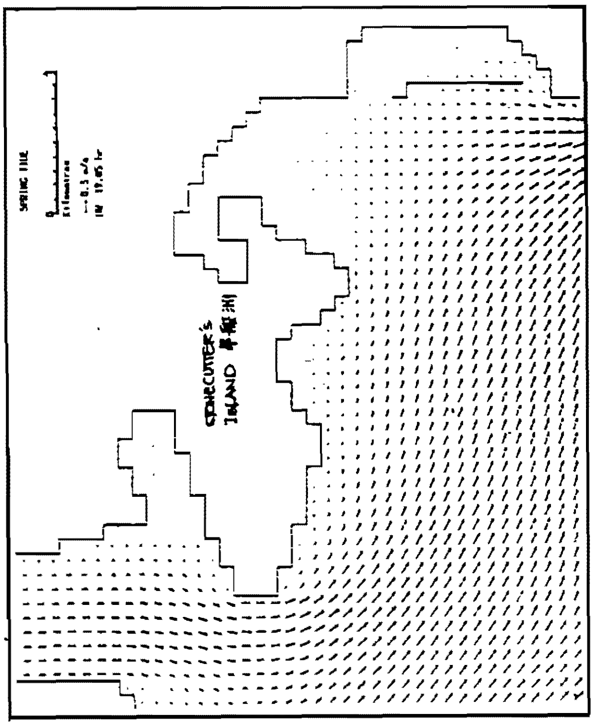
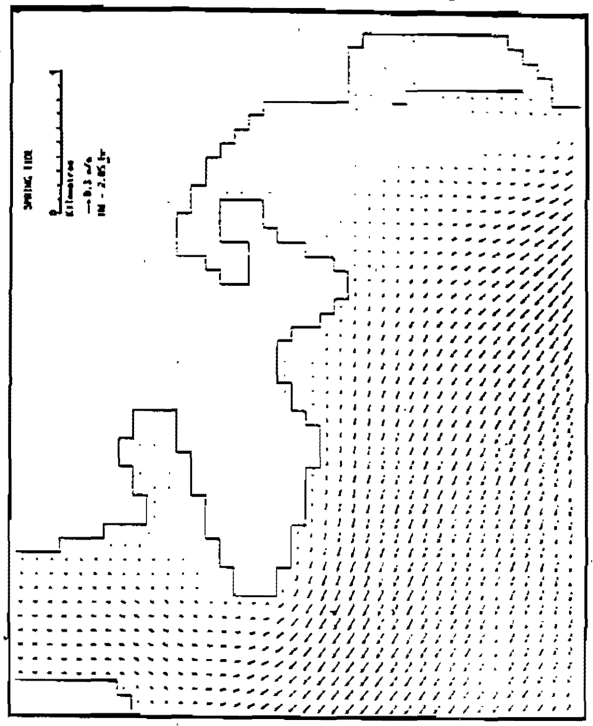


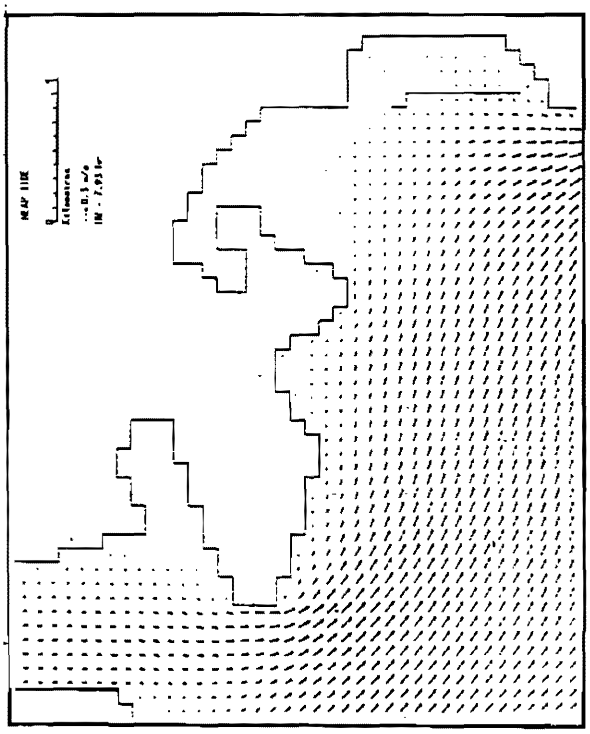
Figure 2.2a
Flow Patterns during the Dry Season



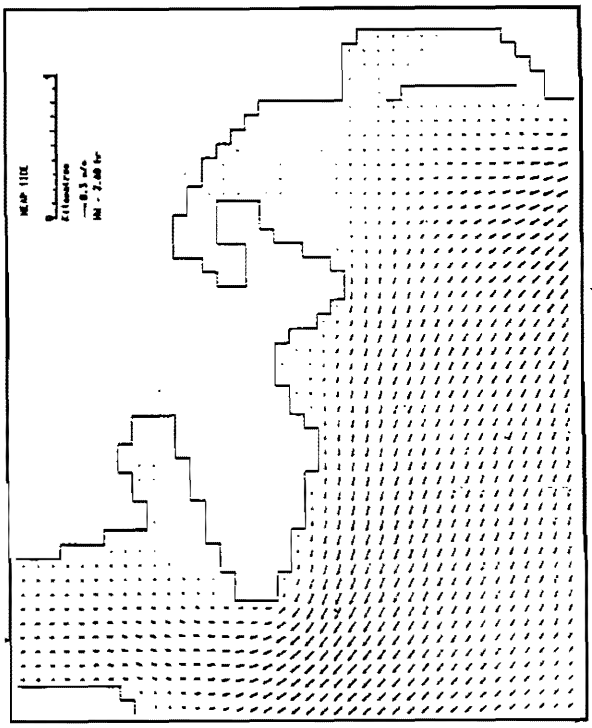
LPWH 2-layer Model (100m grid) - Upper
Dry season Spring Ebb - Baseline



LPWH 2-layer Model (100m grid) - Upper
Dry season Spring Flood - Baseline

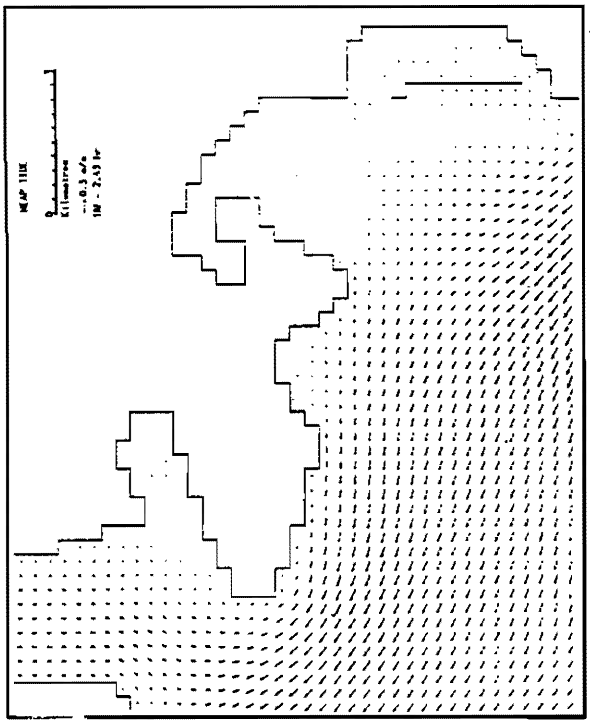


LPWH 2-layer Model (100m grid) - Upper
Dry season Neap Ebb - Baseline

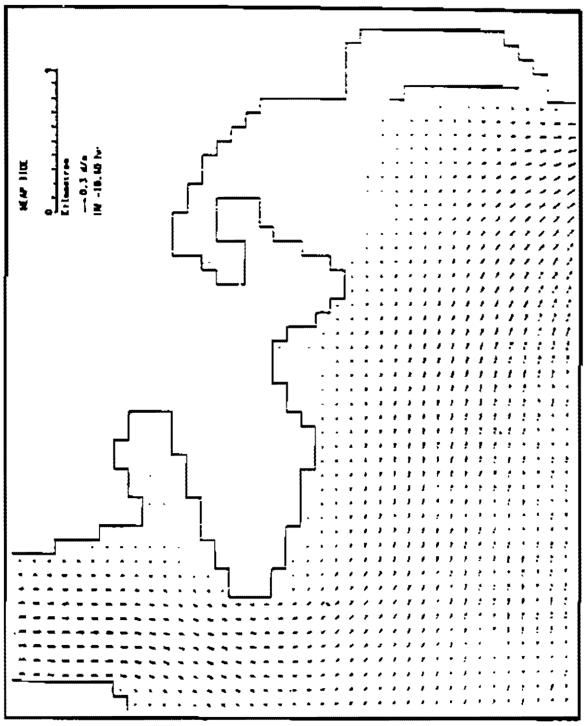


LPWH 2-layer Model (100m grid) - Upper
Dry season Neap Flood - Baseline

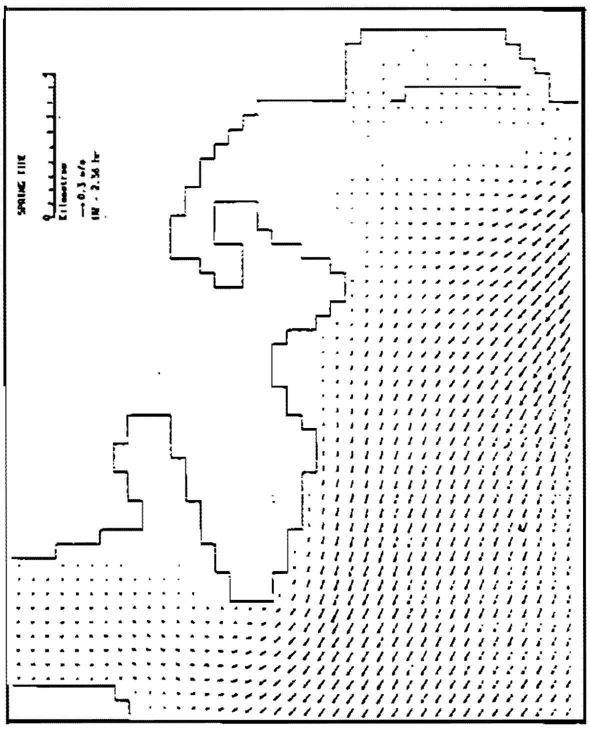
Figure 2.2b
Flow Patterns during the Wet Season



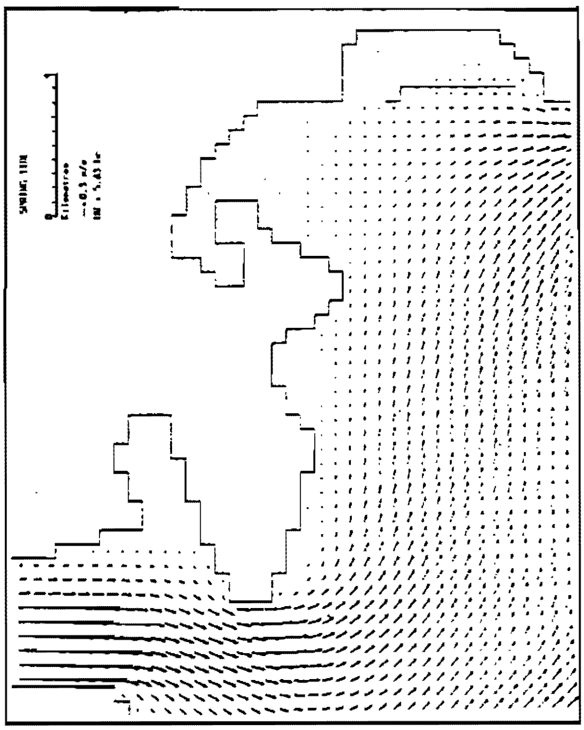
LPWH 2-layer Model (100m grid) - Upper
Wet season Neap Flood - Baseline



LPWH 2-layer Model (100m grid) - Upper
Wet season Neap Ebb - Baseline

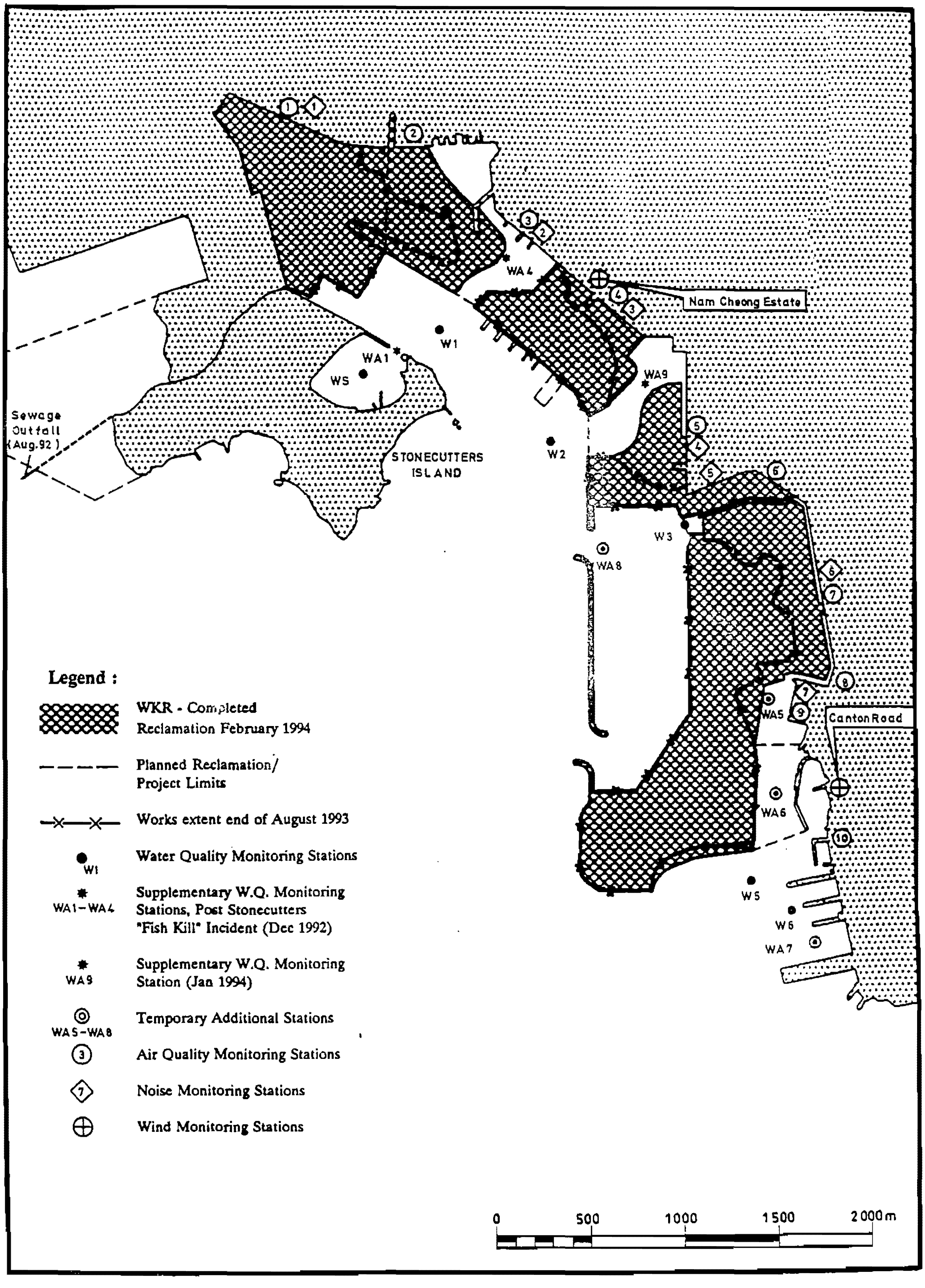


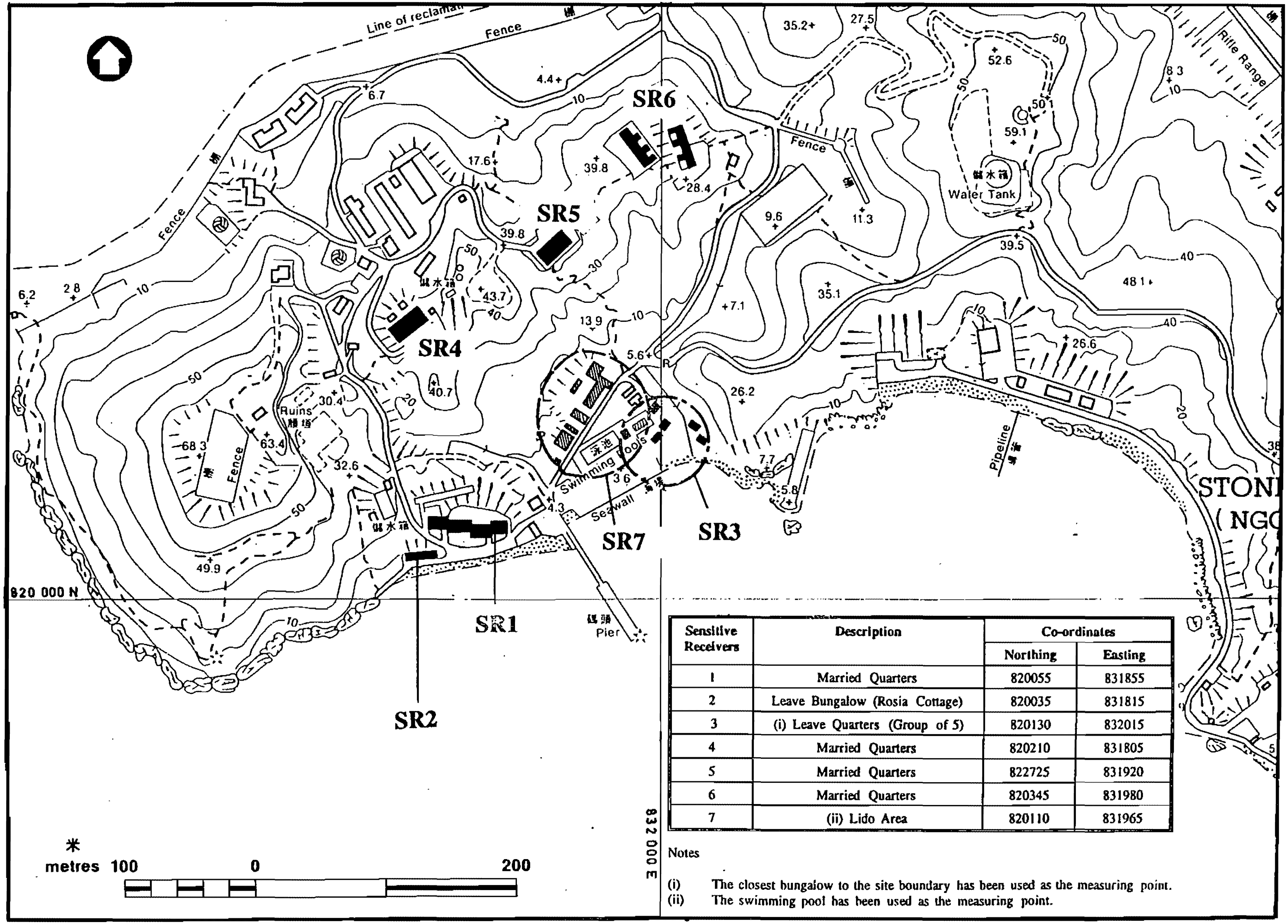
LPWH 2-layer Model (100m grid) - Upper
Wet season Spring Flood - Baseline



LPWH 2-layer Model (100m grid) - Upper
Wet season Spring Ebb - Baseline

Figure 2.3
ENPO Water Quality Monitoring Stations for the WKR Project Area





Sensitive Receivers	Description	Co-ordinates	
		Northing	Easting
1	Married Quarters	820055	831855
2	Leave Bungalow (Rosia Cottage)	820035	831815
3	(i) Leave Quarters (Group of 5)	820130	832015
4	Married Quarters	820210	831805
5	Married Quarters	822725	831920
6	Married Quarters	820345	831980
7	(ii) Lido Area	820110	831965

Notes

(i) The closest bungalow to the site boundary has been used as the measuring point.
(ii) The swimming pool has been used as the measuring point.

Figure 2.4
Location of Sensitive Receivers

3. ENVIRONMENTAL LEGISLATION

3. ENVIRONMENTAL LEGISLATION

3.1 Noise

The Noise Control Ordinance (NCO), gazetted in 1988, in the main legislation controlling noise levels at industrial and commercial premises and construction works. The Ordinance is enacted through three Technical Memoranda and two sets of Regulations. Noise standards are also set in Chapter 9 of the Hong Kong Planning Standards and Guidelines.

The NCO imposes stringent controls on construction works involving percussive piling in close proximity to noise sensitive receivers.

The Technical Memorandum on Construction Noise other than Percussive Piling (TM1) prescribes maximum noise levels for all construction activities that included powered mechanical equipment other than those which involve percussive piling.

The regulations for control of percussive piling are set out in the Technical Memorandum on Noise from Percussive Piling (TM2). Piling times are restricted and work is only allowed within the limits of a Noise Control Permit (NCP) issued by the Environmental Protection Department (EPD).

The Technical Memorandum For The Assessment of Noise From Places Other Than Domestic Premises, Public Places or Construction Sites (TM3) details the procedures that should be adopted for the measurement and assessment of noise emanating from industrial premises.

The Noise Control (Hand Held Percussive Breakers) and (Air Compressors) Regulations, implemented in 1992, imposes controls on the use of construction equipment such as breakers and air compressors. This is the first legislative control introduced in Hong Kong specifically for the purpose of controlling noisy equipment. All such equipment must comply with statutory noise standards and be fitted with noise emission labels when operated.

3.1.1 Construction Noise other than Percussive Piling

TM1 sets out Basic Noise Levels (BNLs) for areas according to their sensitivity rating (ASR). The definitions of ASRs are shown in Table 3.1 and ASR A will apply to the Study Area. There will be no effect from Influencing Factors (IF) in this area. BNLs that will apply are shown in Table 3.2

Acceptable Noise Levels (ANLs) are derived from the BNLs after corrections have been made for the duration of the Construction Noise permit and for Multiple Site Situations. However in this project the ANLs will be the same as the BNLs.

Table 3.1 Area Sensitivity Ratings (ASRs)

Type of Area Containing NSR		Degree to which NSR is affected by IF		
		Not Affected	Indirectly Affected	Directly Affected
(i)	Rural area, including country parks or village type developments	A	B	B
(ii)	Low density residential area consisting of low-rise or isolated high-rise developments	A	B	C
(iii)	Urban area	B	C	C
(iv)	Area other than those above	B	B	C

Table 3.2 Basic Noise Levels for Construction Noise other than Percussive Piling.

Time Period	ASR		
	A	B	C
All days during the evening (1900 to 2300 hours), and general holidays (including Sundays) during the day-time and evening (0700 to 2300 hours).	60	65	70
All days during the night-time (2300-0700 hours).	45	50	55

In addition to the above EPD recommend a maximum level of 75dB(A) Leq (30 min) during construction.

3.1.2 Acceptable Noise Levels for Percussive Piling

The ANLs for percussive piling are shown in Table 3.3, based on the requirements of TM2. The TM allows for reductions to be applied to the ANLs for NSRs that are particularly sensitive to noise but this will not apply to this site. The permitted hours of operation of the piling operation are determined by the amount by which the Calculated Noise Level (CNL) exceeds the ANL as shown in Table 3.4.

Table 3.3 Acceptable Noise Levels for Percussive Piling.

	NSR Window Type or Means of Ventilation	ANL (dB(A))
(i)	NSR (or part of NSR) with no windows or other openings.	100
(ii)	NSR with central air conditioning system.	90
(iii)	NSR with windows or other openings but without central air conditioning system.	85

Table 3.4 Permitted Hours of Operation for Percussive Piling

Amount by which CNL exceeds ANL	Permitted hours of operation on any day not being a general holiday
more than 10dB(A)	0800 to 0900 AND 1230 to 1330 AND 1700 to 1800
between 1dB(A) and 10dB(A)	0800 to 0930 AND 1200 to 1400 AND 1630 to 1800
no exceedance	0700 to 1900

3.1.3 Acceptable Noise Levels during Operation

Acceptable Noise Levels (ANL) to be used in this study for operation impacts are shown in Tables 3.5. The ANLs are based on the TM3. Different ANLs are applied for the daytime and evening (0700 to 2300 hours) and night-time (2300 to 0700 hours). ANLs for residential uses are applicable to night-time and ANLs for non-residential uses are applicable to daytime and evenings only as these properties are assumed to be unoccupied at night-time.

Table 3.5 Acceptable Noise Levels for Commercial Activities

Time Period	ANL (dB(A))
Day (0700 to 1900 hours)	60
Evening (1900 to 2300 hours)	
Night (2300 to 0700 hours)	50

3.2 Air Quality

3.2.1 Air Quality Legislation

Air Quality legislation is enacted under the Air Pollution Control Ordinance (APCO) (Cap 311) which encompasses all emissions from chimneys, furnaces, ovens or industrial plant. Table 3.6 indicates the statutory controls applicable to the air quality assessment.

Table 3.6 Air Pollution Legislation in Effect as of December 31, 1992

Statutory Control	Description of Control
Air Pollution Control Ordinance (Cap 311)	Provides for control of air pollution from stationary sources and motor vehicles. Also enabling legislation under which regulations (as below) have been promulgated.
Air Pollution Control (Smoke) (Amendment) Regulations 1990	Restricts emissions of dark smoke from stationary combustion sources.
Air Pollution Control (Furnaces, Ovens & Chimneys) (Installation and Alteration) Regulations	Requires the submission of plans for the installation and alteration of furnaces, ovens and chimneys to ensure appropriate design.
Air Pollution (Dust & Grit) Emission Regulations	Stipulates the Procedures and requirement for assessing emissions to the atmosphere that are controlled under the Air Pollution Control Ordinance.
Air Pollution Control (Appeal Board) Regulations	Provides for appeal by any person aggrieved by decisions, requirements or specifications under the Air Pollution Control Ordinance.
Air Pollution control (Specified Processes) Regulations	Provides for the licensing of new specified processes and registration of existing ones.
Air Pollution Control (Vehicle Design Standards) (Emission) Regulations 1991	Specified emission standards for vehicle engines.
Building (Demolition Works) Regulations (Cap 123)	Regulates building demolition, including prevention of dust nuisance.
Public Health and Municipal Services ordinance (Cap 132)	Makes provisions for urban services and public health; including prevention of nuisance caused by emissions of dust and fumes.
Road Traffic (Construction and Maintenance of Vehicles) Regulations	Specifies smoke levels for in-house vehicles

Under the Air Pollution Control Ordinance, Government has declared Air Control Zones (ACZ) for the whole Territory. Air Quality Objectives (AQO) for Hong Kong are given in Table 3.7.

Table 3.7 Hong Kong Air Quality Objectives

Pollutant	Concentration in $\mu g/m^3$ (i) Averaging Time				
	1hr (ii)	8hrs (iii)	24hrs (iii)	3mnths (iv)	1yr (iv)
Sulphur Dioxide	800		350		80
Total Suspended Particulates (v)			260		80
Respirable Suspended Particulates (v)			180		55
Nitrogen Dioxide	300	150			80
Carbon Monoxide	3,000	10,000			
Photochemical Oxidants (as ozone (vi))	240				
Lead				1.5	

(i) Measured at 298K (25°C) and 101.325 kPa (one atmosphere).
(ii) Not to be exceeded more than three times per year.
(iii) Not to be exceeded more than once per year.
(iv) Arithmetic means.
(v) Respirable suspended particulates means suspended particulates in air with a nominal aerodynamic diameter of 10 micrometers and smaller.
(vi) Photochemical oxidants are determined by measurement of ozone only.

Note : In addition to the above EPD recommended a maximum TSP level of 500 $\mu g/m^3$ at the site boundary during construction (1 hour).

3.3 Solid Waste

The Waste Control Ordinance (WCO) (Cap 354) was enacted in 1980 and provided the framework for the waste disposal plan for the Territory which was formulated in 1989. Reference has been made to the aforementioned when considering waste arisings and disposal methods during the construction phase of this project.

The Waste Disposal (Chemical Waste) (General) Regulations, phased in from 1992, and the relevant sections of the WDO imposes controls on the proper disposal of chemical waste. Acids, alkalis, solvents, organic compounds and oils used in industry must be packaged, collected, stored and disposed of according to statutory controls. it is an offence to indiscriminately discharge chemical waste into sewers and the offence is subject to prosecution.

3.4 Water Quality

Marine water quality in Hong Kong is governed by the 1980 Water Pollution Control Ordinance (Cap 358) (WPCO). Territorial waters are divided into Water Control Zones which have each been ascribed a series of Water Quality Objectives. The Study Area is located within the Victoria Harbour Water Control Zone (which has still to be gazetted) and the relevant water quality objectives promulgated for this area are given in Table 3.8 below:

Table 3.8 Water Quality Objectives for Victoria Harbour

Water Quality Parameter	Objective	
	Victoria Harbour*	Sub-Zone
Offensive odour, tints and colours	- Not to extend natural by >10%	- Whole zone
Visible foam, oil, grease scum, litter	- Not to be present	- Whole zone
E.coli	- Not to exceed 1000/100ml, calculated as the geometric mean of the most recent 5 consecutive samples taken at intervals of between 7 and 21 days	- Secondary contact recreation subzone - Inland waters
D.O. within 2m of bottom	- not less than 2mg/l within 2m of the seabed for 90% of the sampling occasions during the whole year	- Marine waters
Depth average D.O.	- Not less than 4 mg/l for 90% of the sampling occasions during the whole year; values should be calculated as the annual water column average (see note 1).	- Whole zone except fish culture zone - Fish culture zone; (BU-2)
pH	- To be within the range of 6.5-8.5 units. In addition, human activity should not cause the natural pH range to be extended by more than 0.2 unit - Human activity should not cause the pH of the water to exceed the range 6.0 - 9.0 units.	- Marine waters - Inland waters
Salinity	- Change due to discharge not to exceed 10% of natural level	- Whole zone
Temperature change	- Change due to discharge not to exceed 2°C	- Whole zone
Suspended solids	- Discharge not to raise the natural ambient level by 30% nor accumulation of SS.	- Whole zone
Toxicants producing significant toxic effects	- Not to be present	- Whole zone
Ammonia	- Annual mean not to exceed 0.021 mg/l calculated as unionised form	- Whole zone

Table 3.8 Water Quality Objectives for Victoria Harbour (Cont'd)

Water Quality Parameter	Objective	
	Victoria Harbour*	Sub-Zone
Nutrients	- nutrients not to be present in quantities sufficient to cause excessive or nuisance growth of algae or other aquatic plants.	- Marine Waters
	- level of inorganic nitrogen should not exceed 0.4 mg per litre, expressed as annual water column average (see note 1)	- Marine Waters

Note 1: Expressed normally as the arithmetic mean of at least 3 measurements at 1m below surface, mid depth and 1m above the seabed. However in water of a depth of 5m or less the mean shall be that of 2 measurements (1m below surface and 1m above seabed), and in water of less than 3m the 1m below surface sample only shall apply.

* Objectives shown for Victoria Harbour are for Beneficial Use Criteria No. 3, (BU-3), except for *E.coli* which BU-6 criteria have been used. Below is a summary of the beneficial Use Criteria.

BU-1; As a source of food for human consumption. WQOs apply to the food itself, not the waters.
BU-2; As a resource for commercial fisheries and shell fisheries (mariculture).
BU-3; As a habitat for marine life and a resource for human exploitation.
BU-4; For bathing (March to October).
BU-5; For secondary contact recreation including diving, sail-boarding and dinghy sailing.
BU-6; For domestic and industrial purposes, including cooling, toilet flushing and desalination.
BU-7; For navigation and shipping including the use of officially approved and endorsed sheltered harbours and typhoon shelters as temporary havens.
BU-8; For aesthetic enjoyment.

In addition to the foregoing, in 1990 an amendment to the Ordinance contained a series of standards to be used as control measures for discharges to sewers, inland and coastal waters.

For this EIA, both the Water Quality Objectives for Victoria Harbour and the Technical Memorandum on Standards for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters (TM) (WPCO Cap 358 S.21) will be adopted as the legislative criteria to be adhered to.

3.5 Marine Legislation

The Shipping and Port Control Ordinance (Cap. 313) (SPCO) which is administered by the Marine Department, controls oil and fuel spillages to coastal waters. The SPCO prohibits pollution of the sea from oil or fuels generated either from marine or land based sources. In addition to which the dumping of refuse, building material and general littering from vessels or port based activities is also strictly prohibited under the Summary Offences Ordinance.

The Dumping at Sea Act 1974 (Overseas Territories) Order 1975 also prohibits dumping at sea without a licence and controls the marine disposal of dredged spoil and excavated materials unsuitable for land reclamation.

3.6 Hong Kong Planning Standards and Guidelines (HKPSG)

Chapter 9 of the Hong Kong Planning Standards and Guidelines (HKPSG), provides wide ranging environmental guideline for incorporation into the planning stages to reflect the requirement of the NCO (1988) Waste Disposal Plan for Hong Kong (1989), the standards for the air and water control zones and the Air Pollution Control (Fuel Restriction) Regulations (1990). Sensitive receptors for all pollution impacts are also identified in the HKPSG.

3.7 Standards for Contaminated Spoil

A classification system for the degree of contamination of sediments has been developed by the marine department and adopted by EPD for issuing marine dumping licences. Based on these criteria it is estimated that about 23 M cu.m of mud generated in the next five years will be contaminated.

3.8 Sediment Quality

Marine sediments are classified in Technical Circular (TC) No. 1-1-92 according to the degree of contamination by toxic metals. The classes are defined as follows:

(i) Class A - Uncontaminated

Material which requires no special dredging, transport or disposal methods beyond those which would normally be applied for the purpose of ensuring compliance with EPD's Water Quality Requirements, or for the protection of sensitive receptors near the dredging or disposal areas.

(ii) Class B - Moderately contaminated

Material which requires special care during dredging and transport, and which must be disposed of in a manner which minimises the dissolution or resuspension of pollutants.

(iii) 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.

Definition of the categories of marine sediment which require disposal are given in Table 3.9 below:

Table 3.9 Classification of Dredged Sediments for Marine Disposal (mg/kg dry weight)

Class	Cr	Cu	Pb	Zn	Cd	Ni	Hg
A	0-49	0-54	0-64	0-149	0-0.9	0-34	0-0.7
B	50-79	55-64	65-74	150-199	1-1.4	35-39	0.8-0.9
C	>80	>65	>75	>200	>1.5	>40	>1.0

Note: Test results should be rounded off to two significant figures before comparing with the table, e.g. Cd to the nearest 0.1 mg/kg, Cr to the nearest 1 mg/kg, and Zn to the nearest 10 mg/kg.

Source : Technical Circular No. 1-1-92

4. WATER QUALITY

4. WATER QUALITY

I. CONSTRUCTION PHASE

4.1 Introduction

Impacts arising from the construction of the naval facilities will be similar to those at many other waterfront sites. While it is anticipated that marine works will have the greatest impact on receiving water quality, the potential for land based construction activities to adversely affect marine water quality, either directly or indirectly, should not be discounted.

The following sections outline the potential impacts on water quality which could arise from either land or marine based construction works. Wherever possible these effects have been quantified, the impacts on potentially sensitive receivers defined, and any mitigation measures which may be necessary have been identified.

4.2 Land Based Construction Impacts

The proposed facilities will require the construction of, inter alia, administration/residential and recreational buildings, a parade ground, stores and workshops, roads, fencing and car parking. General earthworks are scheduled to be completed within a period of ten months. Other construction activities such as the provision of drainage, infrastructure, utilities and construction of new buildings have not yet been specified. Potential impacts on water quality which could arise from the provision of the aforementioned facilities include:

- runoff of silt and oil/fuel laden surface waters;
- discharge of washout water from any concrete batching plants, which may be employed on-site, to the receiving waters;
- discharge of domestic wastes (liquid or solid) from the construction worksite to the receiving waters;
- disposal of effluent from the workforce directly into the receiving waters; and
- the backing up of existing drains (both foul and stormwater) and soakaways from existing residential dwellings consequent to the formation of seawalls, and changes in levels of the land.

Potential impacts on water quality arising from land based construction works are summarised in Table 4.1.

Table 4.1 Potential Impacts on Water Quality from Land Based Construction Activities

Construction Activity	Potential Impact on Receiving Waters
Runoff of silt/oil laden surface waters	- increases in suspended solids concentration - increase in BOD over a long period of time as the oil/fuel decomposes - decrease in clarity
Discharges from concrete batching plants	- increase in pH - increase in suspended solids concentrations and turbidity - decrease in clarity

Table 4.1 Potential Impacts on Water Quality from Based Construction Activities (Cont'd)

Construction Activity	Potential Impact on Receiving Waters
Discharge of untreated domestic effluent from worksite	- increase in BOD - increase in suspended solids - increase in *E.coli* counts - increase in nutrient loading - increase in oil/grease (primarily from canteen/cooking facilities)
Backing up of drains/soakaway consequent to the formation of a new seawall and reclamation	- complete malfunctioning of drainage facilities

The degree to which uncontrolled runoff could affect receiving water quality depends on nature and extent of the facilities provided, as well as the phasing of the construction programme. If for example the marine based facilities, such as the seawalls are constructed in advance of the land based facilities the implications of pollution discharges to the semi-enclosed embayment would be more significant than if an alternative phasing was adopted.

Many of the impacts on water quality which have been identified can be controlled through good site management and practices. These include the provision of perimeter drains around the site, collection and containment systems for spillages and bunding and/or dedicated drainage collection systems around concrete batching plants, vehicle maintenance and fuel storage areas. Perimeter drains around the site will be connected to the foul sewer and effluent or runoff will not be permitted to be discharged directly or indirectly into the marine water.

The reprovisioning of drainage connections (both foul and surface water) early in the construction programme is a fundamental issue arising from this EIA. The existing outfalls cannot simply be extended for two reasons; the first is that under the provisions of the WPCO untreated effluent cannot be discharged into a semi-confined embayment. Secondly as the formation levels change gravity drainage will no longer apply.

Although the nature of this problem has been identified the scale cannot be quantified at this stage. It is thus recommended that these drainage issues are studied during detailed design to examine the extent of the problem and to determine the most effective remedial measures.

4.3 Marine Based Construction Impacts

Activities which have the potential to adversely affect receiving water quality include:

- dredging;
- construction of vertical seawalls and breakwater/armour seawall;
- reclamation;
- finishing/concreting/paving; and
- spoil disposal.

4.4 Dredging

Impacts on receiving water quality due to dredging activities, relate primarily to the elevation of suspended solids, increased turbidity with a consequent decrease in clarity in the water column, in addition to a possible decrease in dissolved oxygen concentrations. The latter is a consequence of the oxygen demand exerted by the sediments which are disturbed during dredging operations. The extent of the impact of dredging on water quality depends on many factors including the release rate and quality of the sediments, the type of equipment used, the experience of the operators and the local hydrodynamic regime.

According to the programming details provided, two grab dredgers will be employed for the duration of the dredging (12 month period). In the immediate vicinity of these dredgers, suspended solids concentrations throughout the water column could easily be in excess of 1000mg/l as a consequence of using grabs to remove material from the seabed, and could be greater if the dredged material is allowed to overflow while being lifted. Measures to reduce the impact on the receiving waters include the employment of water tight grabs, although while these reduce the suspended solids concentration in the upper water column they will increase concentrations in the lower layer.

Measures to minimise the impact of dredging contaminated mud will include closed grabs which can be sealed and water tight. At the disposal sites the contract conditions provided in Appendix G17 will apply.

Although no physico-chemical testing of the sediments in the Study Area was undertaken for this Study recourse was made to sediment quality data collected as part of the West Kowloon Reclamation Study, and detailed in the Construction Environmental Impact Assessment Report, January 1991, (Mott MacDonald et al). While the sediments of West Kowloon, are severely contaminated through long exposure to pollution, it may be surmised from the geographical position of this sheltered embayment and its relationship to the principal tidal flows, that the material to be dredged could be less contaminated than that analysed for the West Kowloon Reclamation Study. While it has been conservatively assumed that the top 1m of the marine mud will be contaminated, the Contractor will be required to confirm this conclusion prior to commencing marine works.

Key issues pertaining to dredging activities to be addressed in the following sections include:

- sediment release rate and thus turbidity generation;
- sediment resuspension, transport, and deposition; and
- oxygen demand exerted on the water column, as a consequence of dredging operations.

4.4.1 Potential Sediment Release Rate

To illustrate the significance of the impacts arising from the dredging method adopted for this project, sediment release rates were estimated for different types of dredgers, currently in use in Hong Kong, using data provided in the EIA carried out for the Tin Shui Wai Development. Assuming a trailer suction dredger is engaged on-site with a dredging rate of 100,000 m^3/wk, a suspended sediment release rate at the face of 1,250 tonne/wk, and slurry density of 1,200 kg/m^3; then the concentration of suspended solids (SS) at the face of the dredger is estimated to be:

SS at work face = dredging mass x coefficient of suspension
1,250 tonne = 120,000 tonne x k
=> k = 1%

Similar calculations were carried out for cutter suction and grab dredgers, which yielded coefficients (k) of 1.5 % and 2.5 % respectively.

In the preliminary programme of construction works, provided by CED, an estimated 2.35Mm^3 of material will need to be dredged prior to forming the seawalls. As this activity is programmed to take 12 months to complete (December 1994 - November 1995) and assuming work will continue six days per week, the average excavation rate will be 7,508m^3/day. Should there be any further reduction in the construction period or restrictions on working hours, the production rate will consequently have to increase with a potential impact on receiving water quality.

Potential sediment release rates were calculated for different types of dredging equipment on the basis of a 12 month dredging period and are shown in Table 4.2.

Table 4.2 Sediment Release Rate (tonne/day)

Type of Dredger	Potential Sediment Release Rate (tonne/day)
Trailer Suction	90
Cutter Suction	135
Grab/bucket	225

Note: the potential sediment release rate of water tight sealed grab will be 5 to 10 times less than that of (non water tight) grab/bucket.

From the data provided in Table 4.2 it is apparent that grab dredging will have a greater impact on the receiving water quality than if other dredging techniques were adopted. As previously identified, grab dredgers will be employed on-site for the duration of the dredging contract ("cleaner" dredging techniques such as trailer suction require a draught of about 8m and thus cannot be used at this site). Notwithstanding this, it is pertinent to note that an estimated 830 tonnes of sediment were released daily during the dredging for the adjacent CT8 reclamation.

The most visible impact of dredging is the generation of the sediment plume in the water column due to an increase in suspended solids concentration. If it is assumed that 225 tonnes of sediment are released (and confined within the embayment with an approximate volume of 1.5 Mm^3) on a daily basis, the total suspended solids load in the water column on a daily basis could be 156mg/l.

Comparison with the data collected at the ENPO station C2 (the closest to the Site as illustrated on Figure 4.1 with a mean range of 14-17mg/l and a maximum of 74 mg/l) indicates that the impact of dredging on these receiving waters could be significant. Relating these estimates to the Water Quality Objectives (an increase in 30% above ambient) suggests a significant breach of the standards set will occur as a result of these works. Even during the wet season when the ambient levels of suspended solids will naturally increase (peak value 74 mg/l) the WQO's could still be breached at Station C2.

4.4.2 Transportation and Redeposition

Once a sediment load has been resuspended within the water column, it is possible that it could be conveyed from the site by currents, winds and wave and redeposited elsewhere. The distances travelled depend on many factors, including the physical characteristics of the dredged material, method of dredging (and thus the potential for resuspension), prevailing hydrodynamic regime and the ability to sustain sufficient kinetic energy. Potentially sensitive receptors in this connection include marine life and any seawater intakes which may be located within the area of influence.

Field data suggest that the majority of the dredged sediments will have a diameter less than 200 µm. Output from the mathematical modelling carried out for this Project indicates that peak velocities are 0.3 m/s at the southern seawall. The velocity (u_2) within the dredged channel may thus estimated by :

$$U_2 = \frac{U_1 . h_i}{h_2}$$

where U_1 = peak velocity above the undisturbed bed, 0.3m/s
h_1 = initial water depth, 9m
h_2 = increased water depth due to dredging a trench, say 11m

Peak velocities immediately adjacent to the dredging zone could therefore be reduced by up to 25%. On this basis, the maximum distance a sediment plume could travel in the first hour following release would be 810m. However, sediment release will occur at all stages of the tide and not only at the point of maximum current velocity in the tidal cycle and the distance the plume could travel in the first hour following release could range between about 30m and 810 m.

According to the findings of the studies currently being undertaken by GEO into the cumulative effects of dredging on the marine environment, it has been observed that in the first ten minutes after release the levels of resuspended sediments in the surface waters are reduced by 50% with a further reduction of 50% in the next 30 minutes. This confirms the view that the impacts of dredging in the surface layers (in terms of elevated suspended solids) are relatively short term and that the majority of resuspended solids will be deposited in close proximity to the dredging site.

On this basis the potential impacts arising from resuspension of sediments should be examined, not over a full working day but over a very much shorter time scale. Assuming 225 tonnes of sediments are released at a constant rate over a 12 hour period (0700 - 1900 hours), in one hour approximately 18.8 tonnes of sediments will be released to the water column. Assuming the sediment plume is confined to the embayment (approximate volume 1.5Mm^3), then the additional suspended solids load in the water column will be 13 mg/l, (cf ambient suspended solids level of 14-17 mg/l at water quality monitoring station C2) which alone exceeds the WQO's for this area.

The closest industrial sensitive receiver is the seawater intake for the pumping station close to the South Shore ferry jetty. It has been recommended that this pumping station is relocated prior to commencing marine works. This facility will be required to be reprovisioned before reclamation commences, however the new intake may still be within the area influenced by dredging works.

Although operating conditions for the seawater intake at the pumping station are not known, it is generally assumed that suspended solids concentrations should not exceed

140 mg/l at the point of entry. On the basis of the foregoing estimates and the ambient suspended solids concentrations recorded (at C2), it may be surmised that dredging works may not adversely affect the operation of this facility. However, it must be stated that the estimates are based on a short time frame and do not take into account the cumulative effect of dredging over the entire working day which could be more significant (depending on the very localised hydrodynamic regime). Furthermore during the wet season the suspended solids concentrations in the Study Area will also naturally rise.

It is recommended that, water quality monitoring is undertaken during the period when any marine works are undertaken. This programme should include sampling stations at any seawater intakes within the area influenced by the dredging activities.

Mitigation measures are also recommended to minimise the impacts of dredging on the receiving water quality.

4.4.3 Oxygen Demand

Prior to commencing any marine works, it is essential to define sediment quality in order to evaluate the potential impacts of dredging on the immediate receiving water body and at the spoil disposal site, in addition to defining the spoil disposal method. Although sediment sampling has not been carried out in the immediate vicinity of the Study Area, recourse has been made to data collected under the West Kowloon Reclamation Study, 1991.

When dredging takes place, dissolved oxygen levels will initially increase due to the perturbation and agitation within the water column. This will soon be followed by a decline in dissolved oxygen as the hitherto undisturbed sediments exert an oxygen demand on the receiving water body. To illustrate the potential extent of these oxygen demands, oxygen uptake rates have been computed on the basis of available information and on the basis of the following assumptions:

- at least two grab dredgers will be employed on-site;
- 225 tonne of suspended sediments could be released into the water column on a daily basis;
- the BOD in sediments are, on average, 11,000 mg/kg (Source : West Kowloon Reclamation Study); and thus
- the estimated oxygen demand exerted by the dredged sediments will be of the order of 2,475 kg/day.

Assuming the oxygen demand/reaeration rate is constant over a volume V (m^3) then the rate of reaeration can be calculated by:

$$r_R = K_r (C_s - C) V$$

where r_R = reaeration rate

K_r = reaeration flux constant taken for Hong Kong Waters to be 0.23/day (Source: WAHMO)

C_s = saturation concentration of dissolved oxygen, taken to be 7.60mg/l at salinity of 30ppt and 20°C (Source : Metcalf and Eddy)

C = dissolved oxygen concentration (4.3 mg/l) (Source : ENPO Station C2)

V = volume of receiving waters assumed to be 400m x 400m x 9m (ie within the Naval Basin) then ⇒ $r = 0.23\ (7.6 - 4.3) \times 10^{-3} \times 1{,}440{,}000$

$= \underline{1093\ \text{kg/day}}$

Based on a release rate of 225 tonnes of sediment per day, and the sediment quality as provided in the West Kowloon Reclamation Report, it may be surmised that the oxygen demand in the receiving waters due to this activity will considerably exceed the oxygen supply.

Even if it is assumed that the oxygen demand of the sediments in this area is low (indicating a relative lack of contamination) say with a BOD of 4,500 mg/kg, then the reaeration rate would be 1,012 kg/day would balance the theoretical oxygen supply. However, it has been conservatively assumed that the top 1m of marine mud will be contaminated and to estimate the oxygen demand on the receiving waters due to dredging, with respect to distance, three scenarios have been considered.

- where the area of influence is a radius 400m;
- where the area of influence is a radius 500m; and
- where the area of influence is a radius 1000m.

$$C = C_\alpha - \frac{\Delta BOD}{V.\ K_r}$$

where : $V_1 = 4.5\ Mm^3$; $V_2 = 7.1\ Mm^3$; and $V_3 = 28.3\ Mm^3$

C = predicted DO concentration
$C\alpha$ = 4.3 mg/l (ambient DO concentration; ENPO station C2)
Δ BOD = 2,475 kg/d
K_r = 0.23/d

Based on the assumptions given, the impact of dredging on receiving waters within a 400m radius will be reflected in a reduction of DO levels by 56 % to 1.9 mg/l. Within a 500m the resulting DO concentration is 2.8 mg/l (a reduction of 35%), and a corresponding 0.4 mg/l reduction in DO (<10%) is predicted as a result of dredging activities within a radius of 1000m. As noted previously these simple calculations are not intended to be definitive but to illustrate the relatively short distances over which the effects of dredging are reduced.

Reference to the Water Quality Objectives promulgated for Victoria Harbour Water Control Zone (not less than 4 mg/l DO in 90% of samples), it is apparent that on the basis of the assumptions made, dredging activities for this project are likely to contravene the WQO's both in terms of DO and suspended solids.

It should be stressed that the foregoing calculations are based on local conditions, various assumptions, and do not take account of the surface liquid oxygen exchange or the reaeration of the water column through wind and wave action. The foregoing estimates do however illustrate the potential impacts on the receiving waters which could occur and highlight the need to consider measures to reduce the impact of dredging on the receiving water body. Such measures include the provision of performance specifications for the dredgers, and operational criteria in the Conditions of Contract.

To estimate the volume of water necessary to maintain water quality within and outside the Naval Basin at the same level the following calculations have been carried out assuming that:

(i) the BOD load is 387,000 kg/day (reference : AB_2H Report : "Stage 1 - Kowloon System Interim Outfall Water Quality Assessment Final Report, July 1993").

(ii) water quality at Station VXO2 nearest to Stonecutters Island is predicted to be DO is 3.8 mg/l (BOD is 3.6 mg/l) during the dry season; DO is 2.6 mg/l (BOD is 3.7 mg/l) during the wet season [source : WAHMO model results for this study].

(iii) K_r = 0.23/day (source WAHMO)

(iv) C_s = 7.6 mg/l

In the dry season

$$C = C_s - \frac{\Delta \text{ BOD}}{K_r \times V}$$

$$3.8\text{mg/l} = 7.6\text{mg/l} - \frac{387{,}000 \text{ kg/day}}{0.23\text{/day} \times V}$$

$$3.8 = \frac{387{,}000 \times 1000\text{m}^3}{0.23 \times V}$$

$$0.87V = 3.87 \times 10^8 \text{m}^3$$

$$V = 442{,}791{,}762 \text{ m}^3$$

In the wet season

$$C = C_s - \frac{\Delta \text{ BOD}}{K_r \times V}$$

$$2.6\text{mg/l} = 7.6\text{mg/l} - \frac{387{,}000 \text{ kg/day}}{0.23\text{/day} \times V}$$

$$5.0 = \frac{387{,}000 \times 1000\text{m}^3}{0.23 \times V}$$

$$V = 336{,}521{,}739\text{m}^3$$

Thus the total volume of water required to assimilate the outfall BOD load is about 440Mm² in the dry season and 340 Mm³ in the wet season. On this basis it can be assumed that X% of the BOD load from the SSDS Stage 1 outfall requires Ym³ of water to be assimilated. Values of X and Y are summarised in the following table:

X %	Y (dry season) $10^6 \times m^3$	Y (wet season) $10^6 \times m^3$
.01	0.04	0.03
.1	.4	.3
1	4.4	3.4

ΔDO = 4 mg/l = ΔBOD / $K_r V$ ⇒ 0.1 x 387,000 / 0.23 x 1.4 M

Clearly not all the total load from the outfall can ever enter the basin since the load is firstly diffused by the outfall over the whole area of mixing zone and only a part of the water in the vicinity of the basin can enter the basin. On the basis of the estimates made in section 4.12 the exchange rate in the dry season was given as 10% of the volume of water in the basin. If it is assumed (conservatively) that 1 percent of the total outfall BOD load arrives in the vicinity of the entrance to the basin (this can be justified by comparing the area of the entrance with the area of the mixing zone) and of this 10 percent enters the basin then only .1 percent of the total load can enter the basin. The flushing of the basin required to assimilate this load will be 0.4 Mm^3, or about 30 percent. Additional flushing of the basin should therefore be provided if at all possible to maintain the water quality and it is recommended that additional openings be provided to accommodate this so long as this can be done without compromising the operational efficiency of the basin.

4.5 Construction of the Seawalls/Breakwater and Armouring

Water quality issues relating to construction of the seawalls, jetties and piers will depend upon the construction methods employed, and the phasing of the works. If the seawalls are initially constructed with reclamation carried out behind and within a semi-enclosed basin as is common practice in Hong Kong, pollutants will tend to be retained within the Naval Basin. The extent to which water quality could be adversely affected, will depend upon the nature and extent of pollution load received. Many of the impacts will relate to elevated turbidity and suspended solids concentrations in the water column. Any floating material or oil spillages will need to be removed by surface skimmers or similar methods. The contractor will be required to include an incidence response plan in his method statement, which will be most pertinent in connection with protection of water quality at seawater intakes located within the area of influence of this Project.

4.6 Reclamation and Finishing Structures

Impacts on water quality arising from finishing works, structures and surfaces will be similar to those outlined for the land based facilities. As it is not possible on the basis of the available information to define the extent of such impacts, it is recommended that consideration is given to developing pollution prevention as well as control measures. This is discussed further in Section 4.8.1.

4.7 Disposal of Dredged Material

The Contractor will be responsible for the disposal of spoil from this site. He will be required to provide a sediment quality report and disposal requirements to the Fill Management Committee (FMC) prior to commencing any dredging works in accordance with Works Branch Technical Circular No. 22/92. The FMC will determine the actual disposal site taking account of the quality and, quantity of spoil generated.

Although no sediment sampling has been carried out in the area for this study, from existing data it may be conservatively assumed that the top layer (1m) of marine deposits is class 'C' and therefore requires special dredging and disposal methods.

Although disposal of other dredged material will ultimately be the Contractor's responsibility, it is recommended that any material which could be used in reclamations or as fill source should be disposed of to a public dump for use at a later date. Any other material which is unsuitable for reclamation or fill should be disposed of at a public landfill as required by the DEP.

Assuming the remainder of the dredged material is uncontaminated, consideration may be given to infilling the embayment which will be created to the east of the proposed Naval Facilities. Direct disposal of marine mud to this area would not only provide a disposal option which eliminates off-site transportation, but would offer an opportunity for soft landscaping of the eastern (external) aspect of the proposed facilities. On advice provided by the ecology specialists, engaged for this Project, this could provide a valuable resting and nesting area for, inter alia, night herons and waders. Furthermore, infilling this bay would reduce the potential for the collection of marine litter and debris which could be washed into this area at various stages of the tide.

4.8 Mitigation Measures

Consideration has been given to ways to reduce the potential impacts on water quality from both land based and marine based construction activities.

4.8.1 Land Based

Prior to commencing construction, a series of perimeter drains should be provided with sediment traps installed at frequent intervals, to prevent surface water which could be contaminated with oils sediments or other materials being discharged directly into the adjacent embayment. The perimeter drains should be connected to the drainage system and discharged via an outfall with screening and oil separation provided.

It is recommended that if any concrete or asphalt batching plant are established on-site, bunds will need to be constructed to contain materials which may be spilled during construction. Such spillages would have to be collected, separated and the liquid fraction discharged to the foul sewer for further treatment in accordance with the provisions set out in the Technical Memorandum on Standards for Effluents discharged into Drainage and Sewerage Systems, Inland and Coastal Waters (TM).

Water or any other liquid which may be used to dampen stockpiled material (to reduce dust generation) should be collected in drainage pits constructed around these areas and reused to minimise both water consumption rates on site and disposal requirements.

In accordance with the requirements of the TM, all liquid wastes including domestic effluent shall be disposed of via a foul sewer, connecting to the new Sewage Treatment Works to the northwest of the site. If this is not practical from the point of view of timing or for other considerations then an adequately sized septic tank arrangement or similar packaged treatment plant will be required, to accommodate the size of workforce engaged on-site. Sewerage and connection to the CT8 sewer should be provided as early as possible in the works programme.

4.8.2 Measures to Protect the Marine Environment

It may be concluded that grab dredgers will have a greater short term impact on the water column compared with other dredging techniques. Although dredging activities could have a severe impact on the receiving waters these should be locally confined and thus able to be controlled through operational practices and application of mitigation measures which include low impact dredging methods. Controls on the operations and water quality monitoring while marine works are being undertaken will need to be specified in the Contract Document.

From the foregoing assessments it has been identified that increases in suspended solids concentrations due to dredging could have an adverse impact on the operation of the seawater pumping stations which may be located within the area of influence of the dredgers. The reprovisioning of the saltwater intake at the south shore ferry jetty prior to commencing marine works is a key issue arising from this EIA. It is recommended that water quality monitoring stations are located at any seawater intake, within a 1km range of the dredging works. Provision should be made for the installation of silt curtains around seawater intakes when the sediment levels in the water column approach the action level of 140mg/l) for the duration of any marine works associated with this project.

It is recommended that wherever possible the aim should be to reduce water consumption on-site. For example, water used in the suppression of dust on stockpiles, should be collected and reused, thereby reducing the requirement to pretreat wastewater in accordance with the TM prior to discharge to the foul sewer.

For the protection of air and water quality, it is recommended that wherever possible concrete should be brought in a ready mix form to reduce the need for providing concrete batching facilities on Stonecutters' Island. Should the Contractor wish to batch concrete on-site he shall be required to apply to the Director of Environmental Protection for a licence prior to installing any facilities at this site. All wastewaters including washout water from concrete batching facilities, will be disposed of via the foul sewerage system and the quality will be regulated through the provisions of the TM (especially in connection with permitted pH and suspended solids concentrations).

It is recommended that any material accidentally discharged to the marine environment which is aesthetically intrusive or which could exert an oxygen demand on receiving waters, should be removed using water witches or similar equipment, as required.

It is recommended that all surface drainage is channelled through sediment traps to separate sediments from runoff water, prior to that disposal via the foul sewer. Regular maintenance of any sediment traps which are provided will be required to maintain their efficiency.

It is recommended that around any concrete batching plant, the bentonite mixing area, and any fuel storage or maintenance areas bunds are provided and dedicated drainage systems installed, to contain and allow pretreatment of any spillages prior to their appropriate disposal.

Measures which may be considered to prevent the backing up or blocking of drains due to the changes in formation levels include the reprovisioning of all septic tanks at a higher elevation, collection of effluent in a sump and pumping out via an outfall, or by raising the level of the existing land and services such that they are higher than the reclamation to permit the principle of drainage by gravity to be reinstated. The foregoing all require further consideration. It is recommended that these issues are considered during detailed design to provide the most cost effective solution to this problem.

The Contractor will be required to formulate an accident response plan which will include his proposals for effectively dealing with any spillages of fuels or oil either directly or indirectly to the marine environment during the course of his work and will be endorsed by the Engineer and all relevant Government Departments.

All effluent will be disposed of via a foul sewer and will be required to comply with the provisions of the TM.

4.9 Impact Monitoring

The Contractor will be required to schedule and design his works such that he:

- minimises disturbance to the seabed while dredging;
- minimises losses of dredged material during lifting and transportation of fill or dredged material;
- prevents discharge of pollutants, fill or dredged material at any location other that approved by the DEP;
- prevents the unacceptable reduction in dissolved oxygen levels due to the dredging or backfilling; and
- prevents release of excessive suspended solids to the water column.

To ensure the Contractor is carrying out the Works in such a manner as to minimise adverse impacts on receiving water quality during execution of the Works, it is recommended that impact monitoring for all marine based activities is undertaken to confirm the standards set are being achieved.

The Engineer should establish a series of Designated Monitoring Stations with each station having a defined (measured) target limit for turbidity defined by the Engineer. One station will be located near any seawater intake within a 1km radius of the site. Two more stations will be located within the immediate Study Area, with a further two stations external to the embayment.

Baseline conditions for water quality will be established at least four weeks prior to commencement of the marine works by insitu measurement of dissolved oxygen concentration (mg/l) (DO) and dissolved oxygen saturation (%) (DOS) and temperature (°C). Water samples will be taken for immediate onsite measurement of turbidity (NTU) and laboratory analysis of suspended solids (mg/L). Baseline monitoring will be undertaken at all Designated Monitoring Stations, for a period of one month prior to the commencement of the marine works on four days of each week. Monitoring shall be undertaken at each station on the mid flood and mid ebb tides at three depths, namely, one metre below the water surface (upper), mid water depth (middle) and one metre above the sea bed (lower). The baseline results and WQO shall form the basis for calculating trigger, action and target levels to be used in the impact monitoring.

Impact monitoring will be undertaken, during the course of the Works, on three working days per week at each predefined Designated Monitoring Station. The interval between each sampling series (mid ebb and mid flood) will not be less than 36 hours where two sets of the turbidity, DO, DOS and temperature levels shall be measured and water samples for suspended solids taken at each depth. Where the difference in value between the first and second reading of each set is more than 25% the readings shall be discarded and further readings shall be taken. Suspended solids analysis will continue until such times as a clear relationship is determined with turbidity.

If the monitoring data of turbidity or suspended solids or dissolved oxygen show a deteriorating trend or TAT levels for any of these three parameters are exceeded, the Contractor shall take action in accordance with an Action Plan which shall be submitted to and agreed by the Engineer and EPD.

Action on detecting a deterioration in water quality shall include all necessary steps taken by the Contractor to stem the deterioration and re-establish the status quo. The steps taken will include but not be limited to:-

- checking of all marine plant and equipment;
- maintenance or replacement of any marine plant or equipment contributing to the deterioration;
- checking and maintenance of all silt screens; and
- review of all working methods.

The general procedures to avoid pollution during dredging works include the requirement that the Contractor shall design his working methods and use equipment that shall minimise the risk of silt and other contaminants being released into the water column.

For the purposes of evaluating the water quality, all values shall be depth averaged. A monthly summary of all data will be prepared and will include at least the following:

- copy of all the monitoring results;
- highlighting whenever the trigger, action and target limits or WQO's are exceeded;
- implementation of the action plan whenever the trigger, action and target levels are exceeded;
- identification of reasons for non-compliance;
- identification of mitigation measures taken by the Contractor as a result of exceeding the trigger, action and/or target limits; and
- copy of all complaints received.

A copy of the summary data will be made available for inspection by the DEP at his request, and by the Contractor.

The Contractor shall 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 whenever target limits are exceeded. If, the Contractor has not taken appropriate and effective measures to reduce the water quality impacts, the Contractor may be required to take all measures necessary to improve the water quality. The trigger, action and target levels (TAT) will be endorsed by both the Engineer and EPD.

An action plan for water quality monitoring has been drawn up and is included as Table 4.3.

Table 4.3 Action Plan for Water Quality Monitoring

Event	Action by	
	Engineer	Contractor
Monitoring results on a single occasion indicate trigger levels are achieved.	Notifies Contractor.	Acknowledges verbally.
Monitoring results on two consecutive occasions indicate action levels are approached.	Notifies Contractor. Requires deployment of Contractor's existing plant and methods to be adjusted to meet WQR. Increases monitoring frequency to daily.	Reviews plant and working methods. Submits remedial proposals to Engineer for written approval. Implements remedial action in receipt of approval.
Monitoring results on three or more consecutive occasions indicate target levels are approached.	Notifies Contractor and Environmental Protection Department. Requires Contractor to deploy alternative or additional plant and/or methods to meet WQR. (for example slower dredging rate) Continues to monitor on a daily basis and takes water samples to confirm suspended solids levels and DO concentrations.	Reviews plant and methods. Submits proposals for alternative or additional plant and/or methods to Engineer for written approval. Implements remedial actions immediately on receipt of approval.
Monitoring results indicate persistently unacceptable conditions.	Notifies Contractor and Environmental Protection Department in writing. If approved remedial measures have not been implemented, Engineer directs Contractor to cease related works or parts of works until approved measures have been implemented and plant and methods made to comply with the required approvals. Continues to monitor on a daily basis and takes water samples to confirm suspended solids concentrations. If all approved measures are implemented and TAT levels still exceeded then the Contractor will be required to to cease work.	Implements approved remediation measures and ensures compliance of plant and methods. Provides further measures to achieve compliance of plant and methods.
S.S. concentration at defined seawater intake > 140mg/l	Notifies Contractor.	Installs silt curtains around the intake.

4.10 Water Quality Monitoring of Disposal Sites

The Contractor shall ensure that all marine mud, contaminated marine mud and unsuitable material is disposed of at the approved locations. He will be required to ensure accurate positioning of vessels before discharge and to submit and agree proposals with the Engineer for accurate positional control at disposal sites before commencing dredging. All disposal in designated marine dumping grounds shall be in accordance with the conditions of a licence issued by the DEP under the Dumping at Sea Act (Overseas Territories) Order 1975. Floating and contaminated materials (as defined by the DEP) will not be acceptable at marine dumping grounds and will require other methods of disposal as required by FMC.

The Engineer may monitor any vessel transporting material to ensure that loss of material does not take place during transportation. The Contractor shall provide all reasonable assistance to the Engineer for this purpose and shall design his methods of working to minimise pollution and shall provide experienced personnel with suitable training to ensure that these methods are implemented.

Water quality monitoring of disposal sites will be required to ensure the working methods do not adversely affect water quality.
The Water Quality Monitoring equipment shall include dissolved oxygen and temperature measuring equipment, turbidity measuring equipment, water depth detector and global positioning system. Baseline monitoring shall be carried out for the various water quality parameters which shall be established prior to the commencement of the dumping or dredging operation. The Contractor shall establish the Baseline conditions by measuring turbidity, dissolved oxygen concentration, dissolved oxygen saturation at all designated monitoring stations on four sampling days per week at mid flood and mid ebb for one week prior to the commencement of the operation. All measurements shall be taken in situ and at three water depths namely 1m below water surface, mid depth and 1m above the seabed.

- During the course of the marine works, monitoring shall be undertaken three 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.

- Should the monitoring programme record levels of turbidity or dissolved oxygen, which are indicative of a deteriorating situation such that, in the opinion of the 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.

- 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. For dissolved oxygen, the target limit should be 2 mg/l within 2m of the seabed and 4 mg/l for the remaining water column.

Should the monitoring programme record levels of turbidity or dissolved oxygen which are indicative of a deteriorating situation such that in the opinion of the DEP more frequent monitoring may be required.

4.11 Contract Clauses

On the basis of the foregoing assessments, it is apparent that specific controls will need to be applied to protect the receiving waters, both at Stonecutters Island and at the spoil dumping grounds. Specific controls will also be required for the protection of facilities using saltwater drawn from within the Study Area.

Contract clauses which are proposed for the construction phase of this Project are detailed in Appendices C and G.

II. OPERATION PHASE IMPACT OF THE NAVALFACILITIES

Key issues to be addressed in connection with the construction of new harbour facilities include alterations to circulation rates, sedimentation patterns and water quality.

4.12 Modifications to the Existing Coastline

4.12.1 Circulation

The following section provides a brief description of the tidal regime prevailing in the waters around Stonecutters Island. Recourse has been made to the predictions of tidal velocity and direction made by the mathematical model (WAHMO) at six stations near Stonecutters Island (Figure 4.1 refers). Velocity data were supplied for the surface and bottom layers during spring and neap tides of both dry and wet seasons, in addition to which a selected areal flow diagram (velocity vector plot) was supplied for each tide. These data are provided in Appendix I.

As the scenario modelled did not include the geometry of the Naval Basin per se, the direct impacts of this facility on the local tidal regime can only be conjectured. As a key concern of this Project is the impact of the operations of the Naval Facility on the receiving water quality, attention has thus focused on the potential conveyance of pollutants in the surface layers around Stonecutters Island and the implications on any sensitive receivers.

Dry Season

Salient features of the tidal field in the vicinity of Stonecutters Island are summarised in Figure 4.2, which depicts directional variation and peak values of tidal velocity during the flood and ebb cycles of a typical neap tide. Both the upper and lower layers flow in unison (vertically homogeneous) with variations exhibited only in the peak velocities. Corresponding spring tidal cycles are very similar with respect to directional variation but differ somewhat in the peak velocity values.

In the deeper waters to the S-SW of Stonecutters Island surface layer flows are principally uni-directional, with the mainstream of the current oscillating along the NW-SE direction (parallel to the axis of the Northern Fairway). Closer to Stonecutters Island, the surface current follows the contour of the CT8 Reclamation and the southern shoreline of the island. Locally, and increasingly so as the shoreline is approached, the flow pattern of the surface current approaches that of one-dimensional tidal flow, exhibiting very limited variations in the direction of the velocity vector during each flood and ebb cycle and regular occurrence of tidal slacks between each six-hourly flood and ebb cycle. At Stations 1 and 4, which are closest to the shoreline, the current practically oscillates along the east-west axis, reducing to zero every 6 hours.

However at station 3 the pattern changes and in the transition from flood to ebb the period of tidal slack is no longer evident and consequently the tidal period extends to 12 hours. The predicted minimum velocity is about 0.03 m/s and occurs between 1.5 to 2 hours before HW at Stonecutters Island. The regular six hourly flood-ebb cycle characteristic of Stations 1 and 4 is replaced by a 2 hour flood (current direction : W-10-N to W-36-N) and a 6 hour ebb (current direction : E to E-18-S) with a 2-hour transition period in between. During this transition period the velocity vector rotates clockwise from 306 to 100 degrees without ever achieving zero velocity.

Station 3 is a typical because it lies at the edge of the mainstream of the tidal current oscillating between Victoria Harbour and Tsing Yi and is influenced by its proximity to Stonecutters Island as well as to the shallow waters in front of the new typhoon shelter at West Kowloon.

On a typical spring tide during the transition from flood to ebb the conditions at Station 3 appear to be influenced by a large clockwise vortex extending from the southern tip to Stonecutters Island to the typhoon shelter and extending to the waters of the Yau Ma Tai anchorage. Evidence of this vortex is confirmed through the velocity magnitude and direction versus time plot for Station 3.

Stations 2 and 6, demonstrate trends in velocity direction and magnitude which are intermediate to those characterising Stations 1 and 4 and Station 3.

Residual circulation patterns, as outlined above, will play a significant role in the transport of pollutants originating in this area (and not just from within the Naval Basin). It may be conjectured that due to the similarity in velocities during spring and neap tides of the dry season (especially at Station 3), residual circulation patterns are likely to be similar throughout the dry season.

On the basis of the foregoing, the following transport scenarios may be inferred for pollution (such as an oil slick) associated with activities relating to the Naval Basin:

- during the flood tide, effluent will be conveyed westwards skimming the CT8 Reclamation, bifurcate and drift towards the Tsing Yi coast and the Rambler Channel;

- during the ebb tide, effluent will be conveyed in an easterly direction following the Facility's southern breakwater and the coastline of Stonecutters Island until it reaches the location of Station 3 where the direction of the surface current velocity persists at E-18-S throughout the ebb cycle. Thereafter, effluent is likely to be dispersed in an E to SE direction, with part lingering in the nearly stagnant and heavily polluted waters off West Kowloon. The formation of the vortex in this area and the potential lack of dispersion suggests that any pollution conveyed into these waters could have an adverse impact on overall water quality in this area. Although the existing situation indicates the waters are heavily polluted it is a fundamental design aim to minimise the potential impact on any water body through construction or operation of this Facility.

Wet Season

In the wet season the situation is more complex. Salient features of the tidal field during the flood and ebb cycles of a typical spring tide are summarised in Figures 4.3 and 4.4. The overall flow pattern is similar to that exhibited during the corresponding dry season tides, net transport in deeper waters being realized along the NW-SE axis and close to the shoreline, in an E-W direction. Broadly similar conditions prevail during the wet season neap tide.

During both spring and neap tides, the variation of velocity magnitude and direction at Station 3 is very similar to that prevailing during the corresponding cycles of the dry season. However, velocity vector plots are not available for the flood-ebb transition of the wet season tides and therefore the occurrence of a residual circulation pattern in the wet season tides cannot be defined.

From the foregoing it may be concluded that alterations to the very local flow regime, the location of the entrance of this facility and the implications for maintaining water quality within the Naval Basin and the effects of activities therein on external water quality all require detailed mathematical modelling (hydrodynamics and water quality) studies to be undertaken.

Water Exchange Rates

Local circulation of water within the basin and the rate of exchange with external tidal streams is of critical significance in maintaining water quality within and external to the Naval Basin Exchange rates are primarily an interaction of the following:

- the tidal prism of the basin;
- the horizontal eddy generated at the entrance by passing flow; and
- the vertical circulation created by density differences between the water within the basin and the external water body.

Simplistically the tidal prism (V_t) is the product of the area of the basin (estimated to be 160,000m^2) and the tidal range. The tidal ranges (taken from previous modelling data, Figure 4.5 refers) are presented in Table 4.4.

Table 4.4 Tidal Ranges

Station	Season/ Tidal Range (m)			
	Dry Neap	Dry Spring	Wet Neap	Wet Spring
"B"	1.2m	2.3m	1.2m	2.4m

If the smallest tidal range is considered (to give the smallest rate of exchange of water), the volume of water which will theoretically be exchanged is 192,000m^3 per tide which is equivalent to approximately 10% of the volume of water within the Basin. An estimated 50% difference exists between the maximum and minimum (wet spring and wet neap respectively) water exchange rates for the proposed facilities.

Depending upon the precise alignment of the seawalls entrainment of the horizontal eddy which could form near the entrance of the basin could also be important in optimising flushing rates and dispersion of pollutants, although cognisance should be given to the foregoing discussion relating to water movements at station 3. The rate of horizontal water exchange may be approximated by the following formula :

$$V_h = f_1 \times h \times b \times \frac{U}{\pi} \times T - f_2 \times V_t$$

where

V_h = total volume of water exchanged per tidal cycle by horizontal exchange flow
f_1, f_2 = empirical coefficients depending on the geometry of the harbour
h = depth of harbour entrance relative to MSL
b = width of harbour entrance
u_o = main flow velocity in front of the entrance
T = tidal period
V_t = tidal prism of harbour basin

Water exchange rates due to density currents may also occur due to differences in density of the waters within the basin and the mainstream flows. Exchange through this mechanism. is more effective than the foregoing as it affects the entire basin with

$$Q_d = \left[f_3 \times (\frac{\Delta\rho}{\rho}gh)^{(0.5)} - u_t\right] \times 0.5hb$$

where

Q_d	= exchange rate due to density currents
U_t	= flow velocity related to the tidal prism
ρ	= density of water
	= densimetric Froude number
f_3	= coefficient

(Source : Delft Hydraulics Laboratory Technical Publication, June 1983)

The foregoing equations have been included to demonstrate that water exchange rates depend upon, inter alia, the actual dimensions of the basin, the width of the harbour entrance and the depth of the basin. The foregoing calculations also illustrate the need for very careful consideration to be given to what appears to be a simple problem but is in fact a very complex issue. Actual dimensions and alignments the openings of the aforementioned need to be designed to maximise water exchange rates and maintain water quality within this semi enclosed basin.

4.13 Future Water Quality

Underlying factors which will influence water quality within the Naval Basin will be defined by interactions between the following:

- tidal exchange rates and the dimensions and positioning of the entrance to the basin, as discussed above;
- quality of the water penetrating the basin;
- any uncontrolled ingression from surface water runoff from the hinterland; and
- water borne operations and activities within the basin itself.

From the foregoing, it is evident that the positioning of the entrance and breakwater and their precise dimensions will have a direct impact on the rate of exchange between water within the basin and external pollution sources. During detailed design this issue will need to be carefully addressed through, for example, modelling of the basin if water quality (both within the basin and in the immediate vicinity external to the Basin) is to be protected.

4.14 External Water Quality

A key issue identified through this Study is the influence of external pollution sources on water quality within the Naval Basin. A fundamental concern relates to the potential ingression of effluent discharged through the diffuser of the SSDS Stage I Outfall into the Naval Basin (refer to Figure 4.5).

For the purposes of this EIA, the results of three discrete scenarios were provided by EPD to assist in the general evaluation of future water quality in the Study Area. The model studies were carried out (for other projects) using the existing situation as a reference point and two future scenarios as follows:

- the 1996 baseline case; and
- the SSDS scenario.

Output from the models was used to generate a series of concentration versus time plots for all parameters studies, which are provided in Appendix I. The three stations (shown on Figure 4.1) chosen for detailed examination include station VM7 to the east of the Study Area, WM3 due west, and station VX02 which is directly in the area of influence of the SSDS Stage I Outfall, to illustrate changes in water quality primarily due to the Stage I outfall.

Summaries of the output are provided as tidally averaged mean values of dissolved oxygen, biochemical oxygen demand, organic nitrogen, chlorophyll and suspended solids, parameters for the 1996 (Baseline) and SSDS Scenario. Predicted mean values for various parameters for these two scenarios are provided in Tables 4.5 through 4.10. The data are related to the existing situation with percentage changes included in parenthesis.

Table 4.5 Summary of Modelling Output DO (mg/l)

Station		Dry Season Neap Tide		Dry Season Spring Tide		Wet Season Neap Tide		Wet Season Spring Tide	
		1996	SSDS	1996	SSDS	1996	SSDS	1996	SSDS
VM7	U.L. L.L	3.5(13↓) 3.4	3.0(25↓) 2.9	2.7(21↓) 2.5	3.4(–) 3.3	0.2(↑x4) 0.1	2.3(↑x56) 2.1	3.3(14↓) 3.3	3.1(18↓) 3.3
VX02	U.L L.L	3.9(17↓) 3.6	4.0(17↓) 3.7	3.6(19↓) 3.4	3.7(17↓) 3.5	0.6(↑45) 0.2	1.5(↑2x) 1.0	3.7(↓9) 3.6	3.7(↓8) 3.6
WM3	U.L L.L	5.3(↓5) 5.3	5.3(↓5) 5.4	5.7(↓7) 5.7	5.6(↓9) 5.7	2.6(↑9) 2.8	2.8(↑20) 3.0	4.5(↓3) 4.6	4.5(↓2) 4.6

Table 4.6 Summary of Modelling Output BOD (mg/l)

Station		Dry Season Neap Tide		Dry Season Spring Tide		Wet Season Neap Tide		Wet Season Spring Tide	
		1996	SSDS	1996	SSDS	1996	SSDS	1996	SSDS
VM7	U.L. L.L	2.7(↓18) 2.8	3.2(↓5) 3.3	3.1(↑20) 3.2	2.8(↑5) 2.8	3.8(↑33) 4.0	2.8(↓50) 2.8	2.6(↑15) 2.5	2.8(↑26) 2.8
VX02	U.L L.L	2.7(↑43) 2.7	3.7(↑95) 3.5	2.7(↑50) 2.7	3.5(↑90) 3.2	3.6(↑9) 3.5	4.2(↑7) 3.4	2.7(↑25) 2.5	3.2(↑60) 2.9
WM3	U.L L.L	1.9(↑17) 1.8	2.8(↑68) 2.6	2.0(↑45) 1.9	3.2(↑190) 3.0	2.6(↑9) 2.4	4.1(↑54) 2.9	2.4(–) 2.0	3.8(↑64) 2.5

Table 4.7 Summary of Modelling Output ON (mg/l)

Station		Dry Season Neap Tide		Dry Season Spring Tide		Wet Season Neap Tide		Wet Season Spring Tide	
		1996	SSDS	1996	SSDS	1996	SSDS	1996	SSDS
VM7	U.L. L.L	0.1(–) 0.1	0.15(↑50) 0.16	0.16(↑14) 0.16	0.16(↑14) 0.16	0.02(↑2x) 0.01	0.17(↑17x) 0.17	0.18(↑6x) 0.17	0.20(↑18x) 0.20
VX02	U.L L.L	0.10(↑25) 0.10	0.13(↑50) 0.14	0.11(↑22) 0.11	0.15(↑22) 0.16	0.03(–) 0.0	0.23(↑6x) 0.20	0.17(↑6) 0.17	0.19(↑19) 0.19
WM3	U.L L.L	0.09 0.09	0.09 0.09	0.07(↑16) 0.07	0.09(↑1.5x) 0.09	0.08(↓20) 0.08	0.15(↑50) 0.13	0.16(↑7) 0.15	0.16(↑7) 0.15

Table 4.8 Summary of Modelling Output TON (mg/l)

Station		Dry Season Neap Tide		Dry Season Spring Tide		Wet Season Neap Tide		Wet Season Spring Tide	
		1996	SSDS	1996	SSDS	1996	SSDS	1996	SSDS
VM7	U.L. L.L	0.69(↓4) 0.70	0.73(~) 0.74	0.76(–) 0.77	0.65(↓15) 0.66	0.67(↓4) 0.68	0.52(↓37) 0.52	0.45(↑2) 0.44	0.47(↑7) 0.47
VX02	U.L L.L	0.51(↑10) 0.51	0.56(↑20) 0.56	0.47(↑17) 0.47	0.50(↑85) 0.50	0.48(↑4) 0.48	0.51(↑11) 0.51	0.39(↑5) 0.39	0.44(↑19) 0.44
WM3	U.L L.L	0.43(↑8) 0.42	0.44(↑10) 0.43	0.28(↑12) 0.26	0.31(↑24) 0.29	0.39(↓2) 0.34	0.43(↑8) 0.36	0.37(–) 0.36	0.40(↑8) 0.36

Table 4.9 Summary of Modelling Output CHL (mg/l)

Station		Dry Season Neap Tide		Dry Season Spring Tide		Wet Season Neap Tide		Wet Season Spring Tide	
		1996	SSDS	1996	SSDS	1996	SSDS	1996	SSDS
VM7	U.L. L.L	1.9(↓11) 1.9	2.0(↓6) 2.0	1.3(↓18) 1.3	1.7(↑6) 1.7	3.6(↑3x) 3.5	4.5(↑4x) 4.3	2.0(↓16) 1.9	2.0(↓16) 1.9
VX02	U.L L.L	2.0(↓2) 2.0	2.0(↑2) 2.0	1.4(↓11) 1.4	1.8(↑13) 1.8	3.8(↑46) 3.8	4.6(↑ ~3x) 4.6	1.9(↓7) 2.0	1.9(↓7) 2.0
WM3	U.L L.L	1.6(↓2) 1.6	1.6(↓4) 1.6	0.9(↓7) 0.9	1.0(↓1) 1.0	3.0(↑32) 2.5	3.4(↑72) 2.8	1.6(↓8) 1.4	1.6(↓9) 1.4

Table 4.10 Summary of Modelling Output SS (mg/l)

Station		Dry Season Neap Tide		Dry Season Spring Tide		Wet Season Neap Tide		Wet Season Spring Tide	
		1996	SSDS	1996	SSDS	1996	SSDS	1996	SSDS
VM7	U.L. L.L	5.9(↑27) 5.7	6.4(↑38) 6.2	5.8(↑20) 5.5	5.7(↑15) 5.4	13.5(↓22) 13.6	11.2(↓35) 11.2	12.8(↑8) 12.5	13.2(↑12) 12.8
VX02	U.L L.L	8.7(↑6) 8.6	9.5(↑17) 9.5	8.8(↓2) 8.8	9.6(↑6) 9.5	10.6(↓4) 10.6	10.9(~) 10.9	11.5(↑6) 11.5	12.3(↑14) 12.3
WM3	U.L L.L	11.5(↑4) 11.0	11.9(↑8) 11.4	13.9(↓3) 13.6	14.5(↑1) 14.1	8.7(↓8) 7.8	9.1(↓4) 7.9	11.3(↑3) 10.9	11.6(↑5) 11.0

Summary Tables : 4.5 to 4.10

Note : ( ) indicates % change from existing conditions

↑ indicate improvement in water quality wrt DO but a deterioration in water quality for all other parameters.

Analysis of these data indicate that although there is likely to be some improvement in water quality in Victoria Harbour, following the implementation of the Strategic Sewage Disposal Scheme, it is still possible that the WQO's for dissolved oxygen will not be achieved in the short term. At station WM3 there is very little difference between the 1996 and the SSDS scenarios, although compared to the existing situation a general decline in water quality is forecast.

In the vicinity of the outfall, water quality is predicted to deteriorate with significant increases in BOD, organic nitrogen and on the neap tide of the wet season chlorophyll-a. While these data cannot be directly extrapolated to determine conditions within the Naval Basin, it can be surmised that there will be a general decline in the quality of water in and around the facilities.

In summary within the Study Area, some significant changes in water quality are predicted over the next few years. As the evaluation of circulation and future water quality were not referenced to the same monitoring stations, and the velocity vector plots do not cover the eastern extremities of the Study Area, it is not possible to determine whether changes in water quality are due to specific alterations to the flow regime or simply to the reduction in pollution loading from individual point sources as a result of the SSDS Scheme.

Although the implementation of Stage II of the SSDS (the Ocean Outfall), will effect an improvement in water quality in the Study Area, in the short term effluent from the Stage I Outfall will probably migrate into the Naval Basin with consequential impacts on water quality.

Conditions under which diluted effluent discharged from the diffuser of the SSDS Stage I outfall could penetrate the Naval Basin are outlined in the following paragraphs. However it must be stressed that the issues involved are very complex, and the impacts can only be confirmed in conjunction with the specific application of more sophisticated evaluation tools such as mathematical models.

The diffuser section of the Stage I Outfall is located within the Western Dangerous Goods Anchorage with its axis oriented in a NE to SW direction. The NE tip of the diffuser is located in close proximity to the Northern Fairway and if a longitudinal line (W-E) is drawn from the NE tip of the diffuser towards Stonecutters Island it will intersect the southern peninsula at about 100m to the north of the tip of the peninsula, as illustrated on Figure 4.5.

Ingress of diluted effluent from the diffuser to the Naval Basin is essentially through two mechanisms which apply both to well mixed (homogenous) and stratified receiving waters. The first of these relates to the lateral spreading of the effluent (referred to as the wastefield) towards the entrance of the basin during the ebb tide; while the second relates to simultaneous advection of effluent discharged from the diffuser (during the preceding flood tide) along the Northern Fairway on the ebb tide.

In order to understand the mechanisms involved in the transfer of pollutants it is important to first consider the development of the wastefield produced by effluent discharged from a diffuser into a well mixed or stratified flow field. Effluent discharged from the diffuser will form a wastefield which will either rise to the surface of the sea when the water column is well mixed, or will stay submerged if the density gradient of the stratified layer is strong enough to counteract the buoyancy of the plume. Depending upon the strength and orientation of the current, the thickness and strength/intensity of the pycnocline, the magnitude of the diffuser discharge, the length of the diffuser and the depth of release it is possible for the buoyant plume to penetrate the pycnocline and rise to the sea surface.

The minimum initial dilution achieved at the sea surface or at the terminal rise height of a submerged wastefield, the thickness and the width of the wastefield and the average spatial initial dilution of the mixing zone depend on the relative magnitude of the variables given above. This issue of initial dilution and the extent of the mixing zone was the subject of mathematical modelling studies carried out for the Preliminary Design of the SSDS Stage I Outfall.

A preliminary analysis of the layout now proposed indicates that a portion of the wastefield derived from the Stage I outfall could penetrate the Naval Basin on the ebb tide during both spring and neap tides. When the tide turns, the wastefield generated on the ebb tide, which will be diluted, will be conveyed back towards the Naval Facility and could enter through the entrance shown on Figure 4.1 - 4.4.

Effluent discharged from the diffuser during the flood tide will form a wastefield which will initially be advected in a northerly direction during which time effluent will be dispersed and diluted. Part of the wastefield, having drifted in the waters around Tsing Yi, will be conveyed by the subsequent ebb tide back into the Northern Fairway and will flow in the eastern part of the Northern Fairway (which is very close to the west coast of Stonecutter Island). From the model results the flows appear to veer to the east and will follow the southern coastline of Stonecutters Island during both spring and neap tides of wet and dry seasons. The alignment of the western seawall now proposed is expected to encourage effluent/flows to be drawn round the southern tip of the breakwater and penetrate the Naval Basin through the southern facing entrance.

It should be noted that this pollution load is likely to be a combination of the very dilute portion of the wastefield originating from previous flood tide, pollution and flotsam from the Rambler Channel in addition to part of the wastefield discharged on the ebb tide.

In the wet season the two layer flow regime is too complex to assess using the foregoing method and can only be addressed through the application of modelling techniques.

On the basis of the foregoing assessments, it could be surmised that efforts should be made to restrict the ingress of external flows of water to the Basin. While in theory this may appear to be a method to maintain water quality (thereby reducing the potential for eutrophic conditions to develop) within the Basin in practice it will be critical to enhance and optimise water exchange between the waters within the Naval Basin and the main stream. This is discussed further in the following section.

Confirmatory modelling would be necessary to define the extent of ingression of pollution to the Naval Basin and will be required for the detailed design of openings with the aim of promoting adequate flushing of pollutants from within of the Naval Basin to maintain water quality.

4.15 Hinterland Drainage

The following facilities could generate liquid effluent and thus have the potential to affect future water quality within the basin:

- administration building;
- medical facilities (clinic and patient ward);
- military accommodation;

- military canteen;
- pier lavatories;
- vessels repair workshop;
- oil depot and working room;
- workshop; and
- inflammable store.

Effluent sources from the administration building, military accommodation, pier lavatories, and canteen relate to toilet and washroom wastewater and kitchen wastes both solid and liquid. Pollution loadings have been estimated on the basis of information provided as follows:

- onshore permanent staff 230 persons (residential);
- local daily staff 60 persons (employed); and
- staff on board vessels 320 persons (residential).

Estimates of effluent flow rates and pollution loads generated by the aforementioned personnel the rapid assessment flow factors provided in the Sewage Strategy Study, 1989, have been adopted (Table 4.11 refers).

Table 4.11 Residential and Employed Contributions to the Effluent Budget

Parameter [Factor]	Residential (230 capital)	Daily Employed (60 capita)	Personnel On-board (320 capita)	Total Effluent Flow Rate or Pollution Load
Flow (m^3) [R = 0.21 E = 0.06]	48.3 m^3/day	3.6m^3/day	67.2 m^3/day	119m^3/day
Suspended solids (kg/d) [R = 0.040 E = 0.034]	9.2 kg/day	2.0 kg/day	12.8 kg/day (190 mg/l) [50 mg/l]	24 kg/day (202 mg/l) [900 mg/l]
BOD (kg/d) [R = 0.040 E = 0.034]	9.2 kg/day	2.0 kg/day	12.8 kg/day (190 mg/l) [50 mg/l]	24 kg/day (202 mg/l) [900 mg/l]
COD (kg/d) [R = 0.09 E = 0.07]	20.7 kg/day	4.2 kg/day	28.8 kg/day (190 mg/l) [50 mg/l]	53.7 kg/day (451 mg/l) [2,200 mg/l]
TKN (kg/d) [R = 0.0077 E = 0.0061]	1.8 kg/day	0.4 kg/day	2.5 kg/day (37 mg/l) [100 mg/l]	4.7 kg/day (40 mg/l) [200 mg/l]
NH_3 (kg/d) [R = 0.005 E = 0.004]	1.2 kg/day	0.2 kg/day	1.6 kg/day (24 mg/l)	3.0 kg/day (25 mg/l)
TTM (kg/d) [R = 0.00008 E = 0.00065]	0.02 kg/day	0.004 kg/day	0.03 kg/day (0.5 mg/l) [2 mg/l]	0.05 kg/day (0.04 mg/l) [8 mg/l]
E.coli (count/no.day) [R = 6.15E11 E = 4.92E11]	1.4E14	2.9E13	1.9E14 [5000 count/ 100ml]	3.4E14

Note 1 : [...mg/l] indicates the standard set in the TM. For the contribution of effluent from the personnel on-board both the pollution contribution and the standards (for inshore waters) have been included as separate components.

Note 2: [ ] denotes the rapid assessment factors from the Sewage Strategy Study (R = residential contribution, E = employed contribution)

Comparison of the data given in Table 4.11 above with the standards set in the TM indicates that the pollution loading from the combined sources of domestic effluent will comply with the standards set for effluent discharging into the foul sewer leading to Government Sewage Treatment Works.

The site layout makes provision for a sewage treatment works. No details are available regarding the anticipated level of treatment, whether or not this is a pumping station or whether the intention is to treat effluent and discharge it from an outfall dedicated to the Naval Facilities. However, in the TM it states that no new effluent will be permitted:

- in any typhoon shelter;
- in any marina; or
- within 100m of a seawater intake point

On this basis, effluent from the sewage treatment works would need to be conveyed round the eastern headland before being discharged through a new outfall, which would have to be so designed that there would be no risk of effluent being drawn into the Naval Basin. The fact that the Strategic Sewage Disposal Scheme, Stage I sewage treatment works located on Stonecutters Island will be commissioned in 1997, when this facility will also become operational, suggests that the most expedient method of treating the effluent arising on-site is to connect into the foul sewerage system and convey the effluent to the new SSDS Stage I STW for further treatment.

Furthermore, under the HKPSG no discharges of surface or foul drainage will be permitted to be made into the Naval Basin. Instead all liquid wastes should be discharged to foul sewers, with connections made to the Stonecutters Island Sewage the Treatment Works. All wastewaters arising on-site will be required to achieve the standards set in the Technical Memorandum on Standards for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters (TM) (WPCO Cap 358, S.21);

In order to achieve the standards set in Table 1 of the TM "Standards for effluents discharged into foul sewers leading into Government sewage treatment plants" it is likely that grease traps will need to be installed within the canteen drainage system. To ensure these facilities operate efficiently the grease traps will need to be frequently cleaned out and the waste material collected, contained and disposed of to landfill.

Details of the medical facilities to be provided are presently unavailable, and for this EIA it has been assumed these facilities will only cater for minor accidents and emergencies. Pollution loadings from these sources are highly specific and depend upon the type of situation being dealt with. It is therefore recommended that no chemical wastes, either liquid or semi-solid, shall be discharged to the foul sewer. Instead, all clinical wastes shall be containerised and disposed of taking account of current and future practices.

Potential pollution loads from the workshop maintenance areas or refuelling points will also depend upon the nature and extent of the activities being undertaken. Until such times as these are defined it is recommended that a series of pollution prevention measures are incorporated in the design of the facilities. It is recommended that:

- gratings and drainage traps should be provided around all working areas where liquids/oil or other fuels/bitumen or other potentially polluting materials are being used, to collect, contain and dispose of all liquid wastes;

- all spent fuels, bitumen, oils and greases should be cleaned and recycled, where practical, to minimise the potential pollution problems; and

- perimeter drains should be installed around the oil depot and working room (located to the NE of the site) and the vessels repair workshop, which should have oil traps installed in the drainage system and should be frequently cleaned out to maintain efficiency. Spent oil should be collected in containers and disposed of at the Chemical Waste Treatment Facility on Tsing Yi.

To prevent uncontrolled runoff from the land based activities into the Naval Basin it is recommended that additional perimeter drains are provided along the edges of all seawalls. These should have sediment and oil traps placed at frequent intervals and should be connected to the drainage system.

It is understood that petrol will be stored in specially designed underground facilities while oil storage tanks will be above ground. To prevent spillages into the Naval Basin, all fuelling systems should be required to be completely contained, and should include dedicated drainage collection systems and pollution control facilities. Bunding and separate drainage, collection and pretreatment systems should be provided around the above ground facilities, prior to discharge of wastewaters into the foul sewer.

All new buildings, including the accommodation and administration blocks, stores and canteens will be provided with foul sewerage. Ultimate disposal of this effluent could either be via a low point sump and connected back to the NW Kowloon treatment works (albeit a short term solution) or through the provision of a dedicated sewage treatment plant with marine discharge via a short outfall. The latter is not a favoured option for various reasons, including the following:

- the overall aim of the SSDS is to collect, pretreat and dispose of effluent through a single point rather than having many effluent point sources treated or otherwise, discharging into Victoria Harbour;

- the land requirements for the treatment works and outfall and the connecting sewerage could be substantial;

- discharge of effluent via the outfall would have to be external to the Naval Basin and would need detailed assessment to ensure no effluent could ingress the Basin at certain states of the tide; and

- the operation of any individual treatment plant is highly dependent upon the duty of care applied by the operators. It is unclear who would be responsible for ensuring effluent standards prescribed in the TM were achieved at this military facility.

As previously noted, details pertaining to the sewage treatment plant at Stonecutters Island, in layout L, are presently unavailable. It is assumed this will provide ship to shore connections and will connect to the main sewerage system for Stonecutters Island. It is recommended that the STW is used as a pumping station to convey effluent to the sewage treatment works provided under the SSDS Stage I Scheme.

Additional problems presently exist at Stonecutters Island with the septic tanks provided at the residential dwellings identified on Figure 2.3 (Sensitive Receivers). At present these facilities drain straight into the beaches and by implication will discharge into the Naval Basin unless connections are made to the foul sewerage system. Furthermore the height of the reclamation is such that, if the drains are permitted to remain, they will back up and cause blockages (as observed on the Northern Shore of Stonecutters Island under similar circumstances).

This issue can only be resolved through the provision of foul sewerage and by connecting this to the Sewage Treatment Works at Stonecutters Island (SSDS Stage 1). Provision of foul sewerage and the necessary connections should be able to be accommodated within the scheduled construction phase.

4.16 Daily Activities

Water quality within the Basin may be adversely affected by daily activities which could also have an adverse impact on local water external to the Basin. Causes for concern relate to the ship to shore transfer of effluent and the supply of fuel/oils to vessels from the shore. While it is recognised that there may be some minor spillages incurred during the transfer of flammable materials, it should be noted that safety and financial considerations usually prevail.

Under the MARPOL Convention, vessels are not permitted to discharge effluent while in port, although this can be very difficult to enforce. Provision of ship to shore pump out facilities will be provided at all new berths. As previously mentioned it is recommended that effluent is collected and conveyed to the Stonecutters Island Sewage Treatment Works for treatment and disposal via the Stage I Outfall. Many of the ships moored in the Naval Basin, either on a short or long term basis, are not expected to be equipped with pump out facilities or connections thereby creating an additional pollution problem. Once underway (and 3km from port) effluent is usually discharged directly to the sea.

It is recognised that some of the older ships which may use these Facilities may not have ship to shore pumping out facilities for the on-shore treatment and ultimate disposal of effluent, and it is difficult to retrofit such facilities. It is possible that some of the newer vessels may have holding tanks on board, however the actual extent of such facilities on Chinese Naval Vessels, or indeed the type of vessels which will call into port are uncertain.

The water body within the Naval Basin could thus receive a pollution load from vessels berthed within which could exert potentially significant oxygen demands on the confined receiving water body. The only practical solution to counteract this, is to optimise the water exchange rates to prevent a serious deterioration in the water quality both within and immediately outside the Naval Basin.

It should also be noted that the MARPOL Convention requires reception facilities at ports as well as harbours and naval facilities for oily wastes (MARPOL ANNEX 1), noxious liquids (MARPOL ANNEX 2) and solid wastes (MARPOL ANNEX 5). The

Naval Basin is expected to generate oily wastes (ballast, oil tank washing) and solid wastes not only from the land side facilities but also from the crews on the vessels, either in residence or those visiting for varying lengths of time estimated to be 320 at any given time.

Under the International Maritime Organisation (IMO 1988) it is recommended that comminutors for food wastes are provided on seagoing vessels for the preprocessing of such wastes, prior to discharge to sea. The majority of naval vessels calling into the proposed facilities are however unlikely to have such facilities on board. MARPOL reception facilities should therefore be adequately sized to accommodate solid wastes arising from visiting ships, those permanently stationed within the Naval Facility and from all land side activities.

In the preceeding paragraphs potential sources of pollution arising during day to day operations have been identified. It is worthy of note that an estimated 80% of hydrocarbons discharged to the marine environment are from day to day minor spillages and general land based activities, and levels even as low as 1μg/l can be harmful to marine life (cf WQO's and the Beneficial Uses for Victoria Harbour). Adverse impacts from tin based antifouling paints on the marine environment are well documented, and indeed in many countries use of such paints is restricted.

Chronic pollution of the marine environment may result in adverse effects on the variety of species found in the area of interest, long term changes in the marine ecosystem, sediment quality and a slow deterioration in overall water quality. While the effects of such chronic pollution may take a long time to be observed, and may indeed not appear as dramatic as acute and highly visible sources of pollution, they must be fully considered in the overall design of the Naval Basin, especially in terms of flushing out pollutants from within the confines of the Naval Basin.

4.17 Sedimentation

Estuaries such as the Pearl River Delta are influenced by a great number of complex interactions between the hydrodynamic regime and sediment load. Changes to the coastline or modifications to tidal regimes, even on a local scale, which may affect sediment transport and deposition patterns are well documented. An attempt has been made for the present Study to assess the potential implications of the reclamation in terms of local circulation patterns and relate these to potential implications on water quality and sediment deposition rates within the Naval Basin.

The data used in this assessment confirm the generally held principle that within the basin current velocities will be weaker than those at the entrance and immediately seaward of the entrance. Thus, once pollutants/sediments are conveyed into the basin on the flood tide, they will remain within until such times as they can be flushed out/resuspended or removed by mechanical means. Furthermore, from the analysis of the local circulation patterns it may be conjectured that sediment and the extraneous material could be conveyed into the embayment east of the Naval Facility due to the development of a vortex at Station 3.

Sediment deposition within the Naval Basin may be due to activities within the Basin or from external sources. Both internal and external sources need to be considered in terms of the potential implication on water quality, maintenance dredging requirements and disposal of spoil. Sources of sediment include for example, those conveyed by water ingressing the facilities, effluent loads as described above and chronic sources of pollution.

Sediment loads entering semi-enclosed basins similar to the proposed facilities can be approximated by relating the total volume of water exchanged per tidal cycle to the amount of sediment conveyed by that volume of water, on the basis that a portion of the sediment load will settle out under gravity. This needs further more detailed study before the frequency of maintenance dredging within the Basin can be determined. The frequency of maintenance would be approximately 1 in 5 to 10 years.

4.18 Modifications to the Design of Naval Basin

From the foregoing assessments the following key issues have been identified. They are, not in order of priority;

- the dimensions of the entrance to the Naval Facilities

  The dimension and the orientation of the entrance of the Naval Basin with respect to the principal tidal flows is fundamental in determining the future water quality (in addition to its primary function of operational requirements). It is essential to maintain and enhance the flow of water into and out of the Naval Basin to maintain internal water quality and to flush out pollutants.. The width and position of the entrance has now, however, been determined for operation reasons.

- Openings to encourage water exchange rates.

  Additional openings, allowing free surface flows (not culverts) are recommended to enhance circulation within the basin and encourage water exchange between the basin and main stream flows. This issue requires further consideration during the detail design but openings could, on the basis of preliminary assessments, be located on the eastern or southern seawall on condition that the primary function of the seawall (to provide berthing for vessels) and the Naval Basin (to provide protection from waves) is not compromised.

- external and internal sources of pollution

  Two fundamental mechanisms exist to protect water quality within the Naval basin. These are enhancing the flushing characteristics of the Basin and implementation of very stringent pollution controls.

4.19 Recommendations

On the basis of the foregoing the main recommendations of the study during construction are as follows:

- low impact dredging techniques should be adopted;
- the top 1m of marine deposits are considered to be contaminated (Class C) and should be dredged and disposed of according to the requirements of FMC;
- sediment losses to the water column should be minimised through adoption of low impact dredging methods;
- around any special works area, batching plant or fuel storage or maintenance areas, a dedicated drainage should be installed to collect and contain any spillages;

- a study of the drainage of the area will be required to define the extent of the problem relating to existing drains and sewers;
- the seawater intake at the south shore jetty should be reprovided as early as possible in the construction phase; and
- water quality monitoring will be required during the period when marine works are carried out.

For the operation of the Naval Basin it is recommended that:

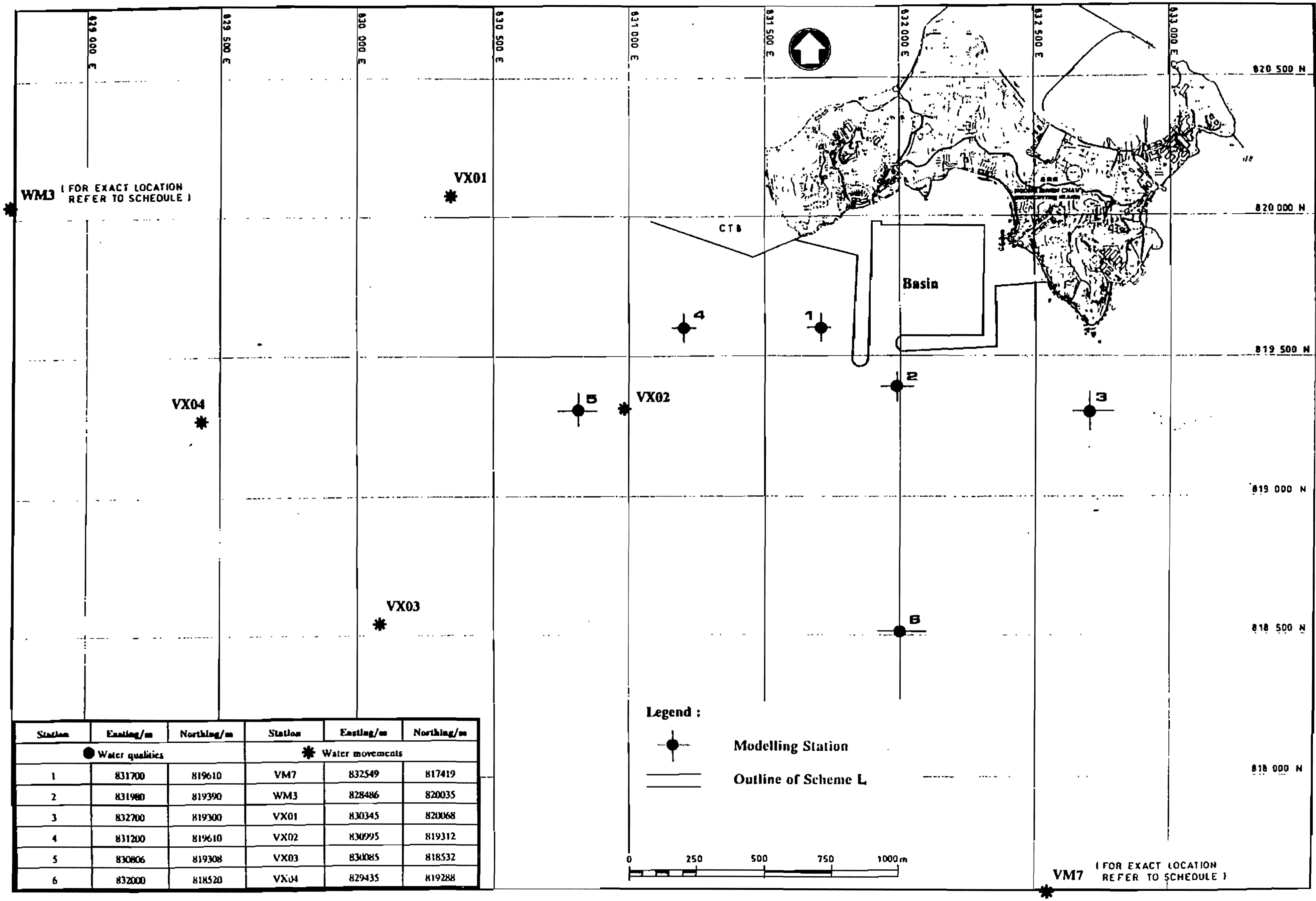
- for the protection of water quality within the Naval Basin, the water exchange rates should be maximised;
- in addition to the foregoing, stringent pollution control measures should be incorporated into the detailed design and include the provision of gratings and oil traps around areas where fuels or oil is stored or used, provision of ship to shore sewage pump out facilities and solid waste reception facilities;
- the sewage treatment plant identified in Scheme L should be used as a pumping station rather than a separate treatment works and a connection should be made, as early as possible, to the CT8 sewer.

4.20 Conclusions

From these preliminary assessments it may be concluded that :

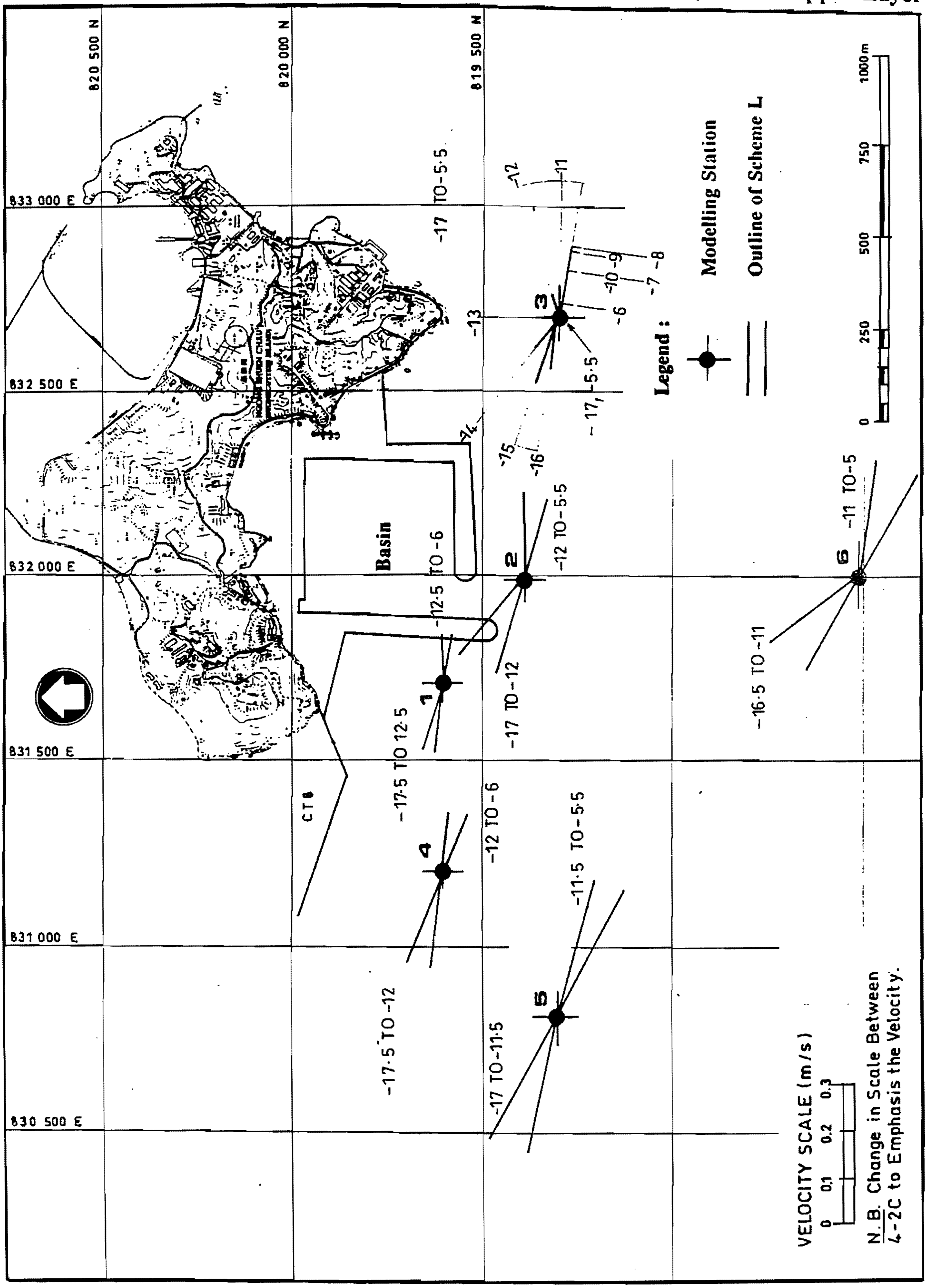
- dredging during construction is likely to have a significant impact on local water quality. Any marine life remaining in the Study Area (a haven for crustaceans and snails) will suffer the consequences of dredging;
- seawater intakes within the Study Area could be adversely impacted while dredging works are carried out;
- the south shore seawater intake needs to be reprovided early in the construction programme;
- the impacts of land and marine based construction activities should be controlled through the application of standard mitigation measures;
- reclamation and land formation will have an adverse impact on foul sewers, and any existing surface drainage as these will cease to function due to the lack of gradient;
- once operational the key issue will be to maintain water quality and prevent eutrophic conditions developing within the Basin;
- significant impacts on water quality within the Basin may result due to the nature, age and type of vessel using the facilities;
- in the next few years, the most significant source of external pollution will be generated by the Stage I outfall.
- optimising water exchange rates and application of stringent pollution control measures will be critical in maintaining water quality.

Figure 4.1
Location of Water Modelling Stations



Station	Easting/m	Northing/m	Station	Easting/m	Northing/m
● Water qualities			✱ Water movements		
1	831700	819610	VM7	832549	817419
2	831980	819390	WM3	828486	820035
3	832700	819300	VX01	830345	820068
4	831200	819610	VX02	830995	819312
5	830806	819308	VX03	830085	818532
6	832000	818520	VX04	829435	819288

Figure 4.2
Dry Season Neap Tide - Upper Layer



DATA FOR THE CONSTRUCTION OF FIGURES 4.3 and 4.4

Figure 4.3 and 4.4
Title : Flood and Ebb flow envelope : directional variation and peak values of tidal velocity during the Wet Season Spring Tide, Upper Layer
Legend : Time in hours, referring to HW at Stonecutters Island

WET season - SPRING tide - UPPER layer

STATION 1			STATION 2			STATION 3		
T	V	Φ	T	V	Φ	T	V	Φ
-18	0.		-18	0.		-18		
-17	0.07	276	-17	0.1	302	-17	0.05	288
-16	0.15	276	-16	0.17	295	-16	0.1	280
-15	0.16	276	-15	0.22	288	-15	0.14	280
-14	0.12	276	-14	0.17	295	-14	0.08	306
-13	0.05	273	-13	0.08	302	-13	0.03	33
-12	0.02	346	-12	0.03	360	-12	0.05	72
-11	0.02	72	-11	0.02	54	-11	0.05	90
-10	0.03	84	-10	0.04	84	-10	0.05	90
-9	0.05	96	-9	0.07	100	-9	0.06	100
-8	0.06	96	-8	0.09	100	-8	0.08	100
-7	0.05	96	-7	0.08	100	-7	0.07	100
-6	0.		-6	0.04	90	-6	0.03	96
STATION 4			**STATION 5**			**STATION 6**		
T	V	Φ	T	V	Φ	T	V	Φ
-18	0.		-18	0.				
-17	0.1	288	-17	0.1	294	-16.5	0.05	351
-16	0.19	288	-16	0.2	294	-16	0.07	324
-15	0.24	285	-15	0.31	294	-15	0.17	314
-14	0.2	285	-14	0.27	294	-14	0.2	314
-13	0.12	279	-13	0.16	288	-13	0.18	314
-12	0.05	288	-12	0.1	288	-12	0.13	316
-11	0.02	12	-11	0.04	298	-11	0.06	319
-10	0.03	90	-10	0.02	79	-10	0.03	336
-9	0.06	108	-9	0.07	119	-9	0.05	95
-8	0.08	105	-8	0.13	119	-8	0.09	105
-7	0.06	96	-7	0.13	114	-7	0.11	108
-6	0.03	78	-6	0.1	114	-6	0.09	95
-5.5	0.02	324	-5	0.		-5	0.03	54

LEGEND

T = time - in hours before predicted HW at Stonecutters
V = current velocity in (m/s)
Φ = current direction : **degrees from North, clockwise**

Figure 4.3
Wet Season Spring Tide - Upper Layer

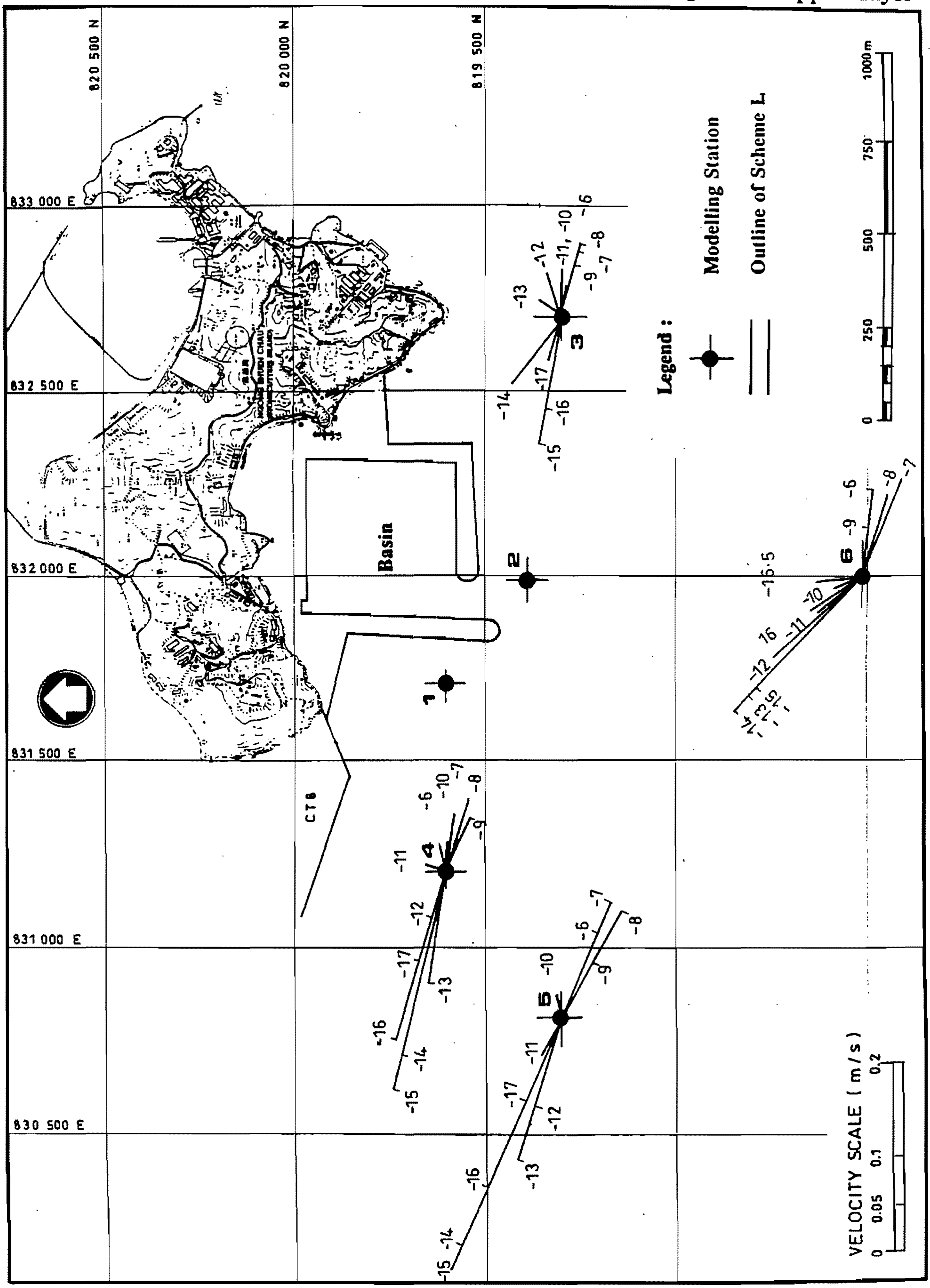


Figure 4.4
Wet Season Spring Tide - Upper Layer

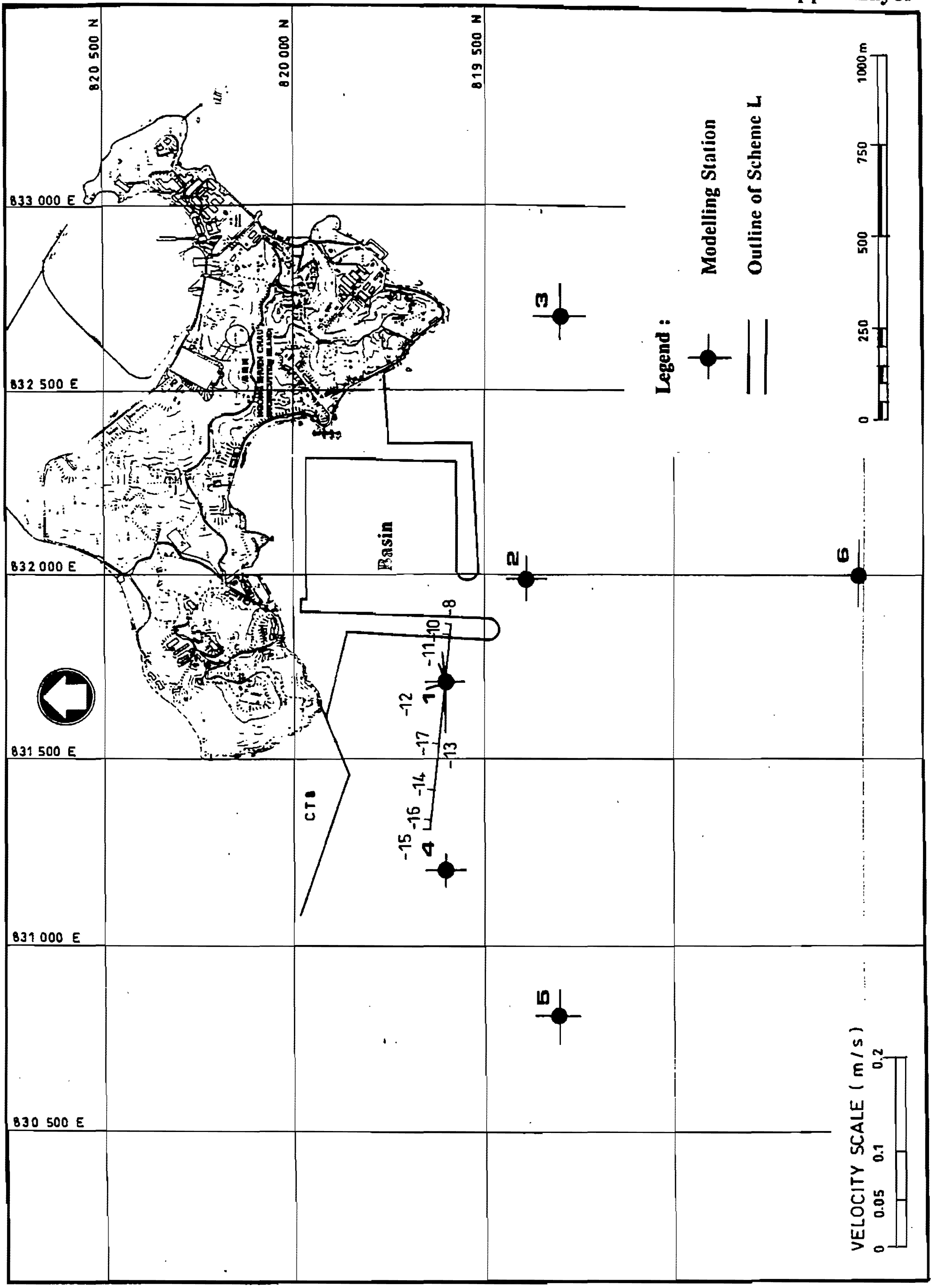


Figure 4.4
Wet Season Spring Tide - Upper Layer
(Cont'd)

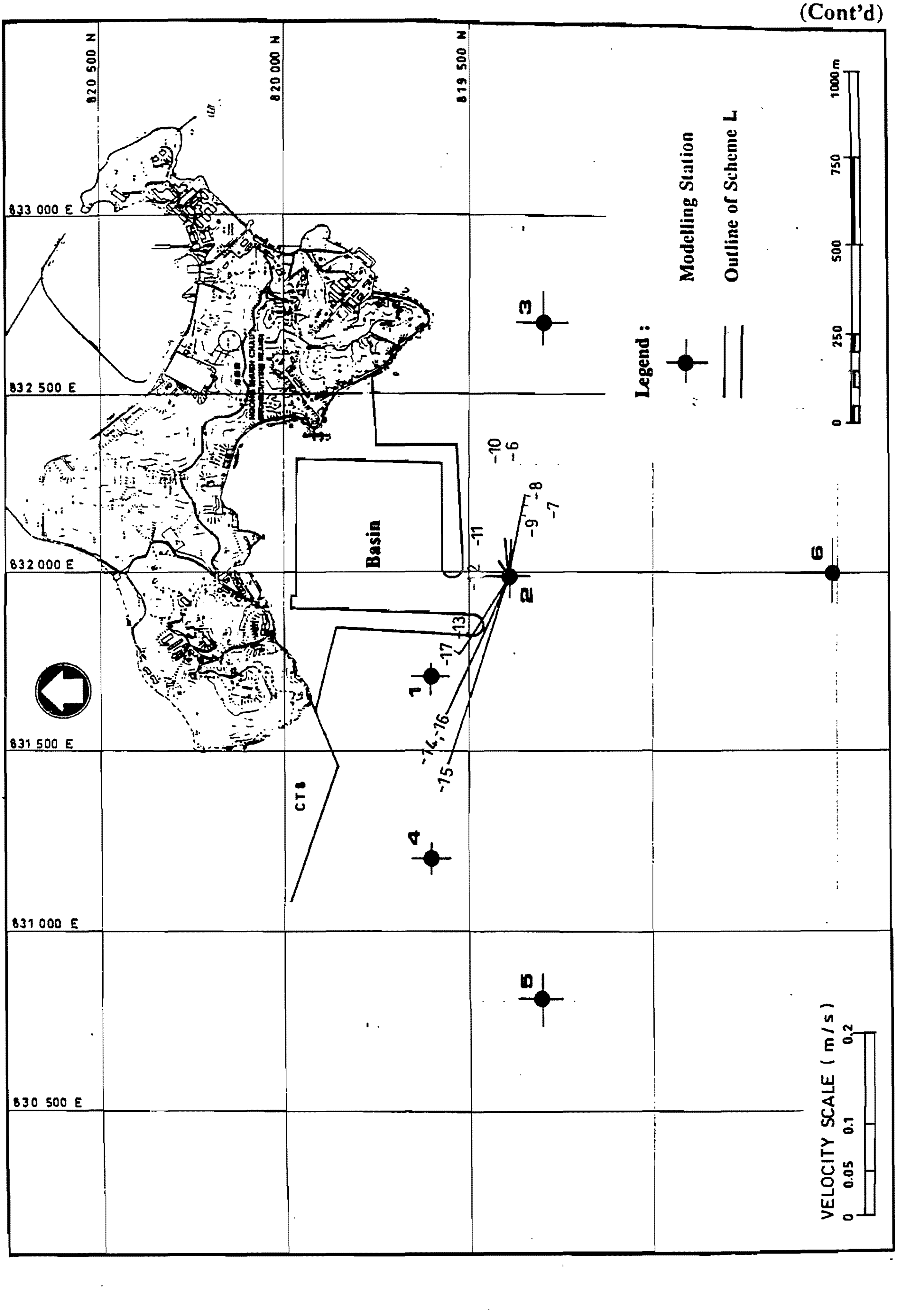
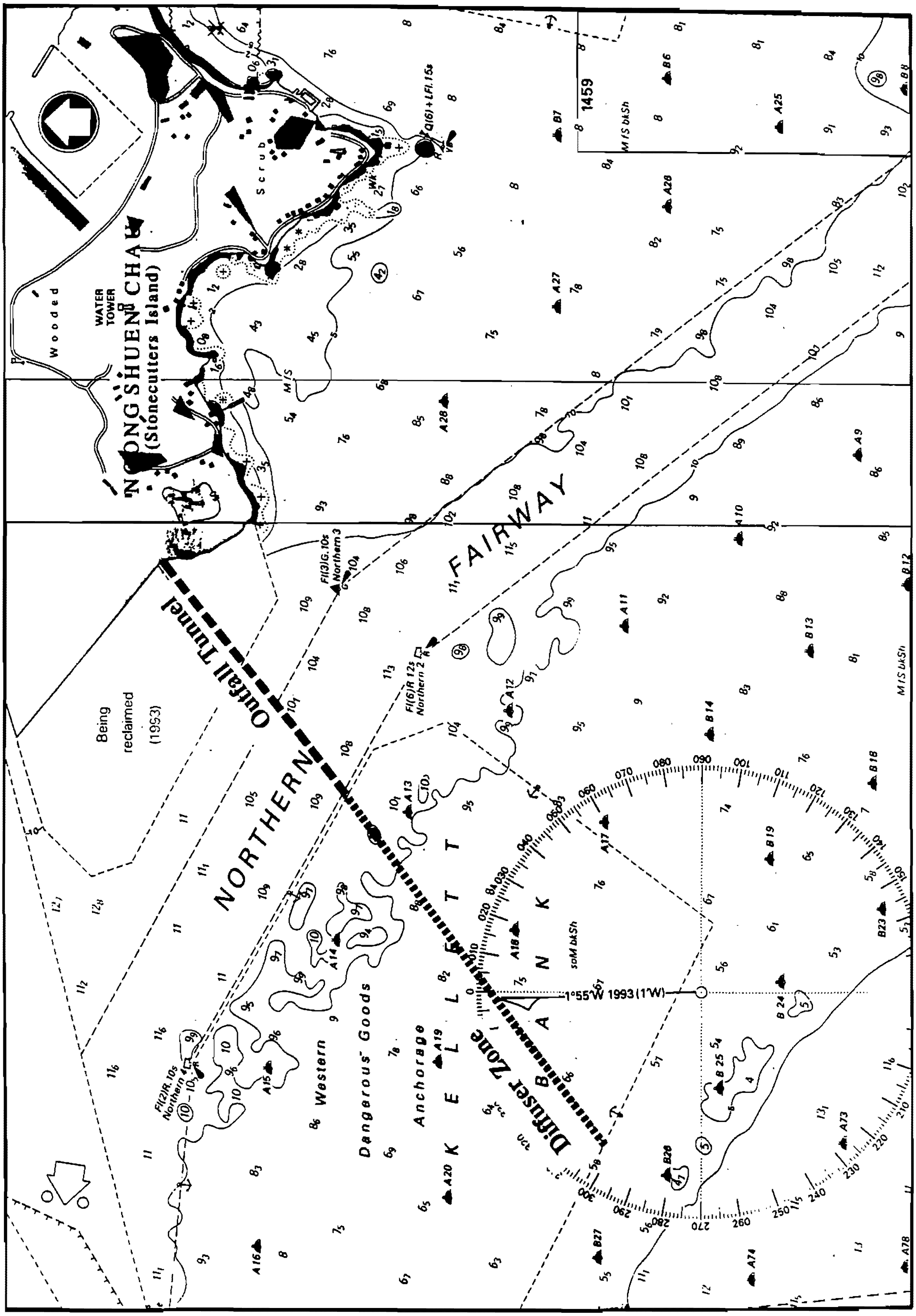


Figure 4.5
Diffuser Zone and Outfall Tunnel



5. MARINE OPERATIONS

5. MARINE OPERATIONS

5.1 Harbour Mooring Buoys Adjacent to the Proposed Naval Base

The Marine Department maintains and operates a number of mooring buoys for ocean-going ships in the harbour. The majority of the buoys (Class A) are designed to accommodate ships up to 183m in length and the remainder (Class B) are for use by vessels up to 137m in length. A number of the moorings are classified as special typhoon buoys. The actual number is subject to change depending, for example, on the progress of the annual maintenance programme, but the average is about 50.

Ships secure to harbour moorings by means of their anchor cable, i.e. the end of the anchor cable is shackled to the upper end of the stud link cable that passes through the centre of the buoy.

The distance between the mooring buoys in Hong Kong is 427m in the case of Class A and 305m in the case of Class B. The nearest harbour mooring to the proposed site of the Naval Base is buoy A-28, which is situated approximately 180m to the south of what would be the southern breakwater. It would therefore be necessary for buoy A-28 to be relocated before construction work started on the proposed Naval Base breakwaters.

The next nearest buoy, A-27, is about 500m from the proposed site. Under normal weather conditions and allowing for the length of the ship's anchor cable secured to the buoy, the stern of a vessel of 180m in length would be approximately 313m from the proposed breakwater during flood tide. During adverse weather conditions it is prudent, in the event of strong winds affecting the port, for a ship's anchor cable to be veered (slackened off) until a reasonable catenary is affected in the chain cable. The length of cable necessary to achieve this purpose has to be left to the discretion of the shipmaster as the length, draught and trim of the ship must be taken into account when making a decision on this point. However, experience over the years has indicated that for the average ocean-going cargo vessel, at least 55m of cable is required in the majority of cases. Under these circumstances, it is highly likely that the stern of a 180m ship secured to buoy A-27 would be about 260m from the proposed breakwater during a southeasterly gale. This is ample clearance and should present no problems.

The "Northern 3" light buoy, situated some 400m off the southwest coast of Stonecutters Island and marking the eastern side of the Northern Fairway is about 210m to the west, and clear of the proposed entrance to the Naval Base. However, note comments in Section 5.3.2 (Sea Access)

5.2 Exposure of the Site to Wind and Seas

The typical wind regime in Hong Kong is dominated by the northeast monsoon in winter and the southwest monsoon in summer. Northeast monsoon winds (and, more rarely, southwest monsoon winds) can exceed 21 knots near sea level anywhere in Hong Kong. These winds may sometimes reach 35 knots or even 40 knots in very exposed locations.

Wind speeds and directions are measured by the Royal Observatory at various Meterological Stations including Cheung Chau, which is the station most exposed to winds from 90° through South to 270° which correspond to the important directions at SW Stonecutters Island. Wind directions outside these sectors are unlikely to have any significant influence on conditions at the proposed Naval Base location.

Records are available from Cheung Chau for the period January 1968 to December 1988. These consist of tabulated one-hour duration wind speeds totalling over 180,000 observations. Figure 5.1 shows annual wind roses, obtained from Royal Observatory records, from which it can be seen that the winds at Cheung Chau are mainly from the north, the east and the southeast.

On average, five or six tropical cyclones threaten Hong Kong each year, necessitating the hoisting of the Typhoon Standby Signal Number 1. Gales due to tropical cyclones have affected Hong Kong as early as 19th May and as late as 25th November. About once in every five years the centre of a typhoon passes sufficiently close to cause winds of hurricane force.

The majority of tropical cyclones which affect Hong Kong approach from the east-southeast. When a tropical cyclone is approaching from this direction, the wind in Hong Kong sets in from the north or north-west and increases in strength. The wind rarely strengthens steadily and, when the rains begins, violent squalls can be expected.

If the centre of the tropical cyclone passes to the south of Hong Kong, the wind will veer from its northern direction through east to southeast or south. In these circumstances, Hong Kong Island provides some protection to Victoria Harbour but the Western Anchorage remains exposed. If the centre of the cyclone passes to the north of Hong Kong, the wind will back and the western part of Victoria Harbour, including the southern part of Stonecutters Island, will become exposed to wind and seas from the west and southwest.

If Hong Kong lies in the track of the centre, the wind will neither veer nor back appreciably as it increases. When the "eye" of a developed tropical cyclone passes, winds fall off very rapidly within the "eye". This lull may last for a few minutes or for several hours, depending upon the shape and size of the "eye" and its speed of movement. After the lull there is a sudden resumption of destructive winds from a different direction and it is at this time that facilities in the western harbour are at their most vulnerable.

In the circumstances described above the proposed site of the Naval Base is relatively sheltered from the west by Lantau Island, from the north by Stonecutters Island and the mainland, from the east by the Kowloon peninsula and from the southeast by Hong Kong Island. The site is very exposed to wind and seas from the south and southwest, particularly within the arc 197° to 215° where the fetch extends directly into the South China Sea. These winds, according to Royal Observatory records, occur for approximately 8% of the time in the average year (i.e. about 29 days).

Experience of relatively recent typhoons has shown that the severest damage to shipping and port facilities has resulted from hurricane force southwesterly winds (e.g. typhoons "Wanda" in 1962, "Rose" in 1971, "Hope" in 1979 and "Ellen" in 1983).

The general requirement for a typhoon shelter for relatively small craft is protection from winds in the northeast to east quadrant because this is the predominant sector for strong typhoon winds in Hong Kong. A secondary sector of strong winds is from the southwest. As indicated above while cyclonic winds from this direction can be of destructive hurricane force, they tend to be of relatively shorter duration.

5.3 The Naval Base

5.3.1 Dredging

It is envisaged that the Naval Base will accommodate, on a regular basis, about five coastal patrol craft, each of 50m in length with a draught of 3m, and a number of smaller operational vessels such as tenders, speed boats and, perhaps fuelling barges. The vessels will lie alongside the seawalls, secure to marina-type berths or be lifted ashore by means of ship hoists.

The types of ship which will routinely use the Naval Base are not yet known. However, the basin is specified as being capable of handling visiting ships up to 250m in length and 8m draught (hence the basin depth of 9m) although the support facilities are not geared to full support of such ships. The most likely mix is a number of 50m fast patrol craft, support vessels and one or sometimes two frigates up to 90 to 130m in length, draught 3.5 to 5m, displacement 1500 to 330 tons. However, it must be stressed that this is an engineering assumption rather than established policy; the future usage is not yet known.

According to Admiralty Chart No. 3280, and if the configuration of the Base is as shown on Scheme L, fairly extensive dredging will be required both in the approaches to and within the Basin itself to obtain the required depth of water.

5.3.2 Sea Access

Under normal conditions vessels would enter the Basin bow-first. The size of the proposed Basin is such that there would be plenty of space for the coastal patrol vessels and the occasional 1,500 ton ship to swing around so as to enable them to leave the Basin bow-first. This would give them complete manoeuvrability when negotiating the entrance to the Base. The occasional visiting large ship would invariably secure alongside the western breakwater arm. The vessel would enter the Basin bow-first and leave stern-first. This is a simple straightforward manoeuvre, giving no cause for concern.

Having regard to the relatively exposed location of the proposed site, the alignment of the entrance to the Base is of importance.

The 100m wide entrance to the Basin is situated on the southern side of the complex and vessels would enter and clear in a north/south direction, giving them direct access to the Northern Fairway. The vessels would not interfere with ships working cargo at buoys. In the case of the occasional large visiting ship a possible conflict could arise with a vessel working cargo at buoy A-27, and during these periods it would probably be necessary to leave buoy A-27 vacant while the visiting large warship was negotiating the entrance to the Base. In any case, it would be necessary for the warship and/or Naval Base to maintain contact with the Marine Department's Port Communications Centre to ensure that the Northern Fairway was clear of marine traffic before the warship backed out into the Channel. Again, this is routine procedure.

Perusal of the wind roses in Figure 5.1 reveals that an entrance on the western side of the Basin would be preferable during adverse weather conditions, as this would provide the best possible protection from winds and seas.

However, an entrance on the southern side of the Basin would also be acceptable subject to the following reservations:

- vessels approaching from the north (probably, the most frequent direction) would have to make a difficult 180 degree turn to gain access to the Basin;
- a swell rolling in from the south would create very confused sea conditions in the entrance to the Basin. This could make conditions difficult for small craft negotiating the entrance; and
- as indicated by the wind roses in Figure 5.1, wind from the southeast are particularly prevalent. They would blow directly across the entrance to the Basin and, during typhoon conditions, this could be serious.

On balance, therefore, and from a purely marine operational point of view, the configuration with an entrance opening towards the west would be favoured, because:

- vessels entering and leaving the basin would have immediate and direct access to the Northern Fairway without having to undergo potentially dangerous and time-consuming manoeuvres;
- the east/west entrance alignment would provide the best all-weather protection to vessels in the basin;
- less dredging would be required to attain the depth of water necessary to accommodate the largest vessel likely to use the facility;
- vessels would enter and clear the basin without endangering other ships in the vicinity. This is important because for obvious reasons the movements of warships should not be allowed to interfere with commercial cargo-working activities;
- in the case of both configurations, it would be necessary to relocate mooring buoy A-28;
- the fact that "Northern 3" lightbuoy may have to be relocated would be a relatively minor consideration; and
- finally, this is the configuration favoured by the Director of Marine.

If for some other practical reason the westward facing entrance is ruled out, a southern facing entrance would be acceptable from a Marine Operational. The proposed Naval Basin assessed in this report is the operators preference and will be south facing.

5.4 Functions of a Naval Base

The principal function of a small Naval Base such as that proposed for South Stonecutters is military support for the Civil Power.

Actual day-to-day activities within the Base include such activities are search and rescue, the training of personnel, the repair and maintenance of equipment and general security duties. Of these, probably the most important activity is search and rescue.

Elements of naval units are always fully operational and capable of responding to an emergency at short notice, with the necessary equipment and expertise. It follows therefore that naval craft must be able to leave their Base quickly and without hinderance. This is one of the reasons why, in typhoon conditions in Hong Kong, naval units from HMS Tamar always secure to typhoon moorings outside their Base. As soon as weather conditions permit, they are able to slip from their moorings and respond to any search and/or rescue situation, often long before Marine Police and other civil units can extract themselves from typhoon shelters (Marine police launches are too small and vulnerable to secure to typhoon berths in the open harbour). There is no reason to believe that a Naval Base situated off South Stonecutters would not function in exactly the same way.

5.5 Oil Spillage

Probably the most important environmental impact from a marine operational point of view would be a spillage of oil during the refuelling of a vessel within the Naval Base.

The means of containing and dealing with a spillage or land within the Base are considered elsewhere in this Assessment. This section of the report deals with a typical incident arising from the overflow from a fuel tank on board a vessel, or the rupture of a fuel pipeline, such that oil flows over the side of the ship into the water within the basin. There are no structural means of preventing such an accident.

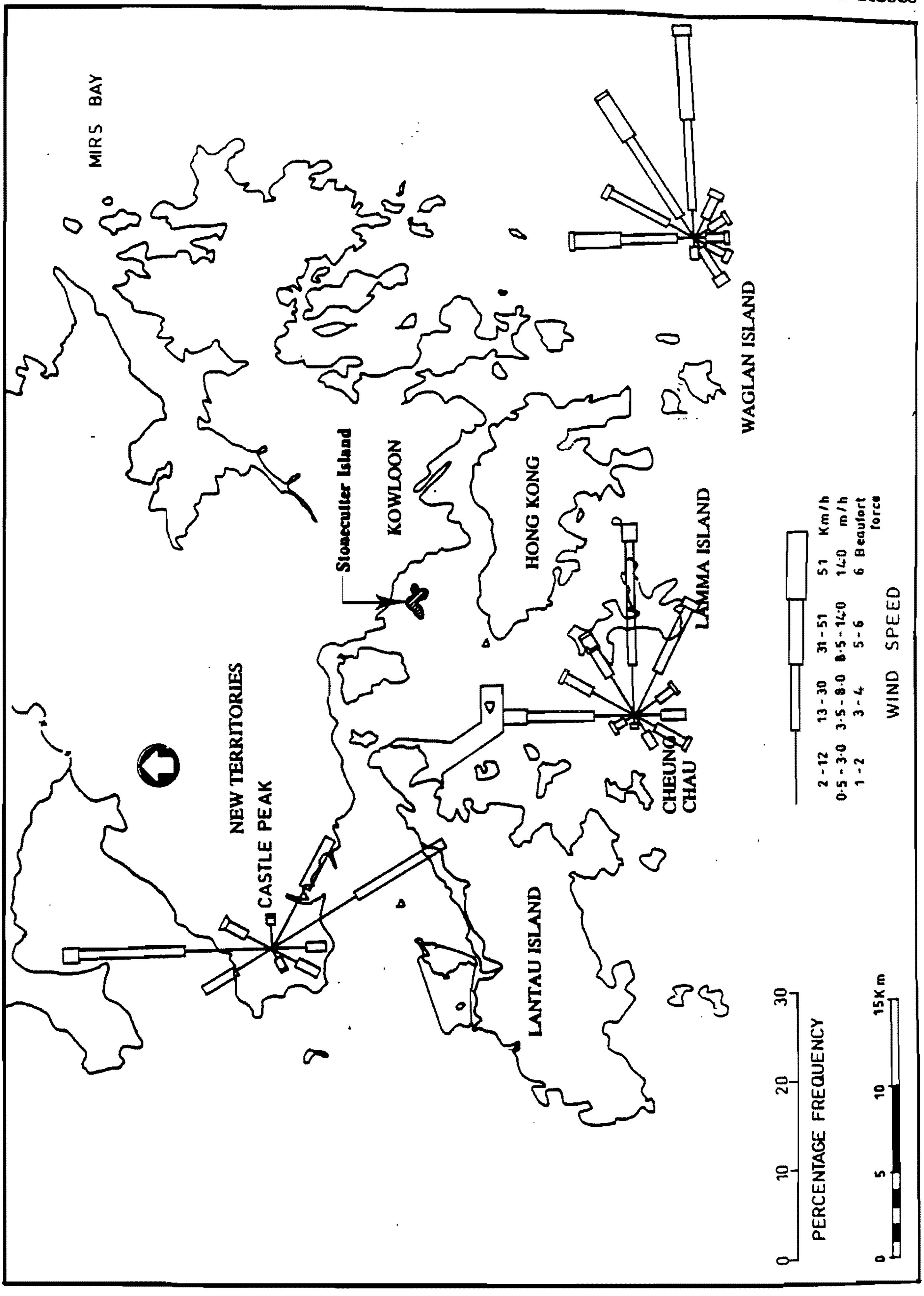
It is normal practice when refuelling a ship for all scuppers to be blocked so that, in theory, any spillage is contained within the vessel. In cases of serious spillage this precaution is not always sufficient to prevent oil escaping over the side of the vessel.

In the event of such an incident the immediate action must be to prevent the spillage from escaping from the basin into the waters of the harbour. This could be achieved by sealing off the entrance to the basin, and any culverts in the seawalls, by means of oil containment booms. Once contained, the spillage can be removed from the water by means of skimmers and/or absorbent materials, depending upon the severity of the problem.

It is stressed, therefore, that oil containment booms must be in the water and ready for deployment whenever a refuelling operation is taking place,

In the event of a major spillage escaping from the basin into the harbour, the Marine Department's Oil Contingency Plans would be put into immediate effect.

Figure 5.1
Annual Wind Roses



6. ECOLOGY

6. ECOLOGY

6.1 Introduction

Stonecutters' Island is well known as an important ecological resource in Hong Kong's Victoria Harbour. The ecology of Stonecutters' Island has been the subject of numerous documentary films prepared for television broadcast by the British Broadcasting Corporation and others (Illingworth pers. comm.). These focused on the bird life of the Island, in particular the roosting and feeding population of black kites (*Milvus migrans*). Although the Island's ecology was known to television audiences around the world, it was not accessible to local scientists for study until the early 1990s, due to the Island's use for high-security military operations.

During the 40 years following World War II the ecology of the Island was not greatly affected by human intervention. The primary impact of the surrounding urban development was use of the Island as a military base. The result of military security was conservation of natural resources rather than exploitation. However, beginning in the late 1980s Hong Kong developments began to encroach on the Island.

Potential impacts of a development in the bay on the northeast of the Island were assessed in Mott-MacDonald (1993). That document addressed impacts due to conversion of shore into a dockyard and port facility. The report identified potential impacts to locally breeding herons and egrets as a key issue.

Earlier development of container terminal 8 (CT8) on the north side of the Island joined the Island to the mainland in autumn 1992. Although the impacts of the project on the ecology of Stonecutters' Island were not documented, substantial areas of coastal habitat were lost. Night herons (*Nycticorax nycticorax*) were known to nest on the north shore of the Island prior to construction of CT8, but to have abandoned that area for a more central location after construction began.

The currently proposed South Shore Naval Facility (hereafter referred to as the "Project") would result in conversion of additional coastal habitats, leaving only the southeast coast of the Island unaffected by development. The purpose of this ecological assessment is to describe the potential direct, indirect, and cumulative impacts of the proposed Project on ecological resources of the Island, and to propose impact avoidance or mitigation measures to avoid or reduce net ecological impacts.

6.1.1 Assessment Methods

In addition to the literature review, field surveys were made on 31 May and 8 June 1994 by coastal, marine, and terrestrial biologists. Ornithological study with special emphasis on night herons was conducted in July 1993, February to April 1994, and 23 May 1994. The latter survey was timed to coincide with the peak period of activity of breeding birds on the Island. Interviews were conducted with a local birdwatcher living on the Island to describe the avifauna of the Island during the non-breeding season.

6.1.2 Description of Stonecutters' Island

Section 2.1 of this report describes the Island in general terms. In ecological terms the loss of coastal habitats due to successive construction projects on the north and northeast shores has been important to the natural resources on the Island. Such losses may have resulted in abandonment of the Island by some birds (Section 6.5.2).

In addition to the 1.0 km of shore line which was lost for construction of CT8 (400 m) and the Kowloon primary sewage treatment facility (600 m), 850 m of the northeast shore line were reclaimed for construction of Hong Kong government dockyards in 1993-1994. CT8 expansion will require conversion of the remaining natural shoreline on the north and west sides of the Island (Figure 2.2). The proposed Project would result in loss of approximately 1.4 km of the southwest coast, leaving about 2.5 km of coastline on the northeast and southeast of the Island in a largely natural condition.

The remaining unaffected portion of the coastline lies in an area which has been developed over time for military facilities including residences, roads, and munitions storage facilities. Therefore, much of the coastline is no longer in a natural condition, but has been modified to accommodate the construction projects. Development has affected the intertidal zone much less that it has the inland habitats which were cleared for facilities construction.

The most unusual ecological feature of the inland habitats on the Island is that they have been protected from wild fire for over 45 years (Illingworth, pers. comm.). The impact of fire protection on woodland community composition was briefly discussed by Williams (19[illegible]). Significantly, the woodlands in 1991 were dominated by native species which often formed a closed canopy. Fruit-bearing trees (mainly figs) were well represented, providing an important forage source plus nesting and escape cover for a variety of wildlife. The grassland-fernland-shrubland fire climax plant communities, common throughout portions of Hong Kong which suffer frequent wildfire, were absent on Stonecutters' Island. One benefit of maturation of the forest canopy has been development of an abundant and diverse bird community on the Island, as described below.

6.2 Intertidal Ecology

6.2.1 Existing Environment

Beginning in 1991 Stonecutters' Island was accessible to ecologists from outside the military operations on the Island. No records referring specifically to Stonecutters' Island were located in the scientific literature for Hong Kong prior to that time. An ecological survey was conducted on the Island on 29 April 1991 by Hong Kong University (Williams 1991; Appendix H). The survey reported 11 forms of marine plant life and 59 taxa of marine animals.

The marine and intertidal ecology of Hong Kong has been documented by others (Hodgkiss and Lee 1981 and 1983; Morton and Morton 1983; Tseng 1984; Ho 1986; and Ho 1992). Taken together with the findings of Williams (1991), the littoral ecology of Stonecutters' Island can be generally described.

There were two main shore types within the study area; open sand beach and boulders/rocky outcrops. Man-made habitats such as wharf pilings and seawalls were also present. Like many coastal habitats in Hong Kong, the shoreline was heavily littered with rubbish.

6.2.2 Intertidal Algae

The first report of the intertidal macroalgae of Stonecutters' Island is that of Ho (1992). This report was generated from the Hong Kong University survey of the Island in April 1991. Ho reported 13 species of macroalgae, including five greens (Chlorophycean algae) and eight reds (Rhodophycean algae). Five of these were new records for Victoria Harbour. The new records included *Enteromorpha crinita*, *Amphiroa ephedraea*, *Bangia fusco-purpurea*, *Corallina sessilis* and *Gelidiopsis variabilis*. The complete macroalgal list is as follows:

- Chlorophyta
  **Enteromorpha crinita* (Roth) J. Ag.
  Enteromorpha flexuosa (Wulf.) J. Ag.
  Ulva conglobata Kjellm
  Ulva fasciata Delile
  Ulva lactuca L.

- Rhodophyta
  **Amphiroa ephedraea* Decaisne
  **Bangia fusco-purpurea* (Dillw.) Lyngb.
  Caulacanthus okamurai Yamada
  Corallina pilulifera Postels et Ruprecht
  **Corallina sessilis* Yendo
  **Gelidiopsis variabilis* (Grev.) Schmitz
  Gelidium divaricatum Martens
  Gloiopeltis tenax (Turn.) J. Ag.

  * = New record for Victoria Harbour

6.2.3 Patterns in the Macroalgae

All five species of green algae recorded belonged to the family Ulvaceae. Members of this family are known for their ability to thrive under eutrophic conditions and to cope with moderate levels of industrial pollution (Ho, 1992).

Members of the brown algae (Phaeophyta) are notably absent from the above list. The absence of brown algae from Stonecutters' Island has been linked to the deterioration of water quality within Victoria Harbour over recent decades (Ho 1986, 1992).

Despite the poor quality of coastal waters around Stonecutters' Island, the intertidal flora is relatively rich in comparison to other parts of Victoria Harbour in recent years (Ho 1986). Two factors are considered to be important in this context:

Restricted access status of Stonecutters' Island as a closed military facility most of the shoreline remained natural and not reclaimed, and provided a variety of substrates and microhabitats suitable for colonisation by algae.

Since 1991, however, much of the coastal habitat has been altered by reclamation for various development projects. Linkage with the Kowloon peninsula and the West Kowloon reclamation projects may have also resulted in changes to coastal ecology.

6.2.4 Intertidal Macroinvertebrates and Vertebrates

Williams (1991) identified some 50 species of macroinvertebrates in the intertidal zone of Stonecutters' Island (Appendix H). These represented the following taxa:

Coelenterata	:	1 identified, 3 unidentified
Ectoprocta	:	1 identified, 2 unidentified
Sipuncula	:	1 identified
Annelida	:	1 identified
Mollusca	:	31 identified
Arthropoda (primarily crabs)	:	16 identified
Chordata (vertebrates)	:	2 identified

No unique species were reported by Williams (1991), and the intertidal fauna was representative of Hong Kong waters generally (Williams pers. comm.). Some of the intertidal molluscan species were, however, unusually large. This was thought to be a result of algal abundance with enhanced feeding opportunities for herbivorous intertidal molluscs (Williams, 1994).

6.3 Terrestrial Habitats

Williams (1991) reported 131 species of terrestrial plants on the Island, none of which was rare or endangered. He noted that the Island "was undoubtedly completely deforested in the past" but had nearly complete protection from fire since World War II.

Terrestrial habitats in the proposed disturbance area were coastal woodland and scrubland plus small areas of ornamental plantings near recreational facilities. Trees dominating the native habitats were *Ficus microcarpa*, *Macaranga tanarius*, *Pandanus tectorius*, and *Hibiscus tiliaceus*. Virtually all of the vegetative cover at the shoreline was located inland of existing facilities (roads, recreation facilities, or seawalls), therefore was not within the proposed disturbance area. Exceptions are pointed out in Section 9 of this report. Because the native vegetation on the site would remain virtually intact during construction and operation of the Project, it was not identified as a key issue warranting further study.

6.4 Amphibians, Reptiles, Mammals

Williams (1991) reported occurrence of 4 reptiles, 2 amphibians, and 3 mammals on the Island (Appendix H). All three mammals were bats, all species of which are protected under the Wild Animals Protection Ordinance (CAP 170). The reptiles and amphibians reported are not protected.

The proposed Project would not disturb terrestrial habitats occupied by any of the above reptiles, amphibians, or mammals. Therefore, potential impacts to these groups were not identified as a key issue warranting further study or comment.

It is likely that bats would feed on insects above the sea surface in the proposed disturbance area, but potential impacts of the project on the prey base of insectivorous bats is considered to be insignificant. Frugivorous bats were seen on the Island, but neither their roost sites nor feeding areas would be affected by the Project.

6.5 Avifauna

The Project requires an assessment of its effects on avifauna, and, in particular, on the Night Heron (*Nycticorax nycticorax*). Potential impacts to the night heron must be assessed because the breeding population of night herons on the Island is locally significant, and because night herons feed on marine organisms in the intertidal zone of the Island which will be disturbed by Project construction.

6.5.1 Existing Avifauna

Williams (1991) reported 25 species of birds during a one-day survey of the Island (Appendix H). This list was supplemented by additional records during 1993 and 1994, as shown in Appendix H.

All of these bird species may be affected by Project construction. However, there is a precedent on the Island for assessment of impacts of large construction projects on important bird habitats. Continued presence of birds alongside the government dockyard development on the north of the Island suggests that impacts may not be as serious as predicted, or may be realised more slowly that expected. Assuming there is no significant loss of inland vegetation on bird nesting or refuge areas surrounding the Project disturbance site, potential impact of the development may be limited.

Terrestrial Bird Species

Of the terrestrial breeding birds on the Island, the most interesting are described below.

Black Kite (*Milvus migrans*)

While Hong Kong hosts a large number of black kites during winter and somewhat lower numbers during summer, not many birds breed here. Stonecutters' holds a few breeding pairs, but no nest sites were located in the area immediately adjacent to the south shore. Should a nesting pair be displaced during Project construction, there would seem to be sufficient alternative habitat on the Island for the birds to relocate.

Indian Cuckoo (*Cuculus micropterus*)
A number of Indian cuckoos breed on the Island. Their continued presence adjacent to the government dockyard development suggests there is little reason to feel that the proposed Project will discourage all birds from breeding. The number of breeding pairs may, however, decline due to impacts of the Project.

White-breasted Kingfisher (*Halcyon smyrnensis*)

In 1993 28 nests of four species of kingfisher were counted on the Island (R. Illingworth in litt.). This included white-breasted, common, black-capped, and one pair of pied kingfishers (*Ceryle rudis*). In addition to the aquatic environment, terrestrial habitat is also important to all of the four regularly occurring species in Hong Kong. Although 4 species of kingfishers were recorded in 1993, only 2 were seen in 1994. No pied or black-capped kingfishers (*H. plicata*) were recorded in four surveys in 1994, suggesting that they have moved off the Island in response to disturbance or habitat loss caused by construction projects on the Island.

Most kingfishers on Stonecutters' are white-breasted kingfishers, a widespread but locally breeding species in Hong Kong. Stonecutters' Island is one of the few sites (probably the only site) in the Victoria Harbour area where the species still nests. As one of the kingfishers most adapted to terrestrial habitats, it requires both well-wooded areas and sources of water, either fresh or salt, for catching prey during the breeding season. It is not known if shallow water is required for fishing. If it is, this species may be affected by construction of the dockyard and consequent loss of shallow water feeding habitats. However, there is little scope for avoiding or mitigating loss of shallow marine feeding habitat should the Project proceed. Because the species depends to a large extent on terrestrial prey (averaging 69% through the year in West Bengal [Cramp 1985]), it may withstand some loss of the marine habitats it favours.
Black Drongo (*Dicrurus macrocercus*)

Many black drongos breed on the Island. Because this species favours wooded areas, it is not likely to be adversely affected by the Project.

Marine Species

Birds which depend on the marine environment and which breed annually at Stonecutters' are: Night Heron, Chinese Pond Heron (*Ardeola bacchus*), Cattle Egret (*Bubulcus ibis*), Reef Egret (*Egretta sacra*), Little Egret (*E. garzetta*) and Great Egret (*E. alba*). Of these, the Night Heron and Little Egret nested on the Island in 1994. Cattle Egrets nested in the recent past and may still do so, although they were not recorded in 1994.

Potential effects of the Project on these species may be assessed based on experience gained to date observing the effects of construction of the new government dockyards on the existing egretry. Surveys have shown that the minimum numbers of birds of each species occupying the egretry during the 1994 breeding season were:

Night Heron - 209, including 31 juveniles;

Chinese Pond Heron - 2;
Cattle Egret - 7;
Reef Egret - 2, though 3 were seen feeding from anchor buoys off the south shore on 23 May 1994;
Little Egret - 49, including single juveniles on three nests;
Great Egret - 11, but no evidence of breeding.

The above results indicate that there is still a significant egretry on the Island despite construction of the immediately adjacent dockyard. The birds seem to tolerate the noise generated by construction in the area the egretry overlooks. This indicates that the construction and operation of the south shore dockyard should not cause abandonment of the egretry.

A more probable source of adverse impact of the Project would be destruction of feeding areas. Observations indicate that the south shore is not used by Night Herons or egrets for feeding. However, there are a number of anchor buoys offshore that are used as perches for feeding by egrets during the day and, to a lesser extent, by Night Herons at night. At one time on 23 May, eleven of the thirteen nearby buoys were occupied by Little or Reef Egrets which were foraging for fish. Removal of these buoys to facilitate construction of the dockyard would have a negative impact on the birds. In order to mitigate this, rocks or buoys should be placed in the sea off the south-east facing shore for egrets to use as foraging perches.

The unfinished government dockyard still provides suitable feeding areas for herons and, to a lesser extent, for egrets. This is because horizontal concrete projections from the dockyard walls, breakwaters, and anchor buoys provide perches from which birds feed. If similar features are incorporated in the south shore dockyard, they may also be used by feeding herons and egrets. Bird use of the dockyard area is not predicted to create management problems which would affect daily operations.

During winter up to 45 Cormorants (*Phalacrocorax carbo*) were seen resting on the rocks adjoining the coast of the south shore (T.J. Ades pers. comm.). Construction and operation of the Project will preclude continued use of these rocks by Cormorants. Suitable perching rocks will remain on the south-east shore and on other islands in the area. Mitigation proposals described in Section 6.7 to replace lost boulder beaches would compensate for loss of Cormorant perches.

The possibility of competition between Cormorants and Night Herons for use of rocks arises during March when Cormorant have not yet departed and most of the Night Herons have already occupied the egretry. However, the importance of such rocks to the colony as a whole appears small. Most birds feed west of Stonecutters' Island (presumably on Lantau Island), north or north-east of Stonecutters', or in the Victoria Harbour area generally. There seems little likelihood of any serious effects on Night Herons or egrets due to competition with Cormorants for perches.

6.5.2 Discussion

Both terrestrial and marine species on the Island depend on an undisturbed terrestrial environment in the form of substantial areas of woodland and minimal human disturbance. Without these two factors, the numbers and variety of breeding species on Stonecutters' would decline. Therefore, it is essential that development around the margins of Stonecutters' not compromise the large, continuous swathe of relatively undisturbed woodland on the Island. Personnel working in the dockyards during construction and operational phases should not be granted unlimited access to the entire Island. Access should be denied to the area near the egretry.

It should be noted that egretry locations are not fixed indefinitely. Indeed, some egretries are notorious for year-to-year changes in location. Thus, it would not be sufficient to restrict access to the current egretry location, as the birds may relocate the egretry to a different site on the Island in future.

6.5.3 Recommendations

The design of the dockyard should incorporate features that provide perching sites in the vertical walls for ardeids to feed from. Horizontal concrete projections should be installed at various heights to provide perching sites at various tide stages, and a number of sloping walls should also be built for use as feeding sites.

Appropriate measures should be taken to ensure that disturbance to the terrestrial environment caused by construction of the dockyard is minimised. Fencing should be erected between the construction areas and the natural environment.

Consideration should be given to conversion of the south-east facing beach to a more attractive feeding site. This would involve placing large boulders in the water to provide perching sites and areas suitable for aquatic vegetation and fish breeding. This would mitigate loss of the anchor buoys off the south shore which at present provide feeding perches for egrets and herons. It would also increase availability of sites for colonisation by intertidal invertebrates.

Security or other measures that restrict human access to the remote areas in the centre of the Island should continue in order to ensure that undisturbed habitats remain attractive to avian and terrestrial wildlife.

Future development on the Island should provide for retention of an undisturbed tract of woodland habitat, of great importance to all avian species on Stonecutters'.

6.6 Construction and Operational Impacts

6.6.1 Construction Impacts

The Project will result in loss of most of the intertidal habitats within the study area. In their place will be a naval basin surrounded by concrete seawalls, which will provide substrates of low habitat diversity. Consequently biodiversity of the intertidal flora and fauna will be reduced. This type of impact is increasingly significant in Hong Kong as coastal development in the form of reclamation and port construction continues. On Stonecutters' Island the cumulative loss of coastal habitats will reach approximately 63% (4.25 of 6.75 km) of the total native coastal habitat on the former Island.

6.6.2 Operational Impacts

Reduction in the diversity of intertidal flora and fauna may result from the operation phase of the Project. Key issues will be disposal of marine wastes and accidental spills of fuels, oils, lubricants, and solvents. Use of anti-fouling compounds will also pose a risk to marine life in the study area.

Water quality management will be a key issue during operation of the Project. Measures should be taken to minimise pollution and maximise tidal flushing and diurnal marine replenishment of the naval basin to reduce the possibility of water quality degradation. Excessive biological or chemical oxygen demand resulting from the combined affects of pollution and inadequate water flushing may pose a significant risk to intertidal life.

6.7 Impact Mitigation Measures

Although on-site mitigation is preferred, the cumulative loss of intertidal habitats on Stonecutters' Island limits potential for enhancement of nearby sites. The objective of mitigation measures in this case should be to compensate for the poor habitat diversity for intertidal organisms offered by the physical structure of the Project.

The type of shoreline in the study area currently offering the greatest number of habitats and displaying the highest degree of biodiversity is the inter- and sub-tidal boulder shore. While this will be totally destroyed by construction of the facility, there are opportunities for mitigation through the replacing of boulders along the new shoreline after construction is completed. If the outer sides of the seawalls are not required for the docking of vessels and are deemed suitable for boulder placement, the possibility exists for a net increase in the area of boulder shore in the study area.

Creation of new boulder shoreline will require stockpiling of the original boulders during construction, supplemented by importing of further boulders if necessary. The boulders can be piled arbitrarily against the shoreline approved for this purpose, although a shallower overall gradient of the finished boulder shore is preferred. This is due to the fact that the zonation of intertidal organisms on the shore is determined, in part, by their ability to deal with the physiological conditions at the varying tidal levels. Organisms will occur within a vertical band along the shore determined by the limits of their tolerance of factors including immersion, desiccation, salinity, etc. The shallower the gradient of the shoreline, the wider these bands will be. Hence, the area available for intertidal organisms to colonise will be increased.

The equipment needed for movement and placement of boulders would be available from the plant necessary for the construction of the Project. Boulders should be placed around the outside of the seawalls from the eastern Project boundary along the southern shore where the boulders will not impede operation of the Project or other existing facilities.

6.8 Ecological Monitoring and Audit

Installation of boulders along the south and southeast shores of the Island should be planned and monitored carefully. This habitat enhancement measure has potential to benefit intertidal fauna as well as feeding birds, therefore it will be important to the overall success of the mitigation plan.

Because cumulative impacts on the nesting community of herons and egrets is a significant possibility which could have severe adverse consequences, monitoring of nesting biology should be continued over the course of the construction programme.

During the detailed design stage, seawalls should be modified to incorporate foraging perches for ardeid birds. This measure may be significant to long-term retention of the nesting community of ardeids on the Island.

7. NOISE

7. NOISE

7.1 Background

The Noise Sensitive Receivers as identified in Chapter 2 include the following:

NSR1	Married Quarters
NSR2	Rosia Cottage
NSR3	Leave Quarters (group of 5 bungalows)
NSR4	Married Quarters
NSR5	Married Quarters
NSR6	Married Quarters

NSR's 1-3 have air conditioners in the bedrooms and the windows are all single glazed.

NSR's 4-6 already have some acoustic secondary glazing installed but not all rooms are provided with air conditioners. The secondary glazing was provided by the Property Services Branch by ArchSD and was funded by the CT8 project.

7.2 Construction Phase Impacts

The assessment of noise impacts has taken account of the two options presented by CED. Construction Programme A allows for reclamation and dredging to take place during the restricted period of 1900 - 2300 hours and Construction Programme B only allows for work is to be completed within the unrestricted period of 0700-1900 hours.

This EIA has considered both construction programmes and their likely noise impacts including activities liking to take place in parallel.

There will be two distinct phases of construction. Phase I will entail dredging, reclamation, backfilling and rock armour placement. Phase II will entail the construction of the buildings and infrastructure improvements.

7.3 Noise Assessment

The objective of the construction noise assessment has been to determine whether noise from the construction activities will comply with the requirements of the Noise Control Ordinance (NCO) when works are necessary in restricted hours and to establish whether construction activities during normal working hours will give disturbance to any noise sensitive receivers in the vicinity of the works.

The prediction of noise levels has been based on the methodology given in the Technical Memorandum on noise from construction work other than Percussive Piling (TM1) and ISO/DIS 9613-2 (1992) for the calculation of atmospheric absorption and ground absorption. The Technical Memorandum on noise from Percussive Piling (TM2) has been adopted for assessing piling noise. The following assumptions have been made:

- Nominal Midband = 500Hz;
- Temperature = 20°C; and
- Humidity = 70%.

Single activity noise levels at the facade of the identified NSRs have been calculated for the types and numbers of items of powered mechanical equipment to be employed for each major construction activity. The type and quantity of mechanical equipment required for each activity has been estimated by Civil Engineering Department (CED) based on the scale of the work and on the likely construction method. The sound power levels (SWL) of the equipment likely to be used are shown in Table 7.1 and 7.2. The construction programmes are shown in Figures 1.4 and 1.5.

It should be noted that working hours quoted are those estimated by CED. The Contractor would be required to apply for a Construction Noise Permit should works extend beyond the unrestricted period of 0700-1900 hours. The acceptability of the late hours operation will be further discussed in the mitigation measures section of this Chapter. Also, note that with the shortening of the working hours the overall duration of activities in certain cases increases. Furthermore, to achieve higher outputs over a shorter time available the number of plant/equipment is likely to increase.

Table 7.1 Summary of Construction Activities and SWL of Equipment Relevant to Construction Programme A

Phase	Activity	Plant & Equipment	Working Period	Working Hours	SWL dB(A)	Qty	Total dB(A)
I	Dredging Seabed	- Grab Dredgers - Hopper Barges - Tugs - Launch	Dec 94 - Nov 95	0700-2300 6 days/week	112 104 110 104	2 3 2 1	117.9
	Dredging Basin + Approach		Nov 96 - Jan 97				
	Reclamation	- Suction Dredger - Marine Sand Pump - Dozers - Tug	Apr 95 - Aug 95	0700-2300 6 days/week	109 104 115 110	1 1 2 1	119.2
	Place Sand in Dredged Trench	- Suction Dredger - Marine Sand Pump - Dozers - Tug	Apr 95 - Feb 96	0700-1900 6 days/week	109 104 115 110	1 1 2 1	119.2
	Place Rock Fill + Armour Rock	- Derrick Barges - Tug - Launch	Apr 95 - Sept 96	0700-1900 6 days/week	104 110 104	3 1 1	113.0
	Set Concrete Seawall Blocks	- Derrick Barges - Tug	Jul 95 - Oct 96	0700-1900 6 days/week	104 110	2 1	111.8
	Concrete Coping	- Concrete Barge - Crane - Concrete Pumps - Vibrators	Nov 95 and Dec 96 - Jan 97	0700-1900 6 days/week	104 112 109 113	2 1 2 8	122.9
	General Earthworks	- Trucks - Dozers - Compactors	Jul 95 - Dec 96	0700-1900 6 days/week	117 115 108	4 3 3	125.0
II	Piling	- Diesel Hammer - Concrete Pile	Sept 95 - Feb 96	Permitted Periods only	128	2	131.0
	Ground Beams & Slabs	- Back Hoe - Circular Saw - Generator - Concrete lorry mixer - Poker (petrol) - Crane	Jun 96 - Aug 96	0700-1900 6 days/week	112 108 108 109 113 112	3 3 1 2 2 1	121.6
	Building	- Circular Saw - Generator - Lorry - Concrete lorry mixer - Poker (petrol) - Crane	Dec 95 - Jun 97	0700-1900 6 days/week	108 108 112 109 113 112	3 1 3 3 2 1	121.8
	Road Construction	- Back Hoe - Concrete truck - Poker	Sept 95 - May 96	0700-1900 6 days/week	112 109 113	2 2 2	119.4

Table 7.2 Summary of Construction Activities and SWL of Equipment Relevant to Construction Programme B

Phase	Activity	Plant & Equipment	Working Period	Working Hours	SWL dB(A)	Qty	Total dB(A)
I	Dredging Seabed	- Grab Dredgers	Feb 95 - May 96	0700-1900 6 days/week	112	3	
		- Hopper Barges			104	4	
	Dredging Basin + Approach	- Tugs	Oct 96 - Feb 97		110	3	
		- Launch			104	1	117.9
	Reclamation	- Suction Dredger	Jun 95 - Apr 96	0700-1900 6 days/week	109	1	
		- Marine Sand Pump			104	2	
		- Dozers			115	2	
		- Tug			110	1	119.2
	Place Sand in Dredged Trench	- Suction Dredger	Apr 95 - Apr 96	0700-1900 6 days/week	109	1	
		- Marine Sand Pump			104	1	
		- Dozers			115	2	
		- Tug			110	1	119.2
	Place Rock Fill + Armour Rock	- Derrick Barges	May 95 - Sept 96	0700-1900 6 days/week	104	3	
		- Tug			110	1	
		- Launch			104	1	113.0
	Set Concrete Seawall Blocks	- Derrick Barges	Jul 95 - Oct 96	0700-1900 6 days/week	104	2	
		- Tug			110	1	111.8
	Concrete Coping	- Concrete Barge	Sept 95 - Jan 97	0700-1900 6 days/week	104	2	
		- Crane			112	1	
		- Concrete Pumps			109	2	
		- Vibrators			113	8	122.9
	General Earthworks	- Trucks	Jun 95 - Apr 96	0700-1900 6 days/week	117	4	
		- Dozers			115	3	
		- Compactors			108	3	125.0
II	Piling	- Diesel Hammer - Concrete Pile	May 96 - Oct 96	Permitted Periods only	128	2	131.0
	Ground Beams & Slabs	- Back Hoe	Jun 96 - Aug 96	0700-1900 6 days/week	112	3	
		- Circular Saw			108	3	
		- Generator			108	1	
		- Concrete lorry mixer			109	2	
		- Poker (petrol)			113	2	
		- Crane			112	1	121.6
	Building	- Circular Saw	Jun 96 - Jun 97	0700-1900 6 days/week	108	3	
		- Generator			108	1	
		- Lorry			112	3	
		- Concrete lorry mixer			109	3	
		- Poker (petrol)			113	2	
		- Crane			112	1	121.8
	Road Construction	- Back Hoe	Apr 96 - Jan 97	0700-1900 6 days/week	112	2	
		- Concrete truck			109	2	
		- Poker			113	2	119.4

7.4 Assessment of Impacts of Construction Programme A and B

The noise levels during construction have been calculated based on the activities and powered mechanical equipment shown in Tables 7.1 and 7.2. The predicted noise level comprises the cumulative impacts from all activities and the assessment has been carried out according to TM1 and TM2.

The predicted noise levels at NSRs from Construction Programmes A and B are shown in Appendix E1 and E2 respectively. Table 7.3 shows the maximum Calculated Noise Level (CNL) received by each NSR with respect to construction works other than percussive piling and due to percussive piling assuming, at this stage of the assessment, that no special forms of mitigation are applied. The daytime and evening noise levels refer to the working period in Table 7.1 with daytime activities being those likely to be carried out from 0700 to 1900 and evening activities being those that will continue up to 2300. The activities that are likely to take place during the restricted period of 1900-2300 are reclamation and dredging only and is noted that the noise levels during this period are almost the same as those during the daytime, indicating that these activities form the dominant noise sources. Night time noise is not considered because the site will close down at 2300 hours.

Table 7.3 Maximum CNLs at NSRs without Mitigation

NSR	CNL dB(A)				
	Construction Programme A			Construction Programme B	
	Daytime (i)	Evening (i)	Percussive Piling	Daytime (i)	Percussive Piling
1	88	88	92	89	92
2	86	86	87	87	87
3	82	79	81	81	81
4	71	69	73	71	73
5	69	68	70	68	70
6	67	66	68	68	68

Notes (i) Noise from construction activities other than percussive piling

7.4.1 Impacts from Percussive Piling

None of the NSRs are provided with central air conditioning systems and therefore the Acceptable Noise Level (ANL) for percussive piling is 85dB(A). The permitted hours of operation of the piling operation are determined by the amount by which the CNLs exceed the ANL. The NSRs most affected are NSR1 (the married quarters) and NSR2 (Rosia Cottage) where the CNLs are predicted to exceed the ANLs by between 1dB(A) and 10dB(A). Therefore, the permitted hours of operation on any day not being a general holiday (when no piling will be allowed) will be 0800 to 0930 and 1200 to 1400 and 1630 to 1800.

7.4.2 Impacts from Construction Activities other than Percussive Piling

In TM1 the ANLs are dependant upon the time of day. For Stonecutters Island the ANLs are as follows:

Table 7.4 ANLs at Stonecutters Island

Time of day	Duration (hours)	Maximum recommended Noise Level dB(A)
Day-time	0700-1900	75[1]
Evening and general holidays	1900-2300	60
Night-time	2300-0700	45

Notes (1) Not included in TM1 but recommended as a maximum noise level during the daytime.

Comparison of the predictions in Table 7.3 with the ANLs in Table 7.4 shows that the noise levels are likely to exceed the standards during the daytime and evening in Programme A and during the daytime in Programme B unless the noise is mitigated. The following sections of this Report consider methods of mitigation.

7.4.3 Mitigation At Source

Methods of Mitigation

It is always preferable to mitigate the noise at source and the normal practice is to include stringent controls on the construction contract to ensure that the contractor takes appropriate measures. While it is not feasible to dictate the methods of construction to the contractor, noise control requirements should be incorporated in the contract documents to specify the noise standards to be met, and any noise monitoring to be carried out. The noise monitoring will be particularly important and the results of these surveys will determine the level of mitigation required at any particular location and time.

Options for mitigating construction noise include:

- use of silenced equipment;
- scheduling activities to avoid parallel operations of several sets of powered mechanical equipment;
- siting of equipment as far as practical from NSRs; and
- use of temporary enclosures and/or noise barriers placed close to the noise source to screen specific receivers.

The noise generated from mechanical plant can often be reduced by the fitting of acoustic mufflers and linings. In general this can reduce the sound power level by 5dB(A) for each activity. It is recommended that mufflers and linings are fitted to all equipment when the predicted or recorded unmitigated noise level is in excess of 75dB(A).

The programme of construction activities has a direct affect upon the resultant noise levels. Therefore as a means of reducing noise levels as much as is practicable the programme should be reviewed, for acceptability in terms of likely noise nuisance, before any programme is finalised and approved.

Noise Levels with Mitigation at Source

The noise calculations have been re-run, to determine the likely noise at the receivers assuming that all possible methods of mitigation at source are applied. The results of this assessment are shown in Table 7.5.

Table 7.5 CNLs After Mitigation at Source

NSR	CNL dB(A)		
	Construction Programme A		Construction Programme B
	Daytime	Evening	Daytime only
1	83	83	84
2	81	81	82
3	77	74	76
4	66	64	66
5	64	63	64
6	62	61	63

For daytime works Table 7.5 illustrates that the noise levels at NSRs 1, 2, and 3 still exceed the recommended maximum noise level of 75dB(A). For evening works in programme A the noise levels at all NSRs exceed the evening maximum noise level of 60dB(A). Therefore, additional noise mitigation is required. This would comprise modification to the construction programme by the Contractor, for example to avoid noisy actvities being carried out at the same time or restricting the working hours to daytime only. Noise insulation at the receivers would reduce noise levels further but it is not Government policy to provide insulation to sensitive receivers to mitigate against daytime construction noise impact.

Table 7.6 summarises the amount that the daytime and evening CNLs exceed the ANLs at each NSR, including mitigation at source.

Table 7.6 Summary of amount CNLs exceed ANLs at each NSR

NSR	Amount CNLs Exceed ANLs dB(A)		
	Construction Programme A		Construction Programme B
	Daytime	Evening	Daytime only
1	8	23	9
2	6	21	7
3	2	14	1
4	0	4	0
5	0	3	0
6	0	1	0

The noise standards are exceeded at all receivers during the evening and at three receivers during the daytime if Programme A is followed.

Clearly, restrictions on evening working would result in no impacts arising from the restricted period of 1900-2300 hrs. It is understood that the activities that are programmed to take place in the evening (dredging and reclamation) need to do so to meet the construction programme. However, CED have prepared an alternative, Programme B, which avoids evening construction activities.

By restricting the working hours to 0700-1900 hrs the noise impact increases slightly due to there being more heavy mechanical equipment used to achieve completion of the project in the given time span. Additionally, the works have slightly different phasing thus increasing the noise impact.

Construction of noise barriers between the construction works and the receivers could be considered but these will be extremely visually intrusive and will only be partially effective. Also, due to the height of some receivers, temporary barriers or enclosures will generally only be effective if they are placed very close to the noise sources and therefore have limited benefit.

7.5 Conclusions

The noise levels shown in Table 7.6 indicates that for Construction Programme A the CNLs at NSRs 1 (married quarters), 2 (Rosia Cottage) and 3 (leave quarters) exceed the daytime recommended level of 75 dB(A), and in the evening the CNLs at all NSRs are exceeded. For construction programme B the CNLs at NSRs 1, 2 and 3 exceed the recommended daytime level of 75 dB(A). Therefore, it is recommended that construction Programme B is implemented.

Furthermore, it is recommended that all practical mitigation measures which can be taken by the contractor are implemented, as detailed in the suggested contract clauses detailed in this Report and the Contractor is instructed to devise a construction programme which is likely to have the least noise impact an neighbouring sensitive receivers.

7.6 Noise Monitoring and Audit

7.6.1 Baseline and Impact Monitoring

Baseline noise monitoring should be carried out at NSRs on Stonecutter Island immediately prior to the first month of the contract to establish representative background noise levels. It is recommended that these noise monitoring stations should be located 1m in front of the facades of NSRs 1-6, shown in Figure 2.3.

Impact noise monitoring should be performed throughout the contract at the NSRs closest to any noisy construction activities. For construction during normal working (unrestricted) hours (0700 - 1900) hours impact monitoring should comprise $L_{eq\ (30\ min)}$ taken at least twice per week. Impact monitoring for construction outside normal working (restricted) hours (1900 - 0700) should comprise $L_{eq\ (5\ Min)}$ taken twice per day, once in each of the restricted periods, unless complaints are received in which case more frequent measurements will be necessary. The precise programme for impact monitoring should be determined when details of the Contractor's programme for construction are known.

Proposals for action should be passed to the Engineer by the Contractor whenever monitoring shows an excessive noise level is arising.

The reporting and auditing of this impact monitoring programme should be carried out on a monthly basis and should commence on completion and approval of the Environmental Monitoring and Audit (EM & A) Manual. This manual should include data collected during the baseline monitoring programme and also contingency plans to take account of the following:

- prolonged non-availability of monitoring assistants;
- non-suitability of monitoring sites;
- equipment failure or theft;
- non-availability of laboratory facilities; and
- adverse weather conditions.

The contingency plan should also be included in contract documents in accordance with the HKPSG, Pollution Ordinances, and EPD monitoring guidelines.

Where monitoring of noise levels shows an excessive noise level, the contractor should take necessary steps to ensure that his actions are not contributing to the excess. These steps should include, but not be limited to the following:

(a) checking plant and equipment;
(b) maintenance or replacement of any plant or equipment contributing to the excess; and
(c) review of working methods.

Resident site staff should be kept informed of steps taken, and written reports and proposals for action should be passed to the contractor whenever monitoring shows an excessive noise level is arising.

Any deterioration in noise levels during construction is measured as a breach of the trigger, action or target shown below in Table 7.7.

Table 7.7 Trigger, Action and Target Levels for Construction Noise at all NSRs

Period (hrs)	Trigger Levels	Action Levels	Target Levels dB(A)
0700 - 1900	When a complaint is received	When more than one complaint is received within two weeks.	75
1900 - 2300			60
2300 - 0700			45

It should be noted that the day-time noise levels for the unrestricted period are recommended only and are not mandatory under the NCO legislation.

Table 7.8 shows a proposed action plan should complaints be received or should certain noise levels be exceeded.

Table 7.8 Construction Noise Action Plan

Event	Action	
	Engineer	Contractor
When a complaint is received	• Notify Contractor • Conduct measurement • Investigate noisy operations	-
When more than one complaints are received within a 2 weeks period	• Notify Contractor • Analyze investigation • Require Contractor to propose measures for the analyzed noise problem • Increase monitoring frequency to check mitigation effectiveness	• Submit noise mitigation proposals to Engineer • Implement noise mitigation proposals
75dB(A) exceeded between 0700-1900 hrs on normal weekdays 60dB(A) exceeded between 0700-2300 hrs on holidays and 1900-2300 hrs on all other days 45dB(A) exceeded between 2300-0700 hrs of next day	• Notify Contractor • Require Contractor to implement mitigation measures • Increase monitoring frequency to check mitigation effectiveness	• Implement mitigation measures • Prove to Engineer effectiveness of measures applied

7.6.2 Contract Clauses

Contract clauses proposed for noise monitoring and audit are as follows:

(a) The Engineer will carry out construction noise monitoring throughout the Works.

(b) The Contractor shall provide suitably qualified and experienced staff to assist the Engineer in carrying out noise measurements.

(c) A schedule of proposed noise measurement times and sites will be prepared by the Engineer. The measurement frequency will be at least once per week at each location for each of the following periods.

(i) 0700 - 1900 hours on normal weekdays

(ii) 0700 - 2300 hours on holidays and
1900 - 2300 hours on all other days

(iii) 2300 - 0700 hours of any day

Measurements will be taken at sites and times chosen to fairly represent normal construction activities.

(d) Three sound level meters complete with tripods and a calibrator shall be provided by the Contractor within one week of the commencement of the contract and comply with the International Electrotechnical Commission Publications 651 : 1979 (Type 1) and 804 : 1985 (Type 1) specifications, as referred to in the Technical Memoranda to the Noise Control Ordinance.

(e) The construction noise level monitoring will be carried out at the above (b) times and at 1m from the external facade at the locations that are more affected, and the Contractor shall be responsible for arranging access. Alternative sites may agreed by the Engineer if difficulties arise in obtaining access, or if the locations become unsuitable.

(f) The exact location and direction of the noise monitoring at each site will be determined by the Engineer.

(g) Construction noise levels will be recorded as $L_{eq(30\ min)}$ measurements during the day time on normal weekdays and $L_{eq(5\ min)}$ measurements during the restricted hours, at each of the locations.

7.7 General Contract Clauses

The following specification clauses are recommended:

(a) The Contractor shall consider noise as an environmental constraint in his planning and execution of the Works.

(b) The Contractor shall comply with the Noise Control Ordinance (Cap 400) including its subsidiary regulations and technical memoranda.

(c) In addition to the requirements imposed by the Noise Control Ordinance, to control noise generated from equipment and activities for the purpose of carrying out any construction work other than percussive piling during the time period from 0700 to 1900 hours on any day not being a general holiday, the following requirements shall also be complied with:

(i) The noise level measured at 1m from the most affected external facade of the nearby noise sensitive receivers during any 30 minute period shall not exceed an equivalent sound level (L_{eq}) of 75dB(A).

(ii) Should the limits stated in the above sub-clause (i) be exceeded, work shall stop and shall not recommence until the Contractor has taken appropriate measures acceptable to the Engineer that are necessary for compliance.

Any stoppage or reduction in output resulting from compliance with this clause shall not entitle the Contractor to any claims of extension of time or to any additional costs whatsoever.

(d) The Contractor shall ensure that all equipment to be used on site shall be effectively sound-reduced by means of silencers, mufflers, acoustic linings or shields, acoustic sheds or screens or other means to avoid disturbance to any nearby noise sensitive receivers. All hand-held percussive breakers and air compressors used by the Contractor shall comply with the Noise Control (Hand-held Percussive Breakers) Regulations and Noise Control (Air Compressors) Regulations respectively under the Noise Control Ordinance (Ordinance No. 75/88, NCO amendment 1992 No. 6).

(e) 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.

(f) The Contractor shall advise and arrange methods of working to minimize noise impacts, and shall provide experienced personnel with suitable training to ensure that these methods are implemented. The Contractor's attention is particularly drawn to the proximity of the Noise Sensitive Receivers to the site.

(g) Before the commencement of the Works the Contractor shall submit to the Engineer the proposed methods of working.

(h) Notwithstanding the requirements and limitations set out in clause (3) above and subject to compliance with clauses.(1), (4) and (6) above, the Engineer may upon application in writing by the Contractor, allow the use of any equipment and the carrying out of any construction activities for any durations provided that he is satisfied with the application which, in his opinion, to be of absolute necessity and adequate noise insulation has been provided to the educational institutions to be affected, or of emergency nature, and not in contravention with the Noise Control Ordinance in any respect.

(i) For the purposes of the above clauses, any domestic premise, hotel, hostel, temporary housing accommodation, hospital, medical clinic, educational institution, place of public worship, library, court of law, performing art centre, recreational facilities shall be considered a noise sensitive receiver.

7.8 Operation Phase Impacts

The facilities likely to give rise to noise pollution are the helipad, workshops,and the emergency power station room.

7.8.1 Helipad

It is assumed that this facility will be extensively used, but neither the frequency of flights nor the type of aircrafts are known. Noise levels for helicopter flights were recorded in the Interim Report of the Site Investigation and Engineering Study for Development of CT8. The L_{max} noise levels ranged from 64dB(A) to 71dB(A). The higher noise levels were generated when helicopters are hovering. It should be noted, however, that the noise levels generated are dependant on the type and make of the helicopters.

It is not possible to quantify impacts from the helipad without more details of the operation. Some general comments on the impacts would, however, be useful. The layout should be designed to ensure, where possible, that noisy activities, such as the helipad, are located in positions where they will not impact on sensitive uses. The sensitive uses include, the office block, recreational facilities, clinic, patient ward, lecture theatre and the existing swimming pool. In Scheme L the helipad is quite some distance from any noise sensitive receivers. Therefore, the noise impact caused by this area is unlikely to be a problem.

7.8.2 Workshops

There will be noise from the motor generator, compressor room, and combined fitting/machine/sheetmetal workshop. It is common to have only a few operations on-going at any one time and these activities can all be enclosed in their individual units within the building. Noise should thus not cause significant impacts at any of the sensitive areas as described above.

7.8.3 Emergency Power Station Room

It is assumed that the type of plant installed would be either a diesel or gas-driven engine. There are three noise sources for this type of equipment: from the engine exhaust, the engine casing, and the air inlet. There will probably be no windows in this building and ventilation will be through steel louvres, which if necessary can be acoustically lined. Other methods of mitigating noise are by installing mufflers, enclosures and barriers. It should be noted however that this plant is intended for emergency use only and it is likely to be operating for very short periods for maintenance inspections.

7.8.4 Conclusions

During the operation phase of the proposed Naval Base the ambient noise level will certainly increase. However, the increase caused by the operations is not likely to be significant. Nevertheless there are mitigation measures which should be incorporated in the design stage to reduce noise levels to a minimum. These include the following:

- construction of barriers;
- installation of mufflers and silencers;
- construction of adequate enclosures around plant and machinery;
- creating barrier effects by situating buildings such as the administration block between quarters or the patient wards and the noisy activities;
- installation of acoustic insulation to buildings in noisy areas;
- installation of double glazing windows and air conditions to all rooms in residential buildings; and
- installation of double glazing to patient ward.

8. AIR QUALITY

8.3 Assessment Methodology

The Fugitive Dust Model (FDM) has been used to model the dust levels at the sensitive receivers. The model is specifically designed for computing dispersion of fugitive dust. Both the line and area sources algorithm were used to quantify the impacts from the construction activities. Hourly meterological data based on analysis of one years data for 1992 from the Mobil Oil Depot, Tsing Yi were employed to identify the worst case situation.

8.3.1 Emission Factors

Emission factors of activities were derived from "Compilation of Air Pollutant Emission Factors" (AP-42, 1985). In this publication (Paragraph 11.2.4.2) it is stated that the quantity of dust emissions from construction operations are proportional to the area of land being worked and the level of construction activity. Also it is assumed that the emissions from heavy construction operations are directly proportional to the silt content of the soil (that is, particles smaller than 75μm in diameter) and inversely proportional to the square of the soil moisture. Details of emission factors, the locations of the sources, and results are given in Appendix F1. To conduct the calculations the following assumptions were made:

- particle size of 30 μm with an average density of 2500 kg/m^3. Particulates with aerodynamic diameters greater than 30 μm tend to settle out a few metres from the source under typical wind conditions and smaller particulate have much slower rates of settling, and are therefore more affected by wind turbulence;
- the emission factor for construction operations was taken as 1.2 tons per acre of construction per month of activity in accordance with para 11.24.2 of AP42. This equals 296.5g/m^2/month;
- silt content of 11%;
- moisture content of 50%; and
- ambient background level TSP level of 125 μg/m^3 (monitored over a one year period at Sham Shui Po station by EPD in 1992).

The calculations have been based upon the worst case scenario of one-hour and 24-hour average concentrations of Total Suspended Particulate (TSP) at the receivers.

8.4 Legislation/Standards

The predicted levels have then been assessed against the Hong Kong Air Quality Objectives (AQO) and 1-hour criteria recommended by EPD as shown in Table 8.1

Table 8.1 Hong Kong Air Quality Objectives (AQO) and 1 hour Criteria recommended by EPD

Pollutant	Concentration $\mu g/m^3$ (i)		
	1-Hour (ii)	24-Hour (iii)	1-Year (iv)
Total Suspended Particulate (TSP)	500 (v)	260	80

Notes: (i) Measured at 298K (25°C) and 101.325 kPa (one atmosphere).
(ii) Not to be exceeded more than three times per year.
(iii) Not to be exceeded more than once per year.
(iv) Arithmetic means.
(v) EPD recommended 1 hour TSP criteria at the site boundary.

8.5 Sensitive Receivers

A total of seven ASRs were identified according to the Hong Kong Planning Standards and Guidelines (HKPSG). These are illustrated in Figure 2.3. The co-ordinates of the sensitive receivers used in the modelling are shown in Table 8.2.

Table 8.2 Co-ordinates of Sensitive Receivers

Sensitive Receivers	Description	Co-ordinates	
		Northing	Easting
1	Married Quarters	820055	831855
2	Leave Bungalow (Rosia Cottage)	820035	831815
3	(i) Leave Quarters (Group of 5)	820130	832015
4	Married Quarters	820210	831805
5	Married Quarters	822725	831920
6	Married Quarters	820345	831980
7	(ii) Lido Area	820110	831965

Notes

(i) The closest bungalow to the site boundary has been used as the measuring point.
(ii) The swimming pool has been used as the measuring point.

8.6 Comparative Assessment of Impacts from Construction Programme A and B

The predicted dust levels for 1-hr and 24-hr averages at the sensitive receivers are given in Appendix F2 for Construction Programme A and F3 for Construction Programme B and are summarised in Table 8.3. These figures include background TSP levels for 1hr and 24hr averages but exclude mitigation of dust at this stage of the assessment.

Table 8.3 Maximum Predicted TSP without Mitigation ($\mu g/m^3$)

ASR	Construction Programme A				Construction Programme B			
	Reclamation		Building & Infrastructure		Reclamation		Building & Infrastructure	
	1 hr Avg	24 hr Avg	1 hr Avg	24 hr Avg	1 hr Avg	24 hr Avg	1 hr Avg	24 hr Avg
1	179	148	793	431	179	148	731	405
2	160	143	722	371	160	143	682	351
3	171	145	541	344	171	145	490	322
4	137	131	246	188	137	131	233	182
5	135	130	253	186	135	130	242	181
6	133	129	236	175	133	129	227	170
7	199	159	552	336	199	159	473	299

As expected the impacts caused by the reclamation activities do not alter with the change in programme durations or change in equipment usage. The reason for this because no dust impacts arise from this activity.

However, the impacts caused by construction programme A is higher due to the difference in cumulative effect of the various site activities.

In both construction programmes the results in Table 8.3 show that TSP levels at all sensitive receivers are within the AQO and EPD recommended criteria during the reclamation period when reclamation works are in progress. However, in both cases the 1-hr average criteria has been predicted to be exceeded at ASRs 1, 2, 3 and 7 during the construction of the buildings and infrastructure.

8.7 Analysis of Assumptions

The modelling results indicate that mitigation measures will be required to protect ASRs 1, 2, 3 and 7. However, before the mitigation measures are considered a number of issues need to be discussed. They are as follows:

- the AP42 emission factors for "heavy construction" assumes a large number of haulage vehicles moving around the site. The quantity of dust emissions from a given segment of unpaved road varies linearly with the volume of traffic, average vehicle speed, average vehicle weight, average number of wheels per vehicle, road surface texture and road surface moisture. There are likely to be reduced number of vehicles likely to be moving around the site when compared with the sites described in AP42, and assumed in the emission factors defined in that document because:
    - British Forces will not permit construction traffic to pass through the military areas of Stonecutters Island and therefore all haul traffic will be by barges; and

- the construction activities will be a phased operation to minimise costs by reducing manpower and quantity of construction plant required;
- the emission factors are taken for a heavy construction site and this work, as defined in AP42, includes demolition, land clearing, blasting, ground excavation, cut and fill, and building construction. It should be noted that construction on this project will only involve ground excavation (including temporary supports), minor levelling works, and the construction of the Naval Base facilities itself. These works will generate less dust than the works defined in AP42.
- dust emissions from unpaved roads will vary in direct proportion to the fraction of silt (particles smaller than 75μm in diameter) in the road surface material and AP42 assumes a fines content of 30%. However, marine sand will be dredged and pumped to fill the area behind the seawall to form the reclamation area on which the buildings and other facilities will be constructed. This type of reclamation material will have a lower level of silt than that assumed in AP42 because the majority of silt will be washed out in the dredging process.

Considering these points the emission factors stated in AP42 may not be completely representative of the actual works that will take place.

8.8 Mitigation Measures at Source

Mitigation measures applicable to this project that would result in dust suppression include:

- paving of all site roads i.e. completion of the infrastructure prior to the main construction activities. It is quoted in AP42 that up to 85% mitigation can be achieved with paving; and
- watering of unpaved areas, which results in road dust suppression by forming moisture cohesive films among the discrete grains of road surface material. An effective watering programme i.e. twice daily watering with complete coverage, is estimated to reduce heavy construction dust emissions by up to 50% and bulldozing dust emissions by 60%.

It has been assumed that the proportion of dust emissions arising from the road surfaces and building construction is 70% and 30% respectively. If the two methods of mitigation are incorporated and the lower silt content of the fill material and absence of haul traffic are taken account of, the assumption is that the emissions from the road surfaces and construction works will reduce by 80% and 50% respectively.

The predicted dust levels at the sensitive receivers incorporating the mitigation measures and the corrections for the differences between the actual working practices and those assumed for heavy construction in AP42 are shown in Table 8.4. These 1-hr and 24-hr average TSP levels include the ambient background TSP levels.

Table 8.4 Predicted mitigated TSP levels including Mitigation ($\mu g/m^3$)

ASR	Construction Programme A		Construction Programme B	
	Building & Infrastructure		Building & Infrastructure	
	1 hr Avg	24 hr Avg	1 hr Avg	24 hr Avg
1	327	218	302	207
2	304	199	288	191
3	253	192	233	183
4	162	144	157	142
5	164	144	159	141
6	158	140	155	138
7	259	191	228	176

These results show that with the implementation of the mitigation measures the dust emissions will be within the AQO and EPD recommended TSP maximum of 260 $\mu g/m^3$ 24-hr average and 500 $\mu g/m^3$ 1-hr average criteria.

Comparatively, the results also show that the impacts caused by Construction Programme A are greater than those of Construction Programme B. Therefore, in terms of dust impacts the latter is the preferred. Additionally, Programme B does not include works beyond 1900 hrs.

8.9 Conclusions

The assessment has considered the impact of dust from reclamation, filling and surcharging. It has concluded that the impact of dust from these activities on ASRs will not be significant. The recommended hour dust level of 500 $\mu g/m^3$ should not be exceeded at any ASRs when reclamation or land formation is proceeding. This is true for both Programme A or B.

The greatest impact will be caused by the construction of foundations, buildings and infrastructure. However, with the incorporation of the mitigation measures the impact can be reduced to an acceptable level. To reinforce the recommended mitigation measures it is important that the Contractor is made responsible for carrying out of these measures. Contract documents should specify the measures to protect air quality and compliance with these should be sufficient to ensure that the standards are not exceeded. Suitable contract clauses are presented in the section 8.11.

8.10 Monitoring and Audit

8.10.1 Baseline Monitoring

TSP baseline monitoring should be carried out for at least two weeks with measurements taken every day immediately prior to the start of the works to establish representative 1 hour and 24 hour TSP background levels. Readings should be taken daily for two weeks for 24 hour TSP and three times daily for two weeks for 1 hour TSP. The baseline monitoring should, if possible, be repeated at six monthly intervals at a time when no activities on site are generating dust to observe trends in the background levels. The High Volume Air Samplers should be installed at the site boundary immediately beside ASRs 1,2,3 and 7.

8.10.2 Impact Monitoring

Impact monitoring of 1 hour TSP levels should then be carried out throughout the works at the closest air sensitive receivers to the activities causing dust and at the site boundary. The programme for impact monitoring should be determined when the Contractor's detailed works programme has been finalised and should be updated to reflect any changes in the Contractor's programme as the works progress. As a guide, 24 hour samples should be taken once every six days and 1 hour samples should be taken over 3 periods on the same day close to ASRs near to the activity when dust generating activities are in progress i.e.ASRs 1,2,3 and 7.

Where monitoring of the air quality indicates a deteriorating air quality, the Contractor should take all necessary steps to ensure that his actions are not contributing to the deterioration. These steps should include, but not be limited to the following:

(i) checking of all plant and equipment;

(ii) maintenance or replacement of any plant or equipment contributing to the deterioration; and

(iii) review of all working methods.

The Engineer should be kept informed of all steps taken, and written reports and proposals for action should be passed to the Engineer by the Contractor whenever monitoring shows an adverse impact upon air quality.

Table 8.5 shows a proposed action plan should any of the trigger, action or target levels be exceeded.

Table 8.5 Proposed Action Plan for Dust

Event	Action	
	Engineer	Contractor
Trigger level exceeded for one sample	Repeat measurement as soon as possible	Identify source.
Trigger level exceeded for more than one consecutive sample	Repeat measurement as soon as possible Notify contractor and EPD immediately	Identify source and impose necessary mitigation measures
Action level exceeded for one sample	Repeat measurement as soon as possible Notify contractor EPD immediately	Identify source and impose necessary mitigation measures

Table 8.5 Proposed Action Plan for Dust (Cont'd)

Event	Action	
	Engineer	Contractor
Action level exceeded for more than one consecutive sample	Daily monitoring to be imposed Notify contractor and EPD immediately Require contractor to make additional proposals for dust suppression	Identify source Review plant and equipment and working procedures Submit proposals for reducing dust to Engineer Implement remedial action to dust emission immediately Notify Engineer of action taken
Target level exceeded for one sample	Daily monitoring is to be imposed Notify Contractor and EPD immediately Require Contractor to make additional proposals for dust suppression Provide investigation report which should be sent to EPD as soon as possible	Identify source Review plant and equipment and working procedures Submit proposals for reducing dust to Engineer Implement remedial action to reduce the dust emission immediately Notify Engineer of action taken Provide investigation report

Table 8.5 Proposed Action Plan for Dust (Cont'd)

Event	Action	
	Engineer	Contractor
Target level exceeded for more than one sample	Daily monitoring is to be imposed immediately Notify contractor and EPD immediately Require Contractor to make additional proposals and to take immediate steps to reduce dust, and to provide report for such instance to the EPD as soon as possible	Identify source Review plant and equipment and working procedures Submit proposals for reducing dust to Engineer Implement dust suppression measures to reduce dust immediately Notify Engineer of action taken Provide investigation report which should include the findings and suggestions to prevent such contravention happening again Stop the relevant portion of work as necessary as determined by the Engineer

8.10.3 Contract Clauses for Monitoring and Audit

(a) The Contractor shall provide assistance to enable the Engineer to carry out dust impact monitoring throughout the construction period.

(b) The Contractor shall provide two high volume air samplers with associated equipment, calibration kit 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. The high volume samplers should be equipped with electronic mass flow controller and be calibrated against a traceable standard at regular intervals. The Contractor shall also provide a suitable direct reading dust meter capable of reading 1 hr TSP in the range 0.1 - 100mg/m^3 and calibrated against a traceable primary standard at regular intervals.

(c) The Contractor shall construct suitable access, hardstanding and a galvanised wire fence and gate at each monitoring station in the following areas if required:

(i) the Site boundary;
(ii) Rosia Cottage;
(iii) Married Quarters ASR 1; and
(iv) the "Lido" area.

Alternative locations may be necessary if difficulties arise in obtaining access, or if the locations become unsuitable. The exact location and direction of the monitoring equipments at each monitoring station shall be agreed with the Engineer. Monitoring stations shall be free from local obstructions or sheltering. The number of monitoring stations will be determined by the Engineer.

(d) The dust (TSP) levels will be measured by the "High Volume Method for total suspended particulate" as described by the United States Environmental Protection Agency in 40 CFR Part 50.

(e) 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.

(f) Impact monitoring during the course of the Works will normally be undertaken at any two or more of the monitoring stations as determined by the Engineer on up to three days per week and must be at least once every six days for each selected monitoring station.

(g) Where impact monitoring results of dust levels indicate a deteriorating situation the Engineer will 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.

(h) The Engineer will provide to the Contractor a report of the monitoring results at monthly intervals.

Table 8.6 Trigger, Action and Target Levels Proposed for Dust

Parameter	Trigger $\mu g/m^3$	Action $\mu g/m^3$	Target $\mu g/m^3$
1-Hour TSP	Background Level plus 30%	Average of Trigger and Target Level	500
24-Hour TSP	Background Level plus 30%	Average of Trigger and Target Level	260

8.10.4 Action on Construction Dust (TSP) Levels

(a) 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.

(b) 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.

8.11 General Contract Clauses

8.11.1 Avoidance of Dust Nuisance

(a) The Contractor shall comply with current enactments and regulations as required in Clause 34 of the GCC, including the Air Pollution Control Ordinance (Cap 311).

(b) 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 satisfaction 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.

8.11.2 General Requirements

(c) 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 particulate shall not exceed those defined in the Hong Kong Air Quality Objectives (see Table 8.5) and 0.5 milligrams per cubic meter at standard temperature (25°C) and pressure (1.0 bar) for one hour.

(d) 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.

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

(f) Before use on the site the Engineer shall be advised of all earth moving plant, demolition plant, concrete mixing plant an any other plant likely to cause dust problems. The Engineer may inspect such equipment to determine if it may be operated in a matter to minimise dust emissions during the works. The Contractor shall provide all necessary facilities to the Engineer for checking or inspecting such plant and the Contractor shall not use such plant without the agreement of the Engineer. The Engineer may require the Contractor to carry out trials of any such plant to prove its suitability.

(g) The location of dust producing plant or facilities, either fixed or temporary, shall be subject to the agreement of the Engineer.

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

- Stockpiles of sand and aggregate greater than 20 m^3 shall be enclosed on three sides, with walls extending above the pile and 2 metres beyond the front of the pile.

- 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.

- Areas within the Site where there is a regular movement of vehicles shall have an approved sealed hard surface as directed and be kept clear of loose surface material.

- 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.

- 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. All air vents on cement silos shall be fitted with suitable fabric filters provided with either shaking or pulse-air cleaning mechanisms. The fabric filter area shall be determined using an air-cloth ratio (filtering velocity) of 0.01 - 0.03 m/s.

- Weigh hoppers shall be vented to a suitable filter.

- 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.

- The provision of adequate dust suppression plant including water bowsers with spray bars.

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

- 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 of materials to be by barges wherever possible.

- 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.

- 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.

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

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

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

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

(j) Emissions of pollutants from the construction operation shall be limited such that the ambient level should not exceed those as stated in Table 8.7

Table 8.7 Maximum Levels of Air Pollutants

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	500		260		80
Respirable Suspended Particulate [v]			180		55
Nitrogen Dioxide	300		150		80
Carbon Monoxide	30000	10000			
Photochemical Oxidant (as O_3)[vi]	240				
Lead				1.5	

[i] Measured at 298 K and 101.325 kPa. (one atmosphere)
[ii] Not to be exceeded more than 3 times per year.
[iii] Not to be exceeded more than once per year.
[iv] Arithmetic means.
[v] Respirable suspended particulate means suspended particulate in air with a nominal aerodynamic diameter of 10 micrometres and smaller
[vi] Photochemical oxidants are determined by measurement of ozone only.

8.11.3 Dust Levels - General

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

(b) 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.

(c) 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.

(d) Before the commencement of the Works, the Contractor shall submit to the Engineer the proposed methods identifying operations and plants likely to cause dust emissions, together with measures to be implemented to mitigate and control dust emissions. This method statement shall be revised and resubmitted as required by the Engineer.

(e) 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 the adequacy of the maintenance or modification is demonstrated to the satisfaction of the Engineer.

(f) 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.

8.12 Operation Phase

As stated in the Inception Report there are no sensitive receivers affected by the operation activities and no information is available regarding the actual plant to be installed on the base. However, the following facilities may cause some impact on the air quality:

- diesel powered generators - release of CO_2 and NO_x;
- vehicular traffic (likely to increase after the access road connecting to West Kowloon is constructed (Route 3));
- air conditioners - release of CFC's from coolants;
- boiler house - release of CO_2 and NO_x;

However, the operational phase impact of CT8, is more likely to be the cause of any resultant rise in pollution levels than the Naval Facilities. For plant installations flue gas cleaning should be recommended to reduce unnecessary pollutant emissions. This should be detailed at the design stage.

9. VISUAL LANDSCAPE

9. VISUAL IMPACT/LANDSCAPE

9.1 Existing Vegetation

The main concentration of trees along the coastline are between the swimming pools and the breakwater within the grassed barbecue area. The main groups of trees within this concentration are visually important, but many have trunk supports due to typhoon wind throw damage. The species found are *Hibiscus tiliaceous* and *Macaranga tanarius*. Various palm species, including *Livistona chinensis* and *Roystonea regia*, can also be found, but are small or recently planted specimens. The one notable exception is a mature specimen of *Phoenix dactylifera* (Figures 9.1 and 9.2). At the eastern end of this area, adjacent to the beach and between the holiday chalets, are located a small number of trees and shrubs, generally of low visual amenity. Species include *Casuarina equisetifolia* and *Pandanus tectorius*. The area further to the east of the beach, towards the former jetty is overgrown with various grass/shrub species. The jetty, though, contains one mature and visually important tree, *ficus microcarpa*.

The bay to the east of the former jetty, which includes the Du Pont (HK) Ltd. manufacturing plant, generally has scrub and shrub-like trees between the road and the shoreline. Species include *Macaranga tanarius* and *Hibiscus tiliaceous* of mainly low visual amenity.

Proceeding westwards along the coast from the main group of trees within the barbecue area, the next area of vegetation is located to the west of the pier. The most visually important tree of the coastline included within the study area is located here. The species is *Ficus microcarpa* (Figure 9.3 and 9.5) and is a mature specimen with a dense, balanced crown. Immediately to the west, around the service building, are juvenile specimens of *Macaranga tanarius*.

No existing vegetation will be affected in the area between the service building and the western wooded headland. The vegetation at the foot of the headland slopes will generally be untouched by the reclamation as the reclamation/hillside interface comprises boulder strewn coastline.

9.2 Proposed Development

The existing HKBF facilities will not lie within the proposed boundary of the reclamation area and the trees adjacent to the Lido are set well back from the high tide mark which defines the seaward boundary of the existing military site. No plans have yet been discussed for the reclamation boundary to move inland of the existing site boundary. Therefore, no plans have been made to fell trees.

9.3 Assessment of Impacts

Two main groups of sensitive receivers will be affected by the proposed development:

- Ferry passengers and general boat traffic within this part of the harbour; and
- Navy and Army personnel on the island, including the families of resident personnel.

9.3.1 Views from the Harbour

The proposed development extends approximately 500 metres from the shoreline, and as such will have a major impact on the harbour, especially as the development will incorporate various built forms and straight edges. This impact, though, will be mitigated to some degree by the existing wooded ridgeline of the island, which will help to soften the outline and provide a unifying backdrop, as would the use, where appropriate, of natural building materials and/or sympathetic colour schemes.

9.3.2 Views from the Island

The main views will be from the residential buildings in the area around the pier, particularly from the married quarters located on the ridgeline and along the shoreline behind the seawall, recreation facilities adjacent to the pier the (including swimming pools, barbecue facilities and holiday chalets) and the road which terminates at the Du Pont (HK) Ltd. manufacturing plant.

9.4 Landscape Masterplan

The aim has been to shield from view the Naval Facilities from those using the area which is currently a recreation facility used by the British Forces, as well as to soften the outline of the proposed Naval buildings and help tie them visually into the existing island edge. It is unknown whether the recreational facility will continue to operate as such in the future when the proposed Base is operational. Nevertheless, any planting should be undertaken early on to shield the construction site from the view of the recreational area. The proposed landscape masterplan is shown in Figure 9.6.

9.4 Mitigation Measures

Mitigation measures can be taken at the interface of the development with the island. The provision of landscaped mounds along the interface will help to screen views at lower levels, and may act as a physical protection barrier should the water gel exposures plant remain in production after completion of the development. Security fencing could be located at the top of the bund within the planting. Also, the barbecue area, which at present looks out onto the harbour, will become a visually enclosed area, with structure planting helping to link this area to the swimming pools. Proposed planting will include species found within this area which are hardy, low-maintenance and salt tolerant to complement and enhance existing trees. Outlines of these measures are shown on Figures 9.8.

Figure 9.1
Tree Survey Plan - Enlarged Area

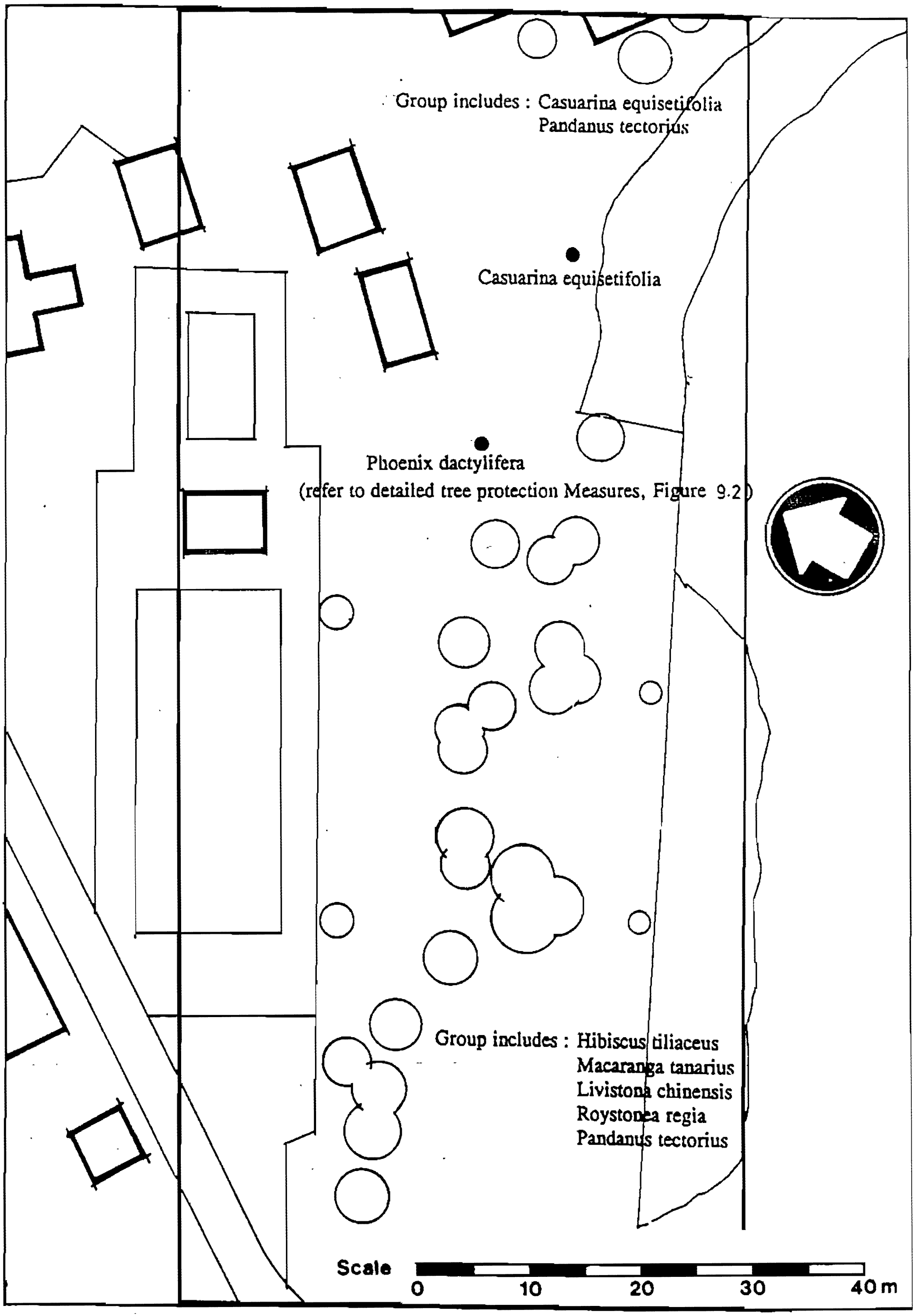


Figure 9.2
Tree Protection measures - Phoenix dactylifera

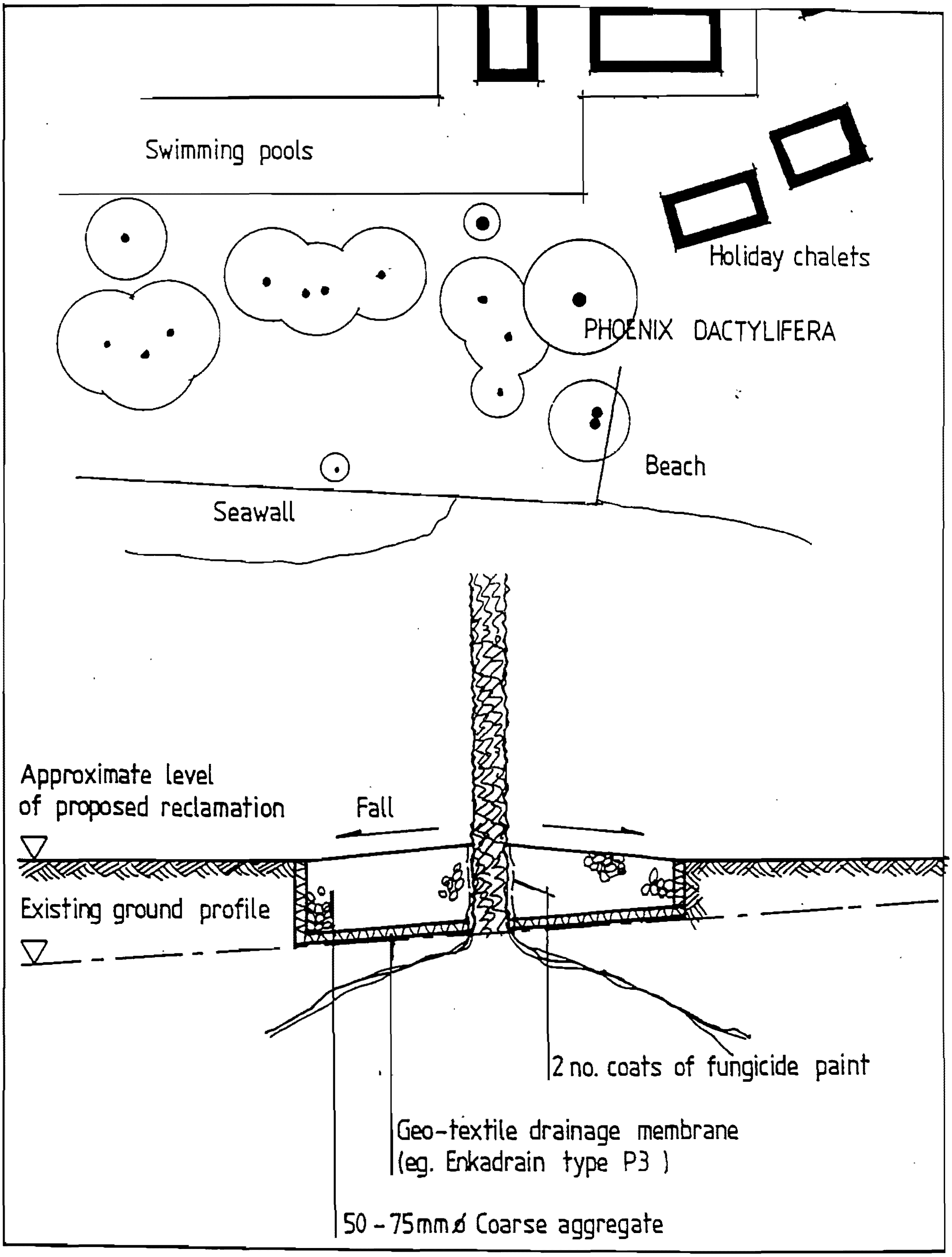


Figure 9.3
Tree Survey Plan - Sheet 1 of 2

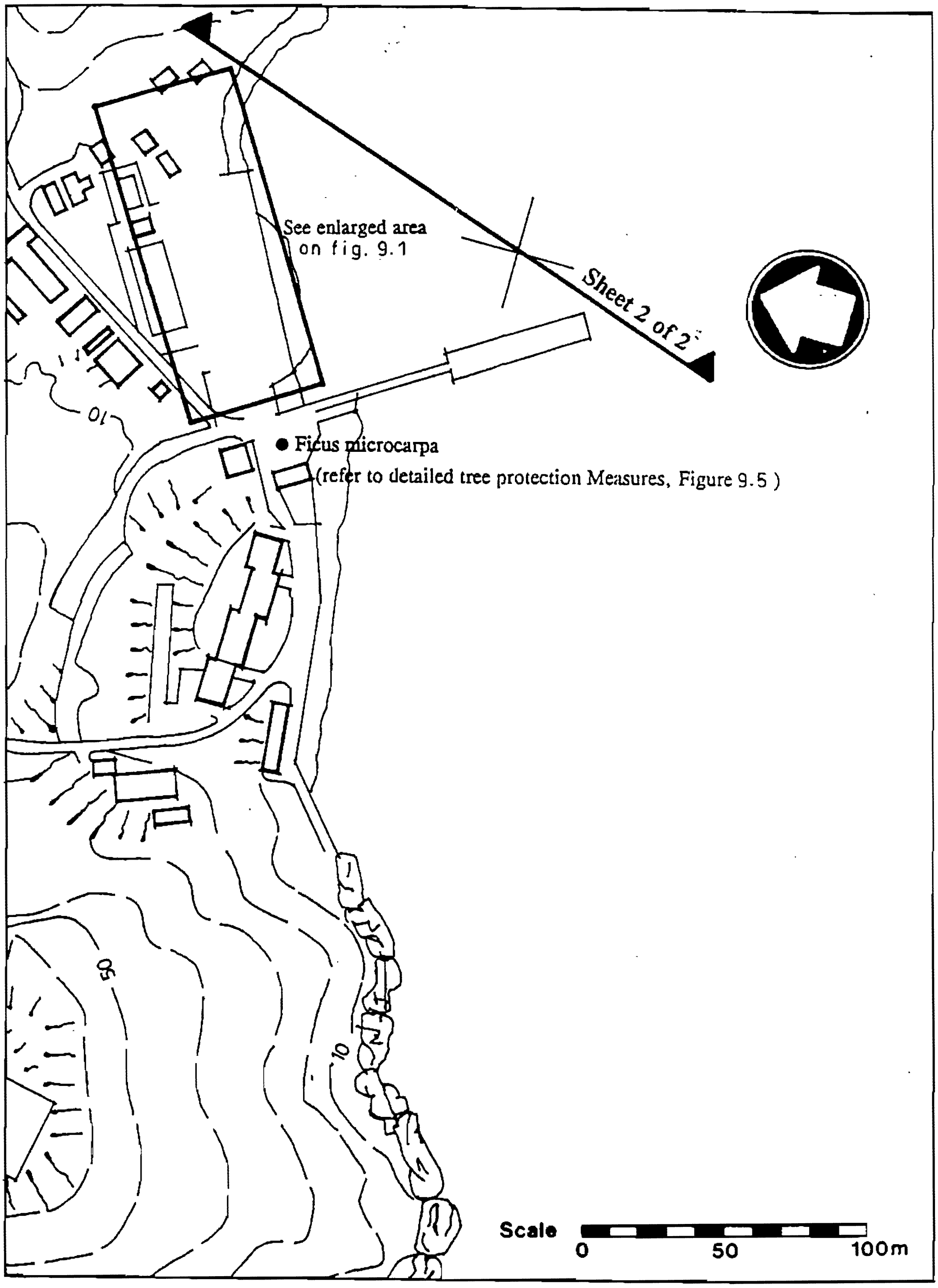


Figure 9.4
Tree Survey Plan - Sheet 2 of 2

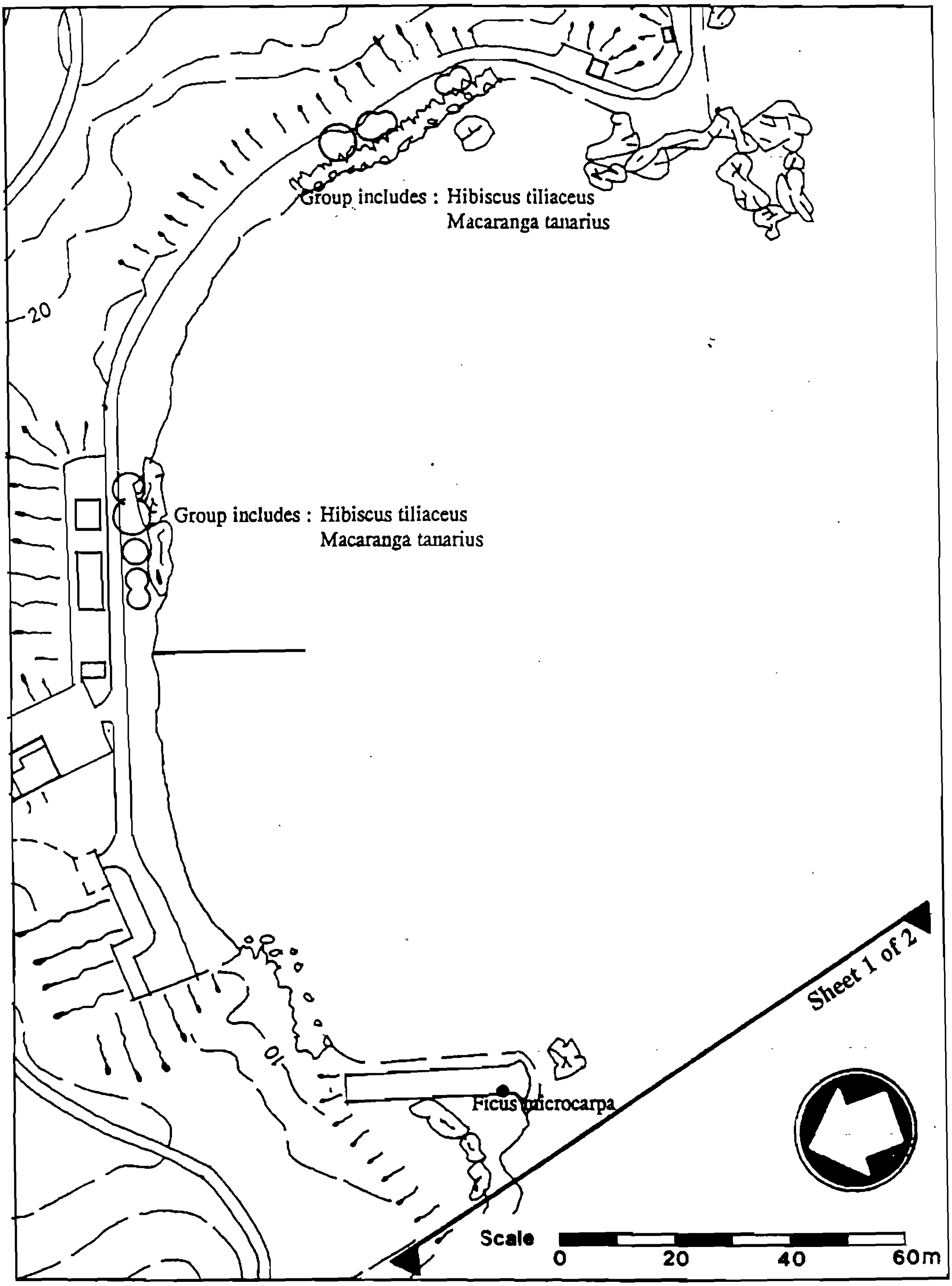


Figure 9.5
Tree Protection Measures - Ficus microcarpa

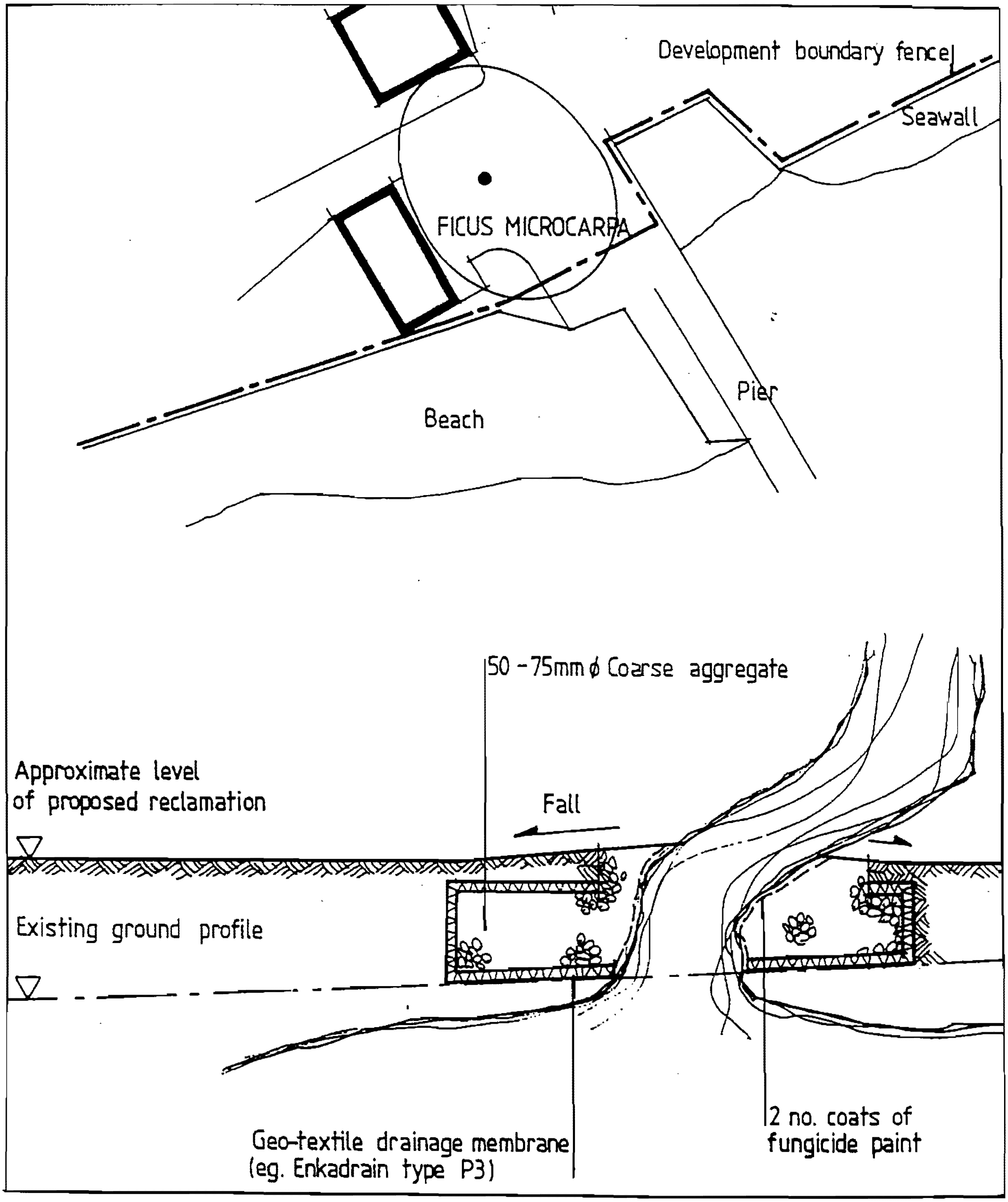


Figure 9.6
Landscape Masterplan - Scheme L

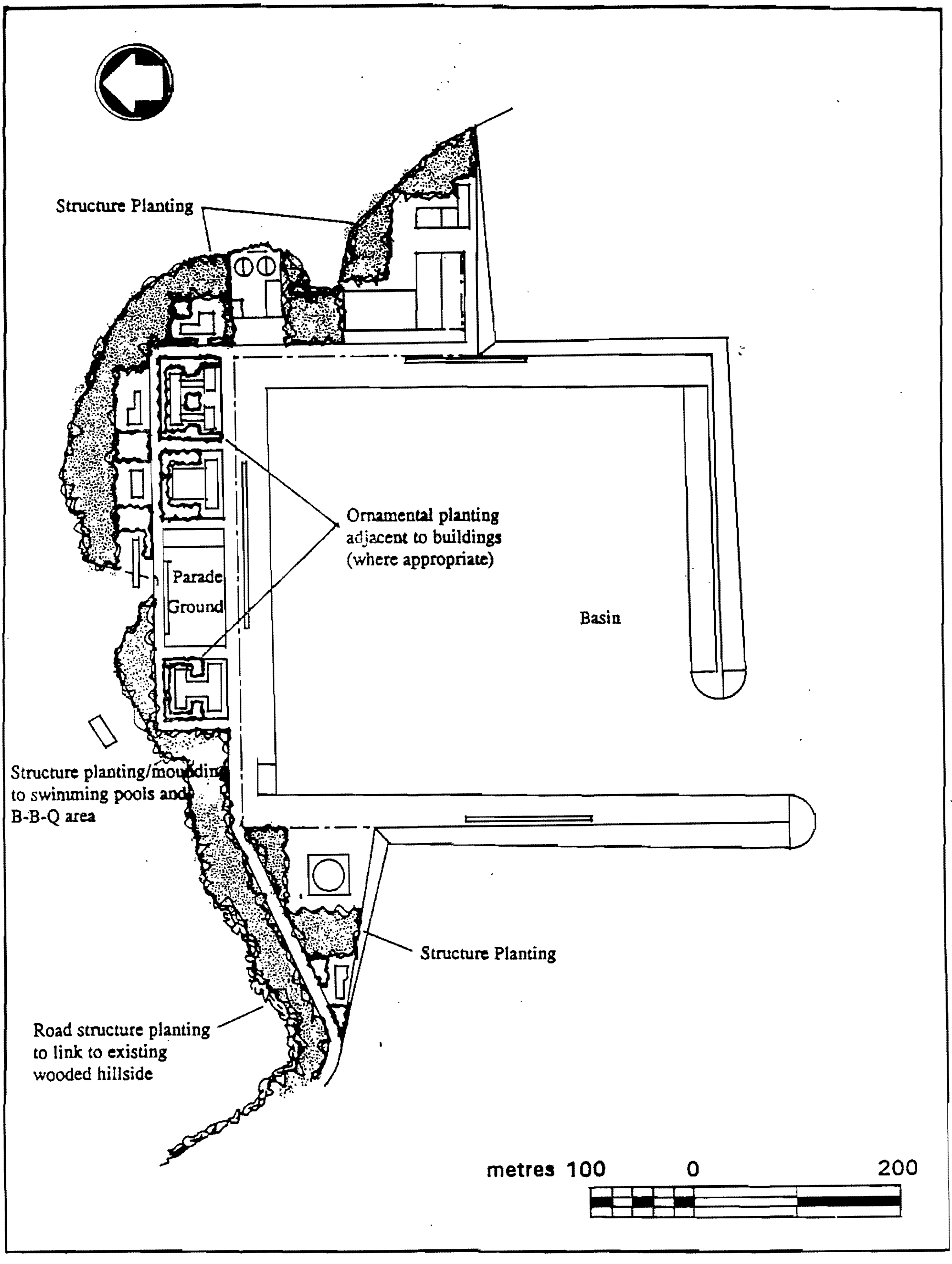
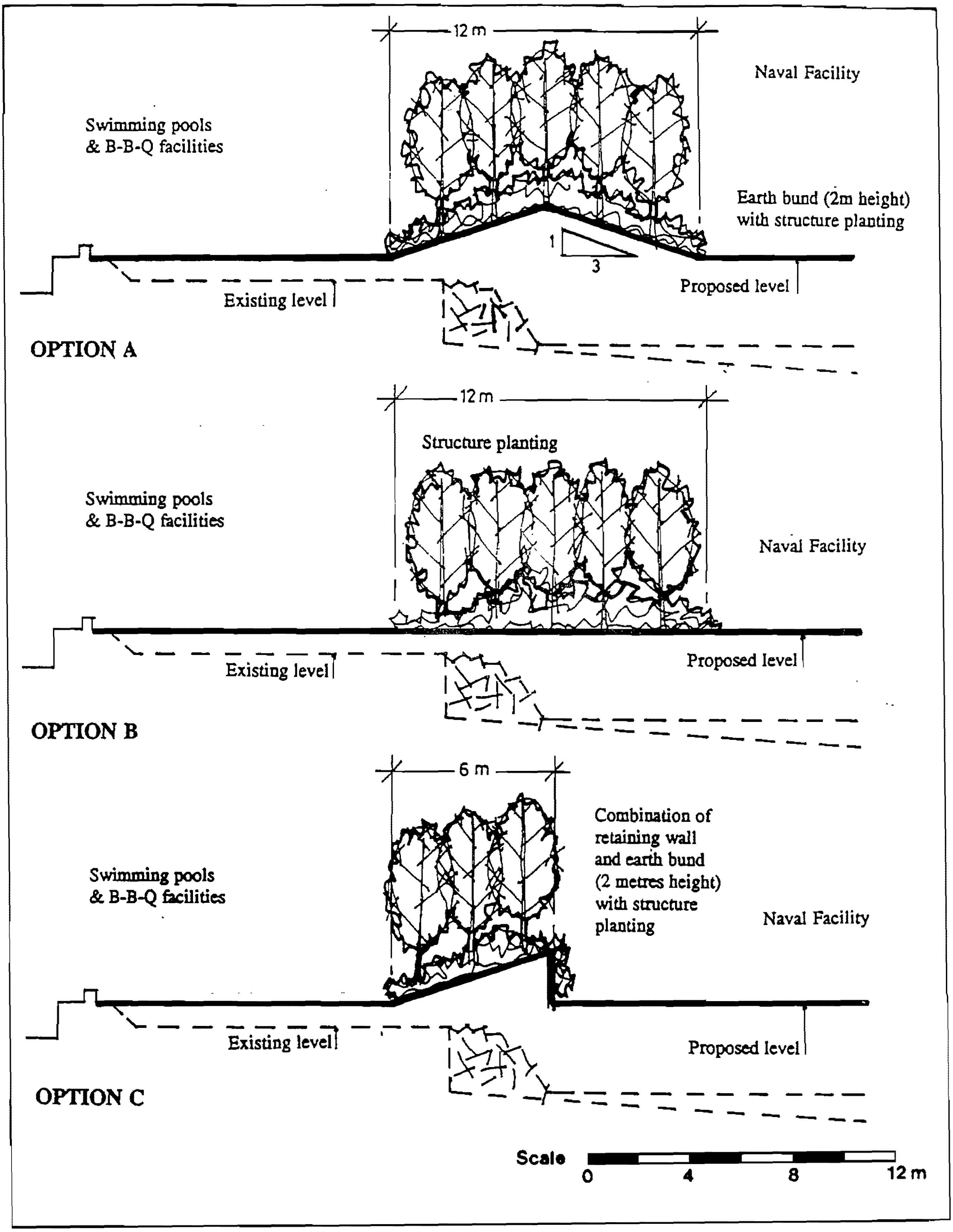


Figure 9.7
Sections Through Structure Planting



10. WASTE

10. WASTE

10.1 Construction Waste

The contractor should ensure throughout the contract that waste is adequate disposed of and where possible opportunities to re-use or recycle should be incorporated. In order to reduce any adverse environmental effects the following clauses are recommended for inclusion in the contract:

10.2 Contract Clauses

10.2.1 General

The Engineer should be kept informed of all steps taken. Written reports and proposals for action should be passed to the Engineer by the Contractor wherever situations arising show a deterioration in waste handling operations.

All waste water generated 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.

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.

No burning of construction wastes or vegetation shall be allowed on the site.

The Contractor shall not permit any sewage, waste water or other effluent containing sand, cement, silt or any other suspended or dissolved material to flow from the Site onto any adjoining land or allow any solid waste to be deposited anywhere within the Site or onto any adjoining land and shall have all such materials removed from the Site.

The Contractor shall be responsible for temporary drainage, diverting or conducting of open streams or drains intercepted by any works and for reinstating these to their original courses on completion of the Works.

Any proposed temporary diversions to stream courses or nullahs shall be submitted to the Engineer for agreement one month prior to such diversion works being commenced. Diversions shall be constructed to allow the water flow to discharge without overflow, erosion or washout. The area through which the temporary diversion runs is to be reinstated to its original condition when the temporary diversion is no longer required.

The Contractor shall segregate all inert construction waste material suitable for reclamation or land formation and shall dispose of such material at a public dumping area(s).

All other waste material and all non-inert construction waste material deemed unsuitable for reclamation or land formation shall be disposed of at a public landfill.

The Contractor's attention is drawn to the Waste Disposal Ordinance, the Public Health and Municipal Services Ordinance and the Water Pollution Control Ordinance.

10.2.2 Discharge into Sewers and Drains

The Contractor shall not discharge directly or indirectly (by runoff) or cause or permit to be discharged into any public sewer, storm-water drain, channel, stream-course or sea, any effluent or foul or contaminated water or cooling water without the prior consent of the relevant Authority who may require the Contractor to provide, operate and maintain at the Contractor's own expense, within the premises or otherwise, suitable works for the treatment and disposal of such effluent or foul or contaminated or cooling or hot water.

If any office, site canteen or toilet facilities is erected, foul water effluent shall, subject to clause as stated in the last paragraph above, be directed to a foul sewer or to a sewage treatment facilities either directly or indirectly by means of pumping.

The Contractor's attention is drawn to the Buildings Ordinance, the Water Pollution Control Ordinance and the Technical Memorandum "Standards for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters".

10.2.3 Protection of Watercourses

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.

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.

10.2.4 Avoidance of Pollution during Dredging, Transporting, and Dumping

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

Pollution avoidance measures

- mechanical grabs shall be designed and maintained to avoid spillage and shall seal tightly while being lifted;
- cutterheads of suction dredgers shall be suitable for the material being excavated and shall be designed to minimise overbreak and sedimentation around the cutter;
- where suction hopper dredgers for dredging of uncontaminated marine mud are in use, overflow from the dredger and the operation of lean mixture overboard systems shall not be permitted for surface discharge unless expressly approved by the Engineer in consultation with the Environmental Protection Department;
- all vessels 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 propeller wash;

- all pipe leakages are to be repaired promptly and plant is not to be operated with leaking pipes;

- the marine works shall cause no visible foam, oil, grease, scum, litter or other objectionable matter to be present on the water within the Site or dumping grounds;

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

- excess material shall be cleaned from the decks and exposed fittings of barges and hopper dredgers before the vessel is moved;

- loading of barges and hoppers shall be controlled to prevent splashing of dredged material to the surrounding water and barges or hoppers shall not be filled to a level which will cause overflowing of material or polluted water during loading or transportation;

- the Engineer may monitor any or all vessels transporting material to ensure that no dumping outside the approved location takes place. The Contractor shall provide all reasonable assistance to the Engineer for this purpose; and

- the Engineer may monitor any or all vessels transporting material to ensure that loss of material does not take place during transportation. The Contractor is to provide all reasonable assistance to the Engineer for this purpose.

- all vessels used for marine works must be currently registered as such with the marine department.

10.2.5 Marine Dumping

The Contractor shall ensure that all marine mud and unsuitable material is accurately disposed of at the approved locations. He will be required to ensure accurate positioning of vessels before discharge and will be required to submit and agree proposals with the Engineer for accurate positional control at disposal sites before commencing dredging. All disposal in designated marine dumping grounds shall be in accordance with conditions of a licence issued by the DEP under the Dumping at Sea Act (Overseas Territories) Order 1975. Floatable and certain contaminated material (as defined by the DEP) will not be acceptable at marine dumping grounds and will require other methods of disposal.

Before commencing the dumping works, the Contractor shall provide, through the Engineer, to the Director of Environment Protection (DEP) and the Secretary of the Fill Management Committee (FMC), a programme for the approval of the dumping works. Dumping works shall only be carried out in accordance with the approved programme which may be amended from time to time with the approval of DEP and FMC.

The Contractor shall provide, through the Engineer, to the DEP and FMC, a schedule containing details of the work included in, and the frequency of, the dumping works, on a monthly basis. A return showing the number of barge loads and the estimated quantity of surplus mud dumped within the mud disposal site shall be submitted to the DEP and FMC within one week after completion of the dumping works.

Mud shall be dumped evenly over the mud disposal site so that no high spots are formed and the dumping works shall be carried out in accordance with the submitted programme, as per the last paragraph.

Water quality monitoring will be carried out by the Engineer during the dumping of mud in marine disposal sites. Requirements and extent of monitoring will be agreed with DEP and FMC.

10.3 Operation Phase Waste Arisings

Although no indication has been given as to the numbers of vessels, sizes of crews or the extent of the activities undertaken on-site has been given, an estimate of the waste production figures for ships at sea has been made by Kosmatos (1984) for:

a) 1.4 - 2.4 kg/person/day for food waste;
b) 0.5 - 1.5 kg/person/day for general wastes; and
c) 20 kg/day for (vessel) maintenance wastes including soots, rust scrapings, oily rags.

10.4 Storage

It is most important that during periods of storage refuse should be kept dry. An accumulation of moist or wet refuse is not only offensive and difficult to remove, but forms an excellent breeding medium for insects and vermin.

10.5 Recycling and Reuse

Opportunities to separate the different types of waste should be encouraged such as recycling or reuse of waste material. Examples of such waste are; paper, glass, wood, metal, and cardboard. Additionally, internal arrangements to reuse materials should be encouraged. such as re-using scrap paper.

10.6 Hazardous Waste

EPD and the Hospital Authority have agreed upon the provision of a single purpose built central incineration facility (CIF) to be built in Tuen Mun. The Facility is expected to be up and running by early 1996. The clinic and the patient ward may generate hazardous waste such as body parts and tissues, used needles, and cytotoxic drugs. These would be suitable for treatment in the CIF. It will be unlikely that the waste from this source will be taken to landfill. However, paper and domestic waste will be dealt with by normal disposal methods such as landfill.

11. CONCLUSIONS AND RECOMMENDATIONS

ND RECOMMENDATIONS

ussed the environmental impacts resulting from the construction and val facilities which are proposed to be located on the south shore of . The assessment has been carried out using the assumption that the will be similar to the existing facilities at HMS Tamar.

assessment has concluded that there are a number of key impacts ed. The key impacts and the mitigation measures that are proposed v. Environmental monitoring and audit has been recommended struction of the project.

ion of the study has been that it will be possible to construct and d naval facilities within guidelines for acceptable environmental areful note is taken of environmental impacts throughout the design. ly important for issues pertaining to water quality.

acts

i d water quality to be a critical issue. The water quality impacts tified are presented in Table 11.1 together with the recommended

r Quality Impacts and Recommended Mitigation Measures

	Mitigation Measure
i life	Use low impact dredging
ater intakes	The intakes should be relocated prior to the start of dredging
	Spill action plan and control of site activities
eas into	Runoff from areas that could be contaminated to be collected and treated before discharge. Flows to be connected to the new foul sewerage system as soon as practical. All drainage to be discharged outside the existing and new embayment
	The existing sewerage and drainage should be improved prior to the start of construction

Table 11.1 Water Quality Impacts and Recommended Mitigation Measures (Cont'd)

Impact	Mitigation Measure
Operation	
Spillage from ships and shore activities	Include openings in the breakwaters to provide flushing and water exchange providing do not affect the operational requirement of the Basin. Provide pumpout at all berths and solid waste reception facilities. The design of the openings should not conflict with the operation requirements of the Basin.
Effluent inflow from the SSDS Interim Outfall	Design the basin to minimise ingress of effluent and encourage water circulation in the basin. Include openings in the breakwaters to improve flushing and water exchange. The design of the openings should not conflict with the operational requirements of the Basin.
Sewage and drainage	Design sewerage to flow to the SSDS sewerage system. Design drainage to avoid runoff into embayed areas

Marine Operations

It has been concluded that a southern facing entrance would be acceptable.

Ecology

This project will result in the loss of most of the intertidal habitats within the study area to be replaced by a naval basin surrounded by seawalls the faces of the western, eastern, and part of the northern walls will be of concrete block construction and the outer walls of the western and eastern breakwaters and both sides of the southern breakwater will be of rubble mound construction, which will provide substrates of low habitat diversity. Consequently biodiversity of the intertidal flora and fauna will be reduced.

Mitigation measures identified would compensate for the poor habitat diversity for intertidal organisms offered by the physical structure of the project. With this regard new boulder shoreline should be created.

Noise

Prediction of construction noise level indicates that, with the exception of the married quarters, Rosia Cottage, and the leave quarters, the noise generated by the works will be within the daytime recommended noise standard of 75dB(A) if noise abatement measures at the source are applied. Working in the evening will cause very high noise impacts to all of the residents. Therefore, it is recommended that working be restricted to 0700-1900 hours. The noise levels have been calculated based upon a provisional construction programme. To further reduce the noise levels calculated in this report it is recommended that the actual construction programme is reviewed, and the phasing of works such that the noise impacts are minimised.

Noise from the operation of the proposed naval base is not likely to cause significant impacts as there will be no noise sensitive receivers on Stonecutters Island outside the naval base.

Air Pollution

The assessment has considered the impact of dust from reclamation, filling and surcharging. It has concluded that the impact of dust from these activities on sensitive receivers will not be significant. The air quality objectives should not be exceeded at any sensitive receivers.

There will be no air sensitive receivers on Stonecutters Island affected by the operation of the Naval Base and it has been concluded that there will not be any significant air pollution impacts from activities in the base.

Visual Impacts/Landscape Masterplan

The proposed development extends approximately 500 metres from the shoreline and will have a major impact on the harbour, especially as the development will incorporate different built forms and straight edges. This impact will be mitigated to some degree by the existing wooded ridgeline of the island which will help to soften the outline and provide a unifying backdrop.

A landscape masterplan has been prepared with the aim of softening the outline of the proposed buildings and to help tie them visually into the existing island edge. Natural building materials and sympathetic colour schemes should be used wherever possible.

Any planting should be undertaken early on to shield the construction site from view. Measures must be taken before the commencement of construction to safeguard trees from damage.

Recommendations

The general conclusion of the study has been that it will be possible to construct and operate the proposed naval facilities within guidelines for acceptable environmental impacts so long as careful note is taken of environmental impacts throughout the design. The key recommendations of the Study are:

- the basin should be designed to optimise water circulation;
- new boulder shoreline should be created on Stonecutters Island;
- contract clauses for environmental protection should be applied to minimise pollution during construction.

APPENDIX A

APPENDIX A

BRIEF FOR STONECUTTERS ISLAND SOUTH SHORE NAVAL FACILITIES ENVIRONMENTAL IMPACT ASSESSMENT

1. Purpose of the Study

The purpose of the assessment is to minimize pollution, environmental disturbance and nuisance arising from the construction and operation of the Stonecutters Island South Shore Naval Facilities and related facilities by providing information on the nature and extent of potential environmental impacts and marine operational impacts, taking into account the alternative configurations of the development. This information will contribute to decisions on:-

(i) the acceptability of any adverse environmental consequences that are likely to arise from the construction and operation of the proposed development;

(ii) the conditions and requirements for the detailed design, construction and operation of the proposed development; and

(iii) the acceptability of any residual impacts, after mitigation measures are implemented.

2. Objectives of the Study

The objectives of the environmental impact assessment are to:

(i) describe the characteristics of the proposed naval facilities and the related facilities and the requirements for their development;

(ii) identify and describe the elements of the community and the environment likely to be affected by the naval facilities;

(iii) identify, predict and evaluate, based on all the alternative configurations, the residual (i.e. after practicable mitigation) environmental impacts and cumulative effects expected to arise during the construction and operation of the project in relation to the existing and planning neighbouring land uses and water bodies.

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

(v) design and specify the environmental monitoring and audit requirements necessary to ensure the effectiveness of the environmental protection measures adopted.

3. Requirements of the Environmental Impact Assessment Study

3.1 To meet all the objectives listed in section 2 above including:-

(i) carrying out any necessary environmental survey and baseline monitoring work to achieve the objectives;

(ii) quantifying, by use of models or other predictive methods, the environmental impacts arising from the construction and operation of the development;

(iii) proposing practicable, effective and enforceable measures to mitigate effectively any significant environmental impacts in the short and long term; and

(iv) outlining a programme by which the environmental impacts of the project can be monitored, audited and assessed.

3.2 The Consultants shall liaise with relevant Government departments and agencies and all other parties involved in this assessment study and any other projects or development likely to be affected by this assessment study.

3.3 The assessment shall consist of the following:-

(i) an <u>Inception Report</u> should be prepared and submitted, within 4 weeks of the Study commencing, by the consultant. The Inception Report shall include, inter-alia the following:-

(a) the consultants' understanding and appreciation of the objectives of the Environmental Impact Assessment Study;

(b) the approach and methodology for the various parts of the Environmental Impact Assessment Study;

(c) selection of evaluation criteria;

(d) a work programme, with major work tasks and key decision points identified and briefed described; and

(e) a schedule detailing the submission of the reports and the Study Management Group meetings.

(ii) a series of Working Papers which contain at least but not be limited to:-

1) An <u>Initial Assessment Report</u> which

(a) provides an initial assessment and evaluation of the environmental impacts arising from the proposed development, sufficient to identify those issues of key concern during the construction and operation of the development, which are likely to influence decisions on the development;

(b) defines measurable parameters likely to be affected by the proposed development and identifies the monitoring studies necessary to provide a baseline profile of existing environment conditions; and

(c) proposes a detailed programme of investigation, monitoring and reporting able to meet all other objectives of the assessment;

2) Key Issue Report(s) to cover those issues of key concern identified through either the Initial Assessment Report or the review of the Initial Assessment Report to be taken by the Director of Environmental Protection (DEP);

(iii) a Final Report shall review and summarise the findings of all Working Papers which should cover all aspects of environmental concern.

(iv) any revisions or supplements to the above as might be required to be carried out by the director of Environmental Protection;

(v) an Executive Summary in both English and Chinese, of the environmental assessment, highlighting the issues of concern to the community, the acceptability of residual environmental impacts and cumulative effects, requirements for implementations of the development, and the basis for an implications of those requirements, but omitting the non-essential technical details. It is intended that the information presented therein should assist the Government in undertaking public consultation.

(vi) The Final Report and Executive Summary may be made available to the public and should be prepared with this in mind. This will involve placing confidential or non-government material in appendices that can be removed prior to public release.

3.4 Technical Requirements of the Study

The Environmental Impact Assessment Study shall include, but shall not necessarily be limited to noise impact, air quality impact, water quality impact and waste/spoil disposal impact assessments of the construction and operation phases of the project.

In addition, the Environmental Impact Assessment Study shall comprise a marine operational impacts assessment, land use and visual impact assessment.

3.5 Sensitive Receivers/Receptors

Sensitive receivers/receptors shall be identified for both existing and planned uses in accordance with the Hong Kong Planning Standards and Guidelines (HKPSG).

3.6 Construction Phase Assessment

Impacts during the construction phase involving the installation of the naval facilities, any additional support infrastructure, utility plant, clinic, canteen, etc. with respect to the acceptable levels noted in HKPSG and relevant Pollution Control Ordinances.

3.6.1 Air & Noise Impact

The cumulative impacts of dust and noise producing processes, plant, vehicles and machinery, spoil disposal, and material transportation on adjacent air and noise sensitive uses, such as military quarters on Stonecutters Island and residential blocks in the vicinity, shall be assessed and evaluated. The background dust and noise levels in the area should be taken into account in the assessment of the cumulative impacts of dust and noise producing processes respectively.

The method and timing of construction should be analysed and potential major sources of dust and noise should be identified.

Where 24 hour working is anticipate, its need and environmental implications have to be assessed.

Task 1 : Identification of Representative Receptors

Consider the existing and future land uses in the Environmental Impact Assessment Study area and prepare plans identifying representative receptors in the vicinity of the proposed project. The locations of the representative receptors should be agreed with the Director of Environmental Protection.

Task 2 : Analysis of Construction Activities

From a knowledge of the likely type, sequence and duration of construction activities required for the project implementation, identify those construction activities likely to cause air quality and noise problems to the receptors.

Task 3 : Air & Noise Pollution Impact Assessment

Assess the air and noise pollution impacts of the proposed project to receptors by suitable modelling with reference to the Hong Kong Air Quality Objectives (HKACO), Noise Control Ordinance (NCO) and Hong Kong Planning Standards and Guidelines (HKPSG). The Consultants should provide detailed methodology statement and key assumptions of the selected models to the Director of Environmental Protection for comment and consent before the commencement of the modelling works.

Task 4 : Proposal for Pollution Control Measures

Recommend appropriate air pollution control measures for the inclusion into the contract documents. Where appropriate, compliance monitoring should be proposed.

3.6.2 Water Quality Impact

The impacts on watercourses and the receiving water body should be identified and assessed. This should include the cumulative impacts of any proposed dredging and reclamation, marine spoil transportation and disposal activities, any marine borrow activities and any discharges to the aquatic environment including the effect of silty run-off and sewage discharge on water quality.

3.6.3 Waste Disposal

Disposal of any liquid effluent, storm water run-off, solid wastes and sludge arising from construction activities shall be assessed and quantified. Particular attention should be paid to the handling and disposal of contaminated marine mud to be dredged from the site. Satisfactory methods of disposal and treatment, if required, shall be determined.

3.6.4 Visual Impact

Visual impacts during the construction of the naval facilities shall be assessed including the effects of site buildings, storage silos and berthing facilities. Mitigation measures shall be recommended.

3.6.5 Ecological Impact

Ecological impacts, if any, due to the construction of the proposed development shall be assessed including the effects on the avifauna and a in particular on the night heron population. Effective mitigation measures shall be recommended.

3.7 Operational Phase

Impacts during the operating phase involving normal, abnormal, transient and emergency operations with respect to the acceptable levels noted in HKPSG and relevant Pollution Control Ordinances.

3.7.1 Noise Impact

The cumulative impacts of noise arising from noisy operations such as firing, helicopper noise, material transportation and handling, marine operations and any other noisy activities on the adjacent noise sensitive receivers should be assessed.

The cumulative air quality impact from nearby development e.g. Container Terminal no. 8 and Government Dockyard etc. should also be evaluated.

3.7.3 Water Quality Impacts

The direct and indirect cumulative water quality impacts due to any reclamation, embayment, dredging and discharges (in terms of trade effluent on-site, storm water run-off and sewage) on the water courses and water bodies need to be identified and quantified, with the consideration given for adequate reception, handling, treatment and disposal of any effluent discharges to comply with discharge and disposal guidelines to be approved by the Director of Environmental Protection (DEP).

3.7.4 Waste Disposal

Liquid and solid wastes from the proposed naval facilities should be identified and quantified with proposals presented for their proper reception, handling, treatment and disposal, as approved by Director of Environmental Protection. Particular attention shall be paid to the handling and disposal of clinical wastes generated. Satisfactory liquid and solid waste disposal and treatment facilities should be determined.

3.7.5 Ecological Impacts

Ecological impacts, if any, during the operational phase of the proposed development shall be assessed and effective mitigation measures shall be recommended.

3.8 Marine Operational Impact

Identify impacts resulting from the passage and mooring of vessels and the effects on nearby marine operations;

Estimate impacts due to leakage an spillage during ship-to-shore transfers including the maximum probable event and the significance of impact in the event of a major marine spillage;

Identify impacts on local water circulation patterns;

Propose an emergency plan to handle spillage at the jetty.

3.9 Land Use

Identify all land uses, including water body to be affected by the project and assess the impacts of the project including all on-site and off-site works areas on these uses. The impacts shall include visual impact.

Identify any impact that may be undesirable or unacceptable and develop suitable mitigation measures to reduce the impacts to acceptable levels.

3.10 Landscape and Visual Impact

Develop proposals for suitable mitigation measures for any landscape and visual impacts which are considered to be undesirable or unacceptable.

Prepare a Landscape Master Plan including proposals for landscape following construction of the project and subsequent maintenance.

3.11 Effective mitigation measures for all significant impacts identified above should be proposed to minimize the occurrences and consequences of predicted impacts, both in terms of layout of the facilities, equipment selection and design and also in terms of management and operational procedures.

3.12 Monitoring and Audit Requirements

3.12.1 Environmental Monitoring

The Consultants shall identify and recommend environmental monitoring requirements for all construction, post-project and operational phases of the development. These requirements shall include but not be limited to the identification of sensitive receivers, monitoring locations, monitoring parameters and frequencies, monitoring equipment to be used, and any other necessary programmes for baseline monitoring, impact and compliance monitoring, and data management of monitoring results.

3.12.2 Environmental Audit

The Consultants shall identify and recommend environmental audit requirements for all construction, post-project and operational phases of the development. These requirements shall include but not be limited to:-

a. organisation and management structure, and procedures for auditing of the implementation of respective environmental mitigation measures recommended for the detailed design, contract document preparation, construction, post-project operation stages of the development;

b. environmental quality performance limits for compliance auditing for each of the recommended monitoring parameters to ensure compliance with relevant environmental quality objectives, statutory or planning standards, or acceptance criteria recommended by the Environmental Impact Assessment. These limits shall give indication of a deteriorating environmental quality and shall allow proactive responses to be taken. (The commonly used approach is a set of trigger, action and target levels).

c. organisation and management structure, and procedures for reviewing the monitoring results and auditing the compliance of the monitoring data with the environmental quality performance limits (point (b) above), project contractual and regulatory requirements, and environmental policies and standards:

d. Event/Action plans for impact and compliance monitoring;

e. complaints handling, liaison and consultation procedures; and

f. reporting procedures, report formats and reporting frequency including periodical reports and annual reviews to cover all construction and post-project/operational phases of the development.

3.10.3 The Consultants shall prepare an Environmental Schedule (Manual) which covers the requirements and recommendations in 3.10.1 and 3.10.2. The Manual shall also contain a summary list of recommended environmental mitigation measures. This Manual shall be used as a guideline for environmental monitoring and audit during the construction and post-project operational phases. This Manual shall be a stand-alone document and form part of the Environment Impact Assessment report.

4. Liaison and Administration

4.1 The Environmental Impact Assessment Study will be managed by a Study Management Group (SMG) chaired by a representative of DEP. This shall be the forum for liaison with Government departments and agencies, providing guidance to the study consultant, and for comment and review on the work and outputs of the study. All secretarial services will be provided by the proponent's consultant.

4.2 The consultant will be expected to communicate and correspond directly with other Government departments to obtain information in connection with the project, copying such correspondence to Director of Environmental Protection, who will cooperate with and assist the consultant to obtain information and arrange meeting with Government officers.

4.3 In accordance with Planning, Environment, & Lands Technical Circular 2/92, if there is any disagreement on the finding of the Environmental Assessment or on the necessary environmental protection and pollution control measures, the issue will be referred to the Secretary for Planning, Environment and Lands who shall resolve the differences in consultation with the Environment Pollution Advisory Committee, appropriate Branches and Departments.

4.4 In accordance with Planning, Environment & Lands Branch General Circular 2/92, the Final Environment Impact Assessment Report and Executive Report should normally be made available to the public. The confidential or public security issues shall be prepared in separate appendices which can be removed prior to public release.

5. Reporting Requirements

The consultant shall produce and forward direct the following reports to the Director of Environmental Protection and other Government Departments at least:-

- 20 copies of the Draft Inception Report;
- 20 copies of the Final Inception Report;
- 20 copies of the Draft Working Papers;

- 20 copies of the Final Working Papers;
- 20 copies of the Draft Final Report;
- 60 copies of the Final Report;
- 20 copies of the Draft Executive Summary Report; and
- 120 copies of the Executive Summary Report.

6. Consultation and Relevant Information

The Consultants will be expected to consult and maintain liaison with any Government Department or any other party as may become necessary in the course of the commission. The Director's Representative for the purpose of this project shall be the Assistant Director (Arch)1 who will appoint a liaison officer to direct and assist the Consultants in any matter relating to the project.

Notes on the Signing of Consultancy Agreements

(i) A consultant who is a sole proprietor shall sign his usual signature and affix a legal wafer.

(ii) If a consultant is a partnership, either all partners must sign and affix legal wagers on a person or persons so authorized by Power by Attorney must sign and affix wafers. The signators shall be required to present their Power of Attorney for perusal, by the Employer at the time of signing.

(iii) A company other than an "overseas company" may executive the Agreement either by the impressment of its Common Seal upon the Memorandum of Agreement, accompanied by such signatures as are required by the Memorandum and Articles of Association of the company, or by the Agreement being signed by a person(s) so authorized by a resolution of the Board of Directors of the company (such resolution has to be submitted to the Employer for perusal) and the impressment of the personal seal(s) of the person(s) so authorized or the affixing by such person(s) of a legal wafer. A copy of the relevant Articles of Association which relate to the affixing of the Common Seal shall be submitted to the Employer.

(iv) An "overseas company" shall execute the Agreement by signature of a person or persons so authorized by the Power of Attorney which expression includes an authority made by a Resolution of the Board of Directors, impressed with the company's Common Seal in the country of origin. Such signators will affix legal wafers. The person or persons signing the Assessment must produce their powers of Attorney for examination by the Employer at the time of signing.

(v) In the case of an incorporated company, the Power of Attorney must relate to the business of the company.

Requirements of Water Quality Modelling

A. For the purpose of carrying out the EIA Study, mathematical models shall be used for water quality assessment. The models shall be used to predict the local and cumulative water quality impact and extent of the sediment plume/deposit in nearby waters affected by the project during both construction and operation phases as required in Sections 3.4.2 & 3.5.3 of the Study Brief. The assessment shall include the potential deterioration of water quality, but not limited to the following phenomena : increase in turbidity levels, SS contents, ammonia and nutrient levels or decrease in dissolved oxygen, in the water column, and reduced flushing capacities, during:-

(i) construction phase;
(ii) operation phase;
(iii) maintenance dredging.

B. The Consultants is not confined to use any mathematical models which are similar to those (WAHMO models) of the government. The Consultant shall set up flow water quality models, analyze and interpret the modelling results. Prior executing the model runs, the Consultants shall submit calibration reports to CED and EPD for comment. No model runs may be executed without prior consent of both CED and EPD.

C. The Consultants shall agree with the Director's Representative the extent and programme of the model testing, taking into account of the advice given by CED and EPD. The Consultants shall provide CED and EPD with all the input data necessary for the testing at least 10 working days before the scheduled commencement of the test. The input data shall include, but not limited to, layout of alternatives, bathymetry data, boundary conditions and pollution loadings.

C. External information relevant for setting up of the model:
The Reports outlined below gave indication of the existing and proposed shoreline configuration and pollution loadings within and in the vicinity of the study area:

Sewage Strategy Study
Strategic Sewerage Disposal Scheme - Site Investigation and Engineering Studies
Tsuen Wan, Kwai Chung, Tsing Yi Sewerage Master Plan Study
North West Kowloon Sewerage Master Plan
West Kowloon Reclamation
Central Reclamation Phase I
Green Island Reclamation
Belcher's Bay Link
Container Terminals No. 8 & 9
Tsing Yi Duplicate South Bridge
Rambler Channel Reclamation
Route 3 - Ting Kau Bridge
Port Peninsular Projects at Lantau Island

D. The Consultants shall propose the specifications of the modelling works for approval. The specifications shall include, but not limited to, the following:-

Item	Specification
i) Dimensions and layers of the model	Max. grid size: 50m and not less than 4km of the naval basin Model layers: At least 2 layers
ii) Site Coverage	
iii) Tidal and seasonal conditions	Including both wet and dry seasons and Spring and Neap tides
iv) Requirement of field data for calibration of the models	Minimum 5 sampling stations required, with:- min. one for the site itself; and min. one for each of the model boundaries Duration of surveys: both flow and water quality surveys should cover a set of whole spring and neap tides for either wet or dry season
v) Scenarios to be tested	Include baseline, various stages in construction period, operational, with and without mitigation measures

F. Minimum functional models required:-

- Flow and Float Track Model
- Water Quality and Bacterial Dispersion Models
- Sediment Transport Models with a gridded cell of not greater than 50m and Sediment Plum.

APPENDIX B

APPENDIX B

ENGINEERING GEOLOGY OF THE SOUTH SHORE OF STONECUTTERS ISLAND

1. Introduction

This report is prepared on the basis of fieldwork carried out by the Hong Kong Geological Survey and desk study of information held in the Civil Engineering Library.

2. Geology of Stonecutters Island

Most part of the island are underlaid by medium-grained granite. The granite is generally strong light grey or light pink in colour when fresh, with uniform equigranular medium-grained texture. This rock weathers to medium dense to very dense yellowish brown, grey silty, clayey sand, often with relict texture and structures preserved.

An outcrop of volcanic rock of tuff breccia is found in a small area at the western tip of the island.

The valleys on the island are generally thinly covered by debris flow deposits. This superficial deposit generally consists of loose boulders and cobbles set in a gravelly, sandy matrix.

Beach deposits are found surrounding the island. A well developed tombolo sand bar occurs at the north eastern part of the island. The beach deposit generally consists of loose, light yellow, coarse sand.

A geological map showing the solid and superficial geology of the island is shown in Figure 1 (based on Strange & Shaw, 1986).

3. Offshore Geology (South side of the island)

The offshore geology generally consists of two sequences of transported soils overlying the insitu weathered granite.

The sandy beach deposits diminish quickly towards the sea. The island is surrounded by a blanket of very soft to soft dark grey marine mud belonging to the Hang Hau Formation. The thickness of this deposit is generally 10 to 15m.

Underneath the soft marine mud is the Chek Lap Kok Formation which is a firm to stiff bluish grey sandy, clayey silt to sand with occasional layer of gravel. the thickness of this deposit is generally less than 10m near the shore and increases to 15m further away from the island. Beneath this formation is the insitu weathered granite.

Figure 2 shows the locations of some of the drillholes reviewed during this study. The positions of three cross sections which are extracted from a geophysical survey carried out near the island are also shown in Figure 2. The cross sections of the south side of the island are given in Figure 3.

4. Engineering Properties of the Weathered Granite

The weathering profile of the granite is highly variable. The depth of weathering is very shallow where rock outcrops and increases sharply to more than 15m elsewhere. SPT N-values recorded are generally more than 10 near the top of the weathering profile and increase sharply to more than 50 with depth. Core stones are present in the weathering profile and the percentage of core stones increases with depth. Laboratory testing of the weathered granite from the island indicated c' (cohesion) values ranging from 0 to 25 KPa and ø' (angle of internal friction) ranged from 32' to 39'.

5. Engineering Properties of the Hang Hau Formation

The Hang Hau Formation is a fairly uniform marine deposit. This formation consists of very soft marine mud near the surface with increase in stiffness with depth. Cone Penetration Test results in this formation indicate that the tip resistances are generally less than 1 MPa. SPT N-values recorded in this formation are generally less than 10. Insitu vane shear tests carried out in this formation at the north side of the island indicate undrained shear strengths of less than kPa.

6. Engineering Properties of the Chek Lap Kok Formation

The Chek Lap Kok Formation is a lithologically diverse deposit. The formation consists of sequences of silt, dense and gravel. The boundary between this formation and the Hang Hau Formation is marked by a sharp increase in tip resistance of the Cone Penetration Test. The profile of tip resistance in this formation is variable due to the layered nature of the formation. Tip resistance in this formation generally varies between 5 and 12 MPa. SPT N-values recorded in this formation are generally more than 10, with much higher values in dense sand and gravel strata.

7. GIU Reports Reviewed

The ground investigation reports from the Civil Engineering Library reviewed in this report are summarised as follows:

GIU No.	Title	Date of Report
3450	GI for the Propose East Pier and South Pier Extension at Stonecutters Island.	July 1982
4049	Marine GI for the Proposed New Wharf at Stonecutters Island.	March 1967
4465	Marine GI for the Harbour Reclamation and Urban Growth Study.	April 1983
4819	Marine GI - Stonecutters Island	Unknown
5453 to 5455	Marine Geophysical Survey for the Harbour Reclamations and Urban Growth Study. Vol. 1 to 3	June 1983

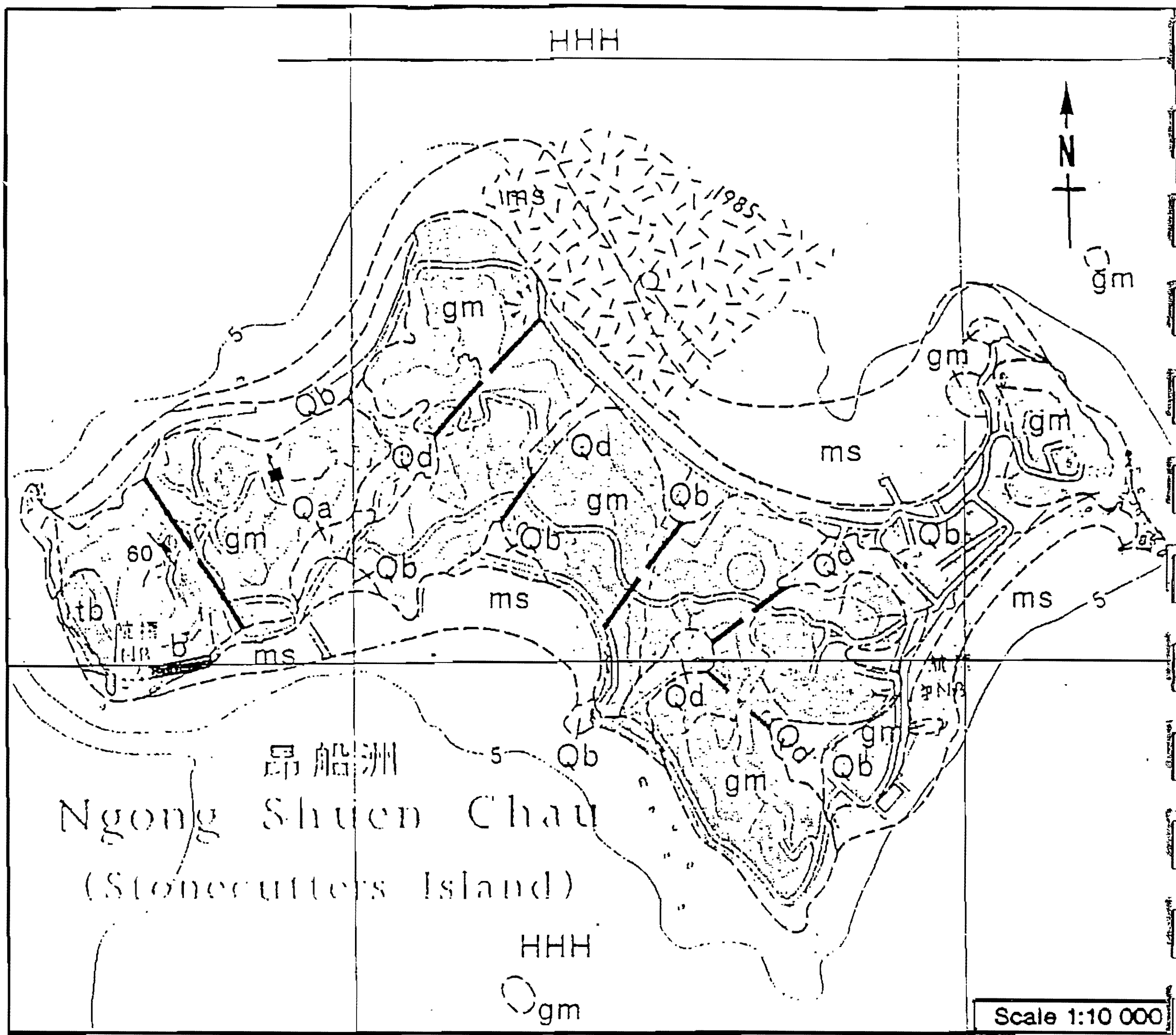
GIU No.	Title	Date of Report
11418	Marine Geophysical Survey for the North West Kowloon Sewage Treatment and Disposal Investigation for Revised Outfall Design.	Nov 1988
11548	Marine GI for the North West Kowloon Sewage Treatment and Disposal Scheme.	Dec 1988
11826	Soil testing report for the North West Kowloon Sewage Treatment and Disposal Scheme.	May 1989
12121	Marine GI for the Development Study of Container Terminal No. 8.	Aug 1989
12678	Marine Geophysical Survey for the Terminal No. 8 At Tsing Yi and Stonecutters Island.	Nov 1989
12956	Marine Geophysical Survey for the Dredging of Yau Ma Tei Anchorage and Kellett Bank. Vol.1.	April 1990
12975	Marine GI for the Route 3 - Feasibility Study Stonecutters Island Section.	May 1990
14192	Soil testing report for the Reprovision of RN Stonecutters Island, Schedule No. 2.	Mar 1991
15682	GI for the Reprovision of RN to Stonecutters Island - Phase I	Nov 1991

8. References

Strange, P.J. & Shaw R. (1986). Geology of Hong Kong Island and Kowloon (Sheet 11 & 15). Hong Kong Geological Survey Memoir No. 2. Geotechnical Control Office, Hong Kong, 134 p.

Binnie Consultants Ltd. et al (1992). Fill Management Study - Phase II. Investigation and Development of Marine Borrow Areas. Kap Shui Mun Area Final Assessment Report, report prepared for Civil Engineering Department, Geotechnical Engineering Office.

Prepared by: Engineering Geology Section/Planning Division/Geotechnical Engineering Office
Date : 23.10.92



Keys:

Legend	Name	Principal Materials
Qb	Beach deposits	Sand
Qd	Debris flow deposits	Unsorted sand, gravel, cobbles and boulders, clay/silt matrix
HHH	Hang Hau Formation	Undivided, mainly dark grey marine mud
ms	Marine sand	Marine sand, part silty
tb	Tuff-breccia	Volcanic rock
gm	Medium grained granite	Granitic rock of grain size 2 to 6 mm
b	Basalt	Fine grained dyke rock

Symbol

60	Inclined jointing
	Vertical jointing
	Geological boundary, superficial deposit
	Inferred geological boundary, solid rock
	Inferred fault
	Photogeological lineament

Note:

Information in this drawing is extracted from Geological map (Sheet 11) produced by Hong Kong Geological Survey.

Figure 1 - Geological Map of Stonecutters Island

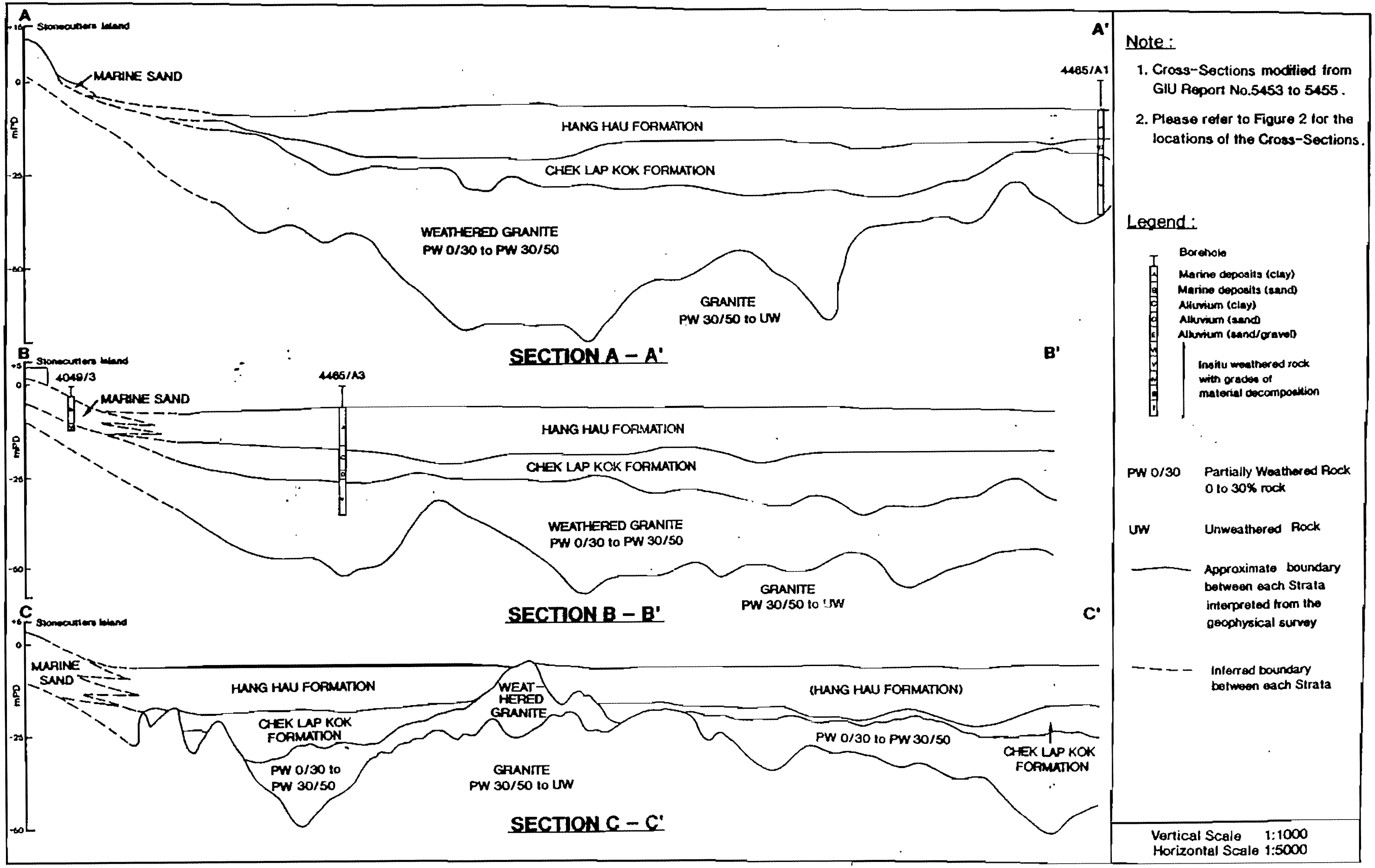


Figure 3 - Cross Sections of the South Shore of Stonecutters Island

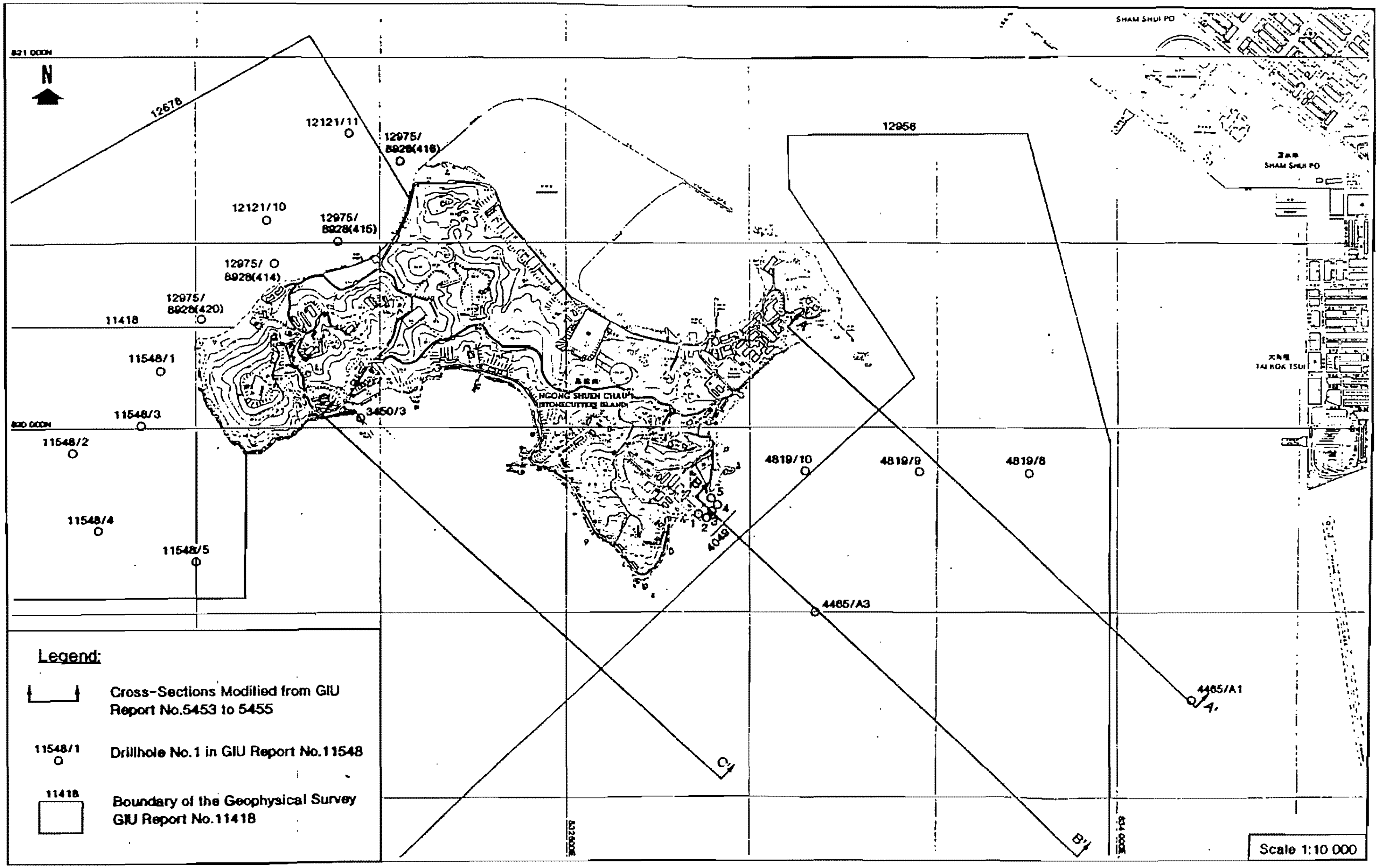


Figure 2 - Engineering Data Map

APPENDIX C

APPENDIX C

PROPOSED CONDITIONS OF CONTRACT DURING CONSTRUCTION

C1. Removal of waste material

(a) Notwithstanding the provisions of the General Conditions of Contract, the Contractor shall not permit any sewage, waste water or effluent containing sand, cement, silt or any other suspended or dissolved material arising from the construction works to flow from the Site onto any adjoining land or allow any waste matter or refuse from the Works to be deposited anywhere within the Site or onto any adjoining land and shall have all such matter removed from the Site.

(b) The Contractor shall be liable for any damage caused to adjoining land through his failure to comply with Clause (a).

(c) The Contractor shall be responsible for temporary training, diverting or conducting of open streams or drains intercepted by any works and for reinstating these to their original courses on completion of the Works.

(d) The Contractor shall be responsible for adequately maintaining any existing site drainage system at all times including removal of solids in sand traps, manholes and stream beds.

(e) The Contractor shall segregate all inert construction waste material suitable for reclamation or land formation and shall dispose of such material at such public dumping area(s) as may be specified from time to time by the Director of Civil Engineering Services.

(f) All non-inert construction waste material deemed unsuitable for reclamation or land formation and all other waste material shall be disposed of at a public landfill.

(g) The Contractor's attention is drawn to the Waste Disposal Ordinance, the Public Health and Municipal Services Ordinance and the Water Pollution Control Ordinance.

C2. Discharge into sewers and drains

(a) The Contractor shall not discharge directly or indirectly (by runoff) or cause or permit or suffer to be discharged into any public sewer, storm-water drain, channel, stream-course or sea any effluent or foul or contaminated water or cooling or hot water without the prior consent of the relevant authority who may require the Contractor to provide, operate and maintain at the Contractor's own expense, within the premises or otherwise, suitable works for the treatment and disposal of such effluent or foul or contaminated or cooling or hot water. The design of such treatment works shall be submitted to the Engineer for approval not less than one month prior to the commencement of construction or as agreed by the Engineer.

(b) If any office, site canteen or toilet facilities are erected, foul water effluent shall be directed to a foul sewer or to a sewage treatment facility either directly or indirectly by means of a pumping facility approved by the Engineer.

(c) The Contractor's attention is drawn to the Buildings Ordinance and to the Water Pollution Control Ordinance and the Technical Memorandum "Standards for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters".

C3. Water Quality

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

(ii) Before the commencement of the Works, the Contractor shall submit to the Engineer the proposed methods of working.

(iii) After commencement of the Works if the plant or work methods are believed by the Engineer to be causing unacceptable levels of pollution, the plant or work methods shall be inspected and remedial proposals drawn up, approved and implemented. Where such remedial measures include the use of additional or alternative plant such plant shall not be used on the Works until agreed by the Engineer. Where remedial measures include maintenance or modification of previously approved plant such plant 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.

(iv) When dredging (or placing fill) the Contractor shall surround any seawater intakes which may be affected by such operations with suitable silt curtain systems, to prevent excess silt contaminating the water drawn into the intakes. The silt curtain systems shall be designed to ensure that the intake water shall contain less than 140 mg/l suspended solids.

(v) The Contractor shall comply with the provisions of the Summary Offences Ordinance, particularly with respect to marine littering.

C4. General Procedures for the Avoidance of Pollution During Dredging, Transporting and Dumping

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

(b) Pollution avoidance measures shall include but are not limited to the following:-

(i) mechanical grabs shall be designed and maintained to avoid spillage and shall seal tightly while being lifted;

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

(iii) where trailing suction hopper dredgers for dredging of uncontaminated marine mud are used, overflow from the dredger and the operation of lean mixture overboard systems shall not be permitted, unless expressly approved by the Engineer in consultation with the EPD;

(iv) all vessels 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 propeller wash;

(v) all pipe leakages are to be repaired promptly and plant 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 Site or dumping grounds;

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

(viii) excess material shall be cleaned from the decks and exposed fittings of barges and hopper dredgers before the vessel is moved;

(ix) loading of barges and hoppers shall be controlled to prevent splashing of dredged material to the surrounding water and barges or hoppers shall not be filled to a level which will cause overflow of material or polluted water during loading or transportation;

(x) adequate freeboard shall be maintained on barges to ensure that decks are not washed by wave action; and

(xi) any other pollution avoidance measures deemed suitable and appropriate by the Contractor.

(c) The Engineer may monitor any or all vessels transporting material to ensure that no dumping outside the approved location takes place. The Contractor shall provide all reasonable assistance to the Engineer for this purpose.

(d) The Contractor shall ensure that all marine mud, contaminated marine mud and unsuitable material is disposed of at the approved locations. He will be required to ensure accurate positioning of vessels before discharge and will be required to submit and agree proposals with the Engineer for accurate positional control at disposal sites before commencing dredging. All disposal in designated marine dumping grounds shall be in accordance with the conditions of a licence issued by the DEP under the Dumping at Sea Act (Overseas Territories) Order 1975. Floatable and contaminated materials (as defined by the DEP) will not be acceptable at marine dumping grounds and will require other methods of disposal.

(e) The Engineer may monitor any or all vessels transporting material to ensure that loss of material does not take place during transportation. The Contractor is to provide all reasonable assistance to the Engineer for this purpose.

(f) The Contractor shall design methods of working to minimise pollution and shall provide both experienced personnel and suitable training to ensure that these methods are implemented.

C5. Designated Contaminated Marine Mud

The locations and depths of the designated contaminated marine mud will be as directed by the Engineer on site. The Contractor is to ensure that the designated contaminated marine mud is dredged, transported and placed in approved special dumping grounds and in such a manner as to minimise the loss of material to the water column.

C6. Special Procedures for the Avoidance of Pollution During Dredging, Transportation and Disposal of Designated Contaminated Marine Mud

(a) Uncontaminated mud shall not be dumped other than in dumping grounds as may be approved by the DEP and in accordance with the Dumping at Sea Act (Overseas Territories) Order 1975. Contaminated mud shall not be dumped in gazetted dumping grounds. If it cannot be left *in situ* it should be disposed of by specific methods as directed by the DEP. The Contractor shall be responsible for obtaining all necessary licences for these operations.

(b) When dredging, transporting and disposing of designated contaminated marine mud, 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 designated contaminated marine mud shall only be undertaken by a suitable grab dredger using a closed watertight grab;

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

(iii) the material will be placed in the pit by bottom dumping, at a location within the pit to be specified, from time to time, by the Secretary of Fill Management Committee;

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

(v) the Contractor must be able to position the dumping vessel to an accuracy of $\pm$10m;

(vi) the Engineer for the Contract which is disposing of the contaminated mud will supervise and record the disposal operation. The Contractor shall provide assistance to the Engineer and the details of the supervision and record keeping are to be agreed beforehand by the Director of Environmental Protection; and

(vii) the Contractor shall ensure that the dumping vessel shall be stationary throughout the dumping operation.

In addition to the foregoing, the Fill Management Committee and the Environmental Protection Department will apply special requirements in respect of dredged material when further details are available.

APPENDIX D

APPENDIX D

EXTRACT FROM THE TM

Table 1 **Standards for effluents discharged into <u>foul sewers leading into Government sewage treatment plants</u>**
(All units in mg/L unless otherwise stated; all figures are upper limits unless otherwise indicated)

Flow rate (m^3/day) Determinand	≤ 10	> 10 and ≤ 100	> 100 and ≤ 200	> 200 and ≤ 400	> 400 and ≤ 600	> 600 and ≤ 800	> 800 and ≤ 1000	> 1000 and ≤ 1500	> 1500 and ≤ 2000	> 2000 and ≤ 3000	> 3000 and ≤ 4000	> 4000 and ≤ 5000	> 5000 and ≤ 6000
pH (pH units)	6-10	6-10	6-10	6-10	6-10	6-10	6-10	6-10	6-10	6-10	6-10	6-10	6-10
Temperature (°C)	43	43	43	43	43	43	43	43	43	43	43	43	43
Suspended solids	1200	1000	900	800	800	800	800	800	800	800	800	800	800
Settleable solids	100	100	100	100	100	100	100	100	100	100	100	100	100
BOD	1200	1000	900	800	800	800	800	800	800	800	800	800	800
COD	3000	2500	2200	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Oil & Grease	100	100	50	50	50	40	30	20	20	20	20	20	20
Iron	30	25	25	25	15	12.5	10	7.5	5	3.5	2.5	2	1.5
Boron	8	7	6	5	4	3	2.4	1.6	1.2	0.8	0.6	0.5	0.4
Barium	8	7	6	5	4	3	2.4	1.6	1.2	0.8	0.6	0.5	0.4
Mercury	0.2	0.15	0.1	0.1	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Cadmium	0.2	0.15	0.1	0.1	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Copper	4	4	4	3	1.5	1.5	1	1	1	1	1	1	1
Nickel	4	3	3	2	1.5	1	1	0.8	0.7	0.7	0.6	0.6	0.6
Chromium	2	2	2	2	1	0.7	0.6	0.4	0.3	0.2	0.1	0.1	0.1
Zinc	5	5	4	3	1.5	1.5	1	0.8	0.7	0.7	0.6	0.6	0.6
Silver	4	3	3	2	1.5	1.5	1	0.8	0.7	0.7	0.6	0.6	0.6
Other toxic metals individually	2.5	2.2	2	1.5	1	0.7	0.6	0.4	0.3	0.2	0.15	0.12	0.1
Total toxic metals	10	10	8	7	3	2	2	1.6	1.4	1.2	1.2	1.2	1
Cyanide	2	2	2	1	0.7	0.5	0.4	0.27	0.2	0.13	0.1	0.08	0.06
Phenols	1	1	1	1	0.7	0.5	0.4	0.27	0.2	0.13	0.1	0.1	0.1
Sulphide	10	10	10	10	5	5	4	2	2	2	1	1	1
Sulphate	1000	1000	1000	1000	1000	1000	1000	900	800	600	600	600	600
Total nitrogen	200	200	200	200	200	200	200	100	100	100	100	100	100
Total phosphorus	50	50	50	50	50	50	50	25	25	25	25	25	25
Surfactants (total)	200	150	50	40	30	25	25	25	25	25	25	25	25

APPENDIX E1

Appendix E1

Noise Level for General Reclamation Based On Duration Of Operation provided by CED
Stonecutters Island Proposed Naval Facilities
Construction Programme A
- Unrestricted Period & Period 1 (0700 - 2300 hr)

A) Reclamation

Operation	PME	SWL	No	Total SWL	1994	1995												1996												1997					
					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
1 Dredging (Seabed & Basin & approach)	Grab dredger	112	2	115.01	—	—	—	—	—	—	—	—	—	—	—	—												—	—	—					
	Hopper barge	104	3	108.77	—	—	—	—	—	—	—	—	—	—	—	—												—	—	—					
	Tug boat	110	2	113.01	—	—	—	—	—	—	—	—	—	—	—	—												—	—	—					
	Launch	104	1	104.00	—	—	—	—	—	—	—	—	—	—	—	—												—	—	—					
2. Reclamation	Suction dredger	109	1	109.00					—	—	—	—	—																						
	Marine sand pump	104	1	104.00					—	—	—	—	—																						
	Bulldozers	115	2	118.01					—	—	—	—	—																						
	Tug boat	110	1	110.00					—	—	—	—	—																						
3. Place sand	Suction dredger	109	1	109.00					—	—	—	—	—	—	—	—	—	—	—																
	Marine sand pump	104	1	104.00					—	—	—	—	—	—	—	—	—	—	—																
	Bulldozers	115	2	118.01					—	—	—	—	—	—	—	—	—	—	—																
	Tug boat	110	1	110.00					—	—	—	—	—	—	—	—	—	—	—																
4. General earthworks	Trucks	117	4	123.02								—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—						
	Bulldozers	115	3	119.77								—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—						
	Roller (vibratory)	108	3	112.77								—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—						
	Total SWL at respective time:				117.91	117.91	117.91	117.91	123.80	123.80	123.80	127.36	127.35	126.62	126.62	126.82	126.00	126.00	120.00	124.97	124.97	124.97	124.97	124.97	124.97	124.97	124.97	125.75	125.75	117.91					

B) Seawall

Operation	PME	SWL	No	Total SWL	1994	1995												1996												1997					
					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
1. Concrete coping	Concrete barge	104	2	107.01												—													—	—					
	Crane	112	1	112.00												—													—	—					
	Concrete lorry mixer	109	2	112.01												—													—	—					
	Vibrators, poker	113	8	122.03												—													—	—					
2 Place rock fill	Derrick Barges	104	3	108.77					—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—									
	Tug boat	110	1	110.00					—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—									
	Launch	104	1	104.00					—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—									
3 Sloping seawall armouring	Derrick Barges	104	3	108.77								—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—						
	Tug boat	110	1	110.00								—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—						
	Launch	104	1	104.00								—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—						
4 Set concrete seawall blocks	Derrick barges	104	2	107.01								—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—								
	Tug boat	110	1	110.00								—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—								
	Total SWL at respective time:								113.02	113.02	113.02	117.41	117.41	117.41	117.41	124.01	117.41	117.41	117.41	117.41	117.41	117.41	117.41	117.41	117.41	117.41	115.45	113.02	123.35	122.93					

C) Construction

Operation	PME	SWL	No	Total SWL	1994	1995												1996												1997					
					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
1. Ground beams and slabs	Generator	108	3	112.77																			—	—	—										
	Circular saw	108	1	108.00																			—	—	—										
	Lorry	112	3	116.77																			—	—	—										
	Concrete lorry mixer	109	3	113.77																			—	—	—										
	Poker (petrol)	113	2	116.01																			—	—	—										
	Crane	112	1	112.00																			—	—	—										
2 Building	Generator	108	3	112.77													—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Circular saw	108	1	108.00													—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Lorry	112	3	116.77													—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Concrete lorry mixer	109	3	113.77													—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Poker (petrol)	113	2	116.01													—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Crane	112	1	112.00													—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
3 Road construction	Backhoe	112	2	115.01									—	—	—	—	—	—	—	—	—	—													
	Concrete truck	109	2	112.01									—	—	—	—	—	—	—	—	—	—													
	Poker	113	2	116.01									—	—	—	—	—	—	—	—	—	—													
	Total SWL at respective time:												119.42	119.42	119.42	119.42	123.80	123.80	123.80	123.80	123.80	123.80	124.84	124.84	124.84	121.83	121.83	121.83	121.83	121.83	121.83	121.83	121.83	121.83	121.83

D) Piling

Operation	PME	SWL	No	Total SWL	1994	1995												1996												1997					
					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
1. Piling	Diesel hammer	128	2	131.00									—	—	—	—	—	—	—																
	Total SWL at respective time:												131.00	131.00	131.00	131.00	131.00	131.00	131.00																

Appendix E1

NOISE LEVEL IMPACTS ASSESSMENT
STONECUTTERS ISLAND PROPOSED NAVAL FACILITIES

CONSTRUCTION PROGRAMME A
– Unrestricted Period & Period 1 (0700 – 2300 hr)

B) Seawall

Coordinate	NSR 1	NSR 2	NSR 3	NSR 4	NSR 5	NSR 6	NSR 7
X	831855	831815	832015	831805	831920	831980	831965
Y	820055	820035	820130	820210	820272.5	820345	820110
Z	15	20	10	50	45	45	10
Notional source							
X	831842.5	831825	831952.5	831842.5	831850	831865	831905
Y	819982.5	819977.5	820045	819982.5	819985	819990	820015
Z	1	1	1	1	1	1	1
A(correction)	−48.35	−46.23	−51.93	−59.73	−62.01	−64.22	−52.56
12/94							
01/95							
02/95							
03/95							
04/95	65	67	61	53	51	49	60
05/95	65	67	61	53	51	49	60
06/95	65	67	61	53	51	49	60
07/95	69	71	65	58	55	53	65
08/95	69	71	65	58	55	53	65
09/95	69	71	65	58	55	53	65
10/95	69	71	65	58	55	53	65
11/95	76	78	72	64	62	60	71
12/95	69	71	65	58	55	53	65
01/96	69	71	65	58	55	53	65
02/96	69	71	65	58	55	53	65
03/96	69	71	65	58	55	53	65
04/96	69	71	65	58	55	53	65
05/96	69	71	65	58	55	53	65
06/96	69	71	65	58	55	53	65
07/96	69	71	65	58	55	53	65
08/96	69	71	65	58	55	53	65
09/96	69	71	65	58	55	53	65
10/96	67	69	64	56	53	51	63
11/96	65	67	61	53	51	49	60
12/96	75	77	71	64	61	59	71
01/97	75	77	71	63	61	59	70
02/97							
03/97							
04/97							
05/97							
06/97							

Appendix E1

NOISE LEVEL IMPACTS ASSESSMENT
STONECUTTERS ISLAND PROPOSED NAVAL FACILITIES

CONSTRUCTION PROGRAMME A
– Unrestricted Period & Period 1 (0700 – 2300 hr)

A) Reclamation

Coordinate	NSR 1	NSR 2	NSR 3	NSR 4	NSR 5	NSR 6	NSR 7
X	831855	831815	832015	831805	831920	831980	831965
Y	820055	820035	820130	820210	820272.5	820345	820110
Z	15	20	10	50	45	45	10
Notional source							
X	831875	831850	832075	831875	832055	832055	832025
Y	820035	820030	820083	820035	820088	820080	820080
Z	1	1	1	1	1	1	1
A(correction)	−39.23	−41.67	−48.62	−57.90	−59.62	−61.08	−47.31
12/94	79	76	69	60	58	57	71
01/95	79	76	69	60	58	57	71
02/95	79	76	69	60	58	57	71
03/95	79	76	69	60	58	57	71
04/95	84	82	75	66	64	63	76
05/95	84	82	75	66	64	63	76
06/95	84	82	75	66	64	63	76
07/95	88	86	79	69	68	66	80
08/95	88	86	79	69	68	66	80
09/95	87	85	78	69	67	66	79
10/95	87	85	78	69	67	66	79
11/95	87	85	78	69	67	66	79
12/95	87	84	77	68	66	65	79
01/96	87	84	77	68	66	65	79
02/96	87	84	77	68	66	65	79
03/96	86	83	76	67	65	64	78
04/96	86	83	76	67	65	64	78
05/96	86	83	76	67	65	64	78
06/96	86	83	76	67	65	64	78
07/96	86	83	76	67	65	64	78
08/96	86	83	76	67	65	64	78
09/96	86	83	76	67	65	64	78
10/96	86	83	76	67	65	64	78
11/96	87	84	77	68	66	65	78
12/96	87	84	77	68	66	65	78
01/97	79	76	69	60	58	57	71
02/97							
03/97							
04/97							
05/97							
06/97							

Appendix E1

NOISE LEVEL IMPACTS ASSESSMENT
STONECUTTERS ISLAND PROPOSED NAVAL FACILITIES

CONSTRUCTION PROGRAMME A
– Unrestricted Period & Period 1 (0700 – 2300 hr)

C) Construction

Coordinate	NSR 1	NSR 2	NSR 3	NSR 4	NSR 5	NSR 6	NSR 7
X	831855	831815	832015	831805	831920	831980	831965
Y	820055	820035	820130	820210	820272.5	820345	820110
Z	15	20	10	50	45	45	10
Notional source							
X	831872.5	831847.5	832035	831870	831982.5	831985	831977.5
Y	820025	820020	820085	850035	820035	820040	820050
Z	1	1	1	1	1	1	1
A(correction)	−41.04	−41.78	−44.15	−57.82	−60.28	−62.30	−46.39
12/94							
01/95							
02/95							
03/95							
04/95							
05/95							
06/95							
07/95							
08/95	78	78	75	62	59	57	73
09/95	78	78	75	62	59	57	73
10/95	78	78	75	62	59	57	73
11/95	78	78	75	62	59	57	73
12/95	83	82	80	66	64	62	77
01/96	83	82	80	66	64	62	77
02/96	83	82	80	66	64	62	77
03/96	83	82	80	66	64	62	77
04/96	83	82	80	66	64	62	77
05/96	83	82	80	66	64	62	77
06/96	84	83	81	67	65	63	78
07/96	84	83	81	67	65	63	78
08/96	84	83	81	67	65	63	78
09/96	81	80	78	64	62	60	75
10/96	81	80	78	64	62	60	75
11/96	81	80	78	64	62	60	75
12/96	81	80	78	64	62	60	75
01/97	81	80	78	64	62	60	75
02/97	81	80	78	64	62	60	75
03/97	81	80	78	64	62	60	75
04/97	81	80	78	64	62	60	75
05/97	81	80	78	64	62	60	75
06/97	81	80	78	64	62	60	75

Appendix E1

NOISE LEVEL IMPACTS ASSESSMENT
STONECUTTERS ISLAND PROPOSED NAVAL FACILITIES

CONSTRUCTION PROGRAMME A
– Unrestricted Period & Period 1 (0700 – 2300 hr)

TOTAL : (Reclamation + Seawall + Construction)

Coordinate	NSR 1	NSR 2	NSR 3	NSR 4	NSR 5	NSR 6	NSR 7
X	831855	831815	832015	831805	831920	831980	831965
Y	820055	820035	820130	820210	820272.5	820345	820110
Z	15	20	10	50	45	45	10
12/94	79	76	69	60	58	57	71
01/95	79	76	69	60	58	57	71
02/95	79	76	69	60	58	57	71
03/95	79	76	69	60	58	57	71
04/95	84	82	75	66	64	63	76
05/95	84	82	75	66	64	63	76
06/95	84	82	75	66	64	63	76
07/95	88	86	79	70	68	66	80
08/95	89	86	80	70	69	67	81
09/95	88	86	80	70	68	66	80
10/95	88	86	80	70	68	66	80
11/95	88	86	81	71	69	67	81
12/95	88	86	82	70	68	67	81
01/96	88	86	82	70	68	67	81
02/96	88	86	82	70	68	67	81
03/96	88	86	81	70	68	66	81
04/96	88	86	81	70	68	66	81
05/96	88	86	81	70	68	66	81
06/96	88	86	82	70	68	66	81
07/96	88	86	82	70	68	66	81
08/96	88	86	82	70	68	66	81
09/96	87	85	80	69	67	66	80
10/96	87	85	80	69	67	65	80
11/96	88	86	80	69	68	66	80
12/96	88	86	81	70	68	67	81
01/97	83	83	79	67	65	63	78
02/97	81	80	78	64	62	60	75
03/97	81	80	78	64	62	60	75
04/97	81	80	78	64	62	60	75
05/97	81	80	78	64	62	60	75
06/97	81	80	78	64	62	60	75

APPENDIX E2

Appendix E2

Noise Level for General Reclamation Based On Duration Of Operation provided by CED
Stonecutters Island Proposed Naval Facilities
Construction Programme B
– Unrestricted Period (0700 – 1900 hr)

A) Reclamation

Operation	PME	SWL	No	Total SWL	1994	1995												1996												1997					
					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
1 Dredging (Seabed & Basin & approach)	Grab dredger	112	3	116.77																															
	Hopper barge	104	4	110.02																															
	Tug boat	110	3	114.77																															
	Launch	104	1	104.00																															
2 Reclamation	Suction dredger	108	1	108.00																															
	Marine sand pump	104	2	107.01																															
	Bulldozers	115	2	118.01																															
	Tug boat	110	1	110.00																															
3. Place sand	Suction dredger	108	1	108.00																															
	Marine sand pump	104	1	104.00																															
	Bulldozers	115	2	118.01																															
	Tug boat	110	1	110.00																															
4 General earthworks	Trucks	117	4	123.02																															
	Bulldozers	115	3	119.77																															
	Roller (vibratory)	108	3	112.77																															
	Total SWL at respective time:						119.56	119.56	122.40	122.40	127.59	127.59	127.59	127.59	127.59	127.59	127.59	127.59	127.59	127.59	127.58						119.56	119.56	119.56	119.56	119.56				

B) Seawall

Operation	PME	SWL	No	Total SWL	1994	1995												1996												1997					
					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
1 Concrete coping	Concrete barge	104	2	107.01																															
	Crane	112	1	112.00																															
	Concrete lorry mixer	109	2	112.01																															
	Vibrators, poker	113	8	122.03																															
2 Place rock fill	Derrick Barges	104	3	108.77																															
	Tug boat	110	1	110.00																															
	Launch	104	1	104.00																															
3 Sloping seawall armouring	Derrick Barges	104	3	108.77																															
	Tug boat	110	1	110.00																															
	Launch	104	1	104.00																															
4. Set concrete seawall blocks	Derrick barges	104	2	107.01																															
	Tug boat	110	1	110.00																															
	Total SWL at respective time:									113.02	113.02	117.41	117.41	124.01	124.01	124.01	124.01	124.01	124.01	124.01	124.01	124.01	124.01	124.01	124.01	124.01	123.64	123.35	123.35	122.93					

C) Construction

Operation	PME	SWL	No	Total SWL	1994	1995												1996												1997					
					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
1. Ground beams and slabs	Generator	108	3	112.77																															
	Circular saw	108	1	108.00																															
	Lorry	112	3	116.77																															
	Concrete lorry mixer	109	3	113.77																															
	Poker (petrol)	113	2	116.01																															
	Crane	112	1	112.00																															
2. Building	Generator	108	3	112.77																															
	Circular saw	108	1	108.00																															
	Lorry	112	3	116.77																															
	Concrete lorry mixer	109	3	113.77																															
	Poker (petrol)	113	2	116.01																															
	Crane	112	1	112.00																															
3 Road construction	Back hoe	112	2	115.01																															
	Concrete truck	109	2	112.01																															
	Poker	113	2	116.01																															
	Total SWL at respective time:																				119.42	119.42	123.80	123.80	123.80	123.80	123.80	123.80	123.80	123.80	121.83	121.83	121.83	121.83	121.83

D) Piling

Operation	PME	SWL	No	Total SWL	1994	1995												1996												1997					
					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
1. Piling beams and	Diesel hammer	128	2	131.00																															
	Total SWL at respective time:																				131.00	131.00	131.00	131.00	131.00	131.00									

Appendix E2

NOISE LEVEL IMPACTS ASSESSMENT
STONECUTTERS ISLAND PROPOSED NAVAL FACILITIES

CONSTRUCTION PROGRAMME B
– Unrestricted Period (0700 – 1900 hr)

A) Reclamation

Coordinate	NSR 1	NSR 2	NSR 3	NSR 4	NSR 5	NSR 6	NSR 7
X	831855	831815	832015	831805	831920	831980	831965
Y	820055	820035	820130	820210	820272.5	820345	820110
Z	15	20	10	50	45	45	10
Notional source							
X	831875	831850	832075	831875	832055	832055	832025
Y	820035	820030	820083	820035	820088	820080	820080
Z	1	1	1	1	1	1	1
A(correction)	–39.23	–41.67	–48.62	–57.90	–59.62	–61.08	–47.31
12/94							
01/95							
02/95	80	78	71	62	60	58	72
03/95	80	78	71	62	60	58	72
04/95	83	81	74	65	63	61	75
05/95	83	81	74	65	63	61	75
06/95	88	86	79	70	68	67	80
07/95	88	86	79	70	68	67	80
08/95	88	86	79	70	68	67	80
09/95	88	86	79	70	68	67	80
10/95	88	86	79	70	68	67	80
11/95	88	86	79	70	68	67	80
12/95	88	86	79	70	68	67	80
01/96	88	86	79	70	68	67	80
02/96	88	86	79	70	68	67	80
03/96	88	86	79	70	68	67	80
04/96	88	86	79	70	68	67	80
05/96							
06/96							
07/96							
08/96							
09/96							
10/96	80	78	71	62	60	58	72
11/96	80	78	71	62	60	58	72
12/96	80	78	71	62	60	58	72
01/97	80	78	71	62	60	58	72
02/97	80	78	71	62	60	58	72
03/97							
04/97							
05/97							
06/97							

Appendix E2

NOISE LEVEL IMPACTS ASSESSMENT
STONECUTTERS ISLAND PROPOSED NAVAL FACILITIES

CONSTRUCTION PROGRAMME B
– Unrestricted Period (0700 – 1900 hr)

B) Seawall

Coordinate	NSR 1	NSR 2	NSR 3	NSR 4	NSR 5	NSR 6	NSR 7
X	831855	831815	832015	831805	831920	831980	831965
Y	820055	820035	820130	820210	820272.5	820345	820110
Z	15	20	10	50	45	45	10
Notional source							
X	831842.5	831825	831952.5	831842.5	831850	831865	831905
Y	819982.5	819977.5	820045	819982.5	819985	819990	820015
Z	1	1	1	1	1	1	1
A(correction)	−48.35	−46.23	−51.93	−59.73	−62.01	−64.22	−52.56
12/94							
01/95							
02/95							
03/95							
04/95							
05/95	65	67	61	53	51	49	60
06/95	65	67	61	53	51	49	60
07/95	69	71	65	58	55	53	65
08/95	69	71	65	58	55	53	65
09/95	76	78	72	64	62	60	71
10/95	76	78	72	64	62	60	71
11/95	76	78	72	64	62	60	71
12/95	76	78	72	64	62	60	71
01/96	76	78	72	64	62	60	71
02/96	76	78	72	64	62	60	71
03/96	76	78	72	64	62	60	71
04/96	76	78	72	64	62	60	71
05/96	76	78	72	64	62	60	71
06/96	76	78	72	64	62	60	71
07/96	76	78	72	64	62	60	71
08/96	76	78	72	64	62	60	71
09/96	76	78	72	64	62	60	71
10/96	75	77	72	64	62	59	71
11/96	75	77	71	64	61	59	71
12/96	75	77	71	64	61	59	71
01/97	75	77	71	63	61	59	70
02/97							
03/97							
04/97							
05/97							
06/97							

Appendix E2

NOISE LEVEL IMPACTS ASSESSMENT
STONECUTTERS ISLAND PROPOSED NAVAL FACILITIES

CONSTRUCTION PROGRAMME B
– Unrestricted Period (0700 – 1900 hr)

C) Construction

Coordinate	NSR 1	NSR 2	NSR 3	NSR 4	NSR 5	NSR 6	NSR 7
X	831855	831815	832015	831805	831920	831980	831965
Y	820055	820035	820130	820210	820272.5	820345	820110
Z	15	20	10	50	45	45	10
Notional source							
X	831872.5	831847.5	832035	831870	831982.5	831985	831977.5
Y	820025	820020	820085	850035	820035	820040	820050
Z	1	1	1	1	1	1	1
A(correction)	−41.04	−41.78	−44.15	−57.82	−60.28	−62.30	−46.39
12/94							
01/95							
02/95							
03/95							
04/95							
05/95							
06/95							
07/95							
08/95							
09/95							
10/95							
11/95							
12/95							
01/96							
02/96							
03/96							
04/96	78	78	75	62	59	57	73
05/96	78	78	75	62	59	57	73
06/96	83	82	80	66	64	62	77
07/96	83	82	80	66	64	62	77
08/96	83	82	80	66	64	62	77
09/96	83	82	80	66	64	62	77
10/96	83	82	80	66	64	62	77
11/96	83	82	80	66	64	62	77
12/96	83	82	80	66	64	62	77
01/97	83	82	80	66	64	62	77
02/97	81	80	78	64	62	60	75
03/97	81	80	78	64	62	60	75
04/97	81	80	78	64	62	60	75
05/97	81	80	78	64	62	60	75
06/97	81	80	78	64	62	60	75

Appendix E2

NOISE LEVEL IMPACTS ASSESSMENT
STONECUTTERS ISLAND PROPOSED NAVAL FACILITIES

CONSTRUCTION PROGRAMME B
– Unrestricted Period (0700 – 1900 hr)

TOTAL : (Reclamation + Seawall + Construction)

Coordinate	NSR 1	NSR 2	NSR 3	NSR 4	NSR 5	NSR 6	NSR 7
X	831855	831815	832015	831805	831920	831980	831965
Y	820055	820035	820130	820210	820272.5	820345	820110
Z	15	20	10	50	45	45	10
12/94							
01/95							
02/95	80	78	71	62	60	58	72
03/95	80	78	71	62	60	58	72
04/95	83	81	74	65	63	61	75
05/95	83	81	74	65	63	62	75
06/95	88	86	79	70	68	67	80
07/95	88	86	79	70	68	67	80
08/95	88	86	79	70	68	67	80
09/95	89	87	80	71	69	67	81
10/95	89	87	80	71	69	67	81
11/95	89	87	80	71	69	67	81
12/95	89	87	80	71	69	67	81
01/96	89	87	80	71	69	67	81
02/96	89	87	80	71	69	67	81
03/96	89	87	80	71	69	67	81
04/96	89	87	81	71	69	68	81
05/96	80	81	77	66	64	62	75
06/96	84	83	80	68	66	64	78
07/96	84	83	80	68	66	64	78
08/96	84	83	80	68	66	64	78
09/96	84	83	80	68	66	64	78
10/96	85	84	81	69	67	65	79
11/96	85	84	81	69	67	65	79
12/96	85	84	81	69	67	65	79
01/97	85	84	81	69	67	65	79
02/97	84	82	79	66	64	62	77
03/97	81	80	78	64	62	60	75
04/97	81	80	78	64	62	60	75
05/97	81	80	78	64	62	60	75
06/97	81	80	78	64	62	60	75

APPENDIX F1

APPENDIX F1 AIR QUALITY MODELLING EMISSION FACTORS FOR TSP

1. LOCATION OF SOURCES

1.1 Area Source

Zone	Easting	Northing	Emission Height (mPD)	Area (m^2)
1	832293	820033	1.0	52,875
2	832145	820118	1.0	3,950
3	832078	820060	1.0	12,300
4	831950	820048	1.0	1,750
5	832008	819993	1.0	23,875
6	831783	819913	1.0	18,375
7	831680	819641	1.0	10,500

1.2 Line Source

Zone	Starting		Ending		Width (m)	Emission Height (mPD)
	Easting	Northing	Easting	Northing		
8	832275	819530	832275	819915	55	1.0
9	831810	819660	831810	819825	60	1.0
10	831710	819530	832275	819530	55	1.0

2. EMISSION RATE OF SOURCE

Based on AP42: "Compilation of Air Pollutant Emission Factors"

2.1 Unloading

$$Emission\ Rate\ (kg/Mg) = \frac{k(0.0009)(\frac{s}{5})(\frac{u}{2.2})(\frac{H}{1.5})}{(\frac{M}{2})^2(\frac{Y}{4.6})^{0.33}}$$

$$Emission = 0.004842 g/Mg$$

where k = particle size multiplier = 0.73
s = material silt content in % = 11
u = mean wind speed (ms^{-1}) = 2 m/s
H = drop height (m) = 3 m
M = material moisture content in % = 50
Y = dumping device capacity (m^3) = 3 m^3

Zone	Emission Factor (ug/s/m2 or ug/s/m)	
	1-hr Avg	24-hr Avg
1	0.013	0.009
2	0.013	0.009
3	0.013	0.009
4	0.013	0.009
5	0.013	0.009
6	0.013	0.009
7	0.013	0.009
8	0.717	0.478
9	0.782	0.521
10	0.717	0.478

2.2 Bulldozing

$$EmissionRate(kg/hour) = \frac{2.6(s)^{1.2}}{M^{1.3}}$$
$$Emission = 0.2857 kg/hr$$

where s = material silt content in % = 11
M = material moisture content in % = 50

Zone	Emission Factor (ug/s/m²)	
	1-hr Avg	24-hr Avg
1	1.50	1.00
2	20.62	13.75
3	6.45	4.30
4	45.35	30.23
5	3.07	2.04
6	4.32	2.88
7	7.56	5.04

2.4 Heavy Construction

Emission Rate ($kg/m^2/month$) = 0.269

Zone	Emission Factor ($ug/s/m^2$)	
	1-hr Avg	24-hr Avg
1	241.4	120.7
2	241.4	120.7
3	241.4	120.7
4	241.4	120.7
5	241.4	120.7
6	241.4	120.7
7	241.4	120.7

Appendix F1

TSP Level for General Reclamation Based On Duration Of Operation provided by CED
Stonecutters Island Proposed Naval Facilities

Operation	Process assessed	PME	No
1. Reclamation	– unloading – dozing	Bulldozers Trucks	2 4
2. Heavy Construction			
a) General earthworks	– dozing	Trucks Bulldozers Roller (vibratory)	4 3 3
b) Place sand	– dozing – unloading	Bulldozers	2
c) Building	– building	Generator Circular saw Lorry Concrete lorry mixer Poker (petrol) Crane	3 1 3 3 2 1
d) Road construction	– building	Back hoe Concrete truck Poker	2 2 2

APPENDIX F2

Appendix F2

TSP LEVEL IMPACTS ASSESSMENT
STONECUTTERS ISLAND PROPOSED NAVAL FACILITIES

Construction Programme A
Period 07:00 – 23:00

1) ASR1 – Maximum predicted dust impacts (Reclamation)

	Before Mitigation		After Mitigation	
	1 hr avg. TSP	24 hr avg. TSP	1 hr avg. TSP	24 hr avg. TSP
4/95	179	148	146	134
5/95	179	148	146	134
6/95	179	148	146	134
7/95	179	148	146	134
8/95	179	148	146	134

2) ASR2 – Maximum predicted dust impacts (Reclamation)

	Before Mitigation		After Mitigation	
	1 hr avg. TSP	24 hr avg. TSP	1 hr avg. TSP	24 hr avg. TSP
4/95	160	143	139	132
5/95	160	143	139	132
6/95	160	143	139	132
7/95	160	143	139	132
8/95	160	143	139	132

3) ASR3 – Maximum predicted dust impacts (Reclamation)

	Before Mitigation		After Mitigation	
	1 hr avg. TSP	24 hr avg. TSP	1 hr avg. TSP	24 hr avg. TSP
4/95	171	[illegible]	144	133
5/95	171	145	144	133
6/95	171	145	144	133
7/95	171	145	144	133
8/95	171	145	144	133

4) ASR4 – Maximum predicted dust impacts (Reclamation)

	Before Mitigation		After Mitigation	
	1 hr avg. TSP	24 hr avg. TSP	1 hr avg. TSP	24 hr avg. TSP
4/95	137	131	130	127
5/95	137	131	130	127
6/95	137	131	130	127
7/95	137	131	130	127
8/95	137	131	130	127

5) ASR5 – Maximum predicted dust impacts (Reclamation)

	Before Mitigation		After Mitigation	
	1 hr avg. TSP	24 hr avg. TSP	1 hr avg. TSP	24 hr avg. TSP
4/95	135	130	129	127
5/95	135	130	129	127
6/95	135	130	129	127
7/95	135	130	129	127
8/95	135	130	129	127

6) ASR6 – Maximum predicted dust impacts (Reclamation)

	Before Mitigation		After Mitigation	
	1 hr avg. TSP	24 hr avg. TSP	1 hr avg. TSP	24 hr avg. TSP
4/95	133	129	128	127
5/95	133	129	128	127
6/95	133	129	128	127
7/95	133	129	128	127
8/95	133	129	128	127

7) ASR7 – Maximum predicted dust impacts (Reclamation)

	Before Mitigation		After Mitigation	
	1 hr avg. TSP	24 hr avg. TSP	1 hr avg. TSP	24 hr avg. TSP
4/95	199	159	154	139
5/95	199	159	154	139
6/95	199	159	154	139
7/95	199	159	154	139
8/95	199	159	154	139

Appendix F2

TSP LEVEL IMPACTS ASSESSMENT
STONECUTTERS ISLAND PROPOSED NAVAL FACILITIES

Construction Programme A
Period 07:00 – 23:00

1) ASR1 – Maximum predicted dust impacts (Heavy Construction)

	Before Mitigation		After Mitigation	
	1 hr avg. TSP	24 hr avg. TSP	1 hr avg. TSP	24 hr avg. TSP
4/95	133	129	128	126
5/95	133	129	128	126
6/95	133	129	128	126
7/95	187	151	150	136
8/95	195	156	154	138
9/95	195	156	154	138
10/95	195	156	154	138
11/95	195	156	154	138
12/95	793	431	327	218
1/96	793	431	327	218
2/96	793	431	327	218
3/96	784	428	324	216
4/96	784	428	324	216
5/96	784	428	324	216
6/96	777	424	320	214
7/96	777	424	320	214
8/96	777	424	320	214
9/96	777	424	320	214
10/96	777	424	320	214
11/96	777	424	320	214
12/96	777	424	320	214
1/97	723	401	298	205
2/97	723	401	298	205
3/97	723	401	298	205
4/97	723	401	298	205
5/97	723	401	298	205
6/97	723	401	298	205

2) ASR2 – Maximum predicted dust impacts (Heavy Construction)

	Before Mitigation		After Mitigation	
	1 hr avg. TSP	24 hr avg. TSP	1 hr avg. TSP	24 hr avg. TSP
4/95	131	127	127	126
5/95	131	127	127	126
6/95	131	127	127	126
7/95	165	145	141	133
8/95	171	148	144	134
9/95	171	148	144	134
10/95	171	148	144	134
11/95	171	148	144	134
12/95	722	371	304	199
1/96	722	371	304	199
2/96	722	371	304	199
3/96	716	369	301	198
4/96	716	369	301	198
5/96	716	369	301	198
6/96	710	366	299	197
7/96	710	366	299	197
8/96	710	366	299	197
9/96	710	366	299	197
10/96	710	366	299	197
11/96	710	366	299	197
12/96	710	366	299	197
1/97	676	349	285	190
2/97	676	349	285	190
3/97	676	349	285	190
4/97	676	349	285	190
5/97	676	349	285	190
6/97	676	349	285	190

Appendix F2

TSP LEVEL IMPACTS ASSESSMENT
STONECUTTERS ISLAND PROPOSED NAVAL FACILITIES

Construction Programme A
Period 07:00 – 23:00

3) ASR3 – Maximum predicted dust impacts (Heavy Construction)

	Before Mitigation		After Mitigation	
	1 hr avg. TSP	24 hr avg. TSP	1 hr avg. TSP	24 hr avg. TSP
4/95	129	127	127	126
5/95	129	127	127	126
6/95	129	127	127	126
7/95	176	147	145	134
8/95	184	151	150	136
9/95	184	151	150	136
10/95	184	151	150	136
11/95	184	151	150	136
12/95	541	344	253	192
1/96	541	344	253	192
2/96	541	344	253	192
3/96	537	342	251	191
4/96	537	342	251	191
5/96	537	342	251	191
6/96	528	338	247	189
7/96	528	338	247	189
8/96	528	338	247	189
9/96	528	338	247	189
10/96	528	338	247	189
11/96	528	338	247	189
12/96	528	338	247	189
1/97	482	317	228	181
2/97	482	317	228	181
3/97	482	317	228	181
4/97	482	317	228	181
5/97	482	317	228	181
6/97	482	317	228	181

4) ASR4 – Maximum predicted dust impacts (Heavy Construction)

	Before Mitigation		After Mitigation	
	1 hr avg. TSP	24 hr avg. TSP	1 hr avg. TSP	24 hr avg. TSP
4/95	126	125	125	125
5/95	126	125	125	125
6/95	126	125	125	125
7/95	138	131	130	127
8/95	139	131	131	128
9/95	139	131	131	128
10/95	139	131	131	128
11/95	139	131	131	128
12/95	246	188	162	144
1/96	246	188	162	144
2/96	246	188	162	144
3/96	245	188	161	144
4/96	245	188	161	144
5/96	245	188	161	144
6/96	244	187	161	144
7/96	244	187	161	144
8/96	244	187	161	144
9/96	244	187	161	144
10/96	244	187	161	144
11/96	244	187	161	144
12/96	244	187	161	144
1/97	232	182	156	141
2/97	232	182	156	141
3/97	232	182	156	141
4/97	232	182	156	141
5/97	232	182	156	141
6/97	232	182	156	141

Appendix F2

TSP LEVEL IMPACTS ASSESSMENT
STONECUTTERS ISLAND PROPOSED NAVAL FACILITIES

Construction Programme A
Period 07:00 – 23:00

5) ASR5 – Maximum predicted dust impacts (Heavy Construction)

	Before Mitigation		After Mitigation	
	1 hr avg. TSP	24 hr avg. TSP	1 hr avg. TSP	24 hr avg. TSP
4/95	126	126	125	125
5/95	126	126	125	125
6/95	126	126	125	125
7/95	136	131	129	127
8/95	137	131	130	128
9/95	137	131	130	128
10/95	137	131	130	128
11/95	137	131	130	128
12/95	253	186	164	144
1/96	253	186	164	144
2/96	253	186	164	144
3/96	252	186	163	143
4/96	252	186	163	143
5/96	252	186	163	143
6/96	251	185	163	143
7/96	251	185	163	143
8/96	251	185	163	143
9/96	251	185	163	143
10/96	251	185	163	143
11/96	251	185	163	143
12/96	251	185	163	143
1/97	241	180	159	141
2/97	241	180	159	141
3/97	241	180	159	141
4/97	241	180	159	141
5/97	241	180	159	141
6/97	241	180	159	141

6) ASR6 – Maximum predicted dust impacts (Heavy Construction)

	Before Mitigation		After Mitigation	
	1 hr avg. TSP	24 hr avg. TSP	1 hr avg. TSP	24 hr avg. TSP
4/95	126	126	125	125
5/95	126	126	125	125
6/95	126	126	125	125
7/95	133	130	128	127
8/95	134	130	129	127
9/95	134	130	129	127
10/95	134	130	129	127
11/95	134	130	129	127
12/95	236	175	158	140
1/96	236	175	158	140
2/96	236	175	158	140
3/96	235	174	158	140
4/96	235	174	158	140
5/96	235	174	158	140
6/96	234	174	157	140
7/96	234	174	157	140
8/96	234	174	157	140
9/96	234	174	157	140
10/96	234	174	157	140
11/96	234	174	157	140
12/96	234	174	157	140
1/97	226	169	154	138
2/97	226	169	154	138
3/97	226	169	154	138
4/97	226	169	154	138
5/97	226	169	154	138
6/97	226	169	154	138

Appendix F2

TSP LEVEL IMPACTS ASSESSMENT
STONECUTTERS ISLAND PROPOSED NAVAL FACILITIES

Construction Programme A
Period 07:00 – 23:00

7) ASR7 – Maximum predicted dust impacts (Heavy Construction)

	Before Mitigation		After Mitigation	
	1 hr avg. TSP	24 hr avg. TSP	1 hr avg. TSP	24 hr avg. TSP
4/95	130	127	127	126
5/95	130	127	127	126
6/95	130	127	127	126
7/95	204	161	157	139
8/95	212	165	161	142
9/95	212	165	161	142
10/95	212	165	161	142
11/95	212	165	161	142
12/95	552	336	259	191
1/96	552	336	259	191
2/96	552	336	259	191
3/96	547	333	257	190
4/96	547	333	257	190
5/96	547	333	257	190
6/96	538	329	253	188
7/96	538	329	253	188
8/96	538	329	253	188
9/96	538	329	253	188
10/96	538	329	253	188
11/96	538	329	253	188
12/96	538	329	253	188
1/97	465	295	224	174
2/97	465	295	224	174
3/97	465	295	224	174
4/97	465	295	224	174
5/97	465	295	224	174
6/97	465	295	224	174

APPENDIX F3

Appendix F3

TSP LEVEL IMPACTS ASSESSMENT
STONECUTTERS ISLAND PROPOSED NAVAL FACILITIES

Construction Programme B
Period 07:00 – 19:00

1) ASR1 – Maximum predicted dust impacts (Reclamation)

	Before Mitigation		After Mitigation	
	1 hr avg. TSP	24 hr avg. TSP	1 hr avg. TSP	24 hr avg. TSP
6/95	179	148	146	134
7/95	179	148	146	134
8/95	179	148	146	134
9/95	179	148	146	134
10/95	179	148	146	134
11/95	179	148	146	134
12/95	179	148	146	134
1/96	179	148	146	134
2/96	179	148	146	134
3/96	179	148	146	134
4/96	179	148	146	134

2) ASR2 – Maximum predicted dust impacts (Reclamation)

	Before Mitigation		After Mitigation	
	1 hr avg. TSP	24 hr avg. TSP	1 hr avg. TSP	24 hr avg. TSP
6/95	160	143	139	132
7/95	160	143	139	132
8/95	160	143	139	132
9/95	160	143	139	132
10/95	160	143	139	132
11/95	160	143	139	132
12/95	160	143	139	132
1/96	160	143	139	132
2/96	160	143	139	132
3/96	160	143	139	132
4/96	160	143	139	132

3) ASR3 – Maximum predicted dust impacts (Reclamation)

	Before Mitigation		After Mitigation	
	1 hr avg. TSP	24 hr avg. TSP	1 hr avg. TSP	24 hr avg. TSP
6/95	171	145	144	133
7/95	171	145	144	133
8/95	171	145	144	133
9/95	171	145	144	133
10/95	171	145	144	133
11/95	171	145	144	133
12/95	171	145	144	133
1/96	171	145	144	133
2/96	171	145	144	133
3/96	171	145	144	133
4/96	171	145	144	133

4) ASR4 – Maximum predicted dust impacts (Reclamation)

	Before Mitigation		After Mitigation	
	1 hr avg. TSP	24 hr avg. TSP	1 hr avg. TSP	24 hr avg. TSP
6/95	137	131	130	127
7/95	137	131	130	127
8/95	137	131	130	127
9/95	137	131	130	127
10/95	137	131	130	127
11/95	137	131	130	127
12/95	137	131	130	127
1/96	137	131	130	127
2/96	137	131	130	127
3/96	137	131	130	127
4/96	137	131	130	127

Appendix F3

TSP LEVEL IMPACTS ASSESSMENT
STONECUTTERS ISLAND PROPOSED NAVAL FACILITIES

Construction Programme B
Period 07:00 – 19:00

5) ASR5 – Maximum predicted dust impacts (Reclamation)

	Before Mitigation		After Mitigation	
	1 hr avg. TSP	24 hr avg. TSP	1 hr avg. TSP	24 hr avg. TSP
6/95	135	130	129	127
7/95	135	130	129	127
8/95	135	130	129	127
9/95	135	130	129	127
10/95	135	130	129	127
11/95	135	130	129	127
12/95	135	130	129	127
1/96	135	130	129	127
2/96	135	130	129	127
3/96	135	130	129	127
4/96	135	130	129	127

6) ASR6 – Maximum predicted dust impacts (Reclamation)

	Before Mitigation		After Mitigation	
	1 hr avg. TSP	24 hr avg. TSP	1 hr avg. TSP	24 hr avg. TSP
6/95	133	129	128	127
7/95	133	129	128	127
8/95	133	129	128	127
9/95	133	129	128	127
10/95	133	129	128	127
11/95	133	129	128	127
12/95	133	129	128	127
1/96	133	129	128	127
2/96	133	129	128	127
3/96	133	129	128	127
4/96	133	129	128	127

7) ASR7 – Maximum predicted dust impacts (Reclamation)

	Before Mitigation		After Mitigation	
	1 hr avg. TSP	24 hr avg. TSP	1 hr avg. TSP	24 hr avg. TSP
6/95	199	159	154	139
7/95	199	159	154	139
8/95	199	159	154	139
9/95	199	159	154	139
10/95	199	159	154	139
11/95	199	159	154	139
12/95	199	159	154	139
1/96	199	159	154	139
2/96	199	159	154	139
3/96	199	159	154	139
4/96	199	159	154	139

Appendix F3

TSP LEVEL IMPACTS ASSESSMENT
STONECUTTERS ISLAND PROPOSED NAVAL FACILITIES

Construction Programme B
Period 07:00 – 19:00
1) ASR1 – Maximum predicted dust impacts (Heavy Construction)

	Before Mitigation		After Mitigation	
	1 hr avg. TSP	24 hr avg. TSP	1 hr avg. TSP	24 hr avg. TSP
4/95	133	129	128	126
5/95	133	129	128	126
6/95	187	151	150	136
7/95	187	151	150	136
8/95	187	151	150	136
9/95	187	151	150	136
10/95	187	151	150	136
11/95	187	151	150	136
12/95	187	151	150	136
1/96	187	151	150	136
2/96	187	151	150	136
3/96	187	151	150	136
4/96	195	156	154	138
5/96	133	129	129	127
6/96	133	129	129	127
7/96	133	129	129	127
8/96	133	129	129	127
9/96	731	405	302	207
10/96	731	405	302	207
11/96	731	405	302	207
12/96	731	405	302	207
1/97	731	405	302	207
2/97	723	401	298	205
3/97	723	401	298	205
4/97	723	401	298	205
5/97	723	401	298	205
6/97	723	401	298	205

2) ASR2 – Maximum predicted dust impacts (Heavy Construction)

	Before Mitigation		After Mitigation	
	1 hr avg. TSP	24 hr avg. TSP	1 hr avg. TSP	24 hr avg. TSP
4/95	131	127	127	126
5/95	131	127	127	126
6/95	165	145	141	133
7/95	165	145	141	133
8/95	165	145	141	133
9/95	165	145	141	133
10/95	165	145	141	133
11/95	165	145	141	133
12/95	165	145	141	133
1/96	165	145	141	133
2/96	165	145	141	133
3/96	165	145	141	133
4/96	171	148	144	134
5/96	131	128	128	126
6/96	131	128	128	126
7/96	131	128	128	126
8/96	131	128	128	126
9/96	682	351	288	191
10/96	682	351	288	191
11/96	682	351	288	191
12/96	682	351	288	191
1/97	682	351	288	191
2/97	676	349	285	190
3/97	676	349	285	190
4/97	676	349	285	190
5/97	676	349	285	190
6/97	676	349	285	190

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TSP LEVEL IMPACTS ASSESSMENT
STONECUTTERS ISLAND PROPOSED NAVAL FACILITIES

Construction Programme B
Period 07:00 – 19:00

3) ASR3 – Maximum predicted dust impacts (Heavy Construction)

	Before Mitigation		After Mitigation	
	1 hr avg. TSP	24 hr avg. TSP	1 hr avg. TSP	24 hr avg. TSP
4/95	129	127	127	126
5/95	129	127	127	126
6/95	176	147	145	134
7/95	176	147	145	134
8/95	176	147	145	134
9/95	176	147	145	134
10/95	176	147	145	134
11/95	176	147	145	134
12/95	176	147	145	134
1/96	176	147	145	134
2/96	176	147	145	134
3/96	176	147	145	134
4/96	184	151	150	136
5/96	134	129	129	127
6/96	134	129	129	127
7/96	134	129	129	127
8/96	134	129	129	127
9/96	490	322	233	183
10/96	490	322	233	183
11/96	490	322	233	183
12/96	490	322	233	183
1/97	490	322	233	183
2/97	482	317	228	181
3/97	482	317	228	181
4/97	482	317	228	181
5/97	482	317	228	181
6/97	48[illegible]	317	228	181

4) ASR4 – Maximum predicted dust impacts (Heavy Construction)

	Before Mitigation		After Mitigation	
	1 hr avg. TSP	24 hr avg. TSP	1 hr avg. TSP	24 hr avg. TSP
4/95	126	125	125	125
5/95	126	125	125	125
6/95	138	131	130	127
7/95	138	131	130	127
8/95	138	131	130	127
9/95	138	131	130	127
10/95	138	131	130	127
11/95	138	131	130	127
12/95	138	131	130	127
1/96	138	131	130	127
2/96	138	131	130	127
3/96	138	131	130	127
4/96	139	131	131	128
5/96	126	125	126	125
6/96	126	125	126	125
7/96	126	125	126	125
8/96	126	125	126	125
9/96	233	182	157	142
10/96	233	182	157	142
11/96	233	182	157	142
12/96	233	182	157	142
1/97	233	182	157	142
2/97	232	182	156	141
3/97	232	182	156	141
4/97	232	182	156	141
5/97	232	182	156	141
6/97	232	182	156	141

Appendix F3

TSP LEVEL IMPACTS ASSESSMENT
STONECUTTERS ISLAND PROPOSED NAVAL FACILITIES

Construction Programme B
Period 07:00 – 19:00

5) ASR5 – Maximum predicted dust impacts (Heavy Construction)

	Before Mitigation		After Mitigation	
	1 hr avg. TSP	24 hr avg. TSP	1 hr avg. TSP	24 hr avg. TSP
4/95	126	126	125	125
5/95	126	126	125	125
6/95	136	131	129	127
7/95	136	131	129	127
8/95	136	131	129	127
9/95	136	131	129	127
10/95	136	131	129	127
11/95	136	131	129	127
12/95	136	131	129	127
1/96	136	131	129	127
2/96	136	131	129	127
3/96	136	131	129	127
4/96	137	131	130	128
5/96	126	126	126	125
6/96	126	126	126	125
7/96	126	126	126	125
8/96	126	126	126	125
9/96	242	181	159	141
10/96	242	181	159	141
11/96	242	181	159	141
12/96	242	181	159	141
1/97	242	181	159	141
2/97	[illegible]	180	159	141
3/97	241	180	159	141
4/97	241	180	159	141
5/97	241	180	159	141
6/97	241	180	159	141

6) ASR6 – Maximum predicted dust impacts (Heavy Construction)

	Before Mitigation		After Mitigation	
	1 hr avg. TSP	24 hr avg. TSP	1 hr avg. TSP	24 hr avg. TSP
4/95	126	126	125	125
5/95	126	126	125	125
6/95	133	130	128	127
7/95	133	130	128	127
8/95	133	130	128	127
9/95	133	130	128	127
10/95	133	130	128	127
11/95	133	130	128	127
12/95	133	130	128	127
1/96	133	130	128	127
2/96	133	130	128	127
3/96	133	130	128	127
4/96	134	130	129	127
5/96	126	125	126	125
6/96	126	125	126	125
7/96	126	125	126	125
8/96	126	125	126	125
9/96	227	170	155	138
10/96	227	170	155	138
11/96	227	170	155	138
12/96	227	170	155	138
1/97	227	170	155	138
2/97	226	169	154	138
3/97	226	169	154	138
4/97	226	169	154	138
5/97	226	169	154	138
6/97	125	125	125	125

Appendix F3

TSP LEVEL IMPACTS ASSESSMENT
STONECUTTERS ISLAND PROPOSED NAVAL FACILITIES

Construction Programme B
Period 07:00 – 19:00

7) ASR7 – Maximum predicted dust impacts (Heavy Construction)

	Before Mitigation		After Mitigation	
	1 hr avg. TSP	24 hr avg. TSP	1 hr avg. TSP	24 hr avg. TSP
4/95	130	127	127	126
5/95	130	127	127	126
6/95	204	161	157	139
7/95	204	161	157	139
8/95	204	161	157	139
9/95	204	161	157	139
10/95	204	161	157	139
11/95	204	161	157	139
12/95	204	161	157	139
1/96	204	161	157	139
2/96	204	161	157	139
3/96	204	161	157	139
4/96	212	165	161	142
5/96	133	129	129	127
6/96	133	129	129	127
7/96	133	129	129	127
8/96	133	129	129	127
9/96	473	299	228	176
10/96	473	299	228	176
11/96	473	299	228	176
12/96	473	299	228	176
1/97	473	299	228	176
2/97	465	295	224	174
3/97	465	295	224	174
4/97	465	295	224	174
5/97	465	295	224	174
6/97	125	125	125	125

APPENDIX G

APPENDIX G

ENVIRONMENTAL PROTECTION REQUIREMENTS

1. AVOIDANCE OF NUISANCE

(1) The Contractor shall comply with current enactments and regulations as required in Clause 34 of the GCC, including but not restricted to the following:

(a) Noise Control Ordinance (Cap 400)

(b) Air Pollution Control Ordinance (Cap 311)

(c) Water Pollution Control Ordinance (Cap 358)

(e) Merchant Shipping (Oil Pollution) (Hong Kong) Order 1975

(f) Summary Offences Ordinance (Cap 228)

(g) Factories and Industrial Undertakings Ordinance (Cap 59)

(h) Waste Disposal Ordinance (Cap 354)

(i) Public Cleansing and Prevention of Nuisances (Regional Council) By-Laws (Cap 132)

(j) Public Cleansing and Prevention of Nuisances (Urban Council) By-Laws (Cap 132)

(k) Building Ordinance (Cap 123)

(l) Building Ordinance (Application to New Territories) Ordinance (Cap 121)

(m) Public Health and Municipal Services Ordinance (Cap 132)

(n) Waste Disposal (Chemical Waste) (General) Regulation (Cap 354)

(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 satisfaction 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 liquid 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 effluent shall comply with the standards stated in the "Technical Memorandum on Standards and Effluent discharges into Drainage and Sewerage Systems, Inland and Coastal Waters" for the appropriate Water Control Zone.

(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 provided and maintained for the duration of the Contract along the site boundary as directed.

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 (see Table A.5.1) and 0.5 milligrams per cubic meter at standard temperature (25°C) and pressure (1.0 bar) for 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) Before use on the site the Engineer shall be advised of all earth moving plant, demolition plant, concrete mixing plant an any other plant likely to cause dust problems. The Engineer may inspect such equipment to determine if it may be operated in a matter to minimise dust emissions during the works. The Contractor shall provide all necessary facilities to the Engineer for checking or inspecting such plant and the Contractor shall not use such plant without the agreement of the Engineer. The Engineer may require the Contractor to carry out trials of any such plant to prove its suitability.

(5) The location of dust producing plant or facilities, either fixed or temporary, shall be subject to the agreement of the Engineer.

(6) 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 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 as directed 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. All air vents on cement silos shall be fitted with suitable fabric filters provided with either shaking or pulse-air cleaning mechanisms. The fabric filter area shall be determined using an air-cloth ratio (filtering velocity) of 0.01 - 0.03 m/s.

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

(g) 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.

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

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

(j) 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.

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

(l) 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.

(m) 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.

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

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

(8) Emissions of pollutants from the construction operation shall be limited such that the ambient level should not exceed those 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	500		260		80
Respirable Suspended Particulates [v]			180		55
Nitrogen Dioxide	300		150		80
Carbon Monoxide	30000	10000			
Photochemical Oxidant (as O_3)[vi]	240				
Lead				1.5	

[i] Measured at 298 K and 101.325 kPa. (one atmosphere)
[ii] Not to be exceeded more than 3 times per year.
[iii] Not to be exceeded more than once per year.
[iv] Arithmetic means.
[v] Respirable suspended particulates means suspended particulates in air with a nominal aerodynamic diameter of 10 micrometres and smaller
[vi] Photochemical oxidants are determined by measurement of ozone only.

3. OPERATING MINERAL WORKS (CRUSHING PLANTS) ON SITE

(1) Should the Contractor operate mineral works (crushing plant) on site with an annual output exceeding 5,000 tonnes, 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 license at least 60 days prior to anticipated operation date and be responsible for payment of all Government fees with this operation.

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 identifying operations and plants likely to cause dust emissions, together with measures to be implemented to mitigate and control dust emissions. This method statement shall be revised and resubmitted as required by the Engineer.

(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 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 Contractor shall provide assistance to enable the Engineer to carry out dust impact monitoring throughout the construction period.

(2) The Contractor shall provide four high volume air samplers with associated equipment, calibration kit 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. The high volume samplers should be equipped with electronic mass flow controller and be calibrated against a traceable standard at regular intervals. The Contractor shall also provide a suitable direct reading dust meter capable of reading 1 hr TSP in the range 0.1 - 100mg/m^3 and calibrated against a traceable primary standard at regular intervals.

(3) The Contractor shall construct suitable access, hardstanding and a galvanised wire fence and gate at each monitoring station in the following areas if required:

(a) the Site boundary.
(b) nearest air sensitive receiver.

[Monitoring stations may be located at the site boundary, in the work areas and/or at sensitive receivers. Site-specific locations shall be agreed by the Engineer.]

Alternative locations may be necessary if difficulties arise in obtaining access, or if the locations become unsuitable. The exact location and direction of the monitoring equipments at each monitoring station shall be agreed with the Engineer. Monitoring stations shall be free from local obstructions or sheltering. The number of monitoring stations shall be determined by the Engineer in consultation with EPD.

(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 two or more of the monitoring stations as determined by the Engineer on up to three days per week and must be at least once every six days for each selected monitoring station.

(7) Where impact monitoring results of dust levels indicate a deteriorating situation the Engineer shall 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.

(8) The Engineer shall provide to the Contractor a report of the monitoring and audits results at monthly intervals.

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.

WATER POLLUTION CONTROL AND WATER QUALITY MONITORING

7. GENERAL REQUIREMENTS

(1) The Contractor shall carry out the Works in such a manner as to minimise adverse impacts on the water quality during the execution of the Works. 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 to and from the Site and at the loading, dredging and dumping areas.

(2) All marine plant and methods of working shall be such as to achieve and maintain the required water quality and minimise water pollution.

(3) The Contractor shall submit, at least four weeks prior to the commencement of any marine works, to the Engineer for approval detailed drawings illustrating the equipment which he proposes to use for the marine works together with a written method statement describing in detail the procedures to be adopted. The Contractor shall include with his submission details of approvals and consent already obtained from DEP and FMC.

(4) The Contractor shall comply with the conditions of dumping approvals and consent obtained from DEP and FMC, which may include water quality monitoring at the marine dumping and borrow sites.

(5) If any time the Engineer determines that a deterioration in water quality has occurred the Engineer may direct the Contractor immediately to initiate remedial measures to plant or working methods as will demonstrably halt such deterioration. Where remedial measures involve maintenance or modification of previously approved plant or vessel, such plant or vessel shall not be used for the Works until the adequacy of the maintenance of modification is demonstrated to the satisfaction of the Engineer.

(6) The Engineer may inspect the marine plant to be used for the Works to ensure that it will minimize the water quality impact arising from the Works as detailed in clause 9(1)(a) to (g). The Contractor shall provide all necessary facilities for the Engineer to inspect or check such vessels or plant for the Works without Contractor, and to carry out trials to any plant or vessels to prove their suitability.

8. DEFINITIONS

(1) For use in this Appendix only, the following definitions are used :-

(a) dredged material - all dredged material.

(b) marine mud - soft marine material to be removed from the reclamation or borrow areas and which will not be reused in the Works.

(c) contaminated marine mud - designated dredged material which, in the opinion of the Engineer, is contaminated by pollutants such as to require particular handling and disposal procedures.

(d) fill material - dredged or land based material to be used in the reclamation, (including foundations to seawall, drainage layers etc.)

(e) 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. The material is to be disposed of at designated spoil dumping grounds. The material may include builders debris, spoil and hard material dumped by others, and seabed debris.

9. WATER QUALITY REQUIREMENTS

(1) The Contractor shall minimise adverse impacts resulting from the Contractor's dredging and dumping operations on water quality. To achieve these requirements the Contractor shall design and implement methods of working that:-

(a) minimise disturbance to the seabed while dredging;

(b) minimise leakage of dredged material during lifting;

(c) minimise loss of material during transport of fill or dredged material;

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

(e) prevent the avoidable reduction, due to the Works, of the dissolved oxygen content of the water adjacent to the Works;

(f) prevent avoidable deterioration in the water quality causing adverse effects on marine life at nearby fish culture zones; and

(g) prevent excess suspended solids from being present in intake water.

10. WATER QUALITY MONITORING EQUIPMENT

(1) The Contractor shall provide the following equipment and assistance within one week of commencement of the Contract.

(a) Dissolved oxygen and temperature measuring equipment

The Contractor shall provide 2 sets of instrumentation, one working and one back up.

The instruments 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 30m in length. Sufficient stocks of spare electrodes and cable shall be maintained for replacement where necessary. (YSI model 59 meter, YSI 5739 probe, YSI 5795A submersible stirrer with reel and cable or similar approved).

(b) Turbidity Measurement Instrument

Turbidity of the water shall be measured by nephelometric method using two (one working and one stand-by) portable, weatherproof turbidity-measuring instrument complete comprehensive operation manuals. The equipment shall be operable from a DC power source. It shall have a photoelectric sensor capable of measuring turbidity between 0-200 NTU (Hach 2100P Turbidimeter or similar approved).

(c) Suspended Solids

The Contractor shall provide transportation and testing for the determination of suspended solids using approved laboratory. The water samples for suspended solids determination shall be taken by water sampler Van Dorn Design. Two such samplers shall be provided by the Contractor. They shall be made of a transparent PVC or glass cylinder (capacity not less than 2 litres) that can be effectively sealed with cups at both ends. The samplers shall have a positive latching system to keep it open and prevent premature closure until released by a messenger at the selected water depth (Kahlsico Water Sampler No. 135WB203 or similar approved). Water samples shall be kept in high density polythene bottles and packed in ice containers for transport to laboratory. Upon arrival at the laboratory, the suspended solids in each sample should be determined in accordance with method 2540D of standard methods for the Examination of Water and Wastewater (APHA, 17th Edition 1989). An accurate electronic balance with precision level of not less than 0.1mg (i.e. 0.0001 g) shall be used.

(d) Thermometer

A laboratory standard certified mercury thermometer with an accuracy of at least 0.5 degree Celsius.

(e) Water Depth Detector

A portable, battery-operated echo sounder shall be used to determine water depth at each designated monitoring station. This unit can either be handheld or affixed to the bottom of the vessel (see clause 11 below) if the same vessel is to be used throughout the monitoring programme. The detector shall have continuous graphic display or digital display of water depth. (Seafarer 701 or similar approved) that month, the corresponding audit and remedial measures, if any, taken to maintain the water quality.

14. ACTION ON DETECTION OF A DETERIORATING WATER QUALITY

(1) When the Engineer determines that the water quality monitoring shows a deteriorating water quality, the Contractor will be advised accordingly by the Engineer and shall execute the actions as stipulated in the Action Plan. These actions shall include but not be limited to the following:-

(a) checking of all marine plant and equipment;

(b) maintenance or replacement of any marine plant or equipment contributing to the deterioration;

(c) checking and maintenance of all silt screens; and

(d) review of all working methods.

(2) After the Contractor have implemented the mitigating measures as according to the Action Plan while the compliance monitoring record levels of turbidity, suspended solids or dissolved oxygen levels still indicate an environmentally unacceptable situation, the Engineer can temporarily suspend the site's construction work until the problem is under control and an acceptable environmental quality is restored.

(3) The Contractor shall inform the Engineer of all steps taken, and written reports and proposals for action shall be passed to the Engineer by the Contractor whenever the Engineer determines that water quality monitoring shows a deteriorating water quality.

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

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

(2) Pollution avoidance measures shall include but are not limited to the following:-

(a) mechanical grabs shall be designed and maintained to avoid spillage and shall seal tightly while being lifted;

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

(c) where suction hopper dredgers for dredging of uncontaminated marine mud are in use, overflow from the dredger and the operation of lean mixture overboard systems shall not be permitted for surface discharge unless expressly approved by the Engineer in consultation with the Environmental Protection Department;

[Note: Works agents should discuss their programme with EPD Water Policy

regarding discharge of excess water, such as by means of an adjustable standpipe at keel level.]

(d) all vessels 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 propeller wash;

(e) all pipe leakages are to be repaired promptly and plant is not to be operated with leaking pipes;

(f) the marine works shall cause no visible foam, oil, grease, scum, litter or other objectionable matter to be present on the water;

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

(h) excess material shall be cleaned from the decks and exposed fittings of barges and hopper dredgers before the vessel is moved;

(i) loading of barges and hoppers shall be controlled to prevent splashing of dredged material to the surrounding water and barges or hoppers shall not be filled to a level which will cause overflowing of material or polluted water during loading or transportation;

(j) Adequate freeboard shall be maintained on barges to ensure that decks are not washed by wave action;

(k) the Engineer may monitor any or all vessels transporting material to ensure that loss of material does not take place during transportation. The Contractor is to provide all reasonable assistance to the Engineer for this purpose.

(3) The Contractor shall ensure that all marine mud and unsuitable material is accurately disposed of at the approved locations. He will be required to ensure accurate positioning of vessels before discharge and will be required to submit and agree proposals with the Engineer for accurate positional control at disposal sites before commencing dredging. All disposal in designated marine dumping grounds shall be in accordance with conditions of a licence issued by the DEP under the Dumping at Sea Act (Overseas Territories) Order 1975. Floatable and certain contaminated material (as defined by the DEP) will not be acceptable at marine dumping grounds and will require other methods of disposal.

(4) Before commencing the dumping works, the Contractor shall provide, through the Engineer, to the Director of Environment Protection (DEP) and the Secretary of the Fill Management Committee (FMC), a programme for the approval of the dumping works. Dumping works shall only be carried out in accordance with the approved programme which may be amended from time to time with the approval of DEP and FMC.

(5) The Contractor shall provide, through the Engineer, to the DEP and FMC, a schedule containing details of the work included in, and the frequency of, the dumping works, on a monthly basis. A return showing the number of barge loads and the estimated quantity of surplus mud dumped within the mud disposal site shall be submitted to the DEP and

FMC within one week after completion of the dumping works.

(6) Mud shall be dumped evenly over the mud disposal site so that no high spots are formed and the dumping works shall be carried out in accordance with the submitted programme referred to in the above sub-clause (4).

(7) Water quality monitoring will be carried out by the Engineer during the dumping of mud in marine disposal sites. Requirements and extent of monitoring will be agreed with DEP and FMC.

16. DESIGNATED CONTAMINATED MARINE MUD

(1) The locations and depths of any contaminated marine mud will be indicated on the drawings or as directed by the Engineer. The Contractor is to ensure that the designated contaminated marine mud is dredged, transported and placed in approved special dumping grounds in accordance with the provision of clauses 15 and 17 and in such a manner to minimise the loss of material to the water column.

(2) The Contractor shall be permitted to use a disposal pit in 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.

(3) The mud shall be placed in a pit by bottom dumping at a location within the pit to be specified from time to time by the FMC.

(4) Flushing of the hopper is not permitted within the disposal site.

(5) The Contractor shall be able to position the dumping vessel to an accuracy of ± 10m. The dumping vessel must have positioning equipment on board which will automatically record the position of the barge at the time of dumping.

(6) The Contractor shall maintain detailed daily records of the number of the 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.

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

(1) Uncontaminated mud shall not be dumped other than in dumping grounds as may be approved for the purpose by the DEP and in accordance with the Dumping at Sea Act (Overseas Territories) Order 1975. Contaminated mud shall not be dumped in gazetted dumping grounds. If it cannot be left in situ, it should be disposed of by specific methods as directed by the DEP. The Contractor shall be responsible for obtaining all necessary licences for these operations.

[Note : The Engineer shall ensure that the Contractor has access to Works Branch Technical Circular No. 22/92 "Marine Disposal of Dredged Mud," EPD Technical Circular No. 1-1-92,

"Classification of Dredged Sediments for Marine Disposal, and Fill Management Committee Paper FMC/58 (6/10/92), General Allocation Conditions for Marine Borrow Areas and Mud Disposal Site."]

(2) When dredging, transporting and disposing of designated contaminated marine mud, the Contractor shall implement additional special procedures for the avoidance of pollution which shall include but not be limited to the following:

(a) Dredging of designated contaminated marine mud shall only be undertaken by a suitable grab dredger using a closed watertight grab.

(b) Transport of designated contaminated marine mud shall be by split barge of not less than 750m^3 capacity, well maintained and capable of rapid opening and discharge at the disposal site.

(c) Discharge from split barges shall be placed in the designated special dumping pit by bottom dumping, at a location within the pit to be specified, from time to time, by the Secretary of the Fill Management Committee (FMC) and Geotechnical Engineering Office of Civil Engineering Department.

(d) The dumping vessel shall be stationary throughout the dumping operation, discharge shall be undertaken rapidly, and the hoppers shall then immediately be closed; any material adhering to the sides of the hopper shall not be washed out of the hopper and the hopper shall remain closed until the barge next returns to the disposal site.

(e) Any substance which is found dumped by the Contractor outside the designated dumping ground shall be removed.

(f) providing and maintaining functional marker buoys at the corners of the pit.

(3) Silt Curtains

(a) The Contractor will be responsible for designing, agreeing with the Engineer, and installing silt curtains, where required, to achieve the water quality requirements and the protection of water quality at any water intakes.

(b) Silt curtains shall be formed from tough, abrasion-resistant, permeable membranes, suitable for the purpose, supported on floating booms in such a way as to ensure that the ingress of turbid waters to the enclosed waters shall be restricted.

(c) The boom of the curtain shall be formed and installed in such a way that tidal rise and fall are accommodated, and that the ingress of turbid waters is limited. The removal and reinstallation of such curtains during typhoon conditions shall be as agreed with the Director of Marine.

(d) The Contractor shall regularly inspect the silt curtains and shall ensure that they are adequately moored and marked to avoid danger to marine traffic.

18. REMOVAL OF WASTE MATERIAL

(1) Notwithstanding the provisions of the GCC the Contractor shall not permit any sewage, waste water or effluent containing sand, cement, silt or any other suspended or dissolved material to flow from the Site onto any adjoining land or allow any waste matter or refuse to be deposited anywhere within the Site or onto any adjoining land and shall have all such matter removed from the Site.

(2) The Contractor shall be responsible for temporary training, diverting or conducting of open streams or drains intercepted by any works and for reinstating these to their original courses on completion of the Works.

(3) The Contractor shall be responsible for adequately maintaining any existing site drainage systems at all times including removal of solids in sand traps, man holes and streambeds.

(4) Any proposed stream course and nullah temporary diversions shall be submitted to the Engineer for agreement one month prior to such diversion works being commenced. Diversions shall be constructed to allow the water flow to discharge without overflow, erosion or washout. The area through which the temporary diversion runs is to be reinstated to its original condition when the temporary diversion is no longer required.

(5) The Contractor shall segregate all inert construction waste material suitable for reclamation or land formation and shall dispose of such material at a public dumping area(s).

(6) All non-inert construction waste material deemed unsuitable for reclamation or land formation and all other waste material shall be disposed of at a public landfill.

(7) The Contractor's attention is drawn to the Waste Disposal Ordinance, the Public Health and Municipal Services Ordinance and the Water Pollution Control Ordinance.

19. DISCHARGE INTO SEWERS AND DRAINS

(1) The Contractor shall not discharge directly or indirectly (by runoff) or cause or permit or suffer to be discharged into any public sewer, storm-water drain, channel, stream-course or sea, any effluent or foul or contaminated water or cooling or hot water without the prior consent of the relevant Authority who may require the Contractor to provide, operate and maintain at the Contractor's own expense, within the premises or otherwise, suitable works for the treatment and disposal of such effluent or foul or contaminated or cooling or hot water.

(2) If any office, site canteen or toilet facilities is erected, foul water effluent shall subject to (1) above, be directed to a foul sewer or to a sewage treatment facilities either directly or indirectly by means of pumping.

(3) The Contractor's attention is drawn to the Buildings Ordinance, the Water Pollution Control Ordinance and the Technical Memorandum "Standards for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters" for appropriate water control zone.

NOISE CONTROL

20. GENERAL REQUIREMENTS

(1) The Contractor shall consider noise as an environmental constraint in his planning and execution of the Works.

(2) The Contractor shall comply with the Noise Control Ordinance (Cap 400) including its subsidiary regulations and technical memoranda.

(3) In addition to the requirements imposed by the Noise Control Ordinance, to control noise generated from equipment and activities for the purpose of carrying out any construction work other than percussive piling during the time period from 0700 to 1900 hours on any day not being a general holiday, the following requirements shall also be complied with:

(i) The noise level measured at 1m from the most affected external facade of the nearby noise sensitive receivers during any 30 minute period shall not exceed an equivalent sound level (Leq) of 75 dB(A).

(ii) Should the limits stated in the above sub-clause (i) be exceeded, work shall stop and shall not recommence until the Contractor has taken appropriate measures acceptable to the Engineer that are necessary for compliance.

Any stoppage or reduction in output resulting from compliance with this clause shall not entitle the Contractor to any claims of extension of time or to any additional costs whatsoever.

(4) The Contractor shall ensure that all equipment to be used on site shall be effectively sound-reduced by means of silencers, mufflers, acoustic linings or shields, acoustic sheds or screens or other means to avoid disturbance to any nearby noise sensitive receivers. All hand-held percussive breakers and air compressors used by the Contractor shall comply with the Noise Control (Hand-held Percussive Breakers) Regulations and Noise Control (Air Compressors) Regulations respectively under the Noise Control Ordinance (Ordinance No. 75/88, NCO amendment 1992 No.6).

(5) 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.

(6) The Contractor shall advise and arrange methods of working to minimize noise impacts, and shall provide experienced personnel with suitable training to ensure that these methods are implemented. The Contractor's attention is particularly drawn to the proximity of the Noise Sensitive Receivers to the site.

(7) Before the commencement of the Works the Contractor shall submit to the Engineer the proposed methods of working.

(8) Notwithstanding the requirements and limitations set out in clause (3) above and subject to compliance with clauses (1), (4) and (6) above, the Engineer may upon application in writing by the Contractor, allow the use of any equipment and the carrying out of any construction activities for any durations provided that he is satisfied with the application

which, in his opinion, to be of absolute necessity and adequate noise insulation has been provided to the educational institutions to be affected, or of emergency nature, and not in contravention with the Noise Control Ordinance in any respect.

(9) For the purposes of the above clauses, any domestic premise, hotel, hostel, temporary housing accommodation, hospital, medical clinic, educational institution, place of public worship, library, court of law, performing art centre shall be considered a noise sensitive receiver.

21. NOISE MONITORING AND COMPLIANCE AUDIT REPORTING

(1) The Engineer will carry out, in conjunction with the Contractor, the following construction noise monitoring procedures:-

(a) The Contractor shall provide suitably qualified and experienced staff for the Engineer's approval, to assist the Engineer in carrying out noise measurements.

(b) A schedule of proposed noise measurement times and sites shall be produced by the Contractor in consultation with and on approval by the Engineer at least two weeks before the commencement of the scheduled period. The measurement frequency shall be at least once per week at each location for each of the following periods

(i) 0700 - 1900 hours on normal weekdays

(ii) 0700 - 2300 hours on holidays and
1900 - 2300 hours on all other days

(iii) 2300 - 0700 hours of next day

Measurements shall be taken at sites and times chosen to fairly represent normal construction activities.

(c) Three sound level meters complete with tripods and a calibrator shall be provided by the Contractor within one week of the commencement of the contract and comply with the International Electrotechnical Commission Publications 651 : 1979 (Type 1) and 804 : 1985 (Type 1) specifications, as referred to in the Technical Memoranda to the Noise Control Ordinance.

(d) The construction noise level monitoring shall be carried out at a distance of 1 m from the external facade at the locations identified in (b) above, and the Contractor shall be responsible for arranging access. Alternative sites may be permitted or agreed by the Engineer if difficulties arise in obtaining access, or if the locations become unsuitable.

(e) The exact location and direction of the noise monitoring at each site shall be agreed with the Engineer.

(f) Construction noise levels should be recorded as the Leq (30 min) measurements during the day time on normal weekdays and Leq (5 min) measurements during the restricted hours, at each of the locations, to the agreed schedule.

(g) The Engineer shall, prior to the commencement of the construction works, carry out baseline monitoring to determine the baseline noise level for each of the time periods mentioned in 19(1)(b). The baseline monitoring shall be carried out for a period of at least two weeks, with measurements to be taken every day at each site and to a schedule agreed with the Contractor. From these measurements baseline noise levels (Leq(5min)), shall be calculated.

(h) Checking of baseline noise levels shall be carried out by the Engineer on at least four occasions during the year, at not less than one monthly intervals, for each site. The checking shall be carried out when construction activities are not taking place.

(2) At monthly intervals, the Engineer shall provide to the Contractor a monitoring and audit report of monitoring and audit results in that month.

22. THE ENVIRONMENTAL MONITORING AND AUDIT PROGRAMME REQUIREMENTS

The Engineer shall implement the EM&A programme in accordance to the guidelines set out in Annex I.

Annex I

Engineer's Guidelines for Implementation of Environmental Monitoring and Audit (EM&A) Programme

The following are guidelines to assist the Engineer in the implementation of an EM&A programme. These guidelines are derived from previous EM&A programme for ACP projects prepared by Works Branch Agents and site engineers. It is the intent that these guidelines be implemented at the earliest practicable stage of the works.

1. Prior to commencement of works, the Engineer shall review the Environmental Impact Assessment of the project in question and ensure that the environmental monitoring and audit requirements are performed in accordance with agreements reached with EPD.

2. The Engineer shall incorporate agreed pollution control contract clauses into tender/contract documents.

3. Prior to contract commencement, the Engineer shall prepare an EM&A Manual and seek guideline from the EPD where necessary. The Manual shall be a stand-alone document and shall be reviewed and updated as necessary during the EM&A programme. Suggestions for the Manual include the following:

   (a) project background including organisation and programme;

   (b) purpose of the manual;

   (c) a summary list of all recommended environmental mitigation measures where available and a programme for their implementation. The measures should include those identified at detailed design, contract preparation, construction, and operation stages of the project;

(d) drawings showing all environmentally sensitive receivers;

(e) an EM&A programme for the construction of the project including:

- responsibility for EM&A work
- EM&A organisation and management structure
- EM&A methodology
- equipment to be used and calibration required
- monitoring locations
- monitoring parameters
- monitoring frequency and duration
- environmental quality performance limits (trigger/action/target levels)
- Event/Action Plans
- procedures for reviewing the monitoring results
- format and presentation of monitoring results
- compliance audit procedures and follow-up

(f) complaint/consultation procedures; and

(g) reporting procedures including format and frequency;

4. Prior to contract commencement, the Engineer shall establish an EM&A team which shall be responsible for the implementation and execution of the agreed EM&A programme. It is very often the case that the EM&A team is formed as part of the resident site staff for the construction phase of the project. Consideration should be given to set up an EM&A team for the post-project operational stage, if such monitoring works are required.

5. The Engineer (his EM&A team) should acquire the stipulated environmental monitoring equipment and consumable through an appropriate means. *[Note: In many cases the Engineer would reply on the Contractor responsible for the construction works to provide the monitoring equipment. This has the drawback of delaying the commencement of the EM&A programme and making it very difficult to acquire sufficient background information before work begins. Therefore, as far as possible, equipment shall be ready for use about 6 weeks before contract commencement by the Employer, the Engineer, and independent laboratory or any other means acceptable to the Employer.]*

6. The Engineer shall recover, if not already available, the baseline environmental profile

of the works area through baseline monitoring as specified in the agreed EM&A Manual. *[Note : The minimum baseline period prior to commencement of the works should be addressed in the Manual.]*

7. The Engineer (his EM&A team) shall carry out or supervise his laboratory or Contractor to carry out regular monitoring as stipulated in the agreed EM&A Manual, and shall audit the monitoring results. The Engineer shall also inspect the work sites regularly and initiate appropriate actions as per the agreed Event/Action Plan contained in the EM&A Manual.

8. Audits shall be conducted in conjunction with the environmental monitoring programme as specified in the EM&A Manual. The results and findings of the audit should be documented in monthly EM&A reports. Audits shall include:

(a) inspection and validating the monitoring procedures and results;

(b) organization and presentation of the monitoring data;

(c) analysis and interpretation of the monitoring results to establish an environmental profile at the time of audit;

(d) verification that the monitoring results are in compliance with established environmental quality limits (trigger/action/target levels and/or any regulatory requirements) and documentation of any exceedances;

(e) on-site inspections and investigations to identify sources and causes of non-compliance and unacceptable impacts;

(f) inspections to ensure the Contractor fulfils the contractual and statutory requirements, licensing conditions etc., relating to protection of environment. Such inspections may or may not involve sampling for analysis which is not covered by the regular monitoring. *[Note: Should non-compliance associated with the works be proven through sampling and testing, the Contractor shall be liable for all such express incurred.]*

(g) inspection to ensure that all environmental mitigation measures are properly and effectively implemented, and review the adequacy of the implemented measures;

(h) comparison of impact predictions with the actual impacts measured to assess the accuracy of predictions;

(i) assessment of the environmental management systems, practices and procedures;

(j) identification of remedial measures if non-compliance and improvements in management, control and operations of environmental objectives are not achieved;

(k) identification of potential environmental problems or impacts associated with the programmed works and solutions to avert or minimise these impacts;

(l) investigation of complaints from residents/sensitive receivers and the actions taken when the complaints are received; and

(m) a review of the overall monitoring philosophy, in terms of procedure, location of monitoring stations, frequency, parameters measured, test methods, acceptance criteria, etc.

9. The Engineer (his EM&A team) shall prepare an EM&A report and submit to the Strategic Assessment Group/EPD for review. Monthly EM&A reports shall include at least the following:

(a) 1-2 pages executive summary;

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

(c) summary of EM&A requirements including:

- all monitoring parameters;
- environmental quality performance limits (trigger/action/target levels);
- Event/Action Plans;
- recommended environmental mitigation measures; and
- environmental requirements in contract documents.

(d) drawings showing environmental sensitive receivers and locations of the monitoring stations;

(e) monitoring results (in both hard and diskette copies) together with the following information;

- monitoring methodology
- equipment used and calibration details
- parameters monitored
- monitoring locations (and depth)
- monitoring time, frequency, duration, and period

(f) graphical plots of the trends of monitored parameters over the past 4 reporting periods for representative monitoring stations annotated against the following:

- weather conditions during the period
- major activities being carried out on site during the period
- other factors which may affect the monitoring result

(g) advise on the solid and liquid waste management status;

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

(i) summary of non-compliance (exceedances) of the environmental quality performance limits (trigger/action/target levels);

(j) review of the reasons for the non-compliance including review of pollution sources and working procedures;

(k) description of the actions taken in the event of non-compliance and any follow-up procedures related to earlier non-compliance;

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

(m) forecast of the works programme and monitoring schedule for the coming month; and

(n) comments and conclusions for the month.

10. The Engineer shall liaise with respective organisations and parties in the case that complaints are received, and to investigate the complaints and initiate appropriate actions as deemed necessary.

11. The Engineer shall continue the monitoring and auditing programme to the end of the agreed period. Meanwhile, there may be a need for ad hoc liaison meetings among the Employer, the Engineer, the EM&A team, NAPCO and the EPD. There may also be a need for briefings and presentations to District Boards and other interested parties, as directed by the Employer.

APPENDIX H

Appendix H

Stonecutters' Island Breeding Bird Species 1993-1994

Species for which breeding has been proven:

Night Heron
Cattle Egret
Little Egret
Black Kite
Spotted Dove
Indian Cuckoo
Greater Coucal
Hoopoe
White-breasted Kingfisher
Common Kingfisher
Chinese Bulbul
Crested Bulbul
Magpie Robin
Long-tailed Tailorbird
Great Tit
Black Drongo
Jungle Crow
Magpie
Black-necked Starling
Crested Mynah
Tree Sparrow
Sulphur-crested Cockatoo

Species for which breeding is probable:

Koel
Violet Whistling Thrush
Rufous-backed Shrike
Japanese White-eye
White-backed Munia
Feral Pigeon

Species which are present in the breeding season and which may or may not breed on the Island:

Chinese Pond Heron
Reef Egret
Great Egret
House Swift
Barn Swallow
Collared Crow

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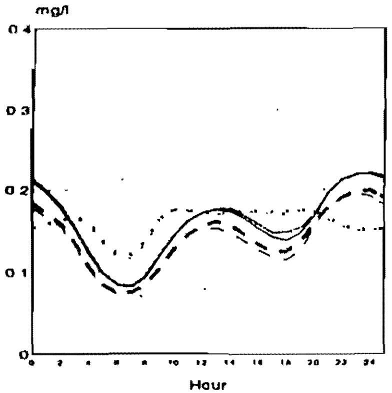
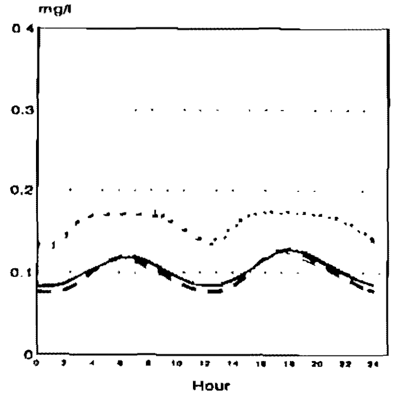


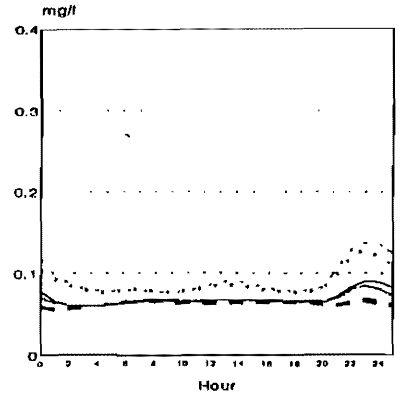
Dry Spring Tide

VM7
ON



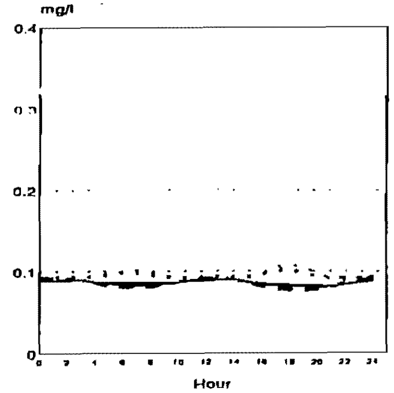
Dry Neap Tide

WM3
ON



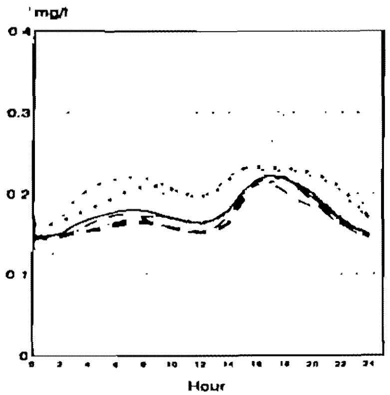
Dry Spring Tide

WM3
ON



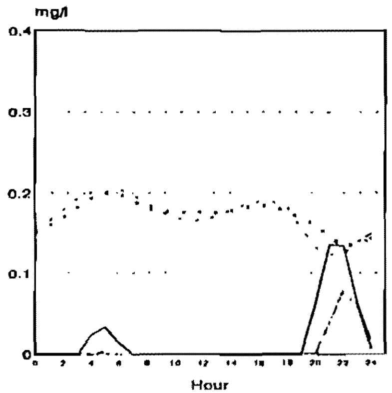
Dry Neap Tide

VM7
ON



Wet Spring Tide

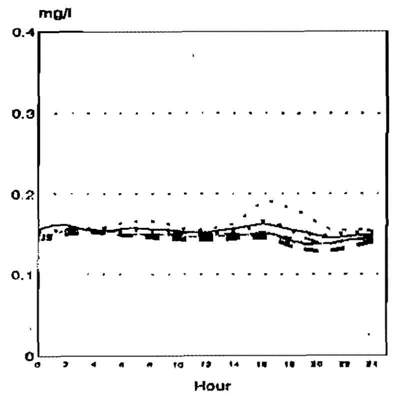
VM7
ON



Wet Neap Tide

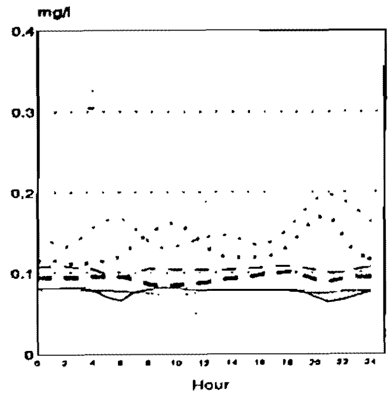
- - - - Existing Upper Layer
- - - - Existing Lower Layer
—— Baseline Upper Layer
—— Baseline Lower Layer
. . . . . . SSDS Stage I Upper Layer
. . . . . . SSDS Stage I Lower Layer

WM3
ON



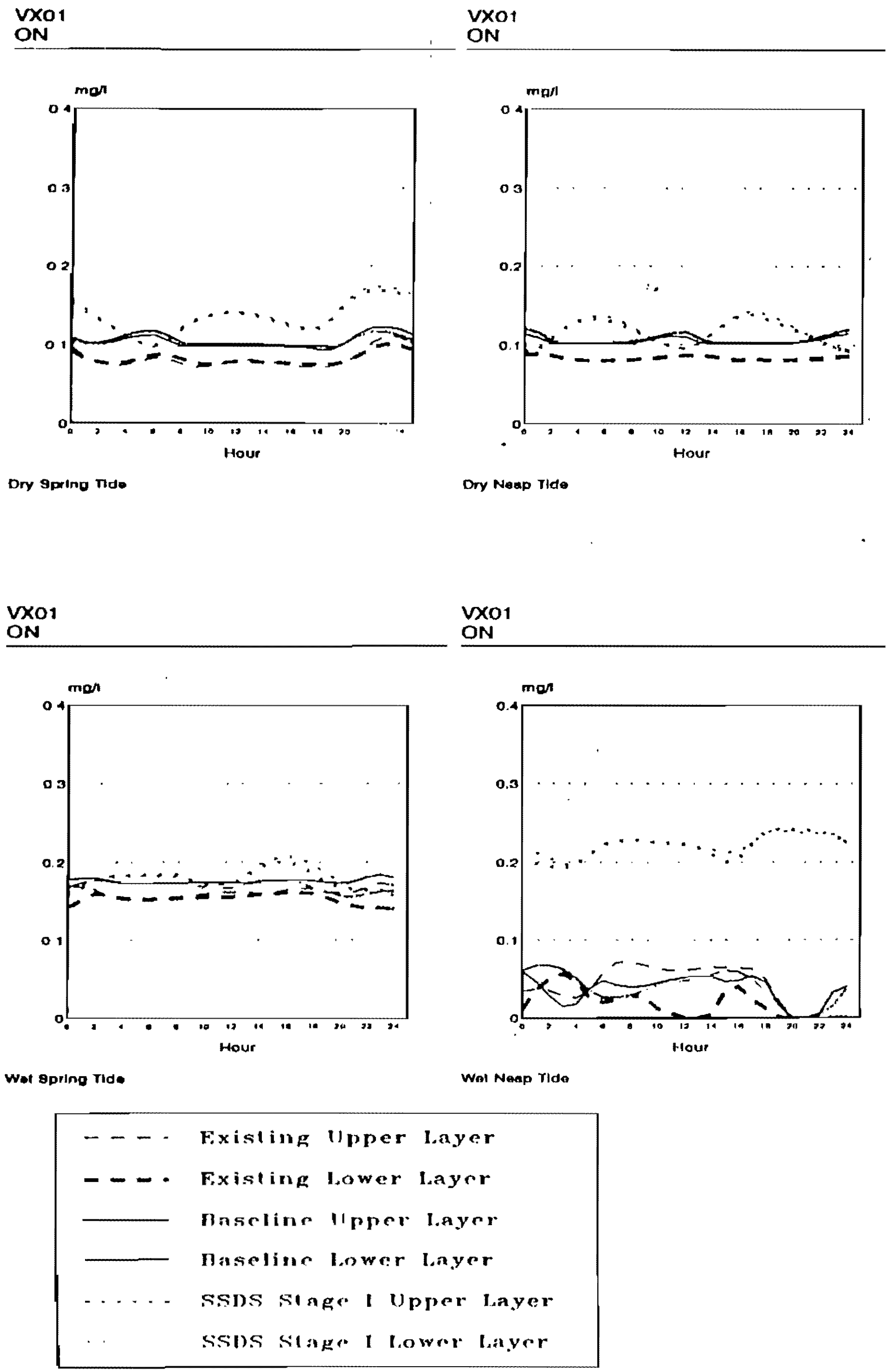
Wet Spring Tide

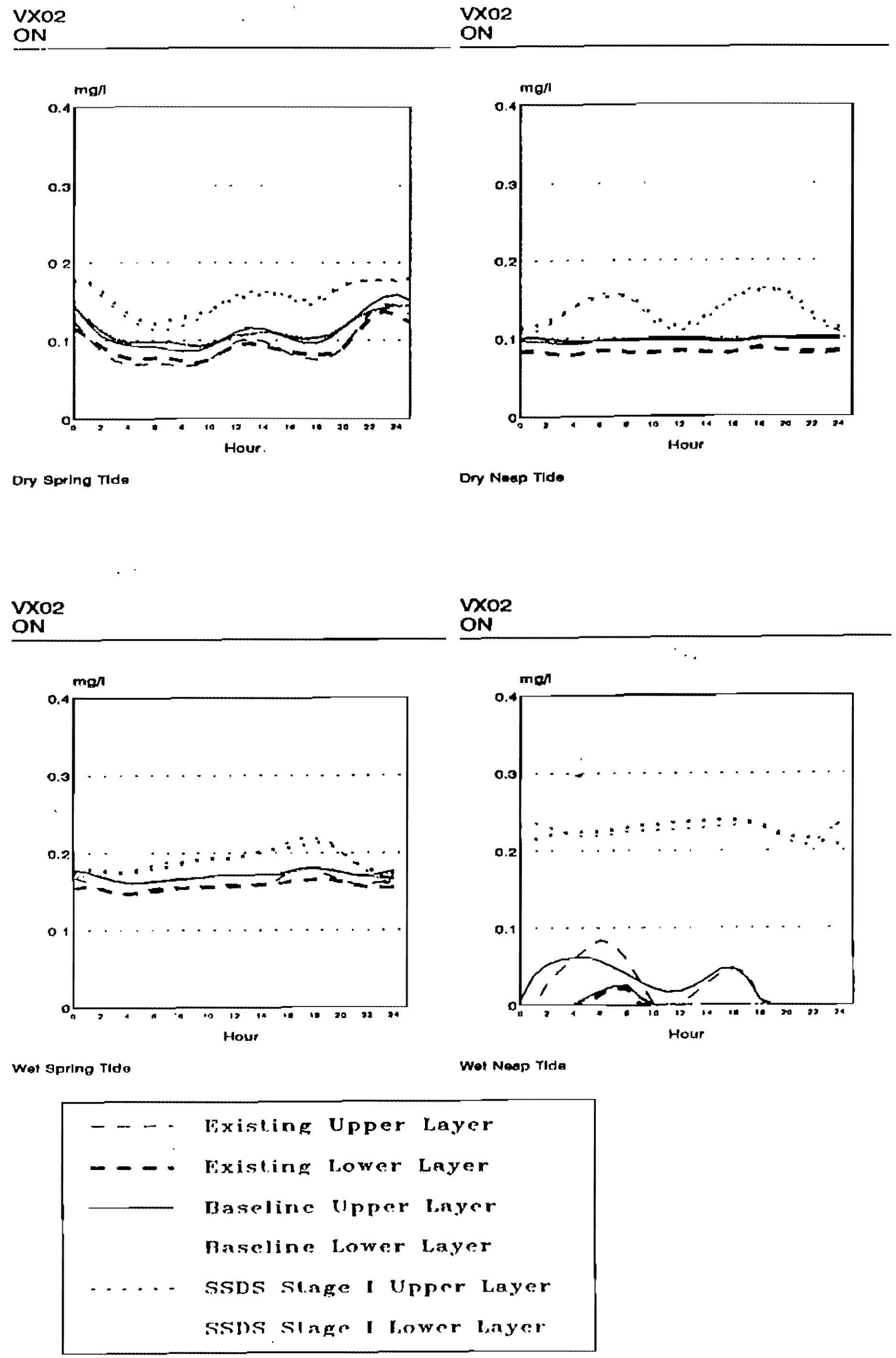
WM3
ON

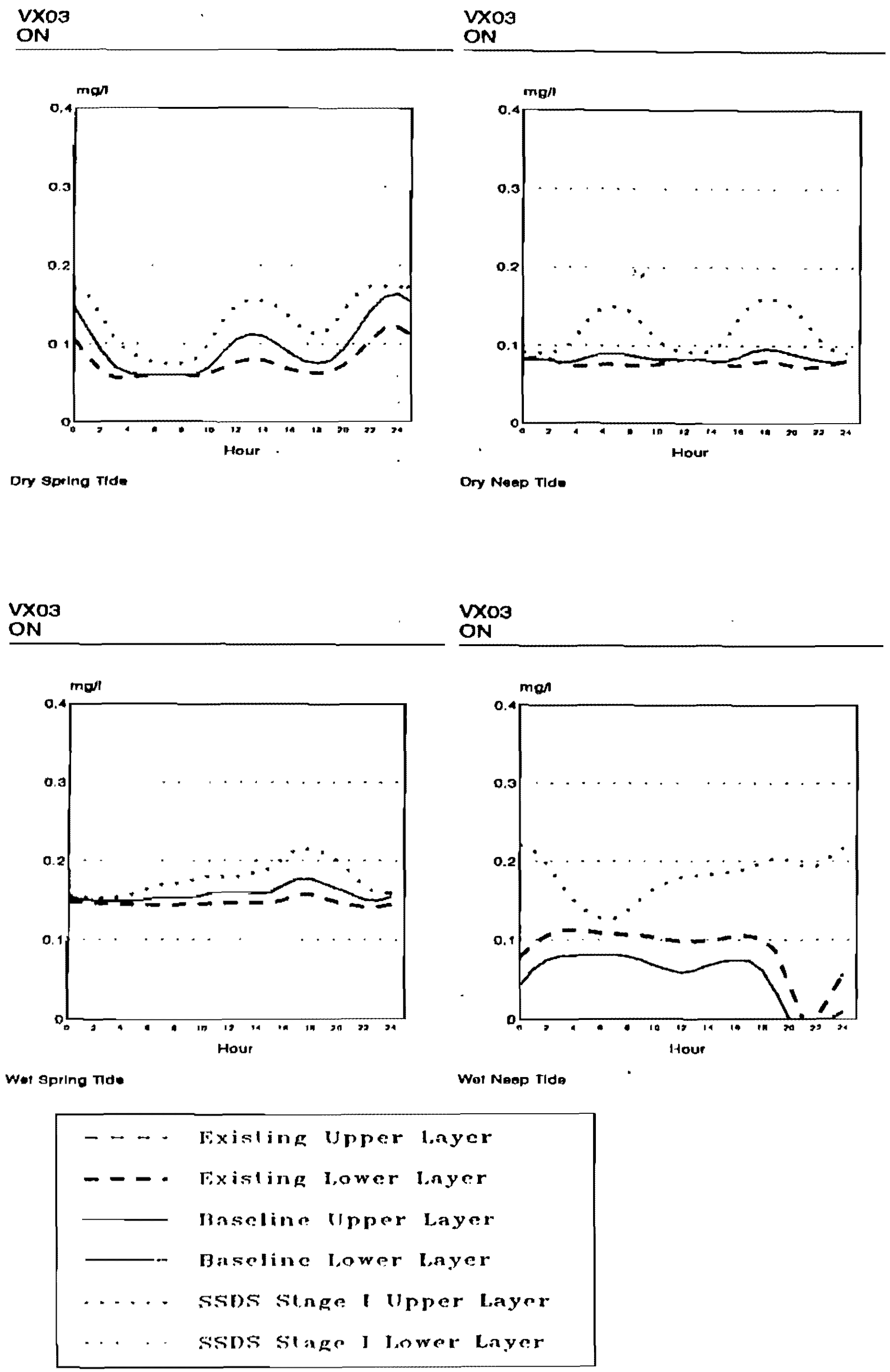


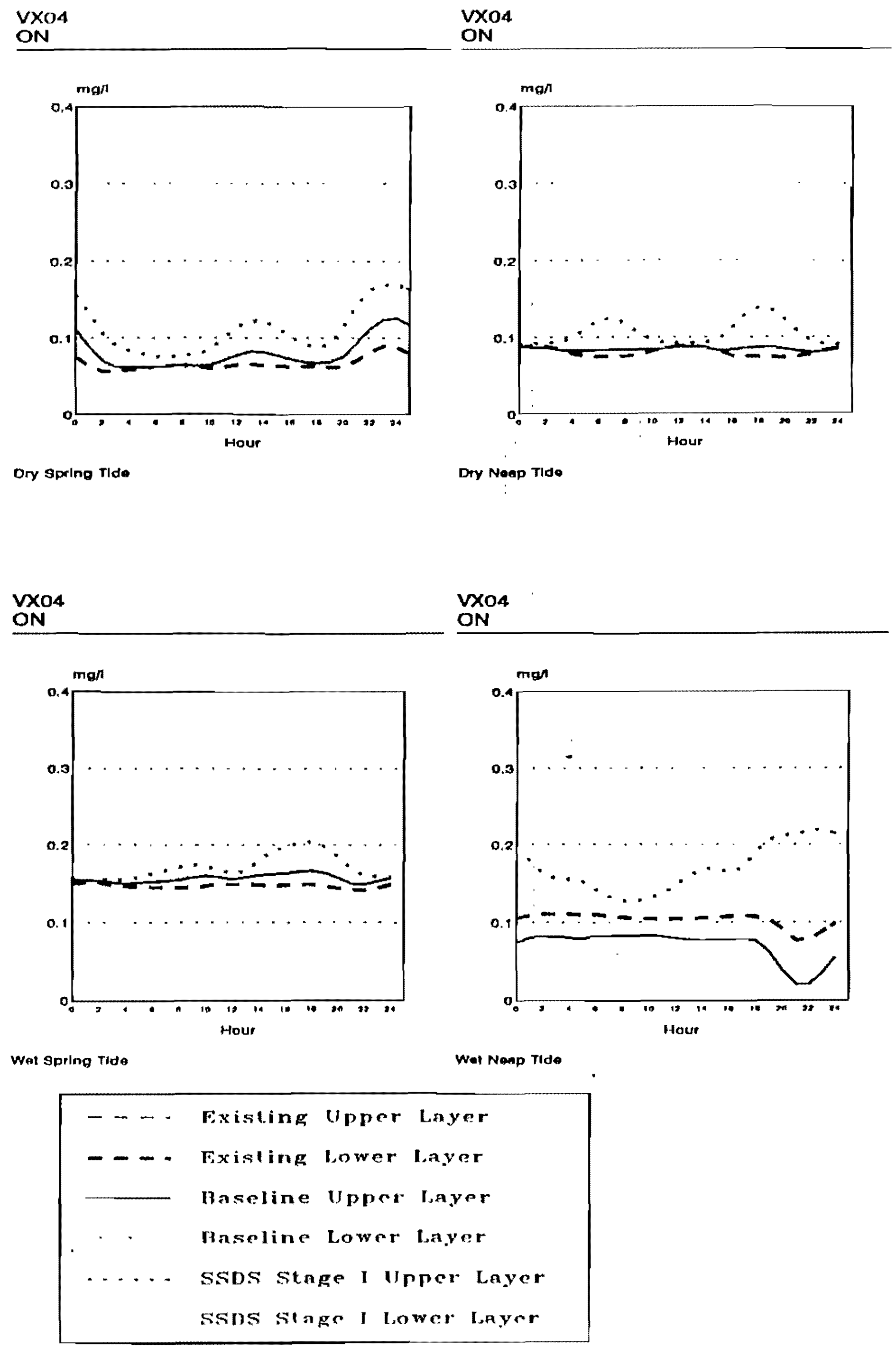
Wet Neap Tide

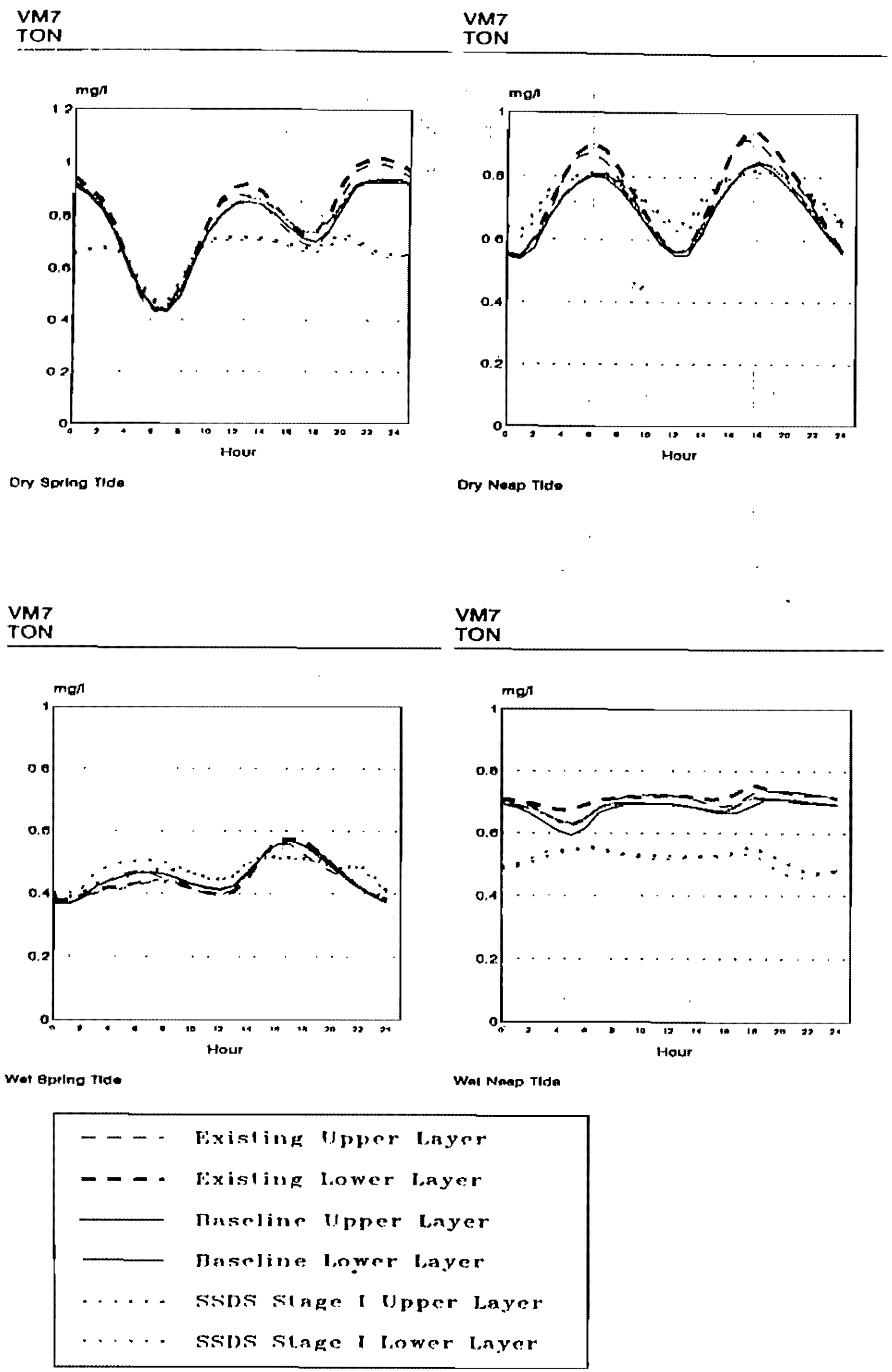
- - - - Existing Upper Layer
- - - - Existing Lower Layer
—— Baseline Upper Layer
Baseline Lower Layer
. . . . . . SSDS Stage I Upper Layer
SSDS Stage I Lower Layer

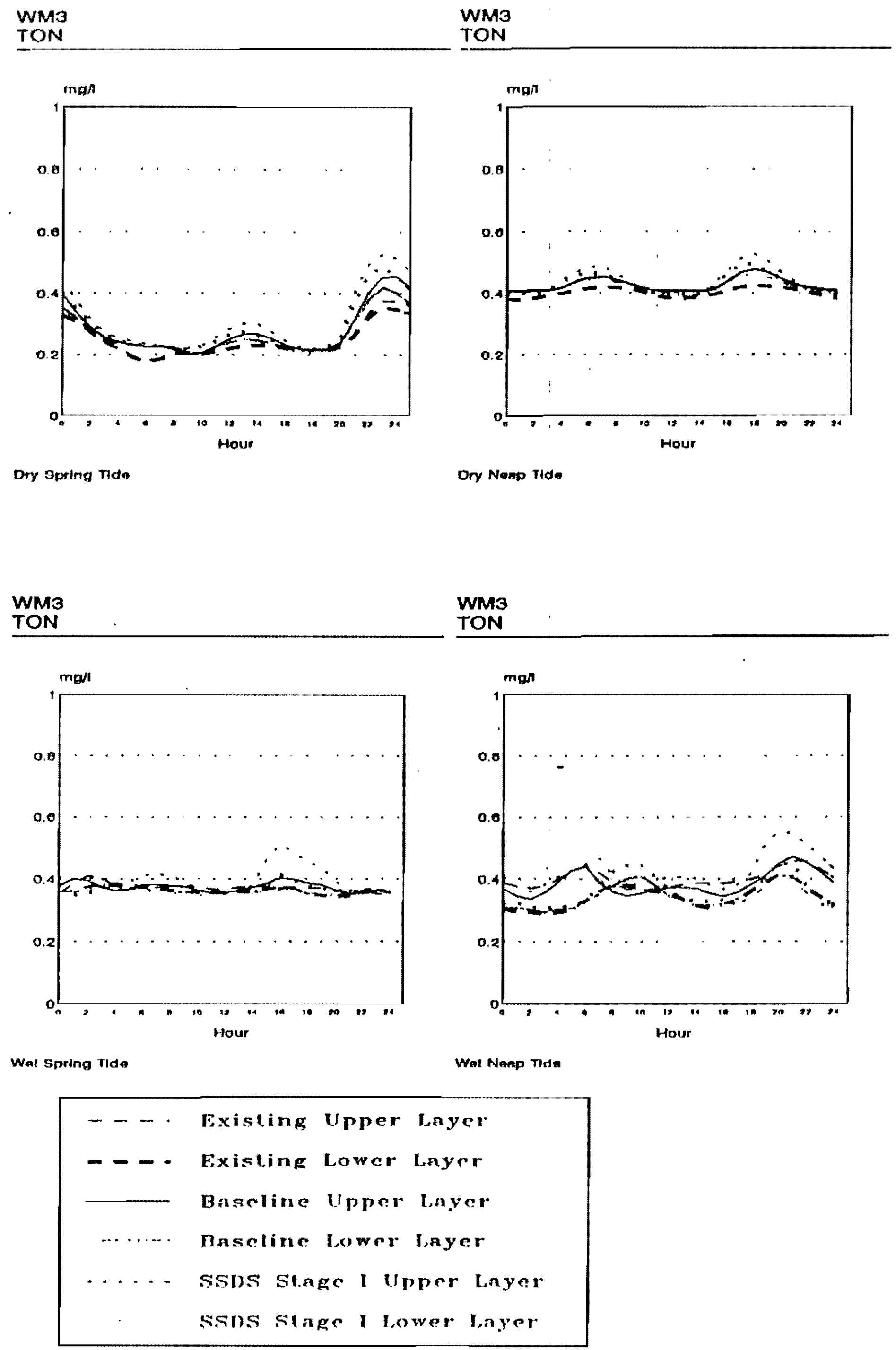

VX01
ON
mg/l
0.4
0.3
0.2
0.1
0
Hour
Dry Spring Tide
VX01
ON
Dry Neap Tide
VX01
ON
Wet Spring Tide
VX01
ON
Wet Neap Tide
Existing Upper Layer
Existing Lower Layer
Baseline Upper Layer
Baseline Lower Layer
SSDS Stage I Upper Layer
SSDS Stage I Lower Layer

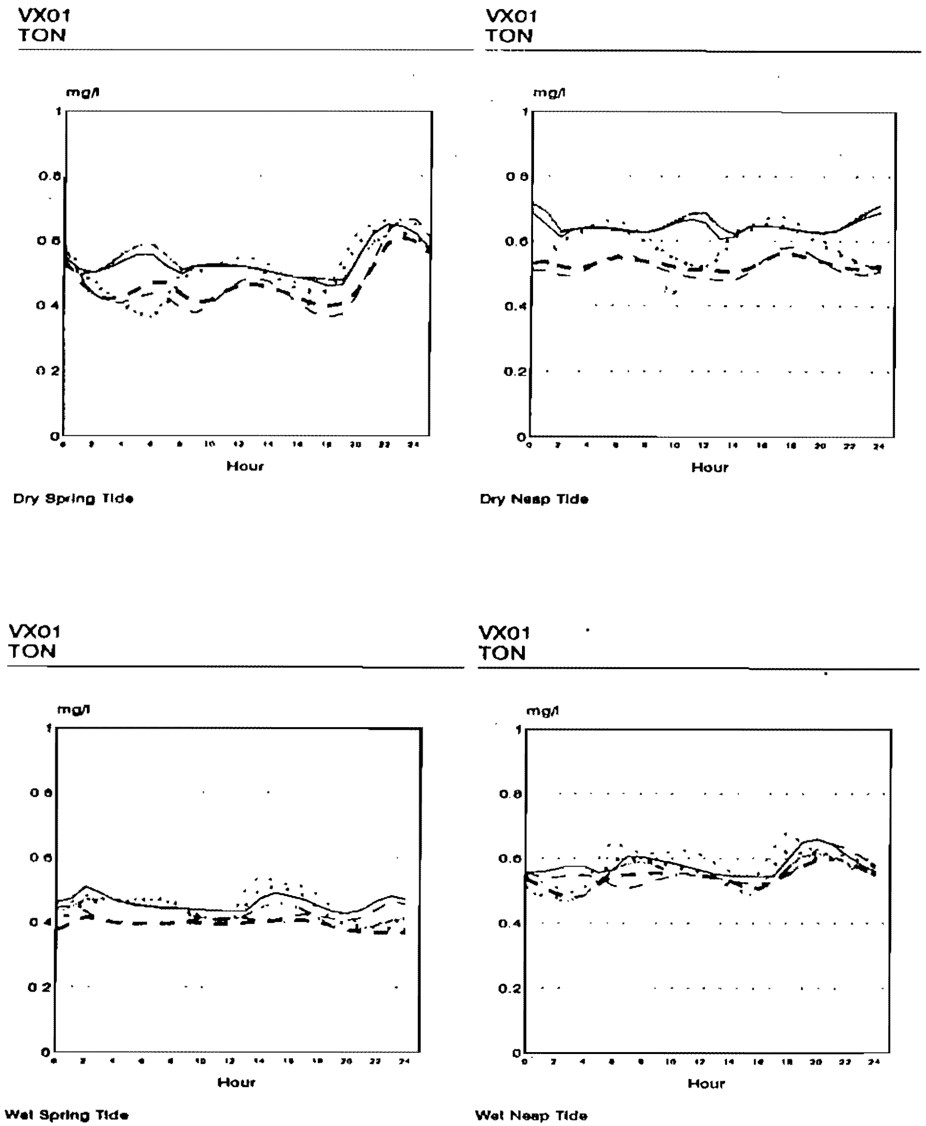

VX02
ON
mg/l
0.4
0.3
0.2
0.1
0
Hour
Dry Spring Tide
VX02
ON
Dry Neap Tide
VX02
ON
Wet Spring Tide
VX02
ON
Wet Neap Tide
Existing Upper Layer
Existing Lower Layer
Baseline Upper Layer
Baseline Lower Layer
SSDS Stage I Upper Layer
SSDS Stage I Lower Layer


VX03
ON
mg/l
Hour
Dry Spring Tide
VX03
ON
mg/l
Hour
Dry Neap Tide
VX03
ON
mg/l
Hour
Wet Spring Tide
VX03
ON
mg/l
Hour
Wet Neap Tide
Existing Upper Layer
Existing Lower Layer
Baseline Upper Layer
Baseline Lower Layer
SSDS Stage I Upper Layer
SSDS Stage I Lower Layer

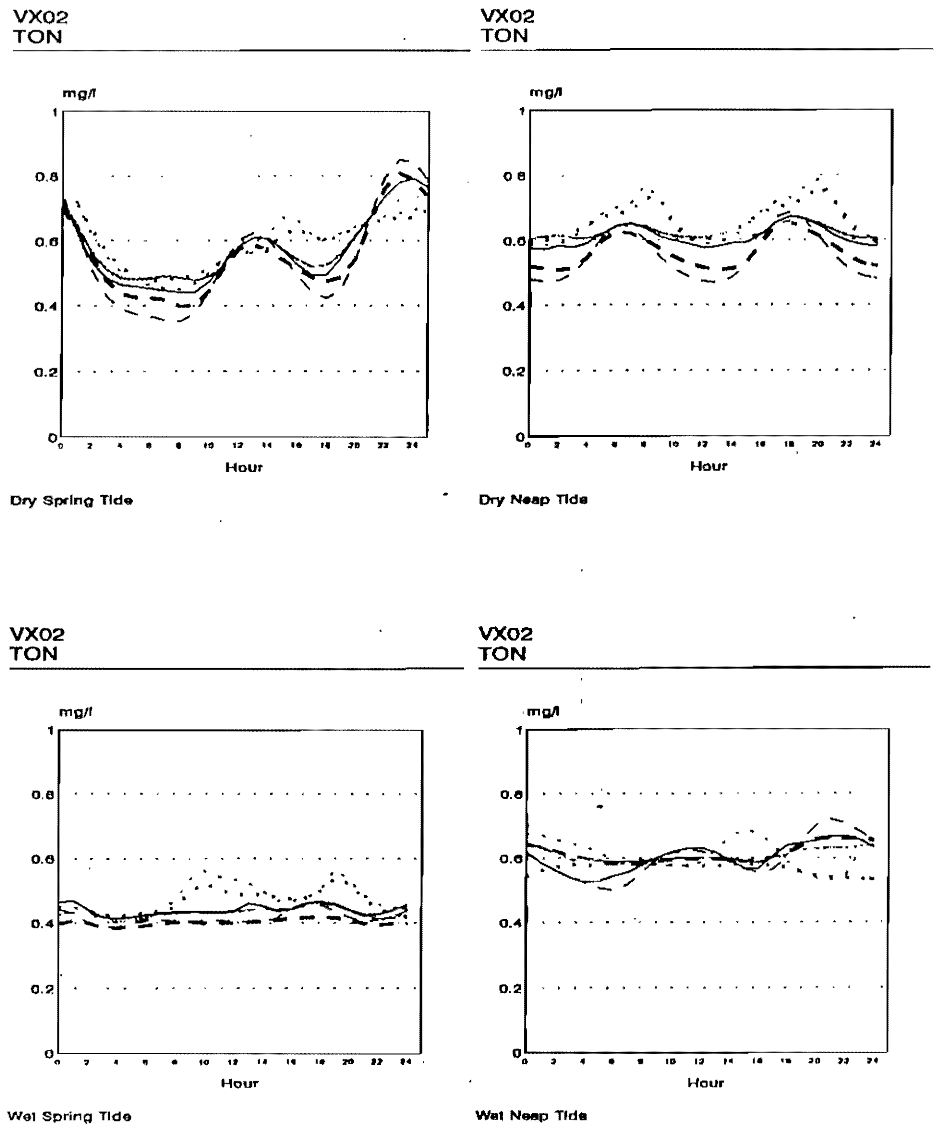

VX04
ON
mg/l
Hour
Dry Spring Tide
VX04
ON
mg/l
Hour
Dry Neap Tide
VX04
ON
mg/l
Hour
Wet Spring Tide
VX04
ON
mg/l
Hour
Wet Neap Tide
Existing Upper Layer
Existing Lower Layer
Baseline Upper Layer
Baseline Lower Layer
SSDS Stage I Upper Layer
SSDS Stage I Lower Layer


VM7
TON
mg/l
Hour
Dry Spring Tide
Dry Neap Tide
Wet Spring Tide
Wet Neap Tide
Existing Upper Layer
Existing Lower Layer
Baseline Upper Layer
Baseline Lower Layer
SSDS Stage I Upper Layer
SSDS Stage I Lower Layer


WM3
TON
mg/l
Hour
Dry Spring Tide
Dry Neap Tide
Wet Spring Tide
Wet Neap Tide
Existing Upper Layer
Existing Lower Layer
Baseline Upper Layer
Baseline Lower Layer
SSDS Stage I Upper Layer
SSDS Stage I Lower Layer

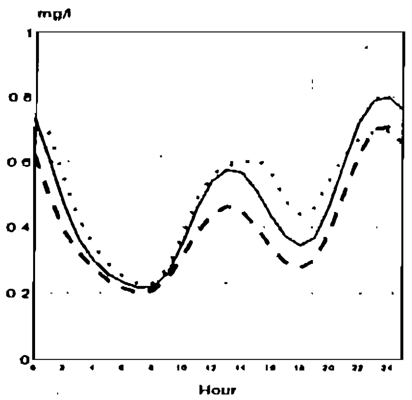


- - - - Existing Upper Layer
- - - - Existing Lower Layer
—— Baseline Upper Layer
—— Baseline Lower Layer
· · · · · · SSDS Stage I Upper Layer
· · · · · · SSDS Stage I Lower Layer



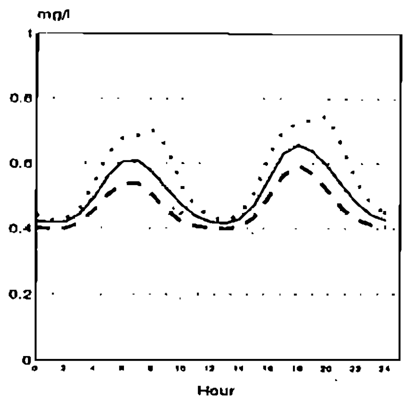
- - - - Existing Upper Layer
- - - - Existing Lower Layer
—— Baseline Upper Layer
Baseline Lower Layer
· · · · · · SSDS Stage I Upper Layer
· SSDS Stage I Lower Layer

VX03
TON



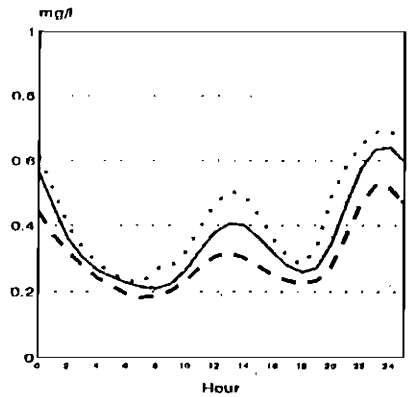
Dry Spring Tide

VX03
TON



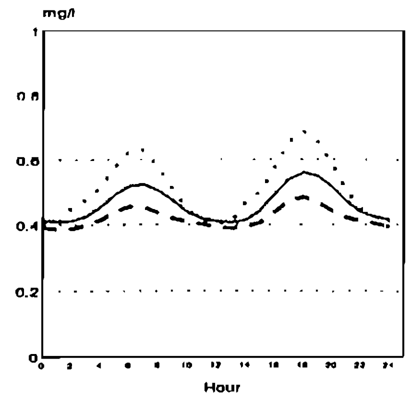
Dry Neap Tide

VX04
TON



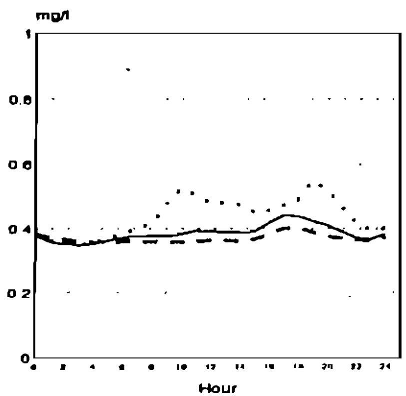
Dry Spring Tide

VX04
TON



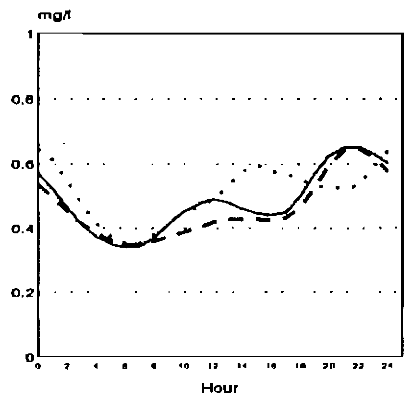
Dry Neap Tide

VX03
TON



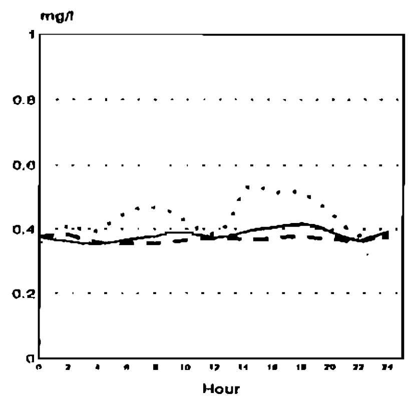
Wet Spring Tide

VX03
TON



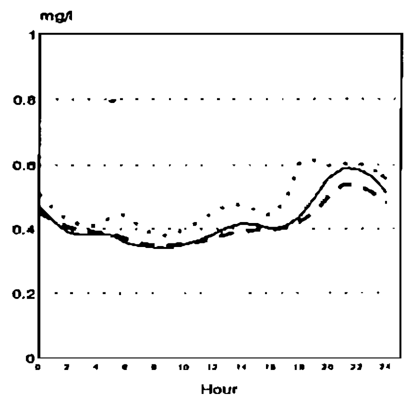
Wet Neap Tide

VX04
TON



Wet Spring Tide

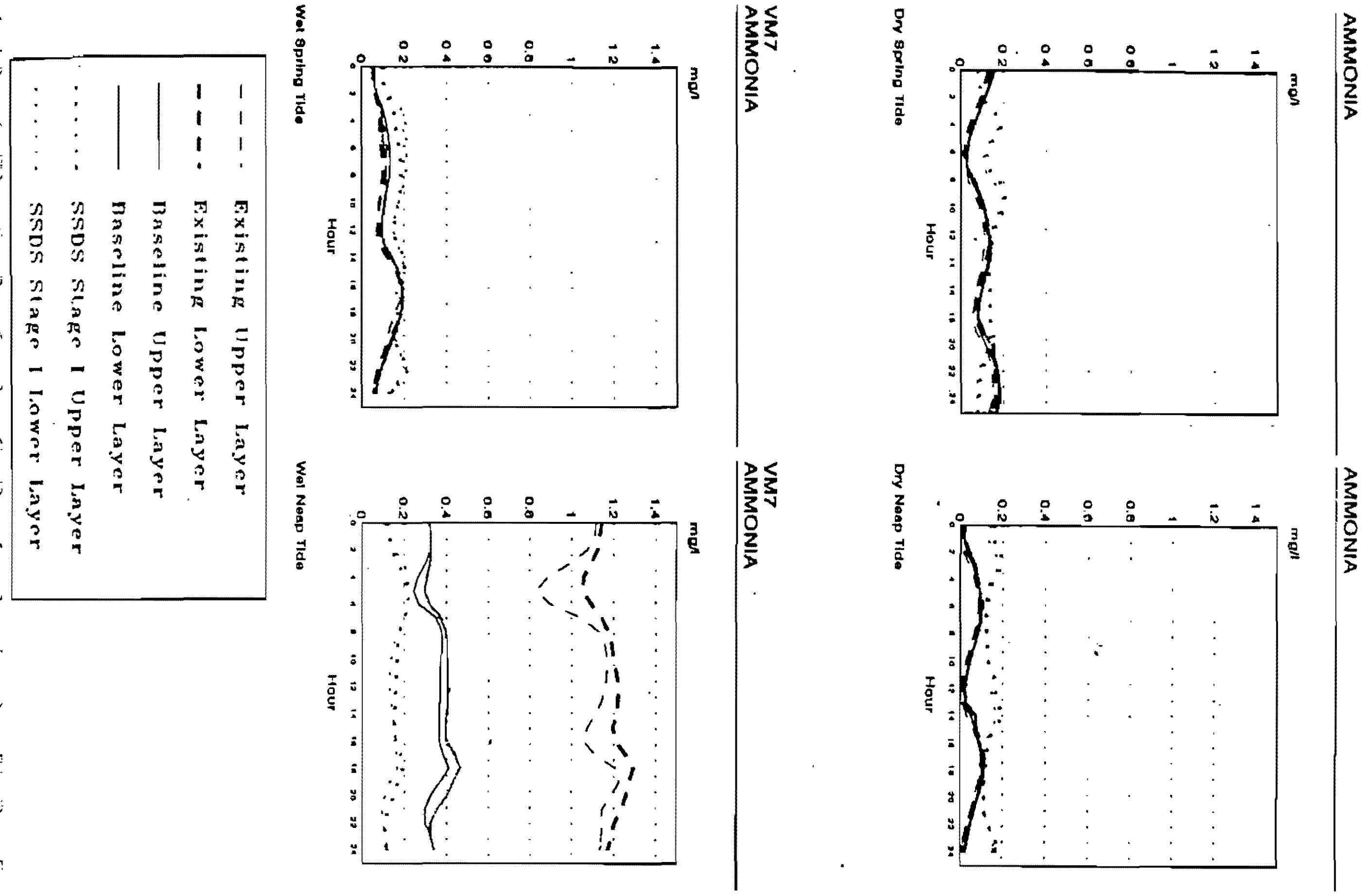
VX04
TON

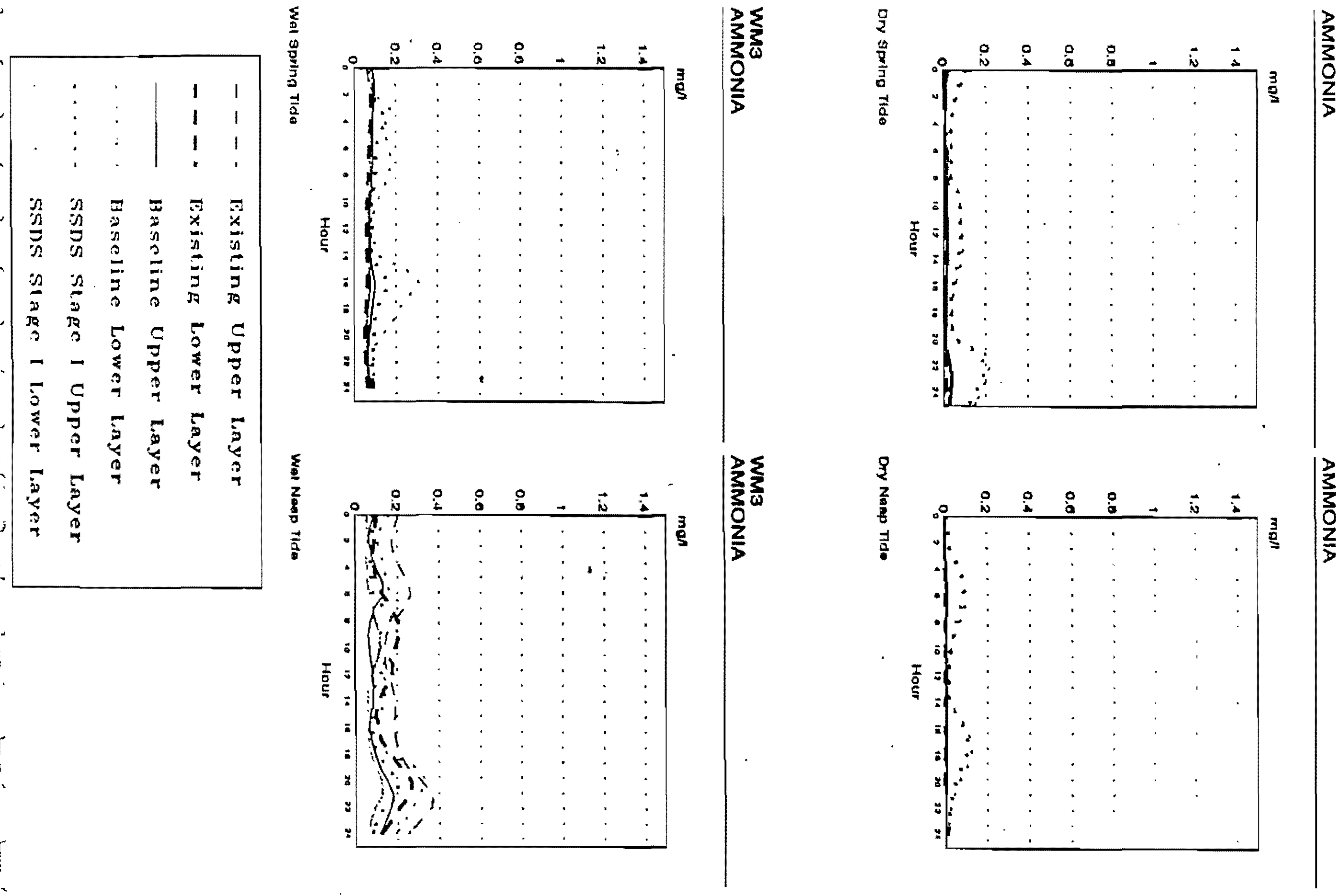


Wet Neap Tide

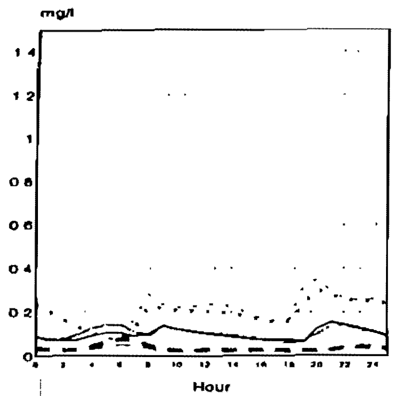
Existing Upper Layer
Existing Lower Layer
Baseline Upper Layer
Baseline Lower Layer
SSDS Stage I Upper Layer
SSDS Stage I Lower Layer

Existing Upper Layer
Existing Lower Layer
Baseline Upper Layer
Baseline Lower Layer
SSDS Stage I Upper Layer
SSDS Stage I Lower Layer


VM7
AMMONIA
mg/l
Dry Spring Tide
Dry Neap Tide
Wet Spring Tide
Wet Neap Tide
Hour
Existing Upper Layer
Existing Lower Layer
Baseline Upper Layer
Baseline Lower Layer
SSDS Stage I Upper Layer
SSDS Stage I Lower Layer

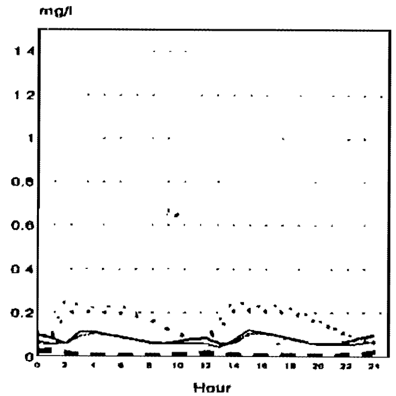

WM3
AMMONIA
mg/l
Dry Spring Tide
Dry Neap Tide
Wet Spring Tide
Wet Neap Tide
Hour
Existing Upper Layer
Existing Lower Layer
Baseline Upper Layer
Baseline Lower Layer
SSDS Stage I Upper Layer
SSDS Stage I Lower Layer

VX01
AMMONIA



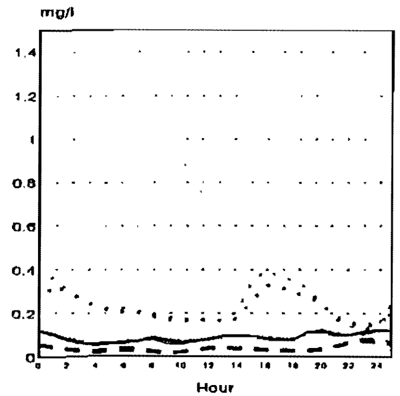
Dry Spring Tide

VX01
AMMONIA



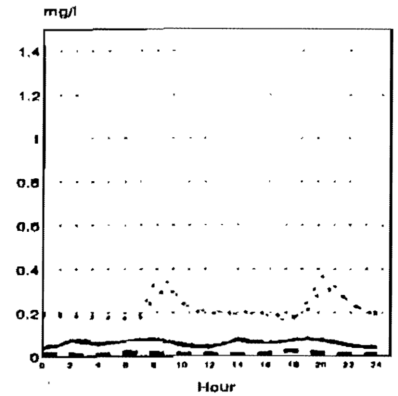
Dry Neap Tide

VX02
AMMONIA



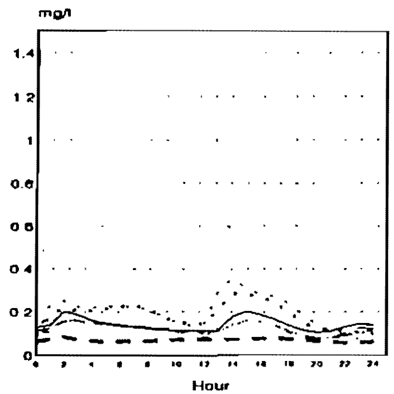
Dry Spring Tide

VX02
AMMONIA



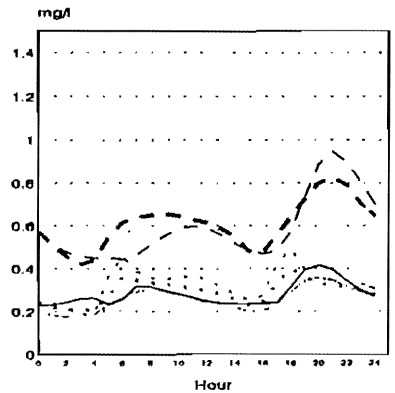
Dry Neap Tide

VX01
AMMONIA



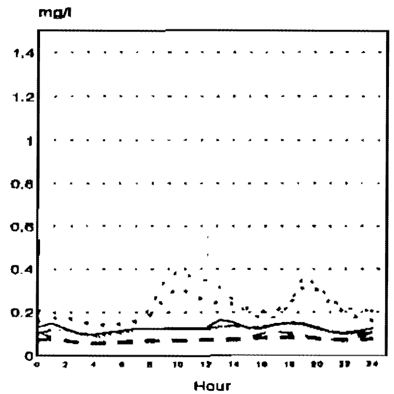
Wet Spring Tide

VX01
AMMONIA



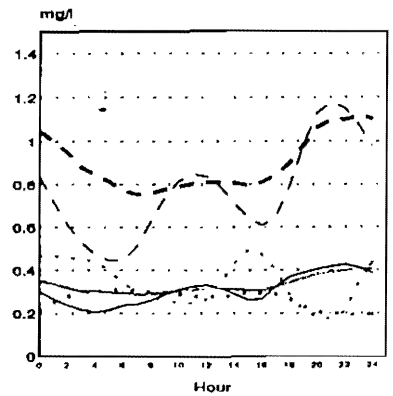
Wet Neap Tide

VX02
AMMONIA



Wet Spring Tide

VX02
AMMONIA

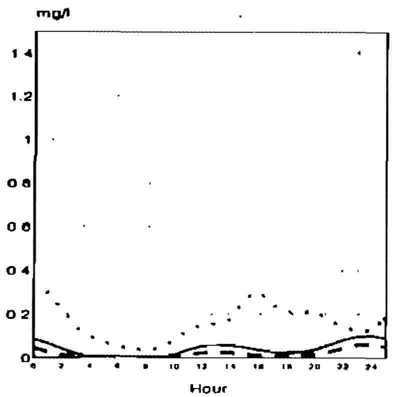


Wet Neap Tide

- Existing Upper Layer
- Existing Lower Layer
- Baseline Upper Layer
- Baseline Lower Layer
- SSDS Stage I Upper Layer
- SSDS Stage I Lower Layer

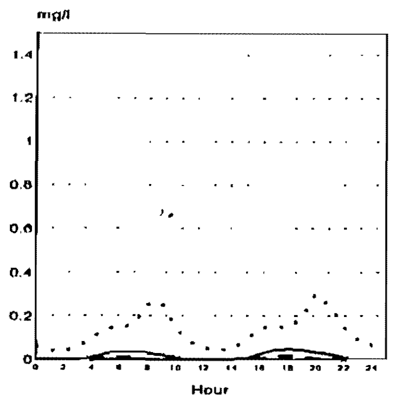
- Existing Upper Layer
- Existing Lower Layer
- Baseline Upper Layer
- Baseline Lower Layer
- SSDS Stage I Upper Layer
- SSDS Stage I Lower Layer

VX03
AMMONIA



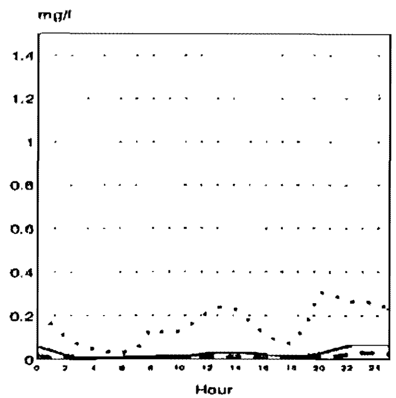
Dry Spring Tide

VX03
AMMONIA



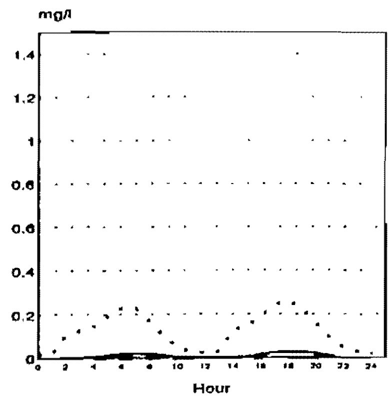
Dry Neap Tide

VX04
AMMONIA



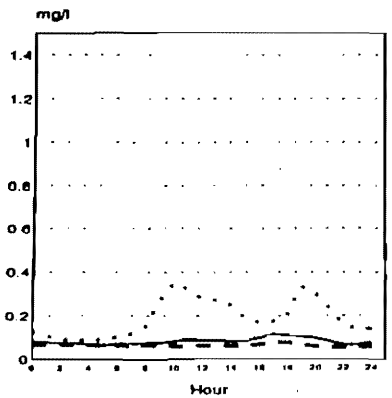
Dry Spring Tide

VX04
AMMONIA



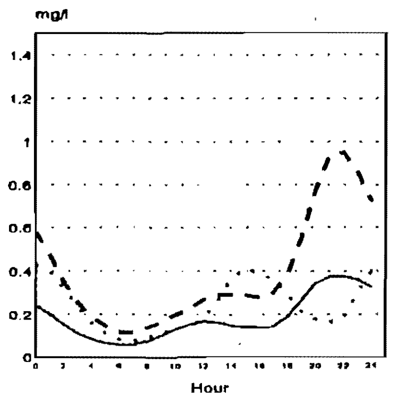
Dry Neap Tide

VX03
AMMONIA



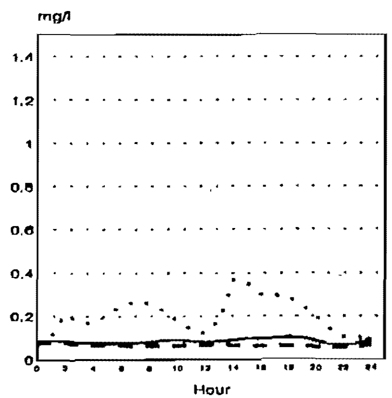
Wet Spring Tide

VX03
AMMONIA



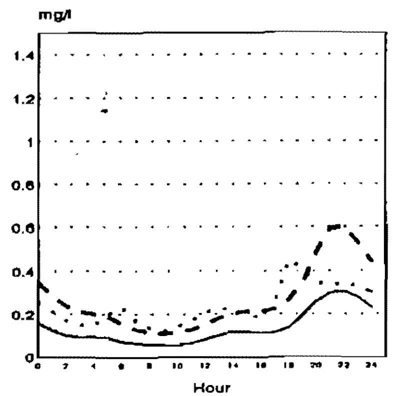
Wet Neap Tide

VX04
AMMONIA



Wet Spring Tide

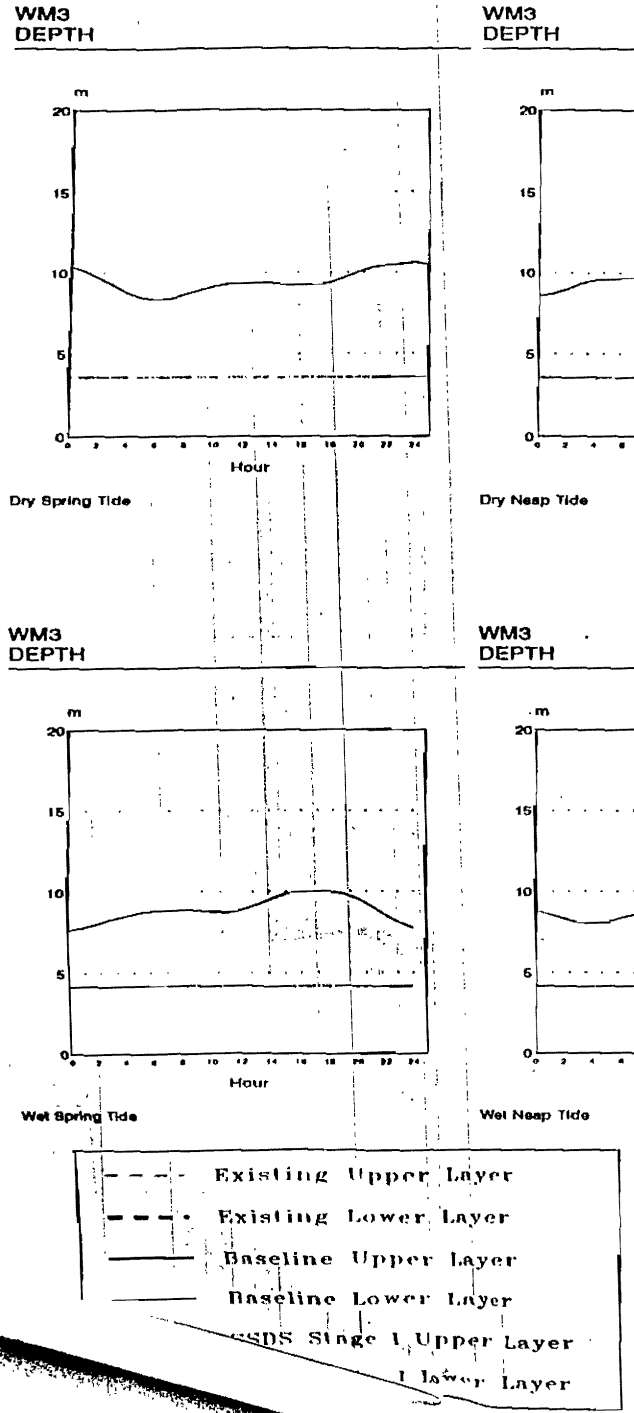
VX04
AMMONIA

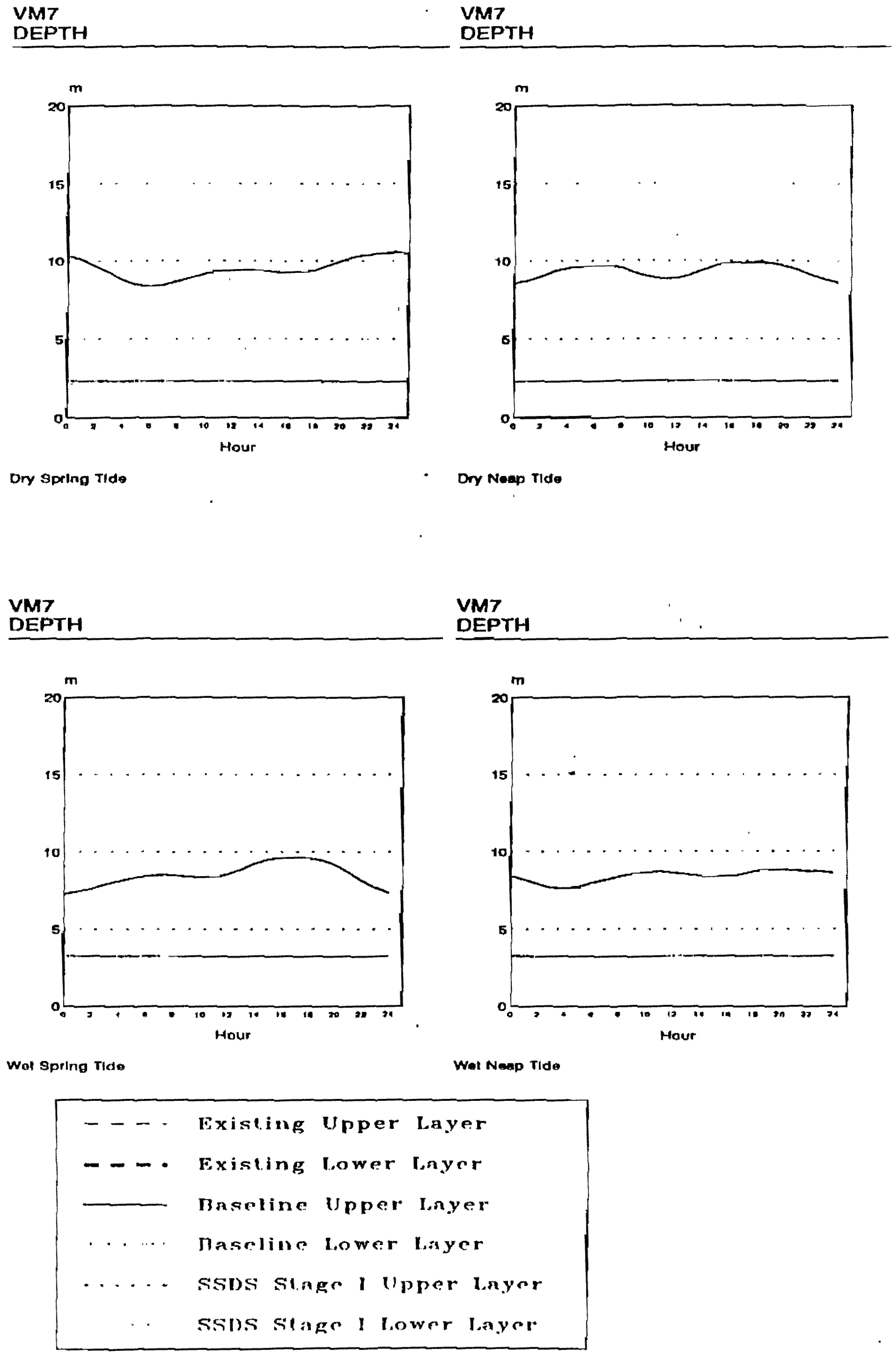


Wet Neap Tide

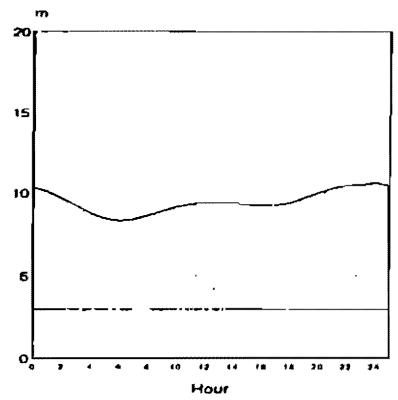
- - - - Existing Upper Layer
- - - - Existing Lower Layer
——— Baseline Upper Layer
——— Baseline Lower Layer
· · · · · · SSDS Stage I Upper Layer
· · · · · · SSDS Stage I Lower Layer

- - - - Existing Upper Layer
- - - - Existing Lower Layer
——— Baseline Upper Layer
· · Baseline Lower Layer
· · · · · · SSDS Stage I Upper Layer
· · · · · · SSDS Stage I Lower Layer


WM3
DEPTH
m
20
15
10
5
0
Hour
Dry Spring Tide
WM3
DEPTH
m
Hour
Dry Neap Tide
WM3
DEPTH
m
Hour
Wet Spring Tide
WM3
DEPTH
m
Hour
Wet Neap Tide
Existing Upper Layer
Existing Lower Layer
Baseline Upper Layer
Baseline Lower Layer
Upper Layer
Layer

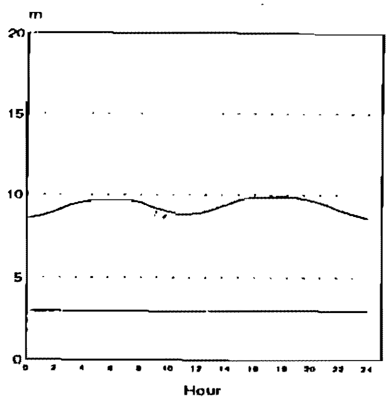

VM7
DEPTH
m
20
15
10
5
0
Hour
Dry Spring Tide
VM7
DEPTH
m
Hour
Dry Neap Tide
VM7
DEPTH
m
Hour
Wet Spring Tide
VM7
DEPTH
m
Hour
Wet Neap Tide
Existing Upper Layer
Existing Lower Layer
Baseline Upper Layer
Baseline Lower Layer
SSDS Stage I Upper Layer
SSDS Stage I Lower Layer

VX01
DEPTH



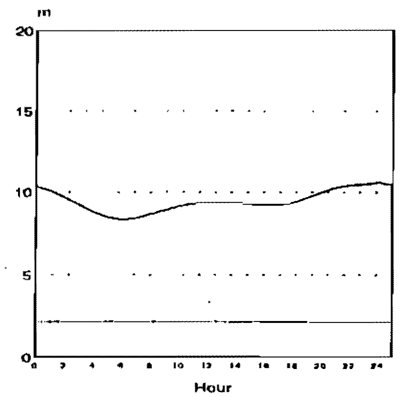
Dry Spring Tide

VX01
DEPTH



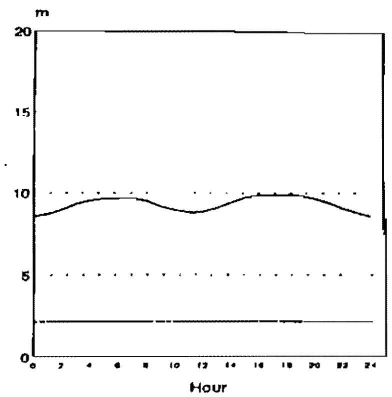
Dry Neap Tide

VX02
DEPTH



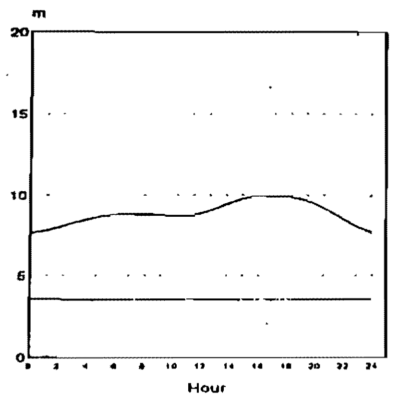
Dry Spring Tide

VX02
DEPTH



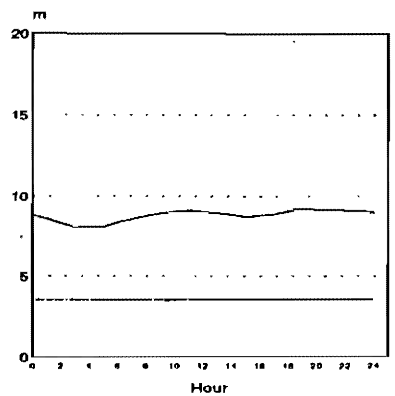
Dry Neap Tide

VX01
DEPTH



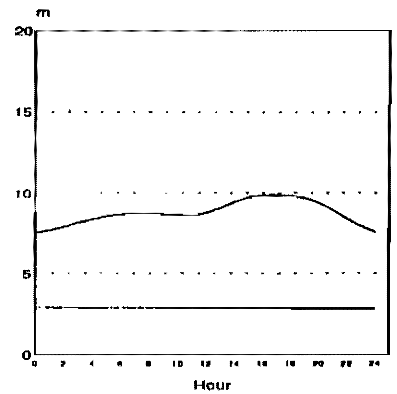
Wet Spring Tide

VX01
DEPTH



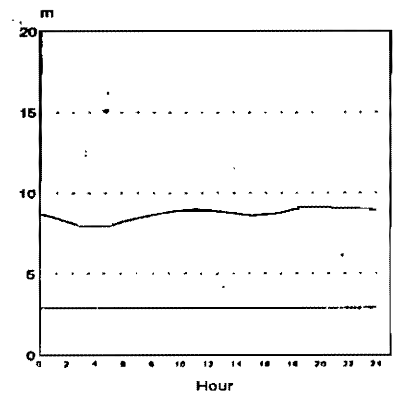
Wet Neap Tide

VX02
DEPTH



Wet Spring Tide

VX02
DEPTH

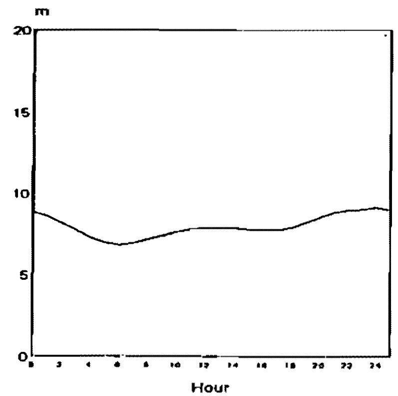


Wet Neap Tide

Existing Upper Layer
Existing Lower Layer
Baseline Upper Layer
Baseline Lower Layer
SSDS Stage I Upper Layer
SSDS Stage I Lower Layer

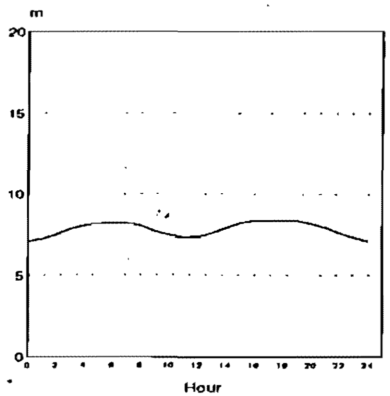
Existing Upper Layer
Existing Lower Layer
Baseline Upper Layer
Baseline Lower Layer
SSDS Stage I Upper Layer
SSDS Stage I Lower Layer

VX03
DEPTH



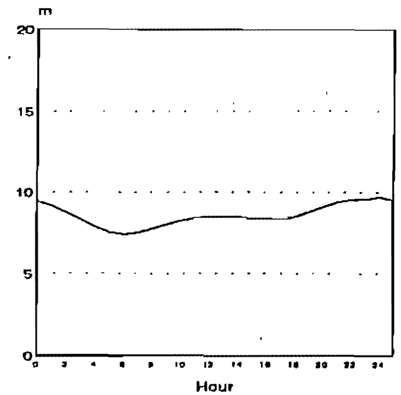
Dry Spring Tide

VX03
DEPTH



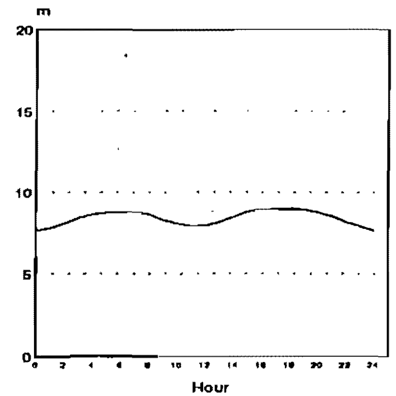
Dry Neap Tide

VX04
DEPTH



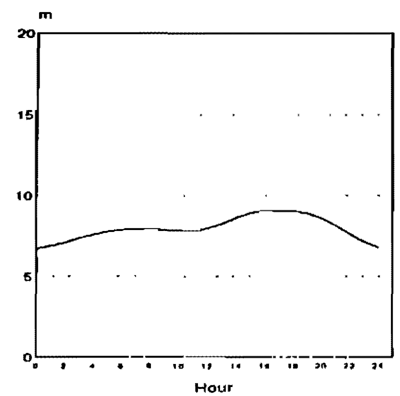
Dry Spring Tide

VX04
DEPTH



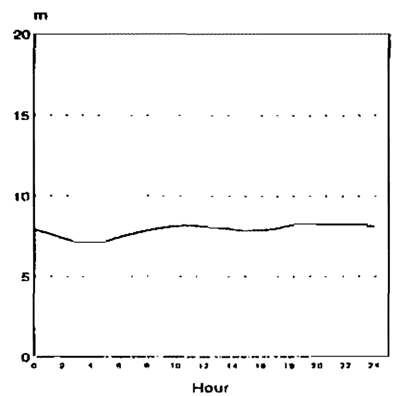
Dry Neap Tide

VX03
DEPTH



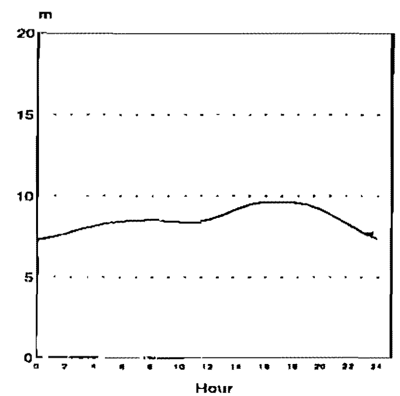
Wet Spring Tide

VX03
DEPTH



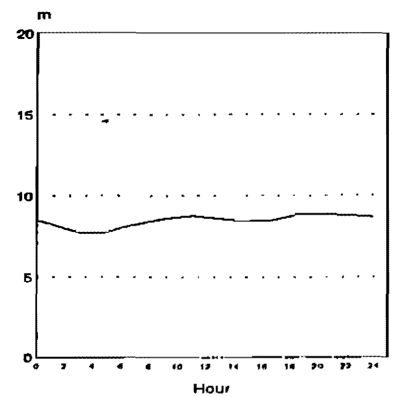
Wet Neap Tide

VX04
DEPTH



Wet Spring Tide

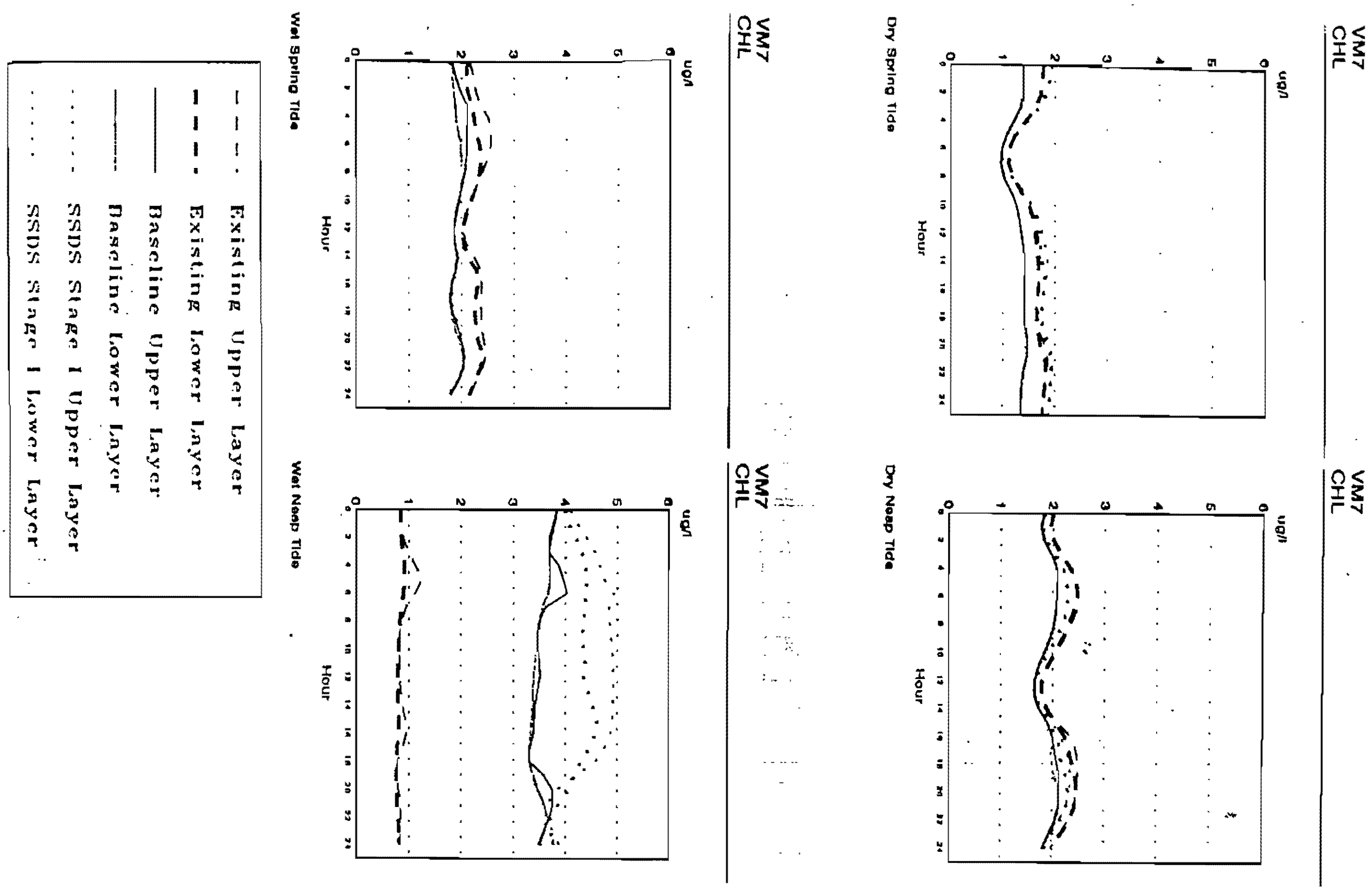
VX04
DEPTH

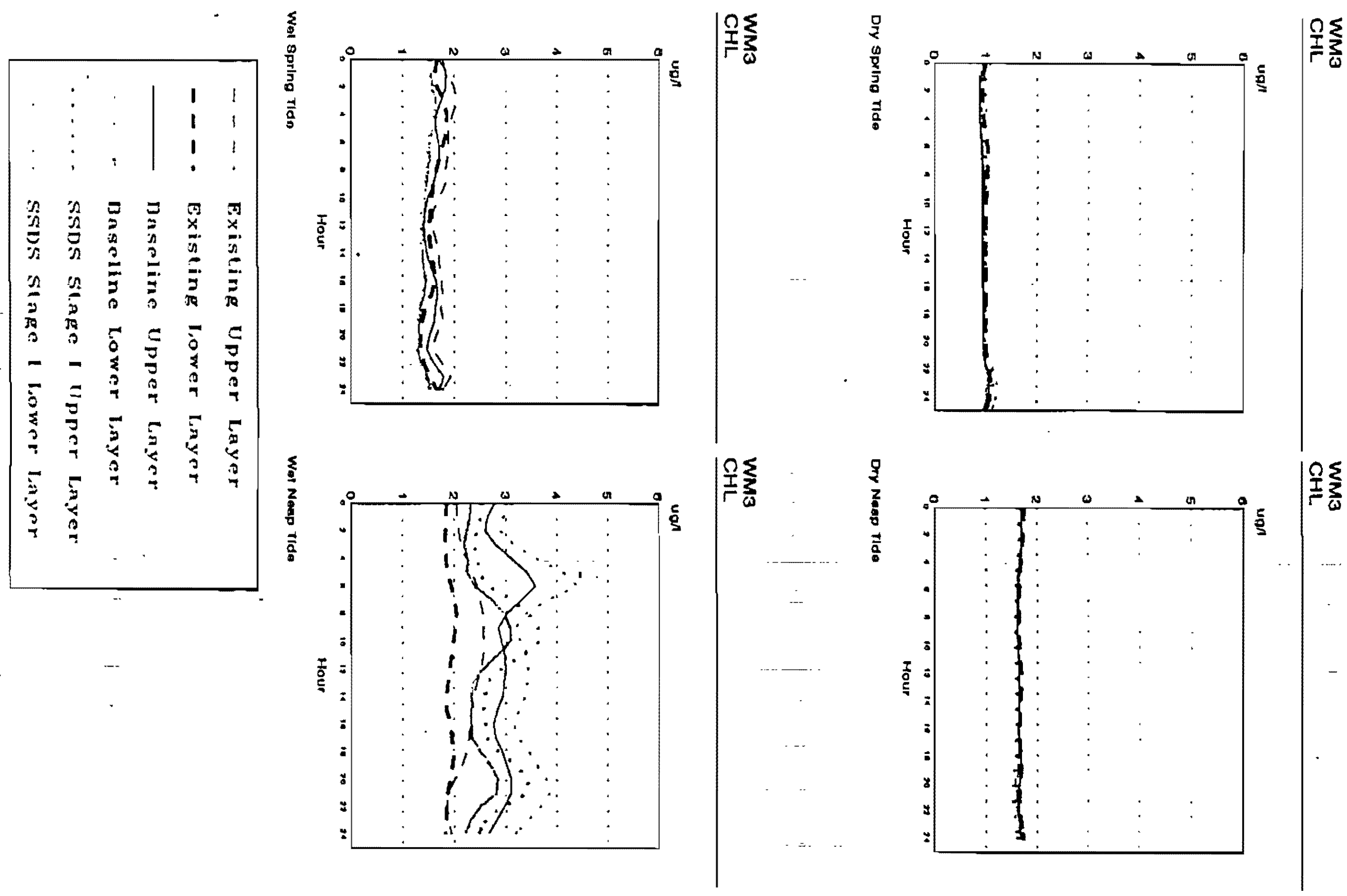


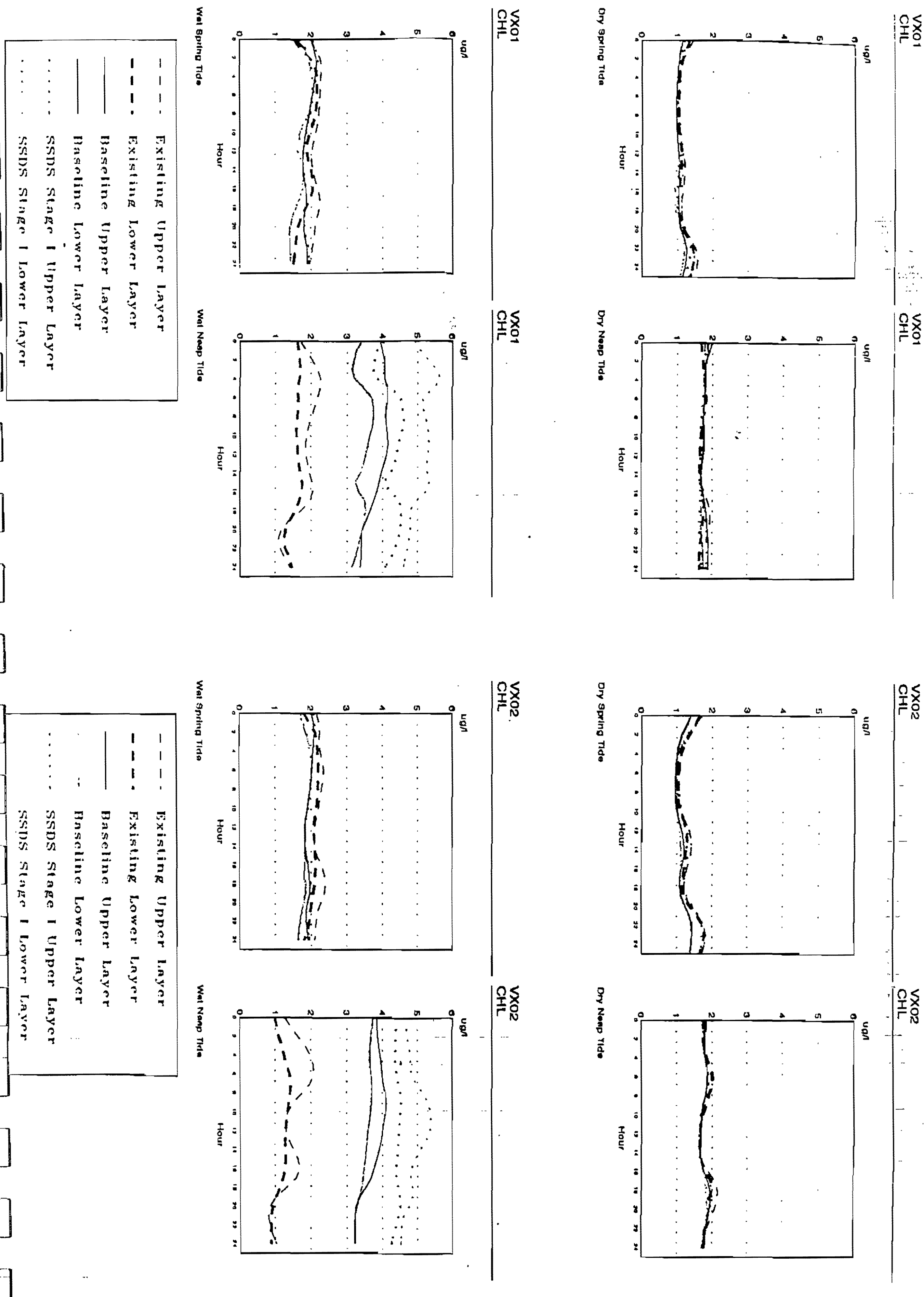
Wet Neap Tide

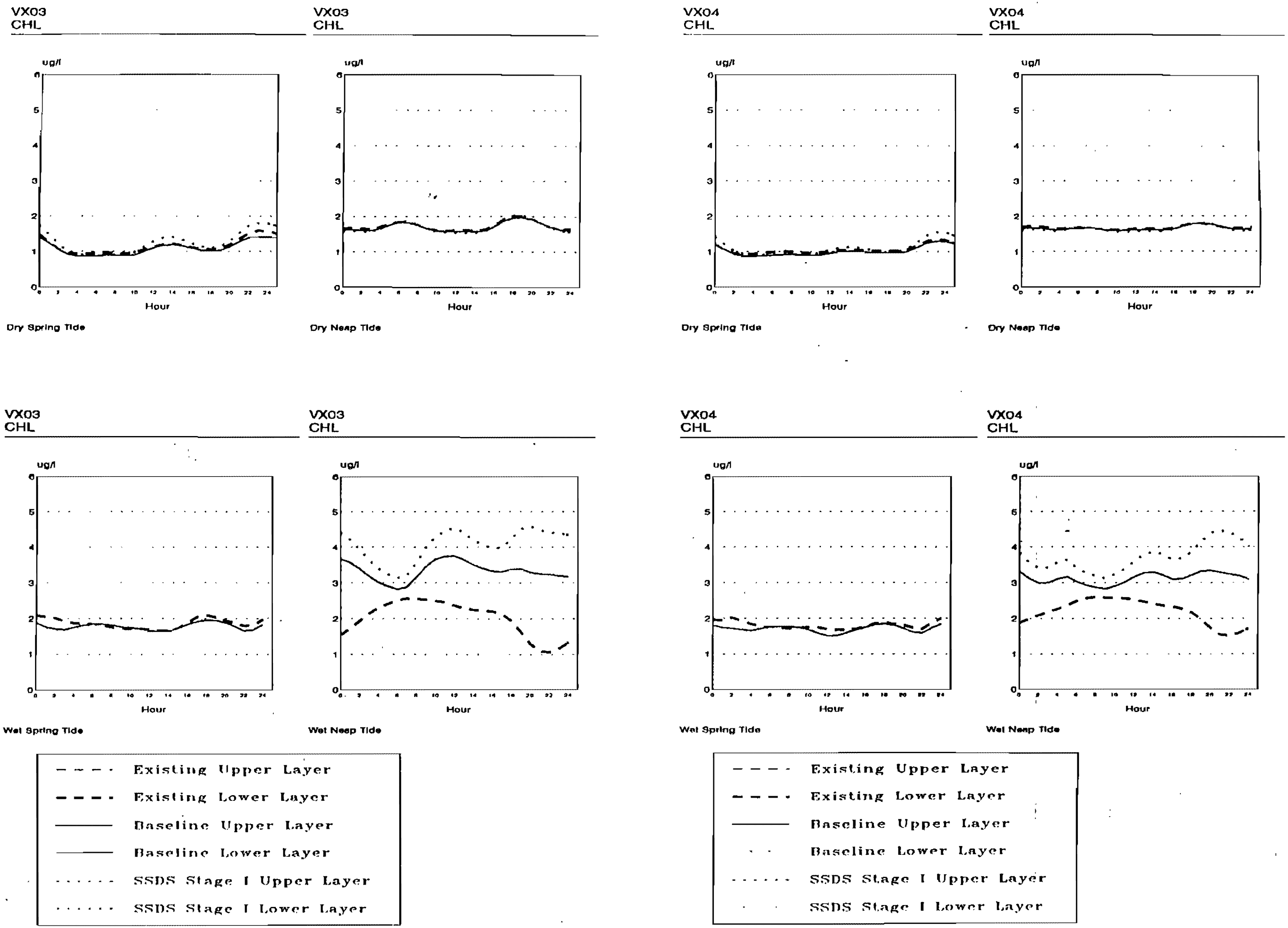
- Existing Upper Layer
- Existing Lower Layer
- Baseline Upper Layer
- Baseline Lower Layer
- SSDS Stage I Upper Layer
- SSDS Stage I Lower Layer

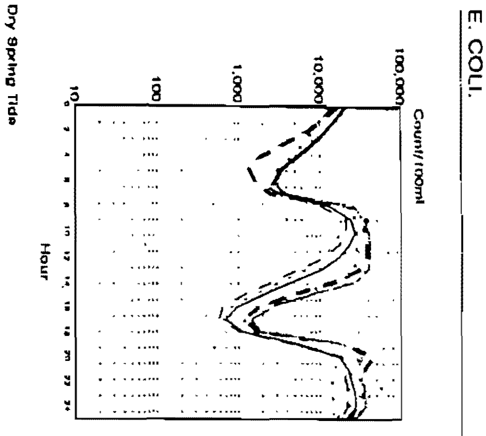
- Existing Upper Layer
- Existing Lower Layer
- Baseline Upper Layer
- Baseline Lower Layer
- SSDS Stage I Upper Layer
- SSDS Stage I Lower Layer

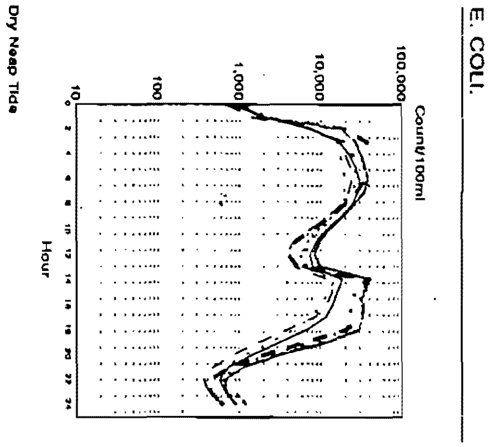

VM7
CHL
ug/l
Hour
Dry Spring Tide
Dry Neap Tide
Wet Spring Tide
Wet Neap Tide
Existing Upper Layer
Existing Lower Layer
Baseline Upper Layer
Baseline Lower Layer
SSDS Stage I Upper Layer
SSDS Stage I Lower Layer

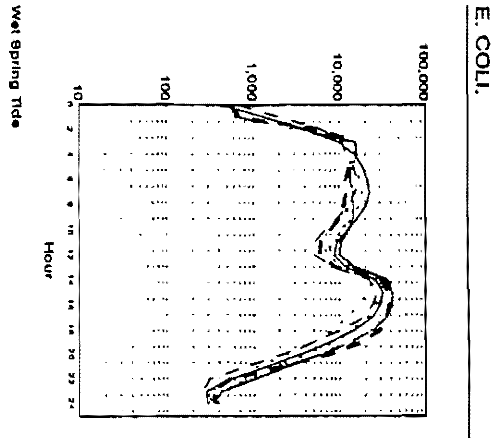

WM3
CHL
ug/l
Hour
Dry Spring Tide
Dry Neap Tide
Wet Spring Tide
Wet Neap Tide
Existing Upper Layer
Existing Lower Layer
Baseline Upper Layer
Baseline Lower Layer
SSDS Stage I Upper Layer
SSDS Stage I Lower Layer

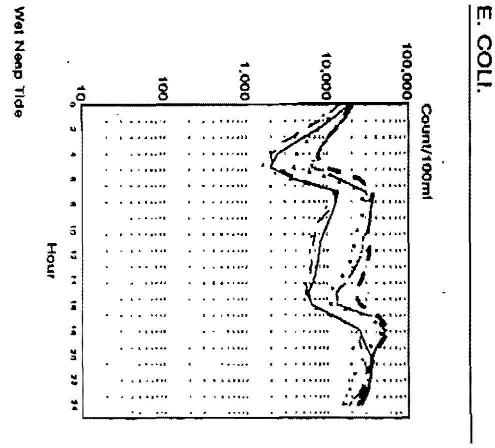

VX01
CHL
Dry Spring Tide
Dry Neap Tide
Wet Spring Tide
Wet Neap Tide
VX02
CHL
ug/l
Hour
Existing Upper Layer
Existing Lower Layer
Baseline Upper Layer
Baseline Lower Layer
SSDS Stage I Upper Layer
SSDS Stage I Lower Layer


VX03
CHL
ug/l
Hour
Dry Spring Tide
VX03
CHL
ug/l
Hour
Dry Neap Tide
VX04
CHL
ug/l
Hour
Dry Spring Tide
VX04
CHL
ug/l
Hour
Dry Neap Tide
VX03
CHL
ug/l
Hour
Wet Spring Tide
VX03
CHL
ug/l
Hour
Wet Neap Tide
VX04
CHL
ug/l
Hour
Wet Spring Tide
VX04
CHL
ug/l
Hour
Wet Neap Tide
Existing Upper Layer
Existing Lower Layer
Baseline Upper Layer
Baseline Lower Layer
SSDS Stage I Upper Layer
SSDS Stage I Lower Layer
Existing Upper Layer
Existing Lower Layer
Baseline Upper Layer
Baseline Lower Layer
SSDS Stage I Upper Layer
SSDS Stage I Lower Layer

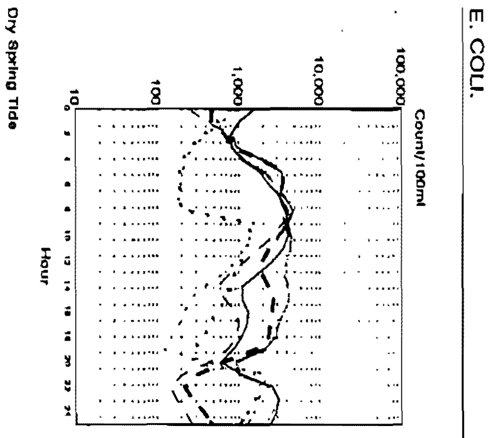


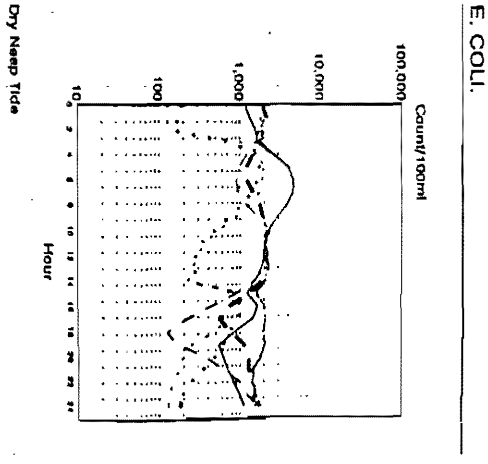


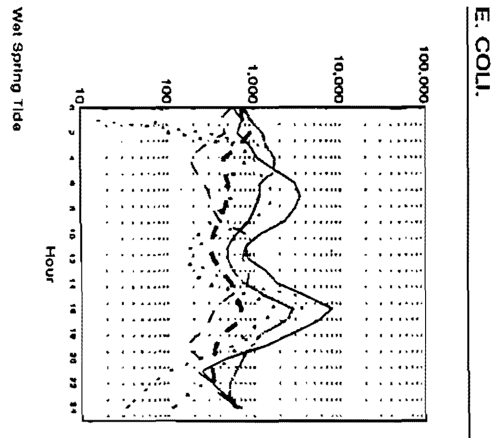


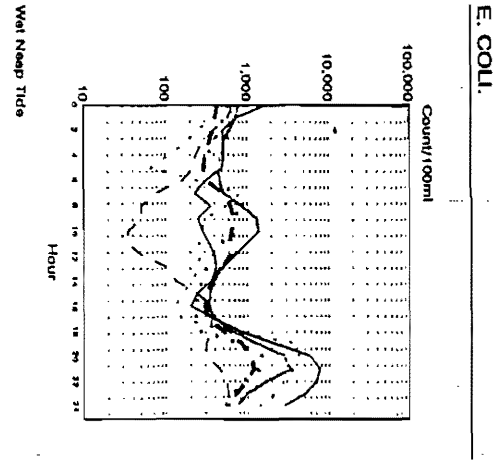


Existing Upper Layer
Existing Lower Layer
Baseline Upper Layer
Baseline Lower Layer
SSDS Stage I Upper Layer
SSDS Stage I Lower Layer



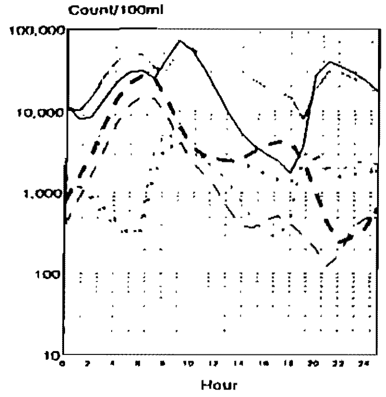






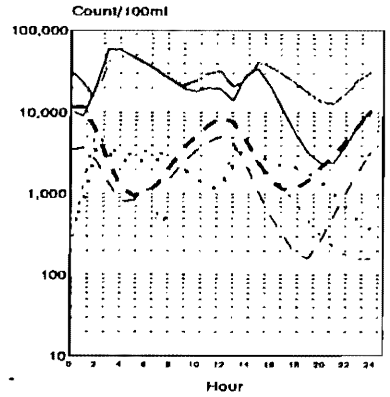
Existing Upper Layer
Existing Lower Layer
Baseline Upper Layer
Baseline Lower Layer
SSDS Stage I Upper Layer
SSDS Stage I Lower Layer

VX01
E. COLI.



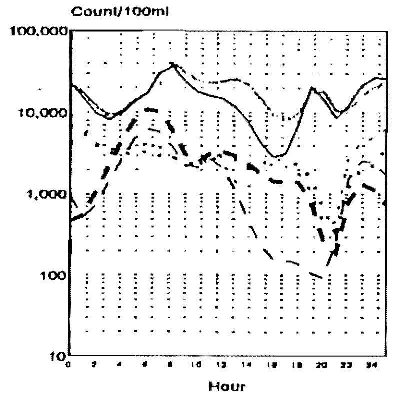
Dry Spring Tide

VX01
E. COLI.



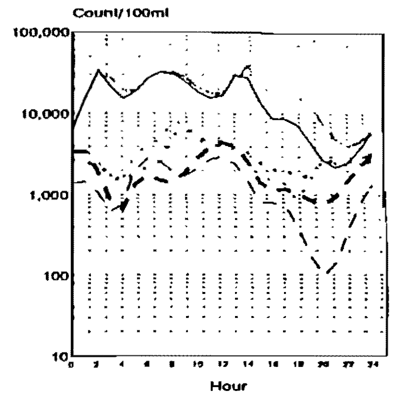
Dry Neap Tide

VX02
E. COLI.



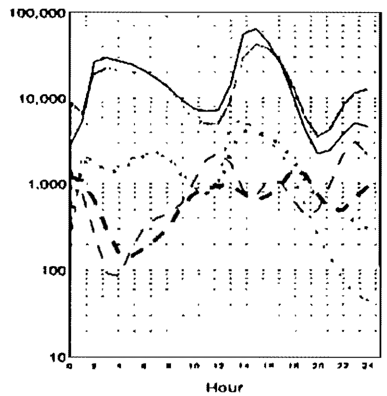
Dry Spring Tide

VX02
E. COLI.



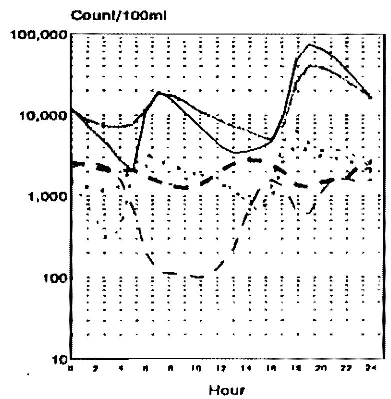
Dry Neap Tide

VX01
E. COLI.



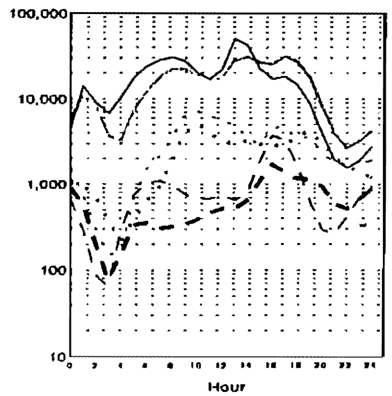
Wet Spring Tide

VX01
E. COLI.



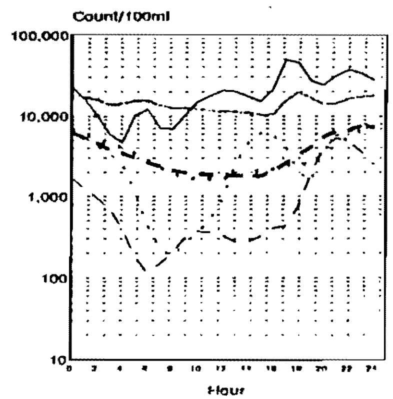
Wet Neap Tide

VX02
E. COLI.



Wet Spring Tide

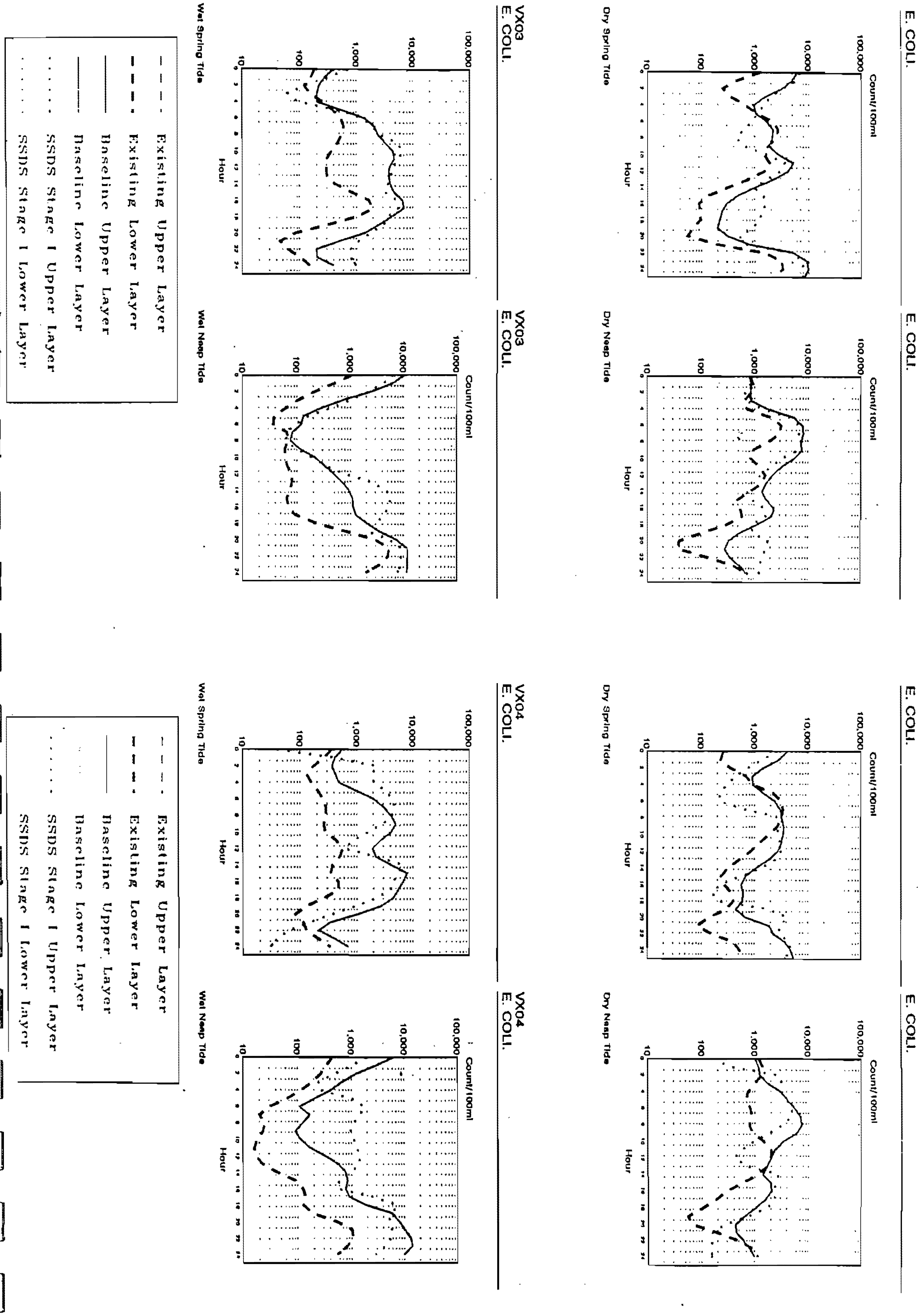
VX02
E. COLI.

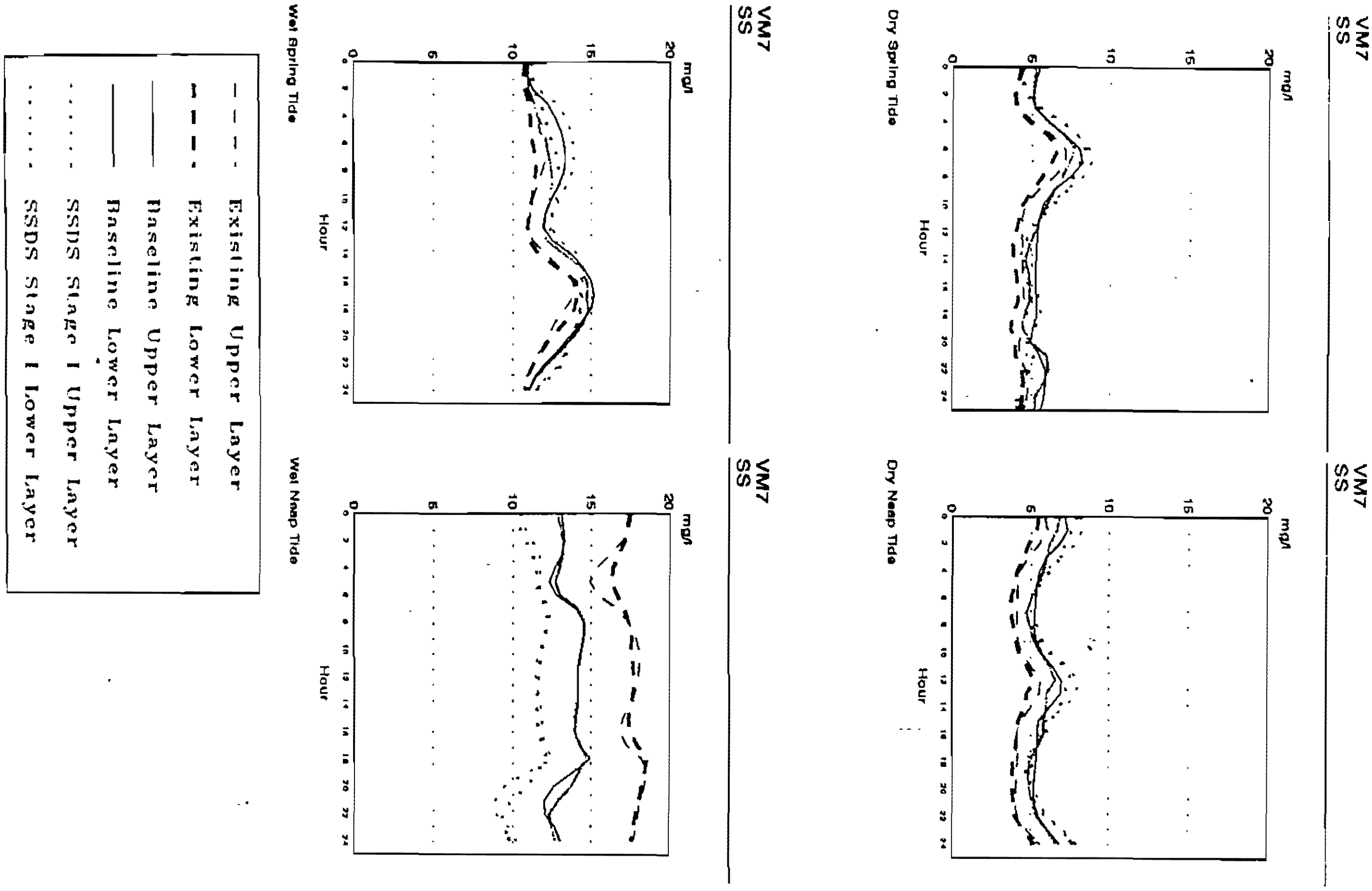


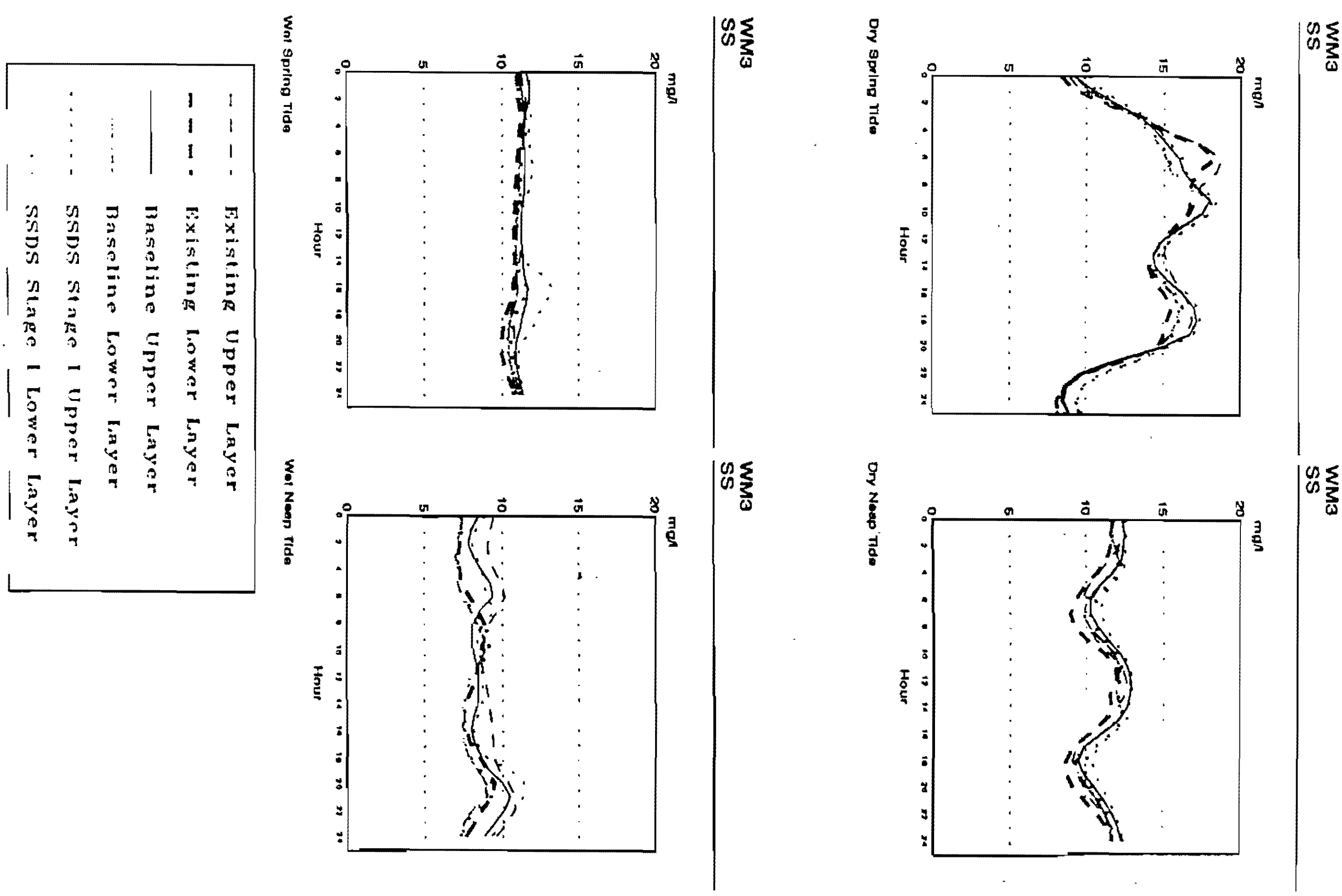
Wet Neap Tide

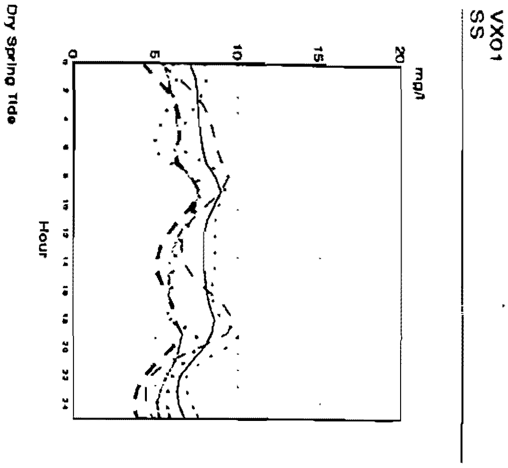
Existing Upper Layer
Existing Lower Layer
Baseline Upper Layer
Baseline Lower Layer
SSDS Stage I Upper Layer
SSDS Stage I Lower Layer

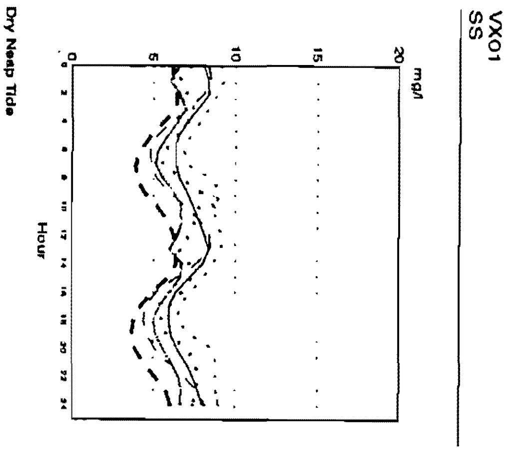
Existing Upper Layer
Existing Lower Layer
Baseline Upper Layer
Baseline Lower Layer
SSDS Stage I Upper Layer
SSDS Stage I Lower Layer

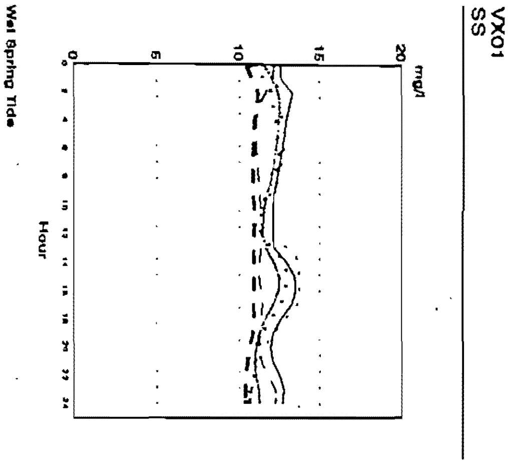

VX03 E. COLI.
Count/100ml
Hour
Dry Spring Tide
Dry Neap Tide
Wet Spring Tide
Wet Neap Tide
VX04 E. COLI.
100,000
10,000
1,000
100
10
Existing Upper Layer
Existing Lower Layer
Baseline Upper Layer
Baseline Lower Layer
SSDS Stage I Upper Layer
SSDS Stage I Lower Layer

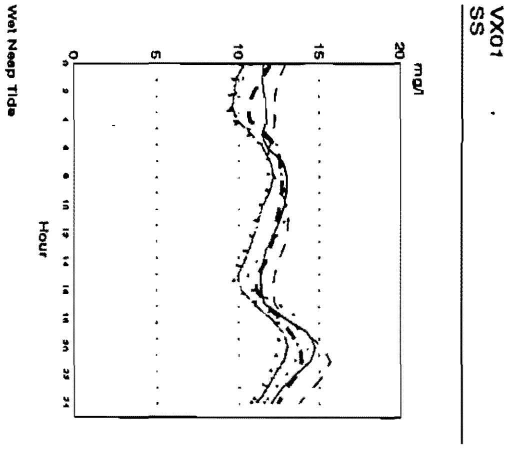

VM7
SS
mg/l
Hour
Dry Spring Tide
Dry Neap Tide
Wet Spring Tide
Wet Neap Tide
Existing Upper Layer
Existing Lower Layer
Baseline Upper Layer
Baseline Lower Layer
SSDS Stage I Upper Layer
SSDS Stage I Lower Layer


WM3
SS
mg/l
Hour
Dry Spring Tide
Dry Neap Tide
Wet Spring Tide
Wet Neap Tide
Existing Upper Layer
Existing Lower Layer
Baseline Upper Layer
Baseline Lower Layer
SSDS Stage I Upper Layer
SSDS Stage I Lower Layer

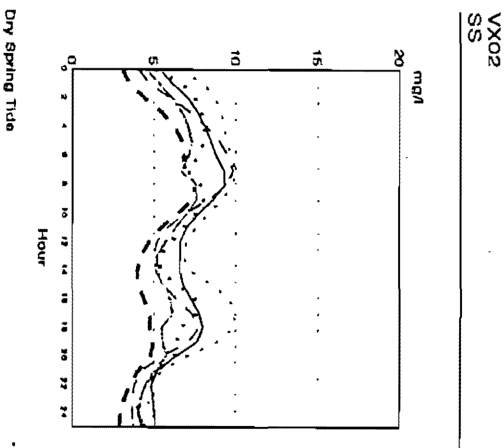


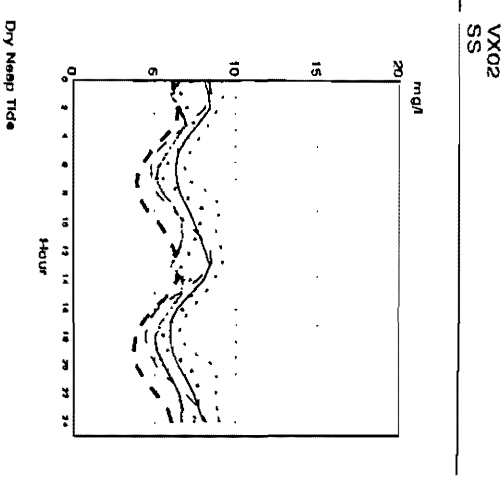


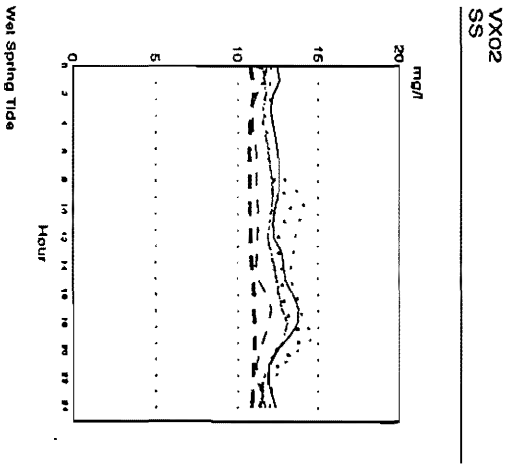


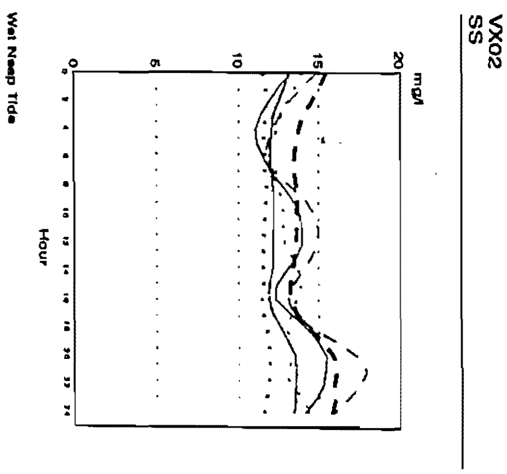


Existing Upper Layer
Existing Lower Layer
Baseline Upper Layer
Baseline Lower Layer
SSDS Stage I Upper Layer
SSDS Stage I Lower Layer



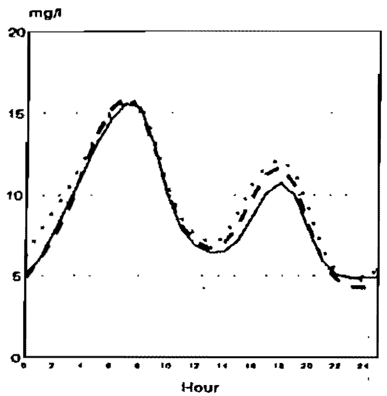






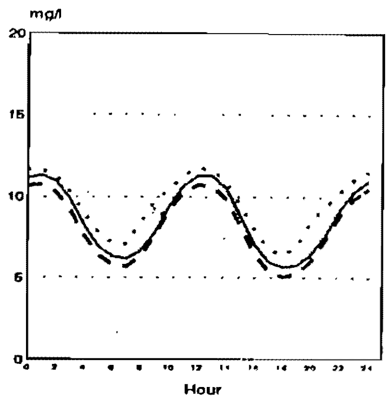
Existing Upper Layer
Existing Lower Layer
Baseline Upper Layer
Baseline Lower Layer
SSDS Stage I Upper Layer
SSDS Stage I Lower Layer

VX03
SS



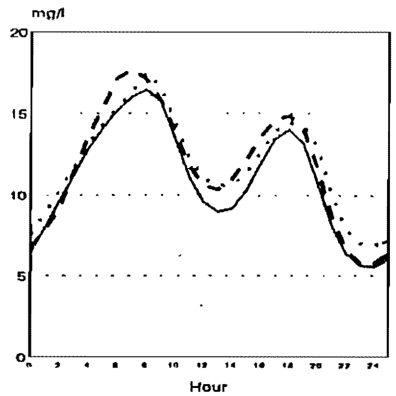
Dry Spring Tide

VX03
SS



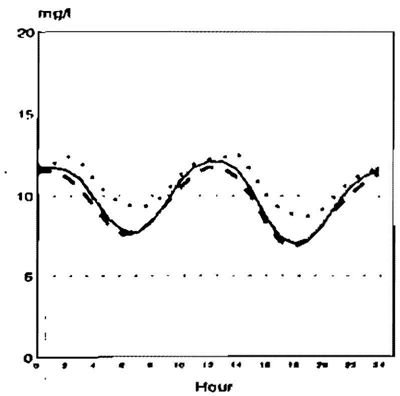
Dry Neap Tide

VX04
SS



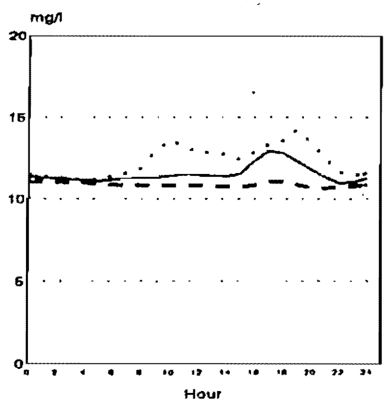
Dry Spring Tide

VX04
SS



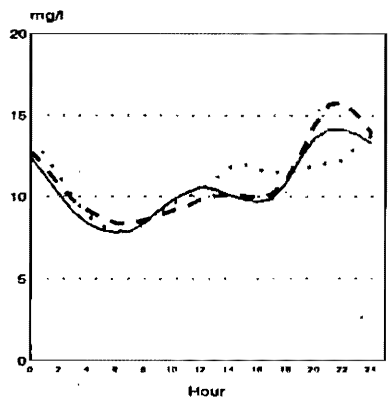
Dry Neap Tide

VX03
SS



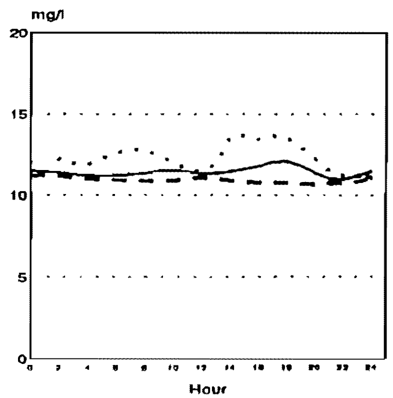
Wet Spring Tide

VX03
SS



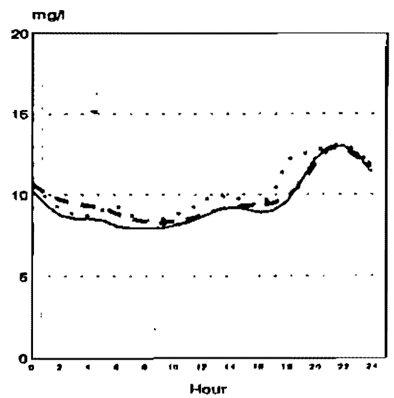
Wet Neap Tide

VX04
SS



Wet Spring Tide

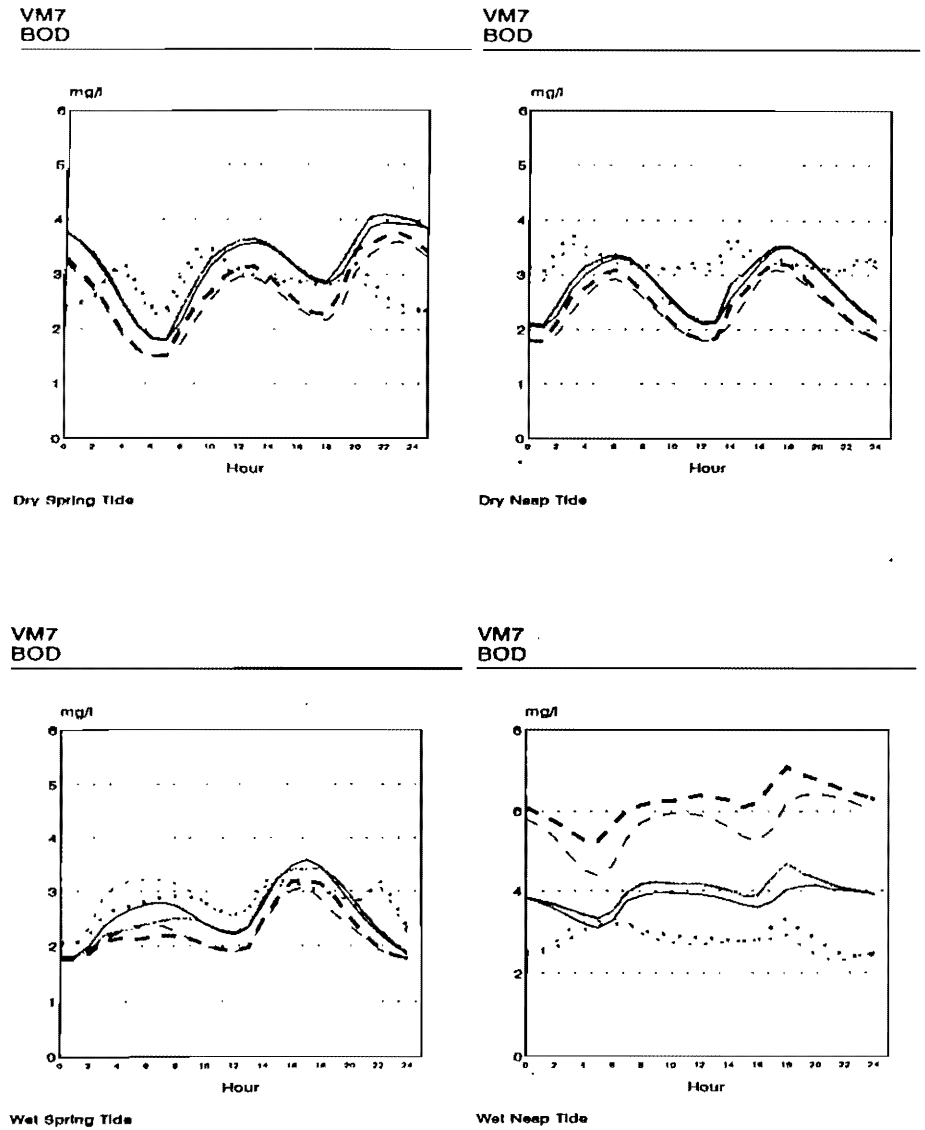
VX04
SS



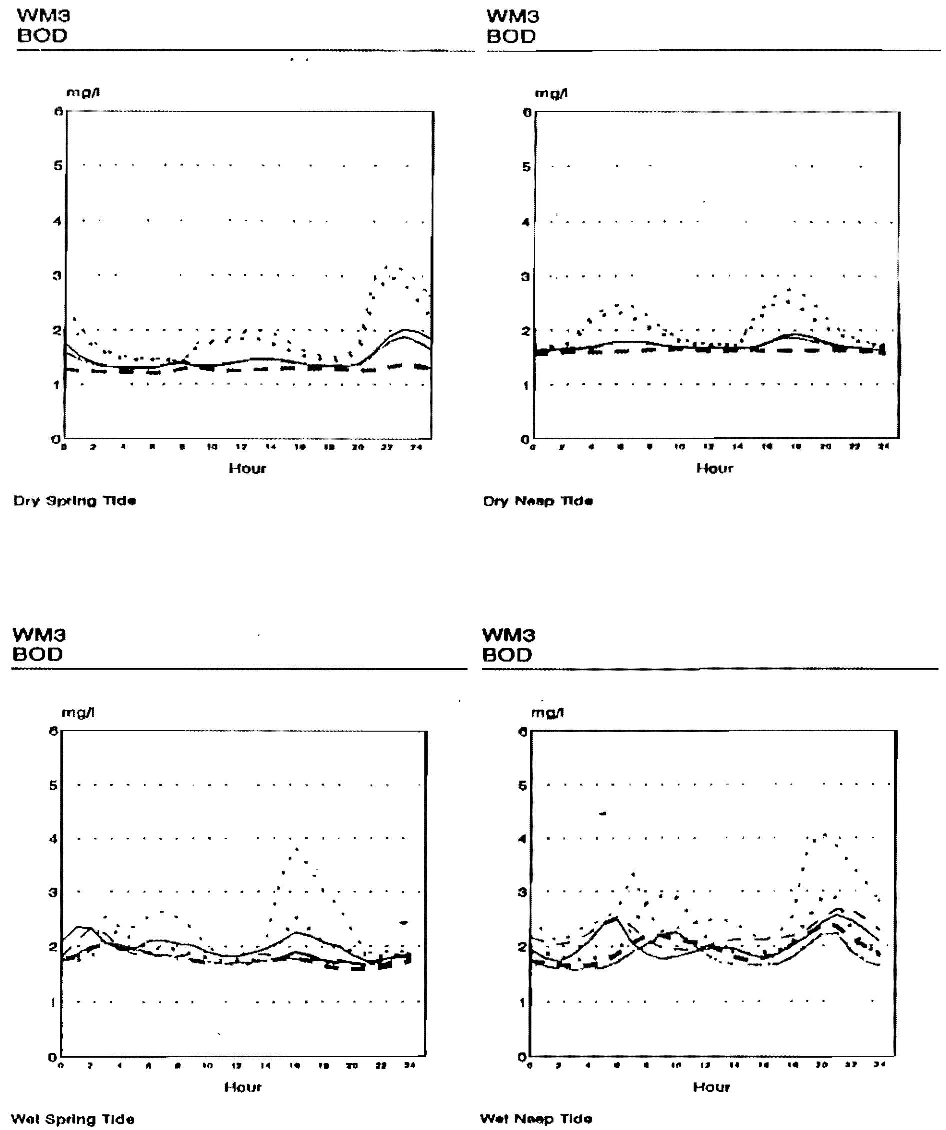
Wet Neap Tide

Existing Upper Layer
Existing Lower Layer
Baseline Upper Layer
Baseline Lower Layer
SSDS Stage I Upper Layer
SSDS Stage I Lower Layer

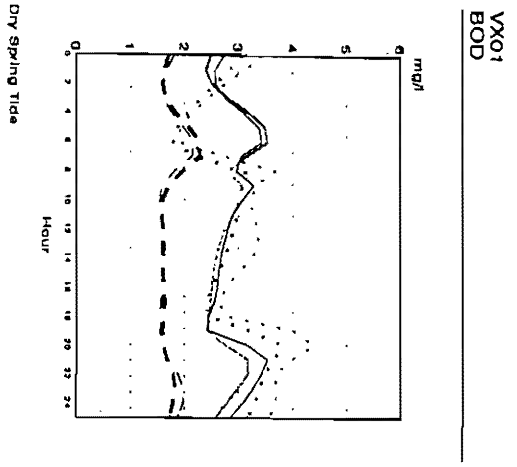
Existing Upper Layer
Existing Lower Layer
Baseline Upper Layer
Baseline Lower Layer
SSDS Stage I Upper Layer
SSDS Stage I Lower Layer

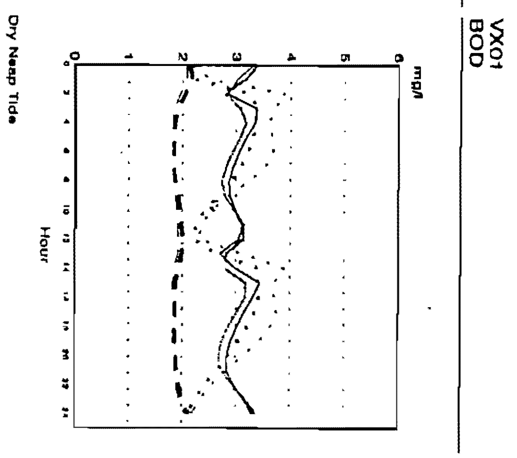


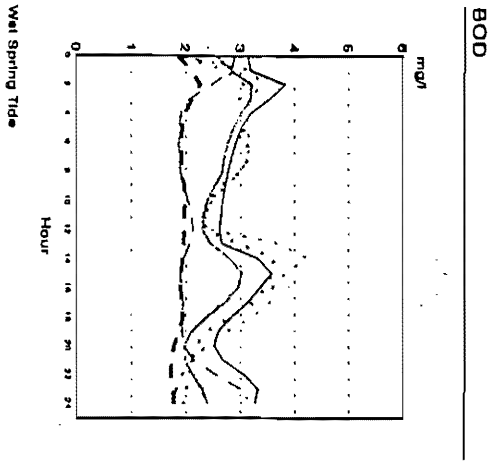
- Existing Upper Layer
- Existing Lower Layer
- Baseline Upper Layer
- Baseline Lower Layer
- SSDS Stage I Upper Layer
- SSDS Stage I Lower Layer

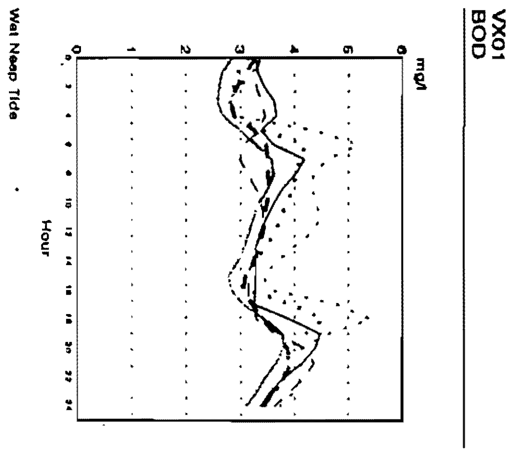


- Existing Upper Layer
- Existing Lower Layer
- Baseline Upper Layer
- Baseline Lower Layer
- SSDS Stage I Upper Layer
- SSDS Stage I Lower Layer

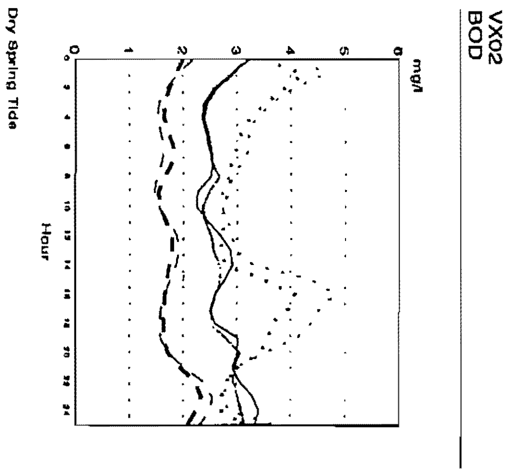


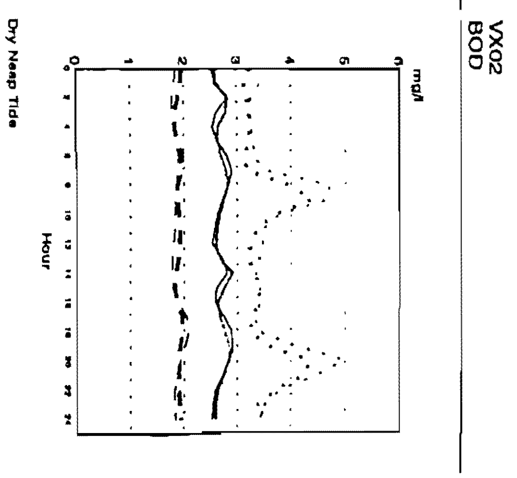


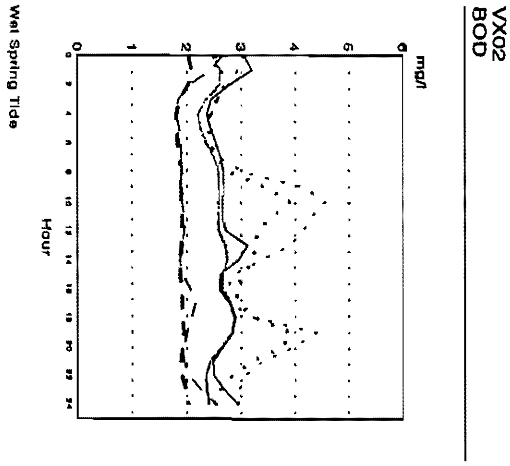


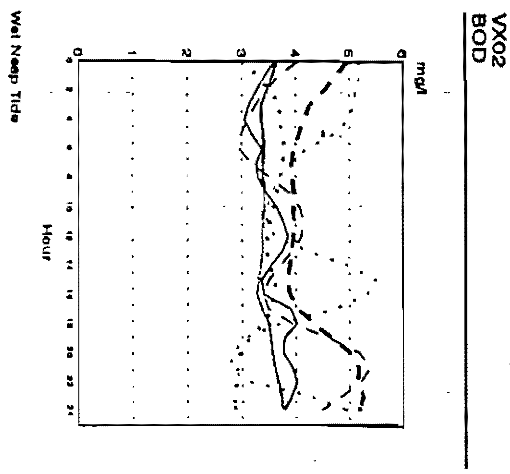


- Existing Upper Layer
- Existing Lower Layer
- Baseline Upper Layer
- Baseline Lower Layer
- SSDS Stage I Upper Layer
- SSDS Stage I Lower Layer

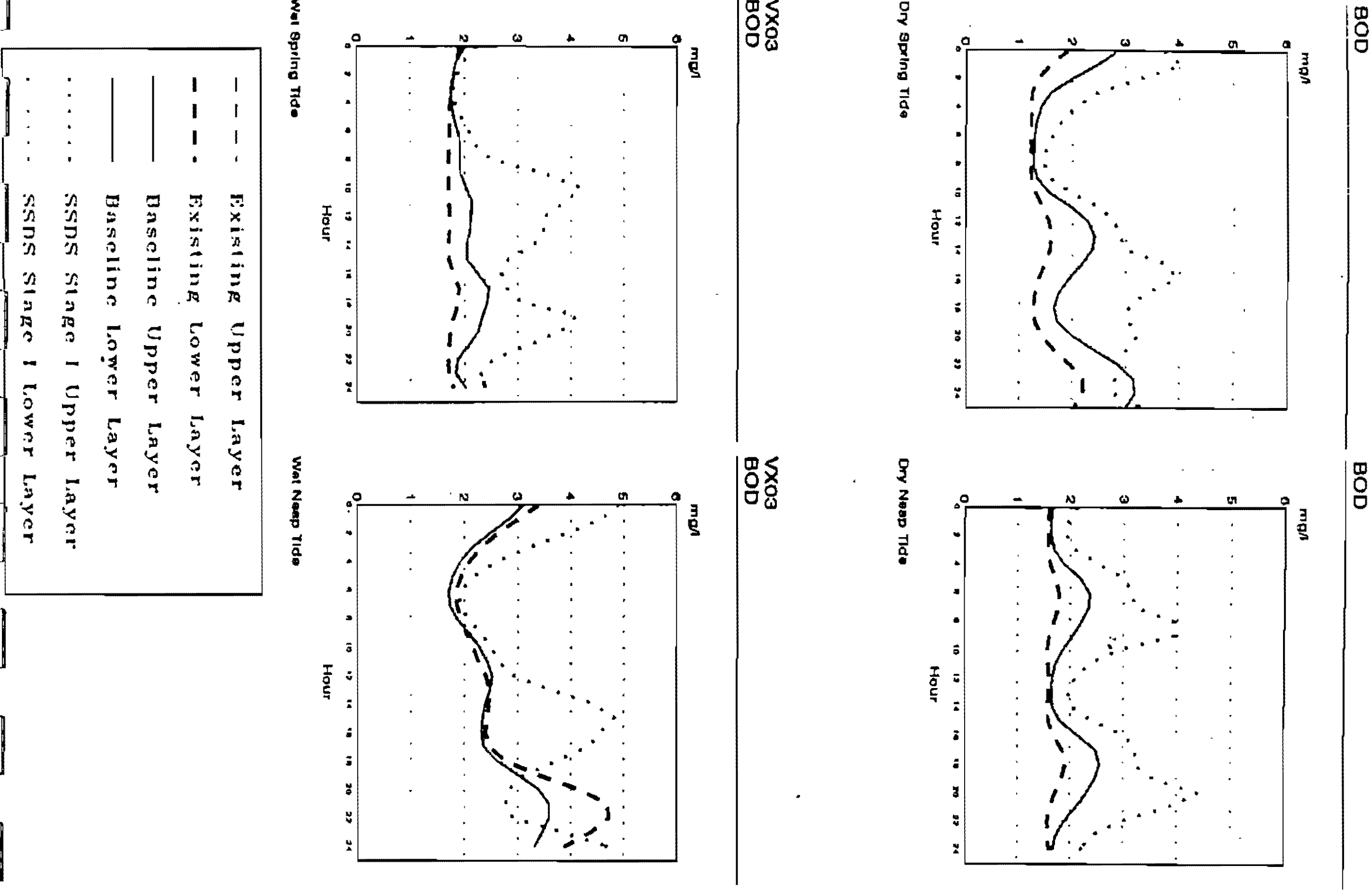


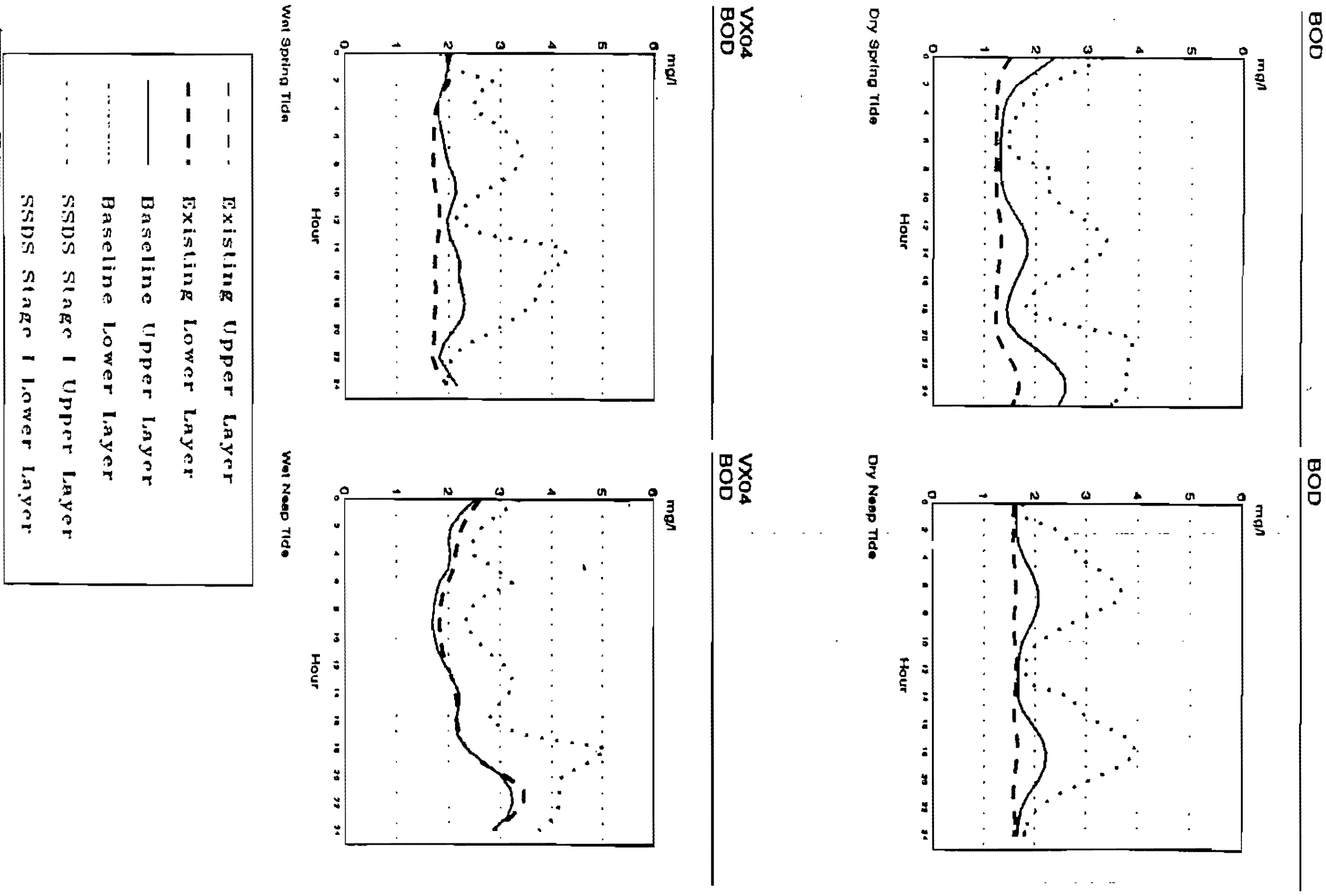




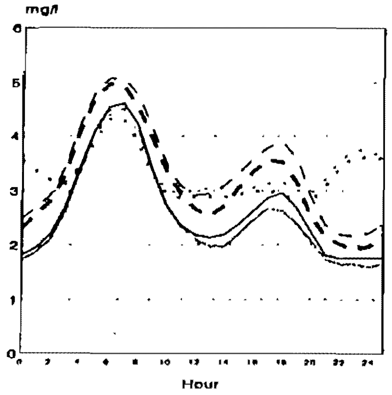


- Existing Upper Layer
- Existing Lower Layer
- Baseline Upper Layer
- Baseline Lower Layer
- SSDS Stage I Upper Layer
- SSDS Stage I Lower Layer


VX03
BOD
mg/l
Hour
Dry Spring Tide
VX03
BOD
mg/l
Hour
Dry Neap Tide
VX03
BOD
mg/l
Hour
Wet Spring Tide
VX03
BOD
mg/l
Hour
Wet Neap Tide
Existing Upper Layer
Existing Lower Layer
Baseline Upper Layer
Baseline Lower Layer
SSDS Stage I Upper Layer
SSDS Stage I Lower Layer

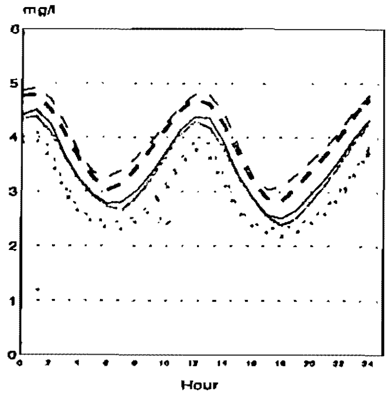

VX04
BOD
mg/l
Hour
Dry Spring Tide
VX04
BOD
mg/l
Hour
Dry Neap Tide
VX04
BOD
mg/l
Hour
Wet Spring Tide
VX04
BOD
mg/l
Hour
Wet Neap Tide
Existing Upper Layer
Existing Lower Layer
Baseline Upper Layer
Baseline Lower Layer
SSDS Stage I Upper Layer
SSDS Stage I Lower Layer

VM7
DO



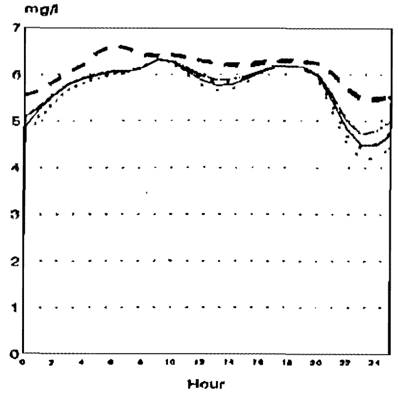
Dry Spring Tide

VM7
DO



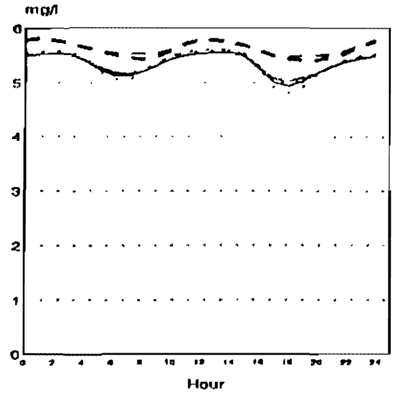
Dry Neap Tide

WM3
DO



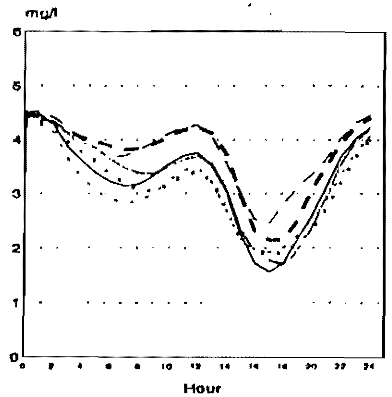
Dry Spring Tide

WM3
DO



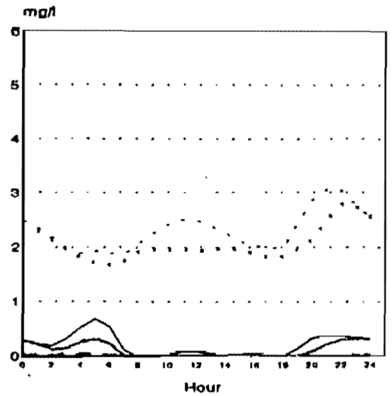
Dry Neap Tide

VM7
DO



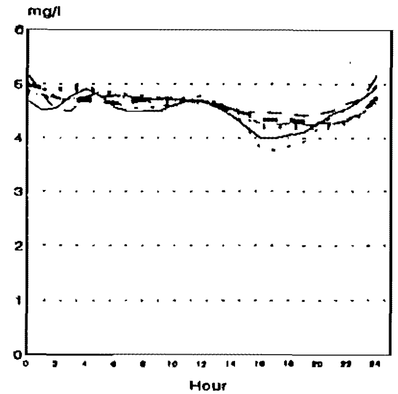
Wet Spring Tide

VM7
DO



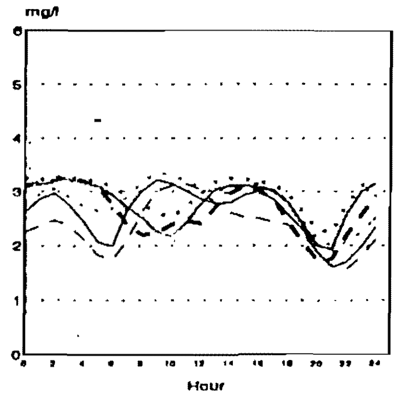
Wet Neap Tide

WM3
DO



Wet Spring Tide

WM3
DO

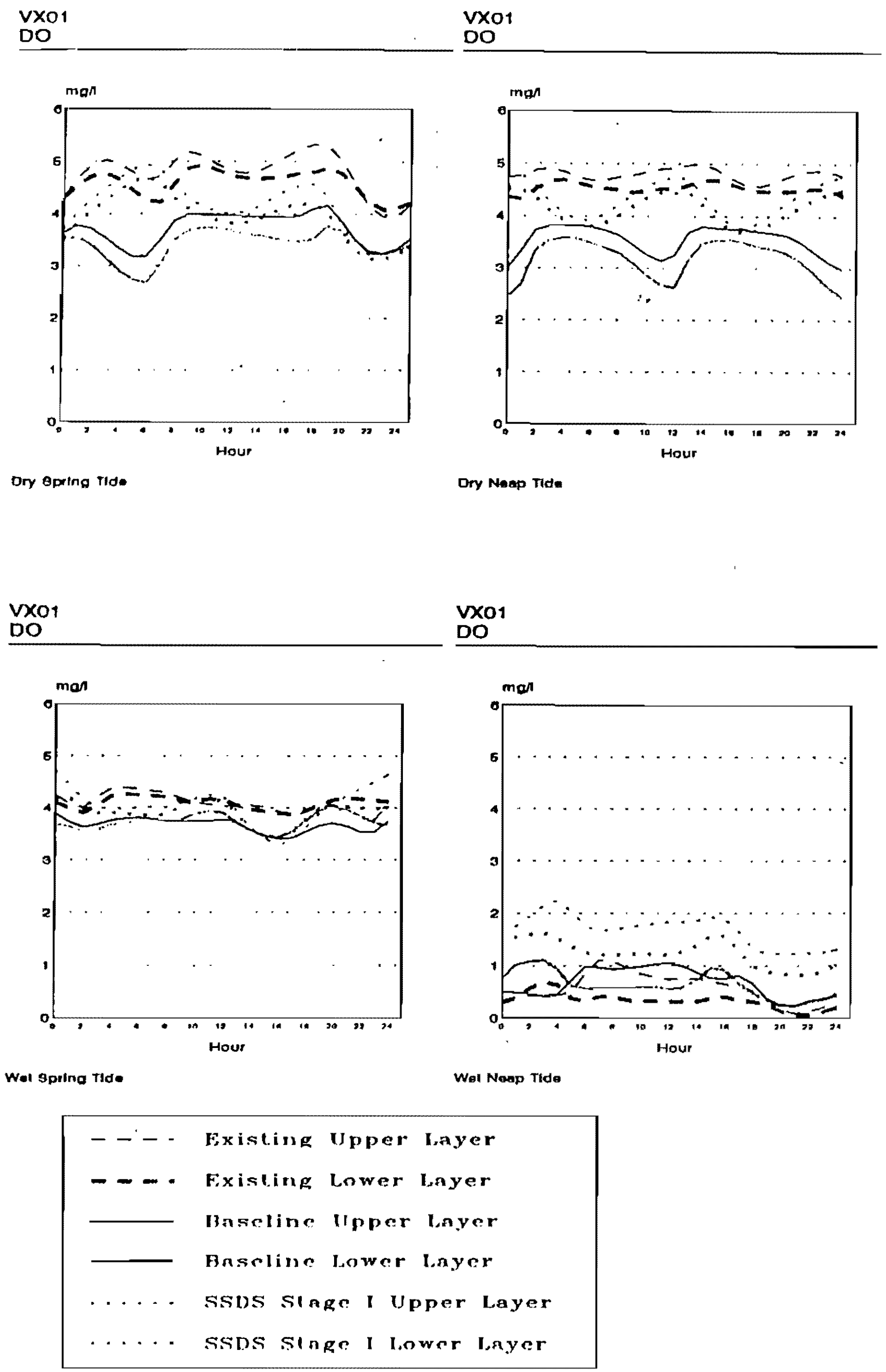


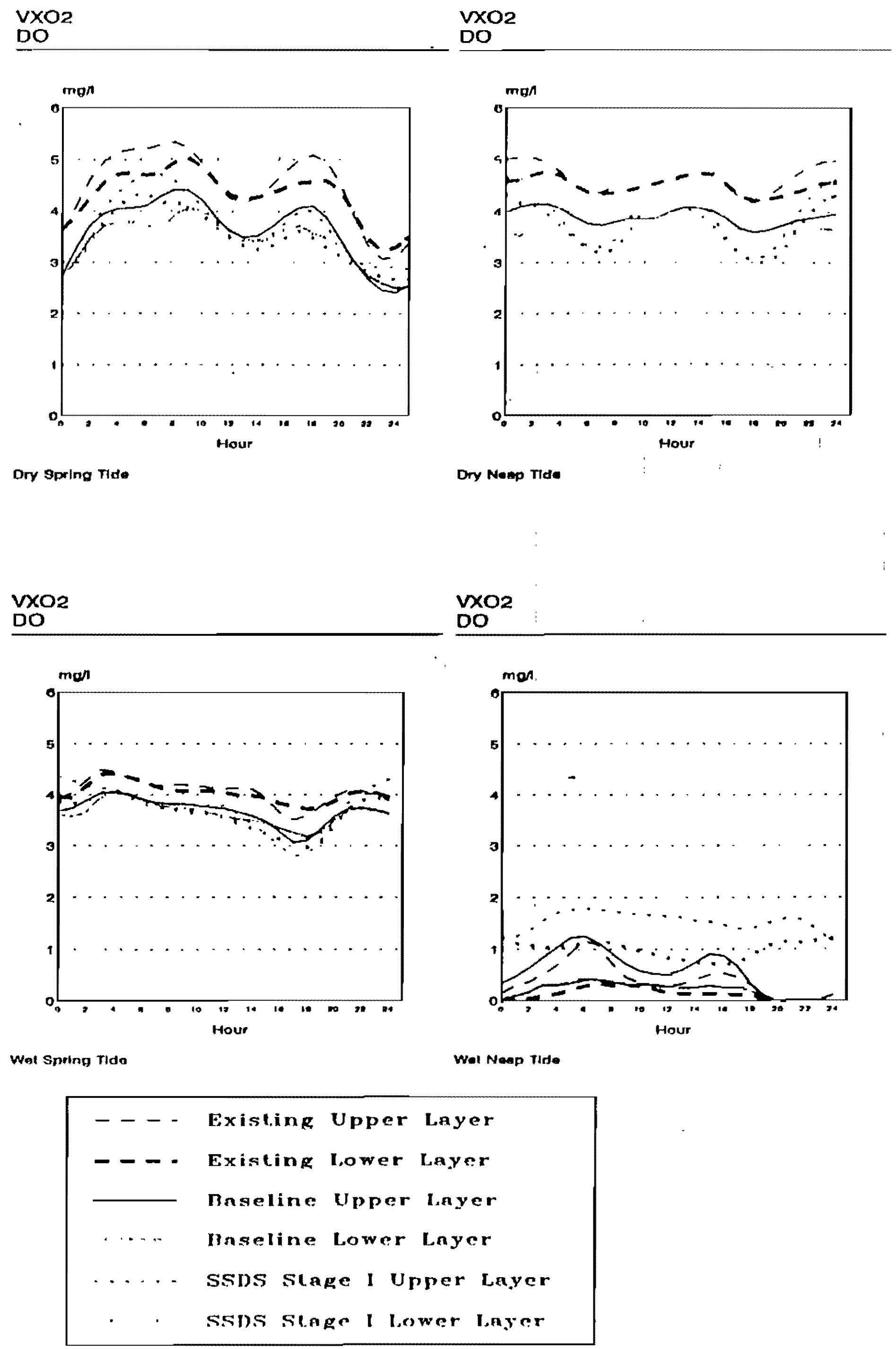
Wet Neap Tide

Existing Upper Layer
Existing Lower Layer
Baseline Upper Layer
Baseline Lower Layer
SSDS Stage I Upper Layer
SSDS Stage I Lower Layer

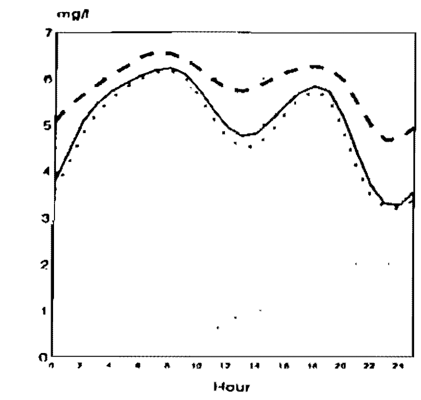
Existing Upper Layer
Existing Lower Layer
Baseline Upper Layer
Baseline Lower Layer
SSDS Stage I Upper Layer
SSDS Stage I Lower Layer

Appendix I


VXO1
DO
mg/l
Hour
Dry Spring Tide
Dry Neap Tide
Wet Spring Tide
Wet Neap Tide
Existing Upper Layer
Existing Lower Layer
Baseline Upper Layer
Baseline Lower Layer
SSDS Stage I Upper Layer
SSDS Stage I Lower Layer

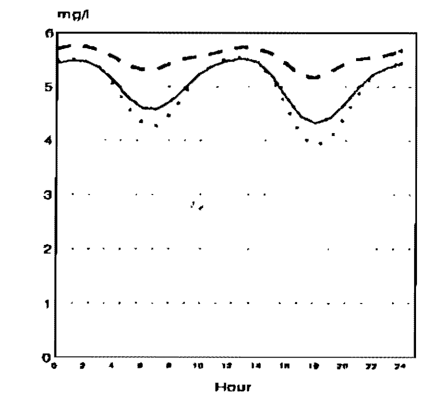

VXO2
DO
mg/l
Hour
Dry Spring Tide
Dry Neap Tide
Wet Spring Tide
Wet Neap Tide
Existing Upper Layer
Existing Lower Layer
Baseline Upper Layer
Baseline Lower Layer
SSDS Stage I Upper Layer
SSDS Stage I Lower Layer

VX04
DO



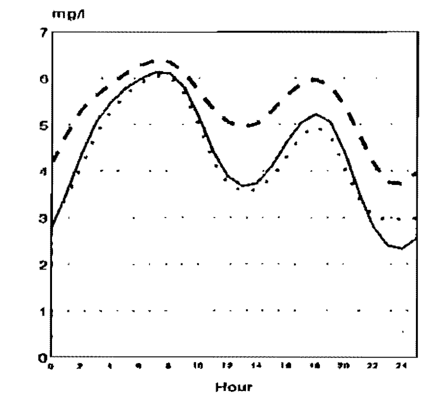
Dry Spring Tide

VX04
DO



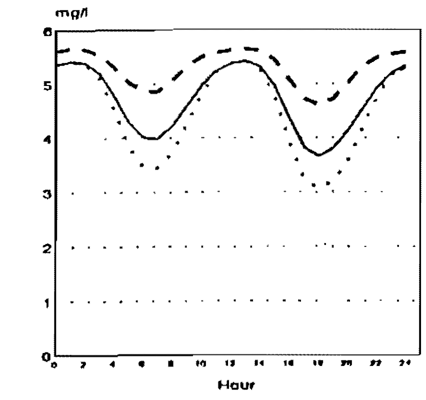
Dry Neap Tide

VX03
DO



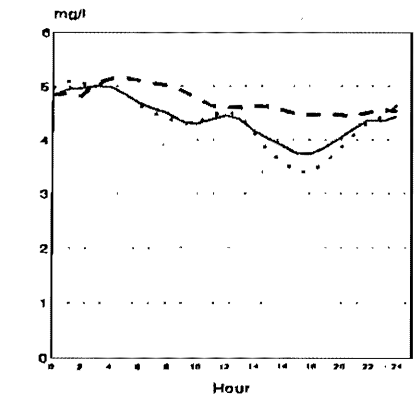
Dry Spring Tide

VX03
DO



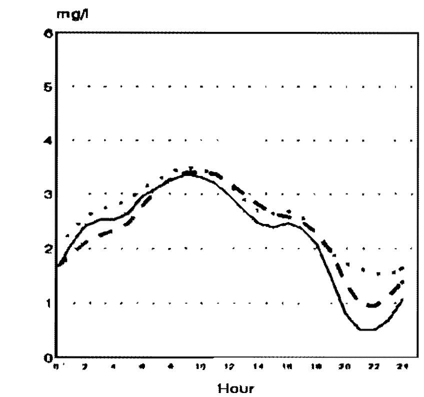
Dry Neap Tide

VX04
DO



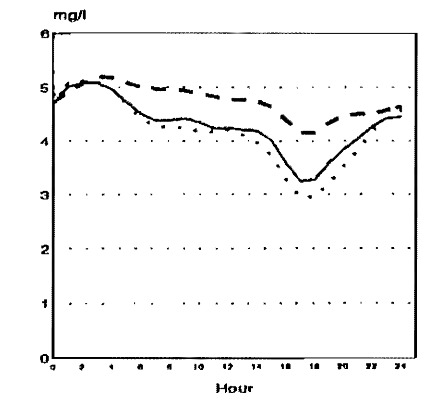
Wet Spring Tide

VX04
DO



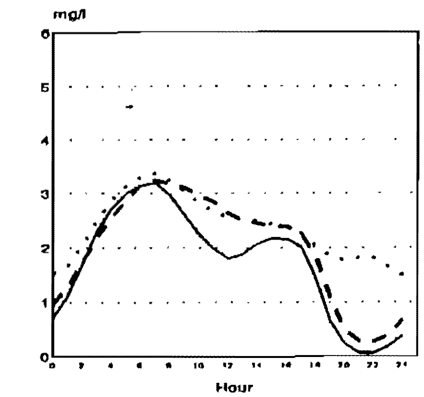
Wet Neap Tide

VX03
DO



Wet Spring Tide

VX03
DO



Wet Neap Tide

- - - - Existing Upper Layer
- - - - Existing Lower Layer
——— Baseline Upper Layer
——— Baseline Lower Layer
· · · · · · SSDS Stage I Upper Layer
· · · · · · SSDS Stage I Lower Layer

- - - - Existing Upper Layer
- - - - Existing Lower Layer
——— Baseline Upper Layer
Baseline Lower Layer
· · · · · · SSDS Stage I Upper Layer
SSDS Stage I Lower Layer