The Hongkong Electric Co Ltd
香港電燈有限公司

ENVIRONMENTAL IMPACT ASSESSMENT (EIA) ORDINANCE, CAP. 499

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LAMMA POWER STATION
NAVIGATION CHANNEL IMPROVEMENT

Report Title	Baseline Monitoring Report (Rev. 1)
Date	11th June, 2003
Certified by	(Mr. Ip Tat-Yan, Environmental Team Leader)
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Lamma Power Station
Navigation Channel Improvement
Baseline Monitoring Report

June 2003 (Revision 1)

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ANNEXES

EXECUTIVE SUMMARY

This is an environmental baseline monitoring report for the Project "Lamma Power Station Navigation Channel Improvement" prepared by the Environmental Team (ET). This report contains the results of the baseline marine water quality survey performed in 2003.

The baseline water quality monitoring was conducted between 31 March and 26 April 2003. There were seven sensitive receivers chosen on the basis of their proximity to the dredging operations and three control stations to monitor the ambient marine water quality in relation to activities from other concurrent construction projects with potential water quality impacts. Monitoring was carried out three times per week for four weeks. Readings were taken at each location during both mid-flood and mid-ebb tides.

Baseline water quality data was collected to derive the Action/Limit Levels for marine water quality during impact monitoring throughout the construction phase of the Project.

No major activity influencing marine water quality was identified during the baseline monitoring. From the analysis of the collected data and field observations, it is concluded that the measured water quality is representative of pre-construction ambient conditions.

1. INTRODUCTION

Baseline water quality monitoring was conducted in accordance with the Environmental Monitoring and Audit (EM&A) Manual (Construction Phase) for the Lamma Power Station Navigation Channel Improvement (thereafter called the "Project") pursuant to Clauses 4.1 and 4.2 of the Environmental Permit (EP-165/2003).

1.1 Purpose of the Report

The purpose of this report is to establish baseline levels for impact monitoring of marine water quality during the construction phase of the Project. This report presents the methodologies and results of baseline marine water quality measurements.

1.2 Background

HEC proposes to improve the existing navigation channel in order to provide safe shipping access for coal ships to and from the Lamma Power Station. The Project involves restoring the depth of existing channel by dredging to a water depth of –16 mPD approximately with an estimated total dredging volume of 2.98 million m^3.

The Channel was first dredged to –15.9 mPD (approximately) in 1981. Maintenance of the Channel by means of dredging down to about –16.5 mPD level was carried out in 1989-1990. To cope with the updated vessel operation, the turning basin of the Channel was enlarged by extending 250m southward in early 2001.

The Environmental Impact Assessment (EIA) Report for the Project, which was prepared in response to EIA Study Brief (ESB-078/2001) issued to The Hongkong Electric Company Limited (HEC) by the Environmental Protection Department (EPD), was completed in January 2003. The EIA Report was submitted to the Director of Environmental Protection Protection (DEP) in accordance with the requirements of the Environmental Impact Assessment Ordinance (EIAO) and was approved by DEP on 11 March 2003. The Environmental Permit (EP-165/2003) was issued to HEC on 8 April 2003.

The Project Area is illustrated in Figure 1.1. The shaded area shows the limit of the Channel where dredging will be required under this Project. According to the latest bathymetric survey of the Channel, there is already sufficient water depth in the remaining section of the Channel in the south (beyond the shaded area in Figure 1.1) and no dredging will be required.

The dredging options for the Project are:
(1) continuous dredging using grab dredgers with cage-type silt curtains or
(2) intermittent dredging using one Trailer Suction Hopper Dredger (TSHD).

Only one of the two dredging options will be deployed. The dredging work is tentatively scheduled to take place from May to December 2003. Dredged sediments

will be transported to the disposal sites approved by the Marine Fill Committee for disposal.

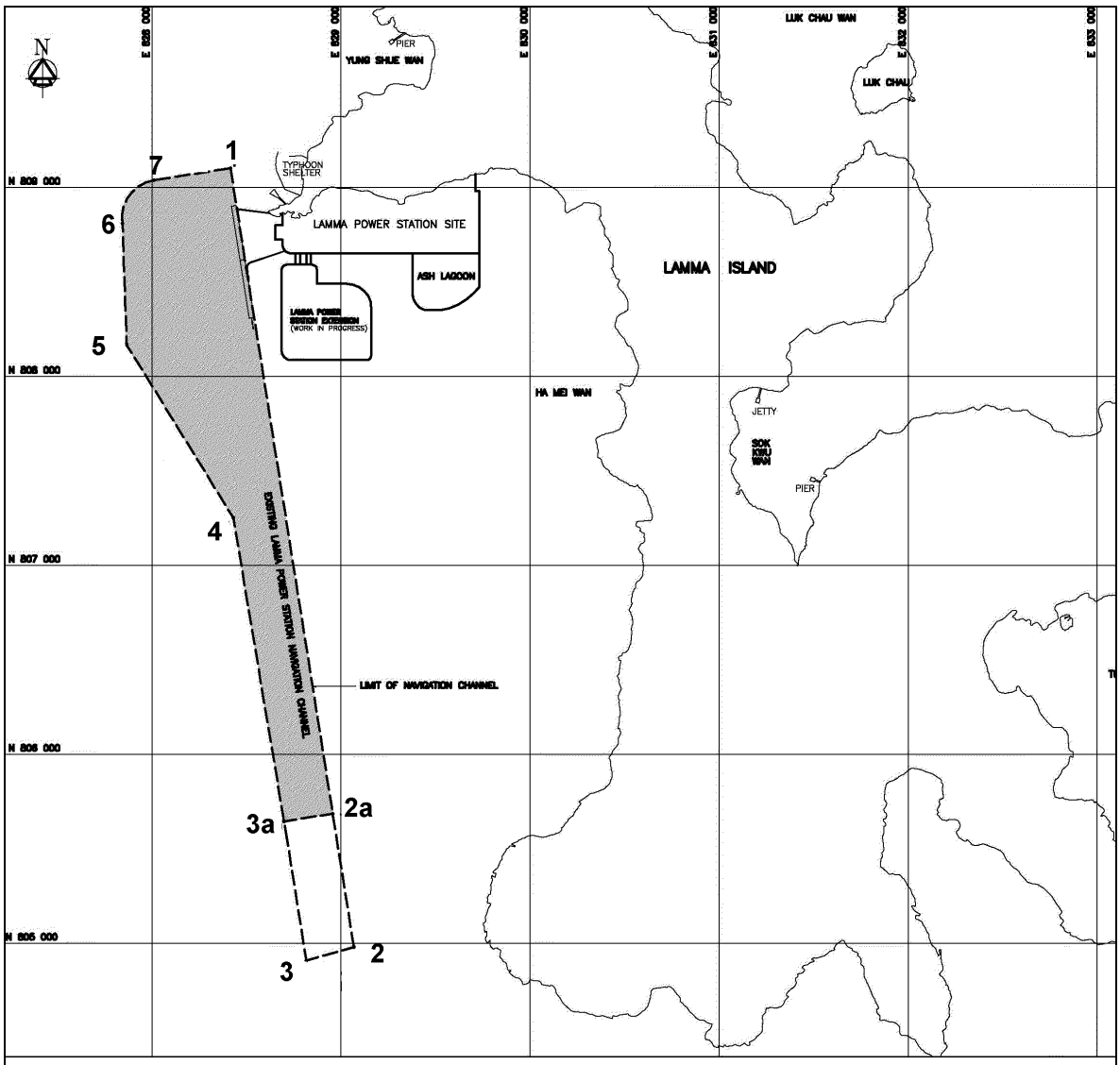
1.3 Structure of the Baseline Monitoring Report

The structure of the report is as follows:

Section 1: Introduction – detailing the purpose and structure of the report

Section 2: Water Quality – presenting the results of baseline marine water quality monitoring

Section 3: Conclusion



SETTING OUT OF NAVIGATION CHANNEL LIMIT

POINT	EASTING (m)	NORTHING (m)
1	828 414.393	809 101.605
2	829 067.326	804 979.151
3	828 815.532	804 906.872
4	828 430.000	807 250.000
5	827 864.900	808 168.200
6	827 843.188	808 808.639
7	828 009.441	809 037.467

SETTING OUT OF POINT "2a" & "3a"

POINT	EASTING (m)	NORTHING (m)
2a	828 956.222	805 680.633
3a	828 704.149	805 608.273

Figure 1.1 Layout of Work Site

2. WATER QUALITY

2.1 Monitoring Locations

In order to monitor the potential environmental impact of the project during the construction period, seven stations (SR6, SR7, SR10, SR11, SR12, SR14 and SR15) were selected as the sensitive receiver monitoring locations to gauge any potential impact on water quality during the entire construction period. Moreover, another three control monitoring stations (CS1, CS2 and CS3), which were not predicted to be impacted by the dredging works related to the project, were also monitored together with the sensitive receiver monitoring stations so as to reveal the possible background fluctuation of the study area during the impact monitoring period. These locations are listed in Table 2.1 below, and are also depicted in Figure 2.1.

Table 2.1 Marine Water Monitoring Locations

Type	Monitoring Location	HK Metric Grid E	HK Metric Grid N
Sensitive Receiver Stations	SR6	830 150	811 500
	SR7	829 004	810 903
	SR10	829 194	808 600
	SR11	830 119	808 650
	SR12	830 386	807 189
	SR14	829 977	805 758
	SR15	829 566	804 545
Marine Control Stations	CS1	828 000	813 492
	CS2	825 000	808 000
	CS3	829 000	802 000

2.2 Monitoring Periods

The monitoring began on 31 March 2003 and continued until 26 April 2003. During the period, baseline marine water quality monitoring data was collected three times per week for four weeks at each monitoring station during mid-ebb and mid-flood tides. The baseline monitoring periods for marine water are summarized in Table 2.2. The monitoring schedule has been submitted to EPD on 19 March 2003.

Table 2.2 Baseline Monitoring Periods

Sampling Dates	Sampling Time	Tide Conditions	Weather
31/3/2003 (Mon)	11:10 - 13:52 16:19 - 18:43	Ebb Flood	Overcast Overcast

Sampling Dates	Sampling Time	Tide Conditions	Weather
2/4/2003 (Wed)	12:00 – 14:56 16:05 – 18:35	Ebb Flood	Overcast Overcast
4/4/2003 (Fri)	09:00 – 10:50 13:00 – 15:40	Flood Ebb	Rainy Rainy
7/4/2003 (Mon)	08:55 – 10:54 14:05 – 16:01	Flood Ebb	Overcast Overcast
9/4/2003 (Wed)	08:55 – 11:14 16:05 – 18:15	Flood Ebb	Overcast Overcast
11/4/2003 (Fri)	10:05 – 12:08 16:15 – 18:36	Flood Ebb	Overcast Overcast
14/4/2003 (Mon)	10:00 – 12:15 15:29 – 17:12	Ebb Flood	Overcast Overcast
16/4/2003 (Wed)	10:50 – 12:55 15:30 – 17:49	Ebb Flood	Overcast Overcast
18/4/2003 (Fri)	08:25 – 10:15 12:30 – 14:55	Flood Ebb	Sunny Sunny
22/4/2003 (Tue)	10:30 – 12:16 15:45 – 17:38	Flood Ebb	Overcast Sunny
24/4/2003 (Thu)	09:55 – 11:50 16:00 – 17:55	Flood Ebb	Sunny Sunny
26/4/2003 (Sat)	09:17 – 11:23 13:59 – 16:01	Ebb Flood	Overcast Overcast

2.3 Monitoring Equipment

Table 2.3 summarizes the equipment used in the baseline water quality monitoring programme.

Table 2.3 Water Quality Monitoring Equipment

Equipment	Detection Limit
YSI 6920 Water Quality Monitor	Temperature: -5 to 45 ^{0}C; +/- 0.15 ^{0}C Salinity: 0 to 70 ppt; +/- 0.1 ppt Dissolved Oxygen: 0 to 200%; +/- 0.2% 0 to 20 mg/L; +/- 0.2 mg/L Turbidity: 0 to 1000 NTU; +/- 5% of the range pH: 0 to 14 units; +/- 0.2 units
Trimble NT300D GPS	Accuracy better than 3m
Eagle Fisheasy ST Portable Depth Finder	Accuracy better than 0.5m

2.4 Monitoring Parameters, Frequency and Duration

Table 2.4 summarizes the monitoring parameters and frequencies of baseline water quality monitoring.

Table 2.4 Water Quality Monitoring Parameters and Frequency

Monitoring Stations	Parameters	Frequency	No. of Depths	No. of Samples
Sensitive Receiver Stations SR6, SR7, SR10, SR11, SR12, SR14 & SR15 Marine Control Stations CS1, CS2, CS3	• Depth, m • Temperature, ^{o}C • Salinity, ppt • DO, mg/L • DO Saturation, % • Turbidity, NTU • SS, mg/L • pH	Three times per week	3 Surface, Mid-Depth and Bottom	2 Mid-ebb and Mid-flood

2.5 Monitoring Methodology and Calibration Details

Monitoring Methodology

- The monitoring stations were accessed using survey boat to within 3m, guided by Differential Global Positioning System (DGPS).
- The water depth of the monitoring location at sampling time was measured using depth meter. Afterwards, the probes of the in-situ measurement equipment were lowered to the predetermined depths and the measurements taken accordingly.
- A water sampler was lowered into the water to the required sampling depths. Upon reaching the pre-determined depth, a messenger to activate the sampler was released which travel down the wire. The water sample was sealed within the sampler before retrieving.
- All measurements were taken at 3 water depths, where appropriate, namely 1m below water surface, mid-depth, and 1 meter from seabed, except where the water depth was less than 6m, whereupon the mid-depth measurement was omitted. If the water depth was less than 3m, only the mid-depth position was monitored.
- One duplicate in-situ measurement and water sample for laboratory analyses were taken at all sampling locations.

- At each measurement depth, two consecutive measurements were be taken. The probe was retrieved out of the water after the first measurement and then redeployed for the second measurement. When the difference in value between the first and second measurement of on-site parameters was more than 25% of the value of the first reading, the reading was discarded and further readings were taken.

- A water sampler, consisting of a transparent PVC or glass cylinder of not less than two litres which could be effectively sealed with cups at both ends, was used. The water sampler had a positive latching system to keep it open and prevent premature closure until released by a messenger when the sampler was at the selected water depth.

- Water samples for SS measurements were transferred directly to high density polythene sample bottles, packed in ice (cooled to 4^{o}C without being frozen), and delivered to a HOKLAS laboratory as soon as possible after collection.

- In addition, field information such as the general meteorological conditions and observations regarding any significant activities in the vicinity of each monitoring location were also recorded.

Equipment Calibration

The equipment deployed for in-situ measurement of marine water quality was calibrated before use. The methodologies for the calibration follow the instruction manuals provided by the corresponding manufacturers. The calibration records are shown in Appendix A.

Laboratory Analysis & QA/QC

The collected marine water samples were analyzed for Suspended Solids with methodologies shown in Table 2.5.

Table 2.5 Laboratory Analysis Methodologies of Marine Water Samples

Parameter	**Method**	**Limit of Reporting (mg/L)**
Suspended Solids	APHA 17 ed 2540 D	1.0

In order to ensure that the laboratory analysis works were carried out properly, stringent QA/QC procedures (which include sample preparation as well as subsequent instrumentation analysis) were followed. According to the requirements stipulated in the EM&A Manual, QA/QC requirements for laboratory testing include:

1) "Blind" duplicate samples analysis of 10% collected marine water samples; and

2) in-house QA/QC procedures of the testing laboratory (this includes the use of blank, batch duplicates and quality control samples).

Blind Duplicate:
In order to cross check the accuracy of the measurement results by the laboratory analysis, "blind" duplicate samples of 10% of the collected marine water samples were analyzed alongside the normal samples. The sample codes for the "blind" duplicates were determined by the sampling team and are not identifiable by the laboratory. The results of the "blind" duplicate samples are summarized in Appendix B.

Blank:
A laboratory blank is an analyte free matrix to which all reagents are added in the same volumes or proportions as used in the standard sample preparation to monitor contamination introduced in laboratory. All the laboratory blank values and acceptance criterion of suspended solids are summarized in Appendix B.

Batch Duplicate:
Batch duplicate is an intra-laboratory split sample randomly selected from the sample batch to monitor the method precision in a given matrix. The acceptance limit of duplicate values of suspended solids and their duplicate results are summarized in Appendix B.

Quality Control Sample:
The quality control sample is the analysis of a material with a known concentration of contaminants to determine the accuracy of results in a given matrix. The results of quality control samples for suspended solids are shown in Appendix B.

A total of (1440) sets of samples for Suspended Solids analysis were received during the marine monitoring period including both ebb and flood tides. At least 5% laboratory blanks, batch duplicates and quality control samples for Suspended Solids were used. The acceptance criteria are outlined in Quality Control data.

The QA/QC results in Appendix B indicated that the laboratory analysis works of the collected marine water samples were properly carried out and the measurement results obtained were valid in accordance with the Hong Kong Laboratory Accreditation Scheme (HOKLAS) requirements. Moreover, the "blind" duplicate measurement results indicated that the precision of the measurements for Suspended Solids complied with HOKLAS requirements.

2.6 Baseline Monitoring Results

The on-site measurement and laboratory analysis results of marine water at all monitoring locations are detailed in Appendix C.

The averages and ranges of the monitoring parameters of the baseline data at each monitoring location are summarized in Appendix D. The results of Dissolved Oxygen, Turbidity and Suspended Solids are presented graphically in Appendix E.

Based on the observation made by the sampling team during the course of baseline monitoring, the weather conditions during the monitoring period at all monitoring locations were suitable for baseline monitoring.

On-site observation was carried out by the sampling team at each monitoring location during each sampling trip. The sampling team did not observe any pertinent activities at the vicinity of the study area that would affect the baseline monitoring results. There was no abnormal operation at the Lamma Power Station during the period of the baseline marine water monitoring. Further, no abnormal construction activities at the construction of Lamma Power Station Extension project was recorded. Based on the above, it is considered that the conditions of the study area during the monitoring periods were appropriate for baseline monitoring.

2.7 Action and Limit Levels

Exceedance of Action Level during the impact monitoring period would indicate that environmental quality is deteriorating. Exceedance of Limit Level during the impact monitoring period would indicate that environmental quality has become unacceptable. An Event Action Plan for responding to these exceedances is documented in the EM&A Manual.

Action and Limit Levels for marine water quality were established from baseline levels in accordance with the EM&A Manual. In order to take into account the seasonal variations of the baseline DO level, separate baseline DO levels in dry seasons (November to March) and wet seasons (April to October) were derived both from the baseline data obtained prior to the commencement of works and EPD's routine monitoring data in the study area over the last 5 years.

One way Analysis of Variance (ANOVA) was applied to test for the differences in the baseline monitoring data of Dissolved Oxygen among the sensitive receiver stations (SR6, SR7, SR10, SR11, SR12, SR14 and SR15). The analysis results (P-values) of DO (Surface & Middle) and DO (Bottom) were 0.989 and 0.974 respectively. This showed that no significant difference in Dissolved Oxygen was found among the seven sensitive receiver stations.

The baseline monitoring work for DO was conducted in April 2003 which was just the onset of the wet season. Also, according to the Hong Kong Observatory, April 2003 was drier than normal as the monthly rainfall was only 84.5 millimetres, about half the normal figure of 161.5 millimetres. Hence, if all the baseline DO figures were placed into the data pool of wet season figures, the true picture of DO levels in the wet season would be skewed. Therefore, it was considered more appropriate to pool the DO baseline monitoring data with EPD's routine monitoring data in dry seasons instead of wet seasons.

EPD monitoring data measured at the same water control zones in which the sensitive receivers are located was applied to the monitoring stations. For SR6, the Action and

Limit levels were calculated from Marine Water Quality (MWQ) results at WM1 while that for SR7-SR15, data at SM5-7 was used.

Based on the above approach, the Action Levels of SR6 and SR7-15 were calculated from the 5th percentile of MWQ results at WM1 and SM5-7 respectively (and baseline results for dry season). Similarly, the Limit Levels of SR6 and SR7-15 were calculated from the 1st percentile of MWQ results at WM1 and SM5-7 respectively (and baseline results for dry season) or the WQO for DO in non-FCZ.

The MWQ results for DO at WM1 and SM5-7 over the last 5 years (viz. from 1997 to 2001) collected from EPD's Website only are analyzed and summarized in Table 2.6 and Table 2.7.

Table 2.6 EPD's MWQ Results for Dissolved Oxygen (Surface & Middle) from 1997 to 2001

Dissolved Oxygen (Surface & Middle)	**WM1**	**SM5-7**
Dry Seasons		
Average	6.9	6.8
Minimum	3.7	4.5
Maximum	8.4	8.6
5 %-ile	5.3	4.8
1 %-ile	4.1	4.5
Wet Seasons		
Average	5.7	6.5
Minimum	3.7	4.2
Maximum	8.7	10.8
5 %-ile	4.2	4.6
1 %-ile	3.9	4.3

Table 2.7 EPD's MWQ Results for Dissolved Oxygen (Bottom) from 1997 to 2001

Dissolved Oxygen (Bottom)	**WM1**	**SM5-7**
Dry Seasons		
Average	6.9	7.0
Minimum	3.2	4.8
Maximum	8.7	8.9
5 %-ile	5.6	5.0
1 %-ile	3.8	4.8
Wet Seasons		
Average	4.8	5.4
Minimum	2.2	2.0
Maximum	7.4	9.3
5 %-ile	2.7	3.5
1 %-ile	2.3	2.0

Subsequent impact monitoring results will be compared against the Action and Limit Levels. Table 2.8 summarizes the methods of determining the Action Levels and Limit Levels for various parameters.

Table 2.8 Methods of Determining Action and Limit Levels for Water Quality

Parameters	Action	Limit
DO in mg/ L (Surface, Middle and Bottom).	Surface and Middle 5%-ile of baseline and last 5 years' MWQ in Hong Kong for surface and middle layers. Bottom 5%-ile of baseline and last 5 years' MWQ in Hong Kong for bottom layer.	Surface and Middle 4 mg/L or 1%-ile of baseline and last 5 years' MWQ in Hong Kong for surface and middle layers. Bottom 2 mg/L or 1%-ile of baseline and last 5 years' MWQ in Hong Kong for bottom layer.
SS in mg/L (depth-averaged)	95%-ile of baseline data or 120% upstream control station's SS at the same tide of the same day	99%-ile of baseline, or 130% of upstream control station's SS at the same tide of the same day. For SR10, the SS limit is 100 mg/L
Turbidity (Tby) in NTU (depth-averaged)	95%-ile of baseline data or 120% of upstream control station's Tby at the same tide on the same day	99%-ile of baseline data or 130% of upstream control station's Turbidity at the same tide on the same day

Notes:

- "Depth-averaged" is calculated by taking the arithmetic mean of the reading of all three depths;
- In order to take into account the seasonal variations of the baseline DO level, separate baseline DO levels for the dry and the wet seasons would be derived both from the baseline data obtained prior to the commencement of works and EPD's routine monitoring data in the study area over the last 5 years.

- For DO, non-compliance of the water quality limits occurs when monitoring result is lower than the limits.
- For SS and Turbidity, non-compliance of the water quality limits occurs when monitoring result is higher than the limits.
- All the figures given in the table subject to revision pending results of the baseline monitoring and subsequent approval by EPD.
- Whichever of the two criteria is greater, except DO which will take the lower of the two criteria, shall be used as the Action and Limit levels. Subject to approval from EPD.

With the above methodology, the Actions and Limit Levels have been calculated in compliance with the EM&A Manual and are shown in Table 2.9, Table 2.10 and Table 2.11. Calculations of 5%-ile and 1%-ile of DO in wet and dry seasons are provided in Appendix F.

Table 2.9 Action / Limit Levels for Dissolved Oxygen (mg/L)

(a) Surface and Middle – Dry Season (November – March)

	SR6	SR7	SR11	SR12	SR14	SR15
Action Level (5%-ile)	5.2*	5.2*				
1%-ile	4.3**	4.6**				
Limit Level	4.0***					

Note:

1. * - figure 5.2 mg/L represents 5%-ile of baseline monitoring data and Marine Water Quality (MWQ) in Hong Kong from 1997 to 2001
2. ** - figures 4.3 and 4.6 mg/L represent 1%-ile of baseline monitoring data and MWQ in Hong Kong from 1997 to 2001
3. *** - WQO for DO in non-FCZ
4. All the figures may be subjected to review by EPD as and when necessary.

(b) Surface and Middle – Wet Season (April – October)

	SR6	SR7	SR11	SR12	SR14	SR15
Action Level (5%-ile)	4.2*	4.6*				
1%-ile	3.9**	4.3**				
Limit Level	4.0***					

Note:

1. * - figures 4.2 and 4.6 mg/L represent 5%-ile MWQ in Hong Kong from 1997 to 2001
2. ** - figures 3.9 and 4.3 mg/L represent 1%-ile of MWQ in Hong Kong from 1997 to 2001
3. *** - the WQO for DO in non-FCZ
4. All the figures may be subjected to review by EPD as and when necessary.

(c) Bottom – Dry Season (November – March)

	SR6	SR7	SR11	SR12	SR14	SR15
Action Level (5%-ile)	5.5*	5.4*				
1%-ile	4.1**	4.8**				
Limit Level	2.0***					

Note:

1. * - figures 5.5 and 5.4 mg/L represent 5%-ile of baseline monitoring data and MWQ in Hong Kong from 1997 to 2001
2. ** - figures 4.1 and 4.8 mg/L represent 1%-ile of baseline monitoring data and MWQ in Hong Kong from 1997 to 2001
3. *** - WQO for DO in non-FCZ
4. All the figures may be subjected to review by EPD as and when necessary.

(d) Bottom – Wet Season (April – October)

	SR6	SR7	SR11	SR12	SR14	SR15
Action Level (5%-ile)	2.7*	3.5*				
1%-ile	2.3**	2.0**				
Limit Level	2.0***					

Note:

1. * - figures 2.7 and 3.5 mg/L represent 5%-ile of MWQ in Hong Kong from 1997 to 2001
2. ** - figures 2.3 and 2.0 mg/L represent 1%-ile of MWQ in Hong Kong from 1997 to 2001
3. *** - WQO for DO in non-FCZ
4. All the figures may be subjected to review by EPD as and when necessary.

Table 2.10 Action / Limit Levels for Turbidity (NTU)

(depth-average)

	SR6	SR7	SR11	SR12	SR14	SR15
Action Level (95%-ile)	16.4	15.3	13.5	14.2	16.1	16.1
Limit Level (99%-ile)	17.4	16.1	16.2	16.2	16.5	16.8

Note:

1. 95% ile of baseline data is adopted for setting the Action Level for various SRs according to the EM&A Manual.
2. 99% ile of baseline data is adopted for setting the Limit Level for various SRs according to the EM&A Manual.
3. All the figures may be subjected to review by EPD as and when necessary.

Table 2.11 Action / Limit Levels for Suspended Solids (mg/L)

(depth-average)

	SR6	SR7	SR10	SR11	SR12	SR14	SR15
95%-ile	16.8	16.4	16.0	16.1	16.8	17.9	16.7
Action Level	16.8	16.4	--	16.1	16.8	17.9	16.7
99%-ile	16.9	16.8	16.2	16.4	17.0	18.8	17.8
Limit Level	16.9	16.8	100	16.4	17.0	18.8	17.8

Note:

1. No Action Level is applied to SR10 according to the EM&A Manual
2. Limit Level of SR10 is 100 mg/L according to the EM&A Manual
3. 95% ile of baseline data is adopted for setting the Action Level for various SRs according to the EM&A Manual.
4. 99% ile of baseline data is adopted for setting the Limit Level for various SRs according to the EM&A Manual.
5. All the figures may be subjected to review by EPD as and when necessary.

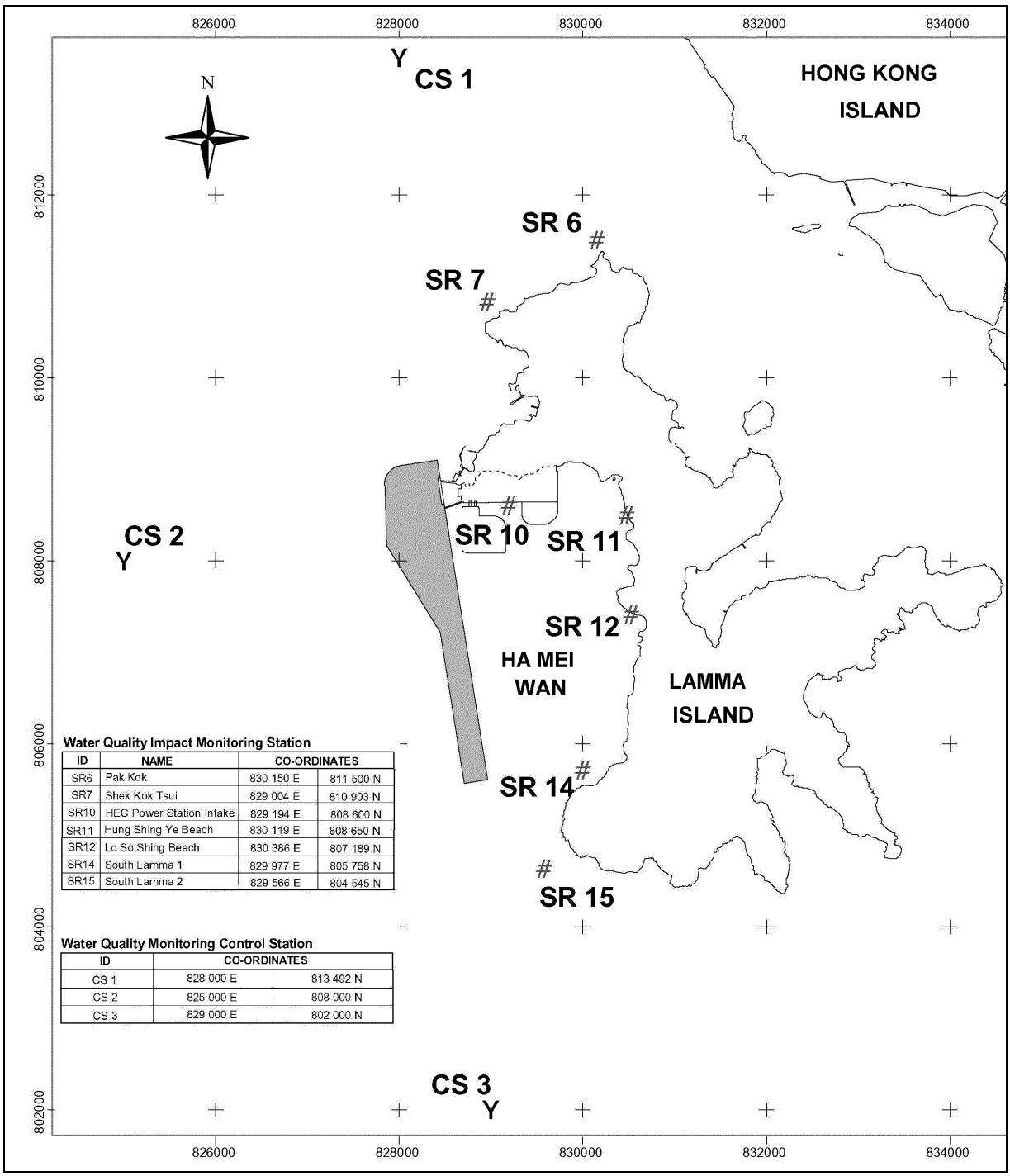


Figure 2.1 Locations of Water Quality Monitoring Stations

3. CONCLUSION

Marine water quality baseline monitoring for the Project in March and April 2003 has been completed. From an analysis of the collected data and field observations, it can be concluded that the measured marine quality are representative of pre-construction ambient conditions.

No major activity influencing water quality was identified while carrying out baseline monitoring.