Annex J

Contract No. 00/9281
Lamma Power Station Extension
Baseline Marine Water Quality Monitoring

Baseline Monitoring Report

(Revision No. 3)

Prepared for

The Hongkong Electric Company Limited

By

Environmental Management Division

Hong Kong Productivity Council

29th March 2001

Contract No. 00/9281
Lamma Power Station Extension
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Quality Index

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EXECUTIVE SUMMARY

The Hongkong Electric Company Limited (HEC) is planning to construct an extension of the existing Lamma Power Station to cater for the forecasted increased in electricity demand. In this connection, HEC has appointed the Hong Kong Productivity Council (HKPC) to conduct the baseline water quality monitoring works in the surrounding waters in accordance with the recommendations as stipulated in the Environmental Impact Assessment under the Environmental Impact Assessment Ordinance.

This Report has been prepared to document the baseline marine water monitoring conducted for the construction of the Lamma Power Station Extension project. Monitoring of marine water quality was carried out from 6th November to 1st December 2000, prior to the commencement of construction works. 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.

Monitoring Results

Depth-average Dissolved Oxygen measurement results at sensitive receiver and control monitoring stations are in the range of 5.7 – 8.4 mg/L and 5.1 – 8.3 mg/L respectively. Dissolved Oxygen measurement results of bottom level at sensitive receiver and control monitoring stations are in the range of 5.6 – 8.4 mg/L and 4.2 – 8.3 mg/L respectively.

Depth-average Suspended Solids measurement results at sensitive receiver and control monitoring stations are in the range of 4.8 – 25.4 mg/L and 5.5 – 25.7 mg/L respectively.

Depth-average measurement results of Unionized Ammonia at the sensitive receiver and control monitoring stations are in the range of 0.001 – 0.007 mg/L and 0.001 – 0.008 mg/L respectively.

The depth–average measurement results of Total Inorganic Nitrogen at the sensitive receiver and control monitoring stations are in the range of 0.01 – 0.27 mg/L and 0.03 – 0.28 mg/L respectively.

Determination of Action and Limit Levels

Based on the collected data, marine water quality Action and Limit Levels have been established at each monitoring station and are documented in Section 4.3 of this Report.

1. INTRODUCTION

1.1 Scope of the Report

This is the Baseline Marine Water Quality Monitoring Report for the Lamma Power Station Extension project. This report has been prepared by the Environmental Management Division of Hong Kong Productivity Council (HKPC) for submission to The Hongkong Electric Company Limited (HEC).

1.2 Structure of the Report

The structure of the report is as follows:

Section 1: **INTRODUCTION -** details the scope and structure of the report.

Section 2: **PROJECT INFORMATION** - summarizes the background of the project.

Section 3: **MONITORING METHODOLOGY** – describes the monitoring locations, monitoring period, monitoring equipment to be used for the on-site measurement, laboratory analysis methodology and the associated QA/QC results

Section 4: **BASELINE MONITORING RESULTS –** presents the monitoring results and the established Action and Limit Levels.

Section 5: **CONCLUDING REMARKS**

2. PROJECT INFORMATION

2.1 Background

The Hongkong Electric Company (HEC) Limited is planning to construct a 1,800 MW gas-fired combined cycle plant as an extension of the existing Lamma Power Station to cater for the forecasted increase in electricity demand. An Environmental Impact Assessment under the EIAO has been conducted which recommended an EM&A programme for the construction activities of Lamma Power Station Extension (Lamma Extension). A baseline water quality monitoring as part of the EM&A programme prior to the construction activities (scheduled to commence in January 2001) was also recommended. In this connection, HEC appointed the Hong Kong Productivity Council (HKPC) to conduct the baseline water

quality monitoring works at all the recommended sensitive receiver monitoring and control stations. The baseline water monitoring was commenced in November 2000 and completed in December 2000. The schedule of the reclamation programme is enclosed in Appendix K.

3. MONITORING METHODOLOGY

3.1 Monitoring Locations

In order to monitor the potential environmental impact of the project during the construction period, seven stations (SR1 to SR7) were selected to be the sensitive receiver monitoring locations to gauge any potential impact on water quality during the entire construction period. On the other hand, in order to monitor the possible background fluctuation of the study area during the impact monitoring period, another five control monitoring stations (C1 to C5), which were not predicted to be impacted by the construction works for the extension, were also monitored together with the sensitive receiver monitoring stations. These locations are listed in Table 3.1 below, and are also depicted in Appendix H.

Table 3.1: Marine Water Monitoring Locations

Station I.D.	HK Metric Grid Easting	HK Metric Grid Northing
Sensitive Receiver Stations		
SR1	830224	811528
SR2	829004	810903
SR3	829194	808600
SR4	830119	808650
SR5	830386	807189
SR6	829977	805758
SR7	829566	804545
Control Stations		
C1	830542	813492
C2	828608	813492
C3	826776	809978
C4	826776	806464
C5	830440	802186

3.2 Monitoring Periods

The monitoring began on 6th November 2000 and continued until 1st December 2000. During this 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 3.2.

Table 3.2: Baseline Monitoring Period

Sampling Dates	Sampling Time	Tide Conditions	Weather
6/11/2000 (Monday)	6:45 a.m. - 9:34 a.m. 2:15 p.m. - 5:17 p.m.	Ebb Flood	Cloudy
8/11/2000 (Wednesday)	8:00 a.m. - 11:10 a.m. 2:53 p.m. - 6:01 p.m.	Ebb Flood	Cloudy
10/11/2000 (Friday)	9:29 a.m. - 12:44 p.m. 3:30 p.m. - 6:31 p.m.	Ebb Flood	Clear
13/11/2000 (Monday)	11:27 a.m. - 2:56 p.m. 6:48 a.m. - 9:56 a.m.	Ebb Flood	Clear
15/11/2000 (Wednesday)	1:05 p.m. - 4:07 p.m. 7:42 a.m. - 10:43 a.m.	Ebb Flood	Cloudy
17/11/2000 (Friday)	3:04p.m. - 5:58 p.m. 9:54 a.m. - 1:09 p.m.	Ebb Flood	Overcast
21/11/2000 (Tuesday)	7:23 a.m. - 10:34 a.m. 1:52 p.m. - 5:01 p.m.	Ebb Flood	Windy
23/11/2000 (Thursday)	9:17 a.m. - 12:40 p.m. 3:00 p.m. - 5:51 p.m.	Ebb Flood	Clear
25/11/2000 (Saturday)	10:35 a.m. -1:38 p.m. 4:03 p.m. - 6:50 p.m.	Ebb Flood	Clear
27/11/2000 (Monday)	11:38 a.m. - 2:39 p.m. 6:23 a.m. - 9:11 a.m.	Ebb Flood	Overcast
29/11/2000 (Wednesday)	12:43 p.m. - 4:07 p.m. 7:51 a.m. - 10:54 a.m.	Ebb Flood	Clear
1/12/2000 (Friday)	1:58 p.m. - 4:50 p.m. 9:19 a.m. - 12:26 p.m.	Ebb Flood	Clear

3.3 Monitoring Methodology

The monitoring stations were accessed using survey boat to within 3 m by the guide of a Differential Global Positioning System (DGPS). The depth of the monitoring location was measured using depth meter in order to determine the sampling depths. Afterwards, the probes of the in-situ measurement equipment were lowered to the predetermined depths (1 m below water surface, mid-depth and 1 m above seabed) and the measurements were carried out accordingly. In case water depth was less than 6 m, only measurement at 1 m below water surface and 1 m above seabed were carried out. The in-situ measurements at predetermined depths were carried out in duplicate. In case the difference in the duplicate in-situ measurement results was larger than 25%, the third set of in-situ measurement would be carried out for result confirmation purpose. Water sampler was lowered into the water to the required depths of sampling. Upon reaching the pre-determined depth, a messenger to activate the sampler was then released to travel down the wire. The water sample was sealed within the sampler before retrieving. At each station, water samples at three depths (1 m below water surface, mid-depth and 1 m above seabed) were collected accordingly. In case water depth was less than 6 m, only water samples at 1 m below water surface and 1 m above seabed were collected. Water samples for physical and chemical analysis were stored into a pre-labelled high-density polyethylene (HDPE) bottle, kept at 4°C and sent to the Hong Kong Productivity Council Environmental Management Division Laboratory upon the completion of each round of sampling (a copy of the certificate of the HOKLAS accreditation is shown in Appendix I). In addition, field information such as general meteorological conditions and notes regarding any significant activities at each monitoring location were also recorded.

3.4 Monitoring Equipment

The equipment deployed for the on-site measurement of marine water quality is summarized in Table 3.3.

Table 3.3: Equipment Used for Marine Water Monitoring

Equipment	Detection Limit
Wildco Water Sampler	Not Applicable
Eagle Fish ID 128 Depth Meter	Not Applicable
YSI 6820 Water Quality Monitor	Temperature: -5 to 50 °C; +/- 0.15 °C Salinity: 0 to 70 ppt (mg/L); +/- 0.1 ppt (mg/L) Dissolved Oxygen: 0 to 20.0 mg/L +/- 0.02 mg/L 0 to 200% +/- 0.5 % Turbidity: 0 to 100 and 100 to 1000 NTU; +/- 5% of the range pH: 0 to 14 units +/- 0.2 units
YSI 58 DO Meter	Temperature: -5 to 45 °C; +/- 0.3 °C Dissolved Oxygen: 0 to 20.0 mg/L +/- 0.002 mg/L 0 to 200% +/- 0.5 %
HACH 2100P Turbidity Meter	Turbidity: 0 to 1000 NTU; +/- 2% of the range
YSI 30 Salinity Meter	Salinity: 0 to 80 ppt; +/- 0.1 ppt
Orion 250A	pH: 0 to 14 units +/- 0.02 units
Trimble NT200 GPS	Accuracy better than 3 m
Note: The measurement ranges and the accuracy of the said monitoring equipment fulfill the requirements as stipulated in the EM&A Manual dated October 2000	

3.5 Equipment Calibration

The equipment deployed for on-site measurement of marine water quality was calibrated before use. The methodologies for the calibration are referred to the instruction manual provided by the manufacturers respectively. The calibration records are shown in Appendix A. The results of calibration indicated that the equipment deployed for the on-site measurement of marine water during the sampling period were calibrated properly and operated with the required accuracy.

3.6 Laboratory Analysis & QA/QC

The collected marine water samples were analyzed for Suspended Solids, Total Inorganic Nitrogen and Unionized Ammonia with methodologies as summarized in Table 3.4.

Table 3.4: Laboratory Analysis Methodologies of Marine Water Samples

Parameter	Method	Limit of Reporting (mg/L)
Suspended Solids	APHA 17 ed 2540 D	1.0
Total Inorganic Nitrogen	APHA 18 ed 4500 NO_2 B & NO_3 E + APHA 17ed 4500-NH_3B, E	0.01
Ammoniacal Nitrogen (Un-ionized Ammonia)	APHA 17 ed 4500-NH_3 G	0.01 (Limit of Reporting for Ammoniacal Nitrogen) x degree of ionization

Note: The determination of unionized ammonia was based on the articles entitled "Aqueous Ammonia Equilibrium Calculation: Effect of pH and Temperature" and "Ionization of Ammonia in Seawater: Effects of Temperature, pH and Salinity" which was accepted by EPD.

In order to ensure that the laboratory analysis works were carried out properly, stringent QA/QC procedures (which include the sample preparation as well as the subsequent instrumentation analysis) were followed. According to the requirements as 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, quality control samples and matrix spike recovery test).

Blind Duplicate

In order to check on the precision of the measurement results obtained from the laboratory analysis, "blind" duplicates samples of 10% of the collected marine water samples were analysed alongside the normal samples. The sample codes for the "blind" duplicates were determined by the sampling team and they are not identifiable by the laboratory. The details of the "blind" duplicate samples are summarized in Appendix G.

In accordance to the QA/QC procedures of Environmental Management Laboratory, QA/QC procedures shall be conducted for 5% of samples. A total of 864 sets of samples were received during the marine monitoring at both ebb and flood tides. Therefore 5% laboratory blanks, batch duplicates, quality control samples and recovery tests (43 sets) for each parameter were conducted. The acceptance criteria are outlined in each type of Quality Control data.

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. The acceptance criterion for laboratory blank in EMD Laboratory stipulated in EMD Quality Manual is less than the detection limit. All the laboratory blank values and acceptance criterion of the following testing parameters are summarized in Table 3 of Appendix G.

- Suspended Solids
- Unionized Ammonia
- Total Inorganic Nitrogen

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 the following testing parameters and their duplicate results are summarized in Table 2 Appendix G.

- Suspended Solids
- Unionized Ammonia
- Total Inorganic Nitrogen

Quality Control Sample:

The quality control sample is the analysis of material with a known concentration of contaminants to determine the accuracy of results in a given matrix. The quality control samples are not applicable to all testing parameters due to the constraints of the testing parameters. The quality control samples results for the following testing parameters are shown in Table 4 of Appendix G.

- Unionized Ammonia
- Total Inorganic Nitrogen

Quality control sample testing is not applicable to the testing of Suspended Solids.

Matrix Spike:

Matrix spike is an intra-laboratory split of a sample digested spiked with target known concentration analyte to determine method bias in a given matrix. The matrix spike is applicable to the following tests:

- Unionized Ammonia
- Total Inorganic Nitrogen

Matrix spike testing is not applicable to testing of Suspended Solids. The matrix spike samples results are shown in Table 5 of Appendix G.

The QA/QC results as shown in Appendix G 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. On the other hand, the "blind" duplicate measurement results indicated that the precision of the measurement of Suspended Solids, Total Inorganic Nitrogen and Unionized Ammonia are in compliance with the HOKLAS requirements.

4 BASELINE MONITORING RESULTS

4.1 General

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

The baseline data of monitoring parameters at each monitoring location in terms of average and ranges are summarized in Table 4.1 and Table 4.2. On the other hand, the results of Dissolved Oxygen, Turbidity, Suspended Solids, Unionized Ammonia and Total Inorganic Nitrogen (which are classified as target parameters of the Water Quality Objectives) are presented graphically in Appendix J. The method of the determination of "Unionized Ammonia" is shown in Appendix L.

4.2 Weather and Major Activities at the Site During the Monitoring Period

Based on the observation made by the sampling team during the course of baseline monitoring, the majority of weather conditions during the monitoring period at all monitoring locations were cloudy. Generally speaking, it is considered that the weather conditions during the monitoring period were suitable for baseline monitoring.

On the other hand, in order to justify whether the activities at the vicinity of the study area is suitable for the baseline marine water sampling, on-site observation by the sampling team was carried out at each monitoring locations during each sampling trips. Based on the on-site observation made by the sampling team during the baseline monitoring period, no pertinent activities were carried out at the vicinity of the study area that would affect the monitoring results. On the other hand, based on the information provided by HEC, no abnormal operation was recorded from the operation of the power plants at the Lamma Power Station during the period of the baseline marine water monitoring. Account for the above, it is considered that the conditions of the study area during the monitoring periods were appropriate for baseline monitoring

Table 4.1: Summary of Field Measurement Data

Station		DO-Top (mg/L)	DO-Mid (mg/L)	DO-Bot (mg/L)	DO-Avg (mg/L)	DO%-Top	DO%-Mid	DO%-Bot	pH-Top	pH-Mid	pH-Bot	pH-Avg
SR1	Average	6.67	6.69	6.65	6.67	90.3	90.0	89.8	8.18	8.19	8.20	8.19
	Minimum	5.94	5.86	5.85	5.93	82.5	80.6	80.6	7.95	7.99	7.99	7.98
	Maximum	8.25	8.63	8.09	8.18	96.9	96.4	96.9	8.51	8.48	8.50	8.47
SR2	Average	6.69	6.68	6.67	6.68	90.6	90.4	90.3	8.18	8.20	8.22	8.20
	Minimum	5.93	5.87	5.94	5.97	81.5	81.9	82.2	7.91	7.99	8.00	7.97
	Maximum	8.35	8.28	8.17	8.26	98.5	98.5	98.2	8.49	8.46	8.55	8.46
SR3	Average	6.90	6.89	6.89	6.89	93.4	93.2	93.0	8.20	8.22	8.22	8.21
	Minimum	5.96	5.98	6.00	5.99	85.3	85.0	84.9	7.93	7.99	8.00	7.99
	Maximum	8.42	8.42	8.38	8.40	99.4	99.2	99.5	8.48	8.43	8.43	8.44
SR4	Average	6.88	6.79	6.84	6.89	93.1	92.8	92.5	8.23	8.22	8.24	8.23
	Minimum	6.01	5.96	5.93	5.99	82.4	81.9	81.5	7.92	7.98	7.99	7.97
	Maximum	8.43	8.28	8.41	8.42	99.1	99.0	98.9	8.43	8.42	8.42	8.42
SR5	Average	6.88	6.73	6.84	6.86	93.3	92.1	92.5	8.22	8.22	8.24	8.23
	Minimum	6.02	5.90	5.86	5.96	82.5	81.1	80.5	7.89	7.98	8.00	7.97
	Maximum	8.38	7.64	8.35	8.36	99.9	99.4	98.8	8.58	8.46	8.48	8.48
SR6	Average	6.86	6.84	6.79	6.83	93.0	92.7	91.9	8.21	8.22	8.23	8.22
	Minimum	5.78	5.70	5.68	5.74	79.4	78.6	78.4	7.95	7.99	8.06	8.01
	Maximum	8.35	8.37	8.25	8.32	99.0	99.4	99.0	8.44	8.45	8.45	8.44
SR7	Average	6.87	6.83	6.80	6.83	93.1	92.5	92.1	8.22	8.23	8.23	8.23
	Minimum	5.68	5.69	5.64	5.69	78.4	78.6	78.0	7.96	8.04	8.06	8.04
	Maximum	8.33	8.34	8.32	8.33	98.7	98.9	98.9	8.43	8.50	8.45	8.45
C1	Average	6.66	6.61	6.62	6.63	90.0	89.4	89.5	8.18	8.19	8.20	8.19
	Minimum	5.88	5.74	5.42	5.80	81.2	79.3	77.6	7.89	7.88	7.98	7.92
	Maximum	8.12	8.21	8.26	8.19	97.0	96.7	97.4	8.47	8.45	8.44	8.45
C2	Average	6.67	6.61	6.60	6.63	90.2	89.4	86.4	8.16	8.17	8.20	8.18
	Minimum	5.81	5.81	5.80	5.84	81.3	80.3	10.6	7.93	7.94	7.96	7.95
	Maximum	8.18	8.08	8.08	8.11	97.0	96.9	96.8	8.46	8.45	8.94	8.53
C3	Average	6.74	6.72	6.69	6.72	91.5	91.1	90.5	8.18	8.18	8.19	8.18
	Minimum	5.28	5.33	5.30	5.32	72.7	73.4	73.0	7.96	7.97	7.99	7.98
	Maximum	8.04	8.02	8.04	8.01	97.8	98.4	97.7	8.70	8.39	8.41	8.39
C4	Average	6.87	6.80	6.74	6.80	93.0	91.7	90.8	8.23	8.23	8.23	8.23
	Minimum	6.07	4.65	4.24	5.12	83.7	66.7	60.4	8.00	8.04	8.00	8.03
	Maximum	8.12	8.18	8.26	8.18	99.2	99.3	99.6	8.55	8.48	8.47	8.49
C5	Average	6.90	6.83	6.81	6.85	93.3	92.2	92.0	8.25	8.24	8.25	8.25
	Minimum	5.61	5.53	5.45	5.55	77.0	76.1	75.0	8.01	8.06	7.93	8.04
	Maximum	8.38	8.35	8.34	8.35	100.0	99.1	99.1	8.56	8.51	8.49	8.51

Table 4.1: Summary of Field Measurement Data
(Cont' d)

Station		Temp-Top (°C)	Temp-Mid (°C)	Temp-Bot (°C)	Sal-Top (ppt)	Sal-Mid (ppt)	Sal-Bot (ppt)	Turb-Top (NTU)	Turb-Mid (NTU)	Turb-Bot (NTU)	Turb-Avg (NTU)
SR1	Average	22.97	23.07	23.01	31.4	31.5	31.5	8.5	9.4	12.0	10.0
	Minimum	21.21	22.01	22.01	30.8	30.8	30.7	4.9	5.5	4.9	5.4
	Maximum	24.46	24.49	24.48	32.5	32.0	32.1	19.1	17.9	43.3	24.1
SR2	Average	23.05	23.09	23.04	31.4	31.4	31.5	10.4	8.8	9.4	9.5
	Minimum	21.33	21.93	21.95	30.8	30.9	31.0	4.2	4.5	4.4	4.8
	Maximum	24.74	24.48	24.53	32.6	32.3	32.0	42.9	16.9	16.5	19.7
SR3	Average	23.04	22.98	22.92	31.5	31.5	31.6	9.1	9.9	10.8	9.9
	Minimum	21.58	21.93	21.84	30.9	30.7	31.1	3.6	3.6	4.4	3.9
	Maximum	24.61	24.52	24.42	32.5	32.0	32.2	24.9	16.9	18.6	18.7
SR4	Average	22.90	22.83	22.81	31.4	31.5	31.6	7.8	9.2	10.4	9.1
	Minimum	21.74	21.84	21.79	30.8	31.2	31.3	3.6	3.5	5.7	4.7
	Maximum	24.61	24.33	24.29	32.6	32.0	32.3	12.3	13.4	20.3	13.7
SR5	Average	22.88	23.05	22.83	31.4	31.5	31.5	8.9	9.7	10.2	9.6
	Minimum	21.56	21.79	21.74	30.7	30.7	30.8	4.7	4.1	3.9	4.3
	Maximum	24.34	31.77	24.26	32.4	31.9	32.0	18.9	21.4	28.5	18.4
SR6	Average	22.92	22.86	22.88	31.5	31.5	31.6	10.3	10.0	11.6	10.6
	Minimum	21.55	21.84	21.85	30.8	30.9	30.7	3.9	3.9	4.7	4.4
	Maximum	24.46	24.50	24.28	32.3	32.1	32.2	21.5	17.6	27.8	18.1
SR7	Average	22.91	22.86	22.85	31.5	31.6	31.6	9.2	10.1	12.1	10.5
	Minimum	21.73	21.88	21.85	30.7	31.1	30.8	2.4	3.0	4.1	3.4
	Maximum	24.32	24.25	24.22	32.2	32.1	32.2	23.2	22.1	23.6	22.7
C1	Average	22.98	23.05	23.00	31.4	31.6	31.5	7.7	9.3	14.3	10.4
	Minimum	21.31	22.09	22.06	30.8	31.0	30.7	4.1	4.2	5.8	4.8
	Maximum	24.48	24.51	24.46	32.4	32.1	32.3	17.9	25.5	41.4	28.1
C2	Average	23.04	23.08	23.06	31.4	31.5	31.6	11.2	12.5	14.8	12.8
	Minimum	21.83	21.85	22.04	30.9	30.8	30.8	4.5	5.4	6.0	5.8
	Maximum	24.43	24.52	24.51	32.2	31.9	32.0	36.7	51.5	68.4	52.1
C3	Average	23.16	23.06	23.03	31.4	31.5	31.6	9.3	9.9	11.1	10.1
	Minimum	22.07	22.02	21.98	30.8	31.0	31.1	3.6	4.4	5.4	4.7
	Maximum	24.78	24.62	24.52	31.9	31.8	32.2	14.9	14.7	18.2	15.2
C4	Average	23.02	22.91	22.83	31.4	31.5	31.6	8.9	8.9	12.9	10.2
	Minimum	21.58	21.90	21.79	31.0	31.0	31.0	3.7	4.4	5.4	5.5
	Maximum	25.15	24.66	24.43	32.4	31.9	32.1	16.4	15.7	29.8	15.7
C5	Average	22.89	22.89	22.85	31.4	31.7	31.6	6.6	6.9	10.7	8.1
	Minimum	21.67	21.80	21.83	30.8	31.1	31.0	2.1	2.9	3.9	3.6
	Maximum	24.42	24.80	24.30	32.4	32.1	32.1	18.4	17.4	19.3	17.5

Table 4.2: Summary of Laboratory Analysis

Station		SS (mg/L)	NH_3-N (mg/L)	(NO_2, NO_3+NH_3)-N(mg/L)
SR1	Average	10.9	0.002	0.12
	Minimum	6.7	0.001	0.05
	Maximum	19.4	0.007	0.27
SR2	Average	10.8	0.002	0.12
	Minimum	6.7	0.001	0.06
	Maximum	15.5	0.005	0.26
SR3	Average	10.9	0.001	0.09
	Minimum	7.2	0.001	0.06
	Maximum	17.9	0.001	0.13
SR4	Average	11.4	0.001	0.08
	Minimum	4.8	0.001	0.04
	Maximum	19.5	0.003	0.12
SR5	Average	11.6	0.001	0.08
	Minimum	5.1	0.001	0.04
	Maximum	18.6	0.002	0.11
SR6	Average	11.7	0.001	0.08
	Minimum	5.6	0.001	0.03
	Maximum	25.4	0.001	0.11
SR7	Average	11.9	0.002	0.09
	Minimum	6.0	0.001	0.05
	Maximum	19.4	0.003	0.13
C1	Average	12.5	0.002	0.12
	Minimum	7.4	0.001	0.06
	Maximum	25.7	0.005	0.26
C2	Average	15.4	0.003	0.15
	Minimum	6.6	0.001	0.06
	Maximum	36.5	0.008	0.28
C3	Average	13.0	0.002	0.11
	Minimum	5.5	0.001	0.07
	Maximum	19.6	0.007	0.16
C4	Average	11.5	0.001	0.08
	Minimum	6.7	0.001	0.04
	Maximum	20.0	0.002	0.12
C5	Average	10.0	0.001	0.08
	Minimum	6.8	0.001	0.03
	Maximum	14.1	0.001	0.13

Note:
The results of Suspended Solids, Unionized Ammonia and Total Inorganic Nitrogen are presented in depth-average.

4.3 Marine Water Quality Action & 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. According to the EM&A Manual, marine water quality Action and Limit Levels are to be established from baseline levels. Subsequent impact monitoring results will be compared against the Action and Limit Levels. Table 4.4 summarizes the methods of determining the Action Levels and Limit Levels.

Table 4.4: Action and Limit (A/L) Levels for Marine Water Quality

Parameter	Action Level	Limit Level
Dissolved Oxygen in mg/L (Surface, Middle and Bottom)	Surface and Middle: 5th percentile of baseline data of surface and middle layer Bottom: 5th percentile of baseline data for bottom layer	Surface and Middle: For non-FCZ stations, the Limit Level shall be 4 mg/L, whereas for FCZ stations, the Limit Level shall be 5 mg/L or 1%-le of the baseline data Bottom: 2 mg/L or 1st percentile of baseline data
Suspended Solid in mg/L (depth-averaged)	95th percentile of baseline or 120% upstream control station's SS at the same tide of the same day. No Action Level is applied to SR3.	99th percentile of baseline, or 130% of upstream control station's SS at the same tide of the same day. For SR3, the Limit Level is 100 mg/L
Turbidity in NTU (depth-averaged)	95th percentile of baseline data or 120% of upstream control station's Turbidity at the same tide of the same day	99th percentile of baseline data or 130% of upstream control station's Turbidity at the same tide of the same day
Un-ionized Ammonia in mg/L (depth- averaged)	95th percentile of baseline data	99th percentile of baseline data or 0.021 mg/L for unionized ammoniacal nitrogen, whichever is greater
Total Inorganic Nitrogen in mg/L (depth-averaged)	95th percentile of baseline data	99th percentile of baseline data or 0.1 mg/L, whichever is greater (Note: as SR1 and C1 are located within the Western Buffer rather than the Southern Waters Control Zone, the limit levels are 99%-ile of the baseline data or 0.4 mg/L whichever is greater)

Notes:

- *"Depth-averaged" is calculated by taking the arithmetic means of reading of all three depths.*
- *For Dissolved Oxygen, non-compliance of water quality limits occurs when monitoring results is lower than the limits.*
- *Unionized ammoniacal nitrogen shall be calculated from the monitored ammoniacal nitrogen based on temperature, pH and salinity which are routinely monitored.*
- *All baseline data were calculated based on the tide average values.*
- *In case the individual measurement result was smaller than the associated detection limit, the calculation of Action and Limit Levels would base on the associated detection limit accordingly.*
- *The methodology of the determination of Action and Limit Levels are based on the EM&A Manual prepared by ERM (HK) Limited*
- *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 the approval from EPD.*

By reviewing the baseline monitoring results, no significant difference in the baseline monitoring results obtained during ebb tides and flood tides was found. Account for the above, it is considered that the use of one set of Action/Limit Levels for both ebb tides and flood tides is already appropriate for the EM&A programme.

With the above methodology, the Actions and Limit Levels have been calculated in compliance with the Environmental Monitoring and Audit Manual and are shown in Table 4.5 to Table 4.9 below:

Table 4.5: Field Measurement of Dissolved Oxygen (mg/L)

(a) Surface and Middle

	SR1	SR2	SR4	SR5	SR6	SR7
Action Level (5%-ile)	6.0	6.0	6.1	6.0	6.0	6.0
1%-ile	6.0	6.0	6.0	6.0	5.8	5.7
Limit Level	4.0					

Note:

1. All impact monitoring stations were considered to be non-FCZ stations

2. *Since the calculated 1%-ile results are larger than 4.0 mg/L, therefore the Limit Levels are proposed to be 4.0 mg/L according to the EM&A Manual*

(b) Bottom

	SR1	SR2	SR4	SR5	SR6	SR7
Action Level (5%-ile)	5.9	6.0	6.1	6.1	6.1	6.1
1%-ile	5.9	5.9	5.9	5.9	5.7	5.7
Limit Level	2.0					

Note:

1. Since the calculated 1%-ile results are larger than 2.0 mg/L, therefore the Limit Levels are proposed to be 2.0 mg/L according to the EM&A Manual

Table 4.6: Turbidity (NTU)

(depth-average)

	SR1	SR2	SR4	SR5	SR6	SR7
Action Level (95%-ile)	17.9	16.3	13.2	17.5	17.2	17.3
Limit Level (99%-ile)	22.8	19.0	13.6	18.3	17.9	21.5

Note:

1. The Action Levels can be 95%-ile of baseline data as mentioned above or 120% of upstream control station at the same tide of the same day according to the EM&A Manual

2. The Limit Levels can be 99%-ile of baseline data as mentioned above or 130% of upstream control station at the same tide of the same day according to the EM&A Manual

Table 4.7: Suspended Solids (mg/L)

(depth-average)

	SR1	SR2	SR3	SR4	SR5	SR6	SR7
95%-ile	16.8	15.3	13.8	17.6	17.5	16.9	17.5
Action Level	16.8	15.3	--	17.6	17.5	16.9	17.5
99%-ile	18.9	15.5	17.0	19.1	18.4	23.5	19.0
Limit Level	18.9	15.5	100.0	19.1	18.4	23.5	19.0

Note:

1. *No Action Level is applied for SR3 according to the EM&A Manual*
2. *Limit Level of SR3 is 100 mg/L according to the EM&A Manual*
3. *The Action Levels can be 95%-ile of baseline data as mentioned above or 120% of upstream control station at the same tide of the same day according to the EM&A Manu*
4. *The Limit Levels can be 99%-ile of baseline data as mentioned above or 130% of upstream control station at the same tide of the same day according to the EM&A Manual*

Table 4.8: Unionized Ammonia (mg/L)

(depth-average)

	SR1	SR2	SR4	SR5	SR6	SR7
Action Level (95%-ile)	0.006	0.005	0.003	0.001	0.001	0.001
99%-ile	0.007	0.005	0.003	0.002	0.001	0.003
Limit Level	0.021	0.021	0.021	0.021	0.021	0.021

Note:

1. *Since the calculated 99%-ile results are smaller than 0.021 mg/L, therefore the Limit Levels are proposed to be 0.021 mg/L according to the EM&A Manual.*

Table 4.9: Total Inorganic Nitrogen (mg/L)

(depth-average)

	SR1	SR2	SR4	SR5	SR6	SR7
Action Level (95%-ile)	0.25	0.23	0.11	0.11	0.11	0.12
99%-ile	0.27	0.25	0.12	0.11	0.11	0.13
Limit Level	0.4	0.25	0.12	0.11	0.11	0.13

Note:

1. *Since the calculated 99%-ile results for SR2 to SR7 are larger than 0.1 mg/L, therefore the Limit Levels are proposed to be calculated 99%-ile for SR2 to SR7 according to the EM&A Manual.*
2. *Since the calculated 99%-ile result for SR1 is smaller than 0.4 mg/L, therefore the Limit Level for SR1 is proposed to be 0.4 mg/L according to the EM&A Manual.*

5. CONCLUDING REMARKS

Marine water quality baseline monitoring for the Project in November and December 2000 have been completed. From analysis of the collected data and field observations, it can be concluded that the measured marine quality are representative of pre-construction ambient conditions.