

Public Golf Course at Kau Sai Chau Island, Sai Kung
Operation Phase
Environmental Monitoring & Audit (EM&A) Report
for March 2009

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Executive Summary

This is the thirteen Operation Phase Monthly Environmental Monitoring and Audit (EM&A) Report prepared by Black & Veatch for the Project “Proposed Extension of Public Golf Course at Kau Sai Chau Island, Sai Kung”. This report presents the results of the EM&A works conducted in the month of March 2009 (25th February to 24th March 2009).

Water Quality

2 sets of water quality monitoring were carried out on 5 and 21 March 2009 at 9 marine and 6 freshwater monitoring locations. For F_Filter (fresh water station), no filter effluent was discharging during sampling except during rainstorm event, thus no water sample was taken. Rainstorm event was recorded on 5 March and 24 March 2009 during this reporting month.

Exceedances found at marine stations (M_Marsh, TTC and KS) and freshwater stations (F_DA, F_DB, F_DC, Lake 1D, F_Filter and F_Inland M) are considered non-project related during the reporting month.

According to the approved revised pesticides monitoring plan at East Course, the monitoring will reduce to bi-monthly during dry season (December and February). Monthly monitoring for pesticides is required during wet season. Monthly pesticides monitoring at East Course will be commenced in the next reporting month.

Marine Ecology

The coral monitoring for the operation of the East Course commenced in July 2008. As the original baseline monitoring for the corals in Site D2 were conducted over 3.5 years before December 2005 and no construction phase monitoring was required for Site D2 due to the avoidance of dredging at the pier, the previously tagged corals at Site D2 have mostly lost the tags. 20 new corals were selected in Site D2 for operation phase monitoring purposes. The July 2008 coral monitoring covering Site D2, Site C and the Control Site served as the baseline for the operation phase. In accordance with the EM&A manual, the operation phase coral monitoring would cover two years. The frequency would be monthly for the first three months, and if no exceedance is recorded, the frequency will change to semi-annually. The present monitoring (October 2008) was the third monthly monitoring. No exceedance was recorded at impact station during the first three months (August, September and October 2008). The coral monitoring would change to semi-annually. The tentative coral monitoring schedule was carried in March 2009 and will be carried out in coming August 2009 and February 2010. The monitoring results of the first three months all complied with the action and limit level. The present monitoring (March 2009) is the fourth operation phase coral monitoring and the first semi-annual monitoring.

Landscaping & Visual

The replanting of death compensatory plants was carried out in December 2008 and March 2009 by the Contractor. In the previous monitoring, among the 841 trees to be planted in accordance with the planting plan, 582 dead individuals were observed. With the 114 additional trees planted in additional planting sites as recorded during the previous monitoring, the total number of trees (i.e. 373) was still below the planting plan.

In the present monitoring, it was observed that a large number of shrubs (mainly *Raphielepis indica*) were recently planted within the East Course, including the original planting locations, as well as some new areas not previously indicated on the landscape plan. In terms of number, the newly planted shrubs should be more than enough to replace all the dead trees recorded in previous monitoring.

During the present audit, however, some dead trees (341 individuals) were still observed. These trees were part of the previously reported 582 dead trees. As the newly planted shrubs are sufficient in number to compensate the dead trees, the Contractor should either replace these dead trees or removed them as maintenance works.

Soil Nutrient

The soil nutrient sampling and testing was completed in January 2008. The soil nutrient sampling and testing was carried out in March 2009. The results will be available in April 2009 and reported in May 2009.

1. Introduction

1.1 Background of the Project

1.1.1 Black & Veatch (hereinafter called the “ET”) was appointed by The Jockey Club Kau Sai Chau Public Golf Course Limited (hereinafter called the “Project Proponent”) to undertake Operation Phase of Environmental Monitoring and Audit (EM&A) for “Proposed Extension of Public Golf Course at Kau Sai Chau Island, Sai Kung” (hereinafter called the “Project”). Under the requirements of Section 4 of Environmental Permit EP-224/2005/A, EM&A programme as set out in the EM&A Manual is required to be implemented. In accordance with the EM&A Manual, environmental monitoring on water quality, marine ecology, landscape and visual and land contamination during operation phase are required for the Project.

1.1.2 This report summarises the environmental monitoring and audit works for the Project in **March 2009**.

1.2 Purpose of the Report

1.2.1 This is the **thirteen** EM&A report which summarizes the impact monitoring results and audit findings for the EM&A programme during the reporting period from **25th February to 24th March 2009**.

1.3 Structure of the Report

1.3.1 The structure of the report is shown in Table 1.1.

Table 1.1 Structure of the Report

Section		Description
1	Introduction	Details the scope and structure of the report
2	Project Information	Summarizes background and scope of the project and site description
3	Environmental Monitoring Requirement	Summarizes the monitoring parameters, programmes, methodology, frequency, location, action and limit levels, event action plans, environmental mitigation measures as recommended in the EIA report and relevant environmental requirements.
4	Monitoring Results	Summarizes the monitoring results obtained in the reporting period.
5	Environmental Non-conformance	Summarizes any monitoring exceedance, environmental complaints and environmental summons within the reporting period.
6	Conclusions	Provides an overall conclusion of the results and findings of the EM&A programme for the reporting period.

2. Project Information

2.1 Background

2.1.1 The Project comprises the following major components:

- Construction of the third 18-hole public golf course on the east side of the island, south of the existing golfing area;
- A new irrigation lake to collect surface runoff from the new 18-hole golf course. Water stored at the new irrigation lake can also be diverted to existing reservoir for tertiary treatment and recycling;
- A new desalination plant adjacent to the existing pier to serve as an additional irrigation water supply for the new golf course during dry season; and
- Expansion of existing administration and maintenance buildings.

2.1.2 The potential environmental impacts of the Project have been studied in the Environmental Impact Assessment (EIA) report (EIAO Register No. AEIAR- 091/2005). The EIA was approved on 14 November 2005 under the EIAO. An Environmental Permit (EP-224/2005) was granted on 28 November 2005. Application for Variation of an Environmental Permit by the Project Proponent was submitted on 2 August 2006 (Application No. VEP-222/2006) and the EP was superseded by EP-224/2005/A.

2.2 Site Description

2.2.1 A layout plan of the Project is provided in **Figure 1.1**.

2.3 Summary of EM&A Requirements

2.3.1 The EM&A programme requires environmental monitoring for water quality, marine ecology, landscape and visual and land contamination during operation phase. The EM&A requirements for each parameter are described in subsequent sections, including:

- All monitoring parameters;
- Action and Limit Levels for all environmental parameters;
- Event and Action Plans; and
- Environmental mitigation measures, as recommended in the project EIA final report.

2.3.2 A summary of impact EM&A requirements is presented in Table 2.1.

Table 2.1 Summary of Impact EM&A Requirements during Operation Phase

Impacts	Parameters/descriptions	Locations	Frequencies
Water Quality	Dissolved Oxygen, Temperature, Turbidity, pH, Salinity, SS, NO ₃ -N, NO ₂ -N, NH ₃ -N, TP, Chl-a and selected pesticides.	9 marine and 6 freshwater locations	2-year of monitoring period for the operation phase. Monitoring should be carried out on bi-weekly basis for the first 12 months, after when the frequency will be reviewed by EPD. Additional monitoring parameters at Lake 1D are required (TKN, Ortho-P and Conductivity)
	Dissolved Oxygen, Temperature, Turbidity, pH, Salinity, SS, NO ₃ -N, NO ₂ -N, NH ₃ -N, TP, Chl-a and selected pesticides.	8 marine locations	Additional water quality monitoring shall be carried out after heavy rain storm or when there is an overflow event from the reservoir, irrigation buffer lake or detention ponds/tanks.
Marine Ecology	Natural corals	Site C, Site D2 and the Control Site.	First three months would be monthly conducted during the first two years of the operation phase. If no exceedance was recorded, the monitoring schedule would be changed to semi-annually, i.e. once in dry season and once in wet season.
Landscape and Visual	Audits to ensure effective implementation of mitigation measures	Golf course area and at visual sensitive receivers	Auditing inspections and reporting shall be undertaken once every two months for the first year of the operation phase.
Soil Nutrient	Nutrient Status of the Soil	Golf course	Twice annually

3. Environmental Monitoring Requirements

3.1 Water Quality

Monitoring Requirement

- 3.1.1 Water quality monitoring was conducted in accordance with the EM&A Manual. Tables 3.1 to 3.3 show the established Action/Limit Levels for the water environmental monitoring parameters.

Table 3.1 Derived Summaries of Action and Limit Levels for Freshwater Water Quality

Parameters	Location	Action	Location	Limit
DO (mid-depth)		6.3 mg/L	All	4 mg/L ξ
pH (mid-depth)		N/A	All	6.0 - 9.0
SS (mid-depth) ☆	All	3.8 mg/L or 120% of upstream control station's SS at the same tide of the same day	All	8 mg/L or 130% of upstream control station's SS at the same tide of the same day
Turbidity (Tby) (mid-depth) ☆	All	3.1 NTU or 120% of upstream control station's Tby at the same tide of the same day	All	4 NTU or 130% of upstream control station's Tby at the same tide of the same day
Ammonia Nitrogen (mid-depth)		N/A	All	0.01 mg/L
Nitrate Nitrogen (mid-depth)	All	0.10 mg/L	All	0.11 mg/L
Nitrite Nitrogen (mid-depth)		N/A	All	0.01 mg/L
TIN (mid-depth)	All	0.12 mg/L	All	0.13 mg/L
Total Phosphorus (mid-depth)		N/A	All	0.02 mg/L

Remarks:

☆ : Action and limit levels are subjected to review especially for wet season.

Freshwater monitoring locations: F-UA, F-DA, F-UB, F-DB, F-UC, F-DC and F-Inland Marsh

As most of the freshwater samples were reported of NH₃-N, NO₂-N levels below the detection limit of 0.01 mg/L, limit level is set at 0.01 mg/L. Similarly for TP, a limit level of 0.02 mg/L (the detection limit of TP) is imposed.

ξ : Water Quality Objectives of the Port Shelter

**Table 3.2 Action and Limit Levels for Water Quality Monitoring
(applicable to irrigation lake 1D and existing reservoir)**

Parameter (mg/L unless stated)	Action and Limit Levels
pH	6.0 - 9.0 ⁽¹⁾
Turbidity (NTU)	-
Dissolved Oxygen	>4 ⁽¹⁾
Chlorophyll a (mg/m ³)	<5 ⁽¹⁾
Nitrate N	0.20 ⁽¹⁾
Nitrite N	0.20 ⁽¹⁾
Ammoniacal N	0.50 ⁽¹⁾
Total Kjeldahl N	1.2 ⁽²⁾
Total Phosphate	0.1 ⁽¹⁾
Ortho Phosphate	0.05 ⁽¹⁾
Conductivity (µS/cm)	<1000 ⁽¹⁾

Note: (1) These values are based on professional judgment and knowledge

(2) Based on 90th percentile of operational phase monitoring data (1996 to June 1998)

Table 3.3 Derived Summaries of Action and Limit Levels for Marine Water Quality

Parameters	Location	Action	Location	Limit
DO (Surface & Middle)	FCZ	6.0 mg/L	FCZ	5.3 mg/L
	All except FCZ	4.9 mg/L	All except FCZ	4.6 mg/L
DO (Bottom)	All	3.7 mg/L	All	3.4 mg/L
pH (depth-averaged)		N/A	All	6.5 - 8.5
SS (Depth-averaged)☆	FCZ	4.5 mg/L	FCZ	5.6 mg/L
	All except FCZ	6.1 mg/L	All except FCZ	10.6 mg/L
SS (Depth-averaged) Dredging for submarine pipelines⊕	M_RO1	6.1 mg/L	M_RO1	10.6 mg/L
Turbidity (Tby) (depth-averaged) ☆	FCZ	2.9 NTU☼	FCZ	3.9 NTU☼
	All except FCZ	3.3 NTU☼	All except FCZ	6.2 NTU☼
Ammonia Nitrogen (depth-averaged)	FCZ	0.02 mg/L	FCZ	0.03 mg/L
	All except FCZ	0.05 mg/L Δ	All except FCZ	0.05 mg/L Δ
Nitrate Nitrogen (depth-averaged)	FCZ	0.08 mg/L	FCZ	0.09 mg/L
	All except FCZ	0.09mg/L Δ	All except FCZ	0.09 mg/L Δ
Nitrite Nitrogen (depth-averaged)	FCZ	0.02 mg/L θ	FCZ	0.02 mg/L θ
	All except FCZ	0.02 mg/L	All except FCZ	0.04 mg/L
TIN (depth-averaged)	FCZ	0.12 mg/L	FCZ	0.14 mg/L
	All except FCZ	0.16 mg/L	All except FCZ	0.18 mg/L
Total Phosphorus (depth-averaged)	All	0.09 mg/L Δ	All	0.09 mg/L Δ

Remarks:

☆ : Action and limit levels are subjected to review especially for wet season throughout the construction phase of the project.

⊕ : Action and limit levels are subjected to review before the dredging works.

☼ : All are based on EM&A baseline monitoring data due to marked difference between EPD turbidity data and those from the baseline survey.

Δ : For nutrient monitoring (except NO₂-N) at non-FCZ stations, the trigger level has made reference to the existing golf course guideline values. The guideline value of NO₂-N is below the current detection limit of 0.01mg/L and thus not used.

θ : The same action and limit level of 0.02 mg/L is determined from the EM&A baseline data as 78% of the NO₂-N data are ≤ 0.01 mg/L and all remaining 22% equal to 0.02 mg/L.

FCZ including fish culture zones of Kai Lung Wan, Tai Tau Chau and Kau Sai

All except FCZ including remaining impact monitoring station of M_RO1, M_Marsh, M_BP and M_Coral.

Control monitoring locations: M_A & M_B

Monitoring Parameters, Frequency and Programme

- 3.1.2 For marine water quality, measurements shall be taken at both mid-flood and mid-ebb tides and at three water depths (1 m below water surface, mid-depth and 1 m above sea bed, except where the water depth is less than 6 m, in which case the mid-depth station may be omitted). Should the water depth be less than 3 m, only the mid-depth station will be monitored.
- 3.1.3 For the stream course, measurements shall be taken at mid-water depth.
- 3.1.4 The water quality parameters which need to be monitored are as follows:
- Marine water quality - dissolved oxygen (DO), temperature, turbidity, suspended solids (SS), pH and salinity
 - Freshwater water quality - dissolved oxygen (DO), temperature, turbidity, suspended solids (SS), pH, salinity and conductivity (Lake 1D only).
- 3.1.5 Additional marine and freshwater water quality monitoring parameters for the impact monitoring during construction include nitrate nitrogen (NO₃-N), nitrite nitrogen (NO₂-N), ammonia nitrogen (NH₃-N), total phosphate (TP) and selected pesticides. For Lake 1D, Total Kjeldahl Nitrogen (TKN) and Orthophosphate (Ortho P) are required.
- 3.1.6 Additional water quality monitoring at Tai Tau Chau FCZ (TTC), Kai Lung Wan FCZ (KLW), Kau Sai FCZ (KS), downstream of the existing marsh (M_Marsh), marine water of Port Shelter (M_Coral), existing reservoir (F_Inland M) and Control stations (M_A and M_B) shall be carried out after heavy rain storm or when there is an overflow event from the reservoir, irrigation buffer lake or detention ponds/tanks. The heavy rain storm shall be defined when there is an amber/red/black rainstorm warning signal issued by the Hong Kong Observatory. The water sample shall be taken within 24 hours after the black/red/amber rainstorm warning signal is cancelled. Please refer to revised EM&A manual for the sampling condition requirement after a heavy rain storm event occurs. The monitoring parameters shall include dissolved oxygen, temperature, turbidity, suspended solids, pH and salinity. Additional parameters shall be the same as stated in paragraphs 3.1.5.

Monitoring Frequency

3.1.7 After reviewing the water quality monitoring results during construction phase and early operation phase, EPD¹ agreed to revise monitoring parameters and frequency are summarized in Table 3.4. The monitoring programme for the reporting period is shown in **Annex A**.

Table 3.4 Water Quality Monitoring Parameter, Frequency and Locations

Parameters	Location	Frequency	Sampling Depth
Dissolved Oxygen (mg/L)	Marine Water Fish culture zone stations: TTC, K LW, KS Control stations: M_A, M_B Impact stations: M_RO1, M_RO2, M_Marsh, M_Coral	Bi-weekly <u>Marine water</u> : 2 times per day – 1 for mid-flood and 1 for mid-ebb <u>Freshwater</u> : Mid-depth per trip	3 individual water depth samples (surface, middle & bottom)
Temperature (°C)			
Turbidity (NTU)			
pH			
Salinity (ppt)			
Suspended Solids (mg/L)			
Nutrients ²	Freshwater Water Stream A (F_DA) Stream B (F_DB) Stream C (F_DC) Inland Marsh (F_Inland_M) Filter System (F_Filter) Irrigation Lake 1D (F_lake 1D)	Monthly (wet season) and Bi-Monthly (dry season) <u>Marine water</u> : 2 times per day – 1 for mid-flood and 1 for mid-ebb <u>Freshwater</u> : Mid-depth per trip	1 composite sample (combine surface, middle and bottom) with replicate
Chemicals ³			

Wet season: Apr to October; Dry season: November to March

¹ EPD letter dated 14 July 2008 (Ref. no.: (6) in EP2/N8/O/47 Ax(7) Pt X) regarding the approval on the revised water quality monitoring proposal.

² Ammonia Nitrogen, Nitrate Nitrogen, Nitrite Nitrogen, Total Inorganic Nitrogen, Total Phosphorus and Chlorophyll a. For Lake 1D, addition nutrient parameters are Total Kjeldahl Nitrogen, Ortho Phosphate and Conductivity (µS/cm).

³ Pesticides (approved lists are Imazaquin, Glyphosate, Oxadiazon, 2,4-D/Mecoprop, Chlorothalonil, Mancozeb, Iprodione, Fosetyl Aluminum, Chlorpyrifos, Fipronil and Imidachloprid).

Monitoring Locations

- 3.1.8 The water quality monitoring locations for marine and freshwater (**Figure 3.1**) are summarized in Table 3.5.

Table 3.5 Water Quality Monitoring Locations during Operation Phase

Identification Number	Location	Approx. Water Depth	No. of Depth
<i>Marine Water (9 stations)</i>			
TTC	Tai Tau Chau Fish Culture Zone	9.5 m	3
KLW	Kai Lung Wan Fish Culture Zone	13 m	3
KS	Kau Sai Fish Culture Zone	11 m	3
M_BP	Temporary barging point	9.6 m	3
M_RO1	Desalination plant south of the existing pier	5 m	2
M_RO2	Desalination plant south of the existing pier	13 m	3
M_Marsh	Discharge point at the existing marsh	7.7 m	3
M_Coral	Marine water of Port Shelter	10.2m	3
M_A	Water Control Station of Port Shelter	7.5 m	3
M_B	Water Control Station of Port Shelter	16.5 m	3
<i>Fresh Water (7 stations)</i>			
F_DA	downstream of stream A	Mid-depth	1
F_DB	downstream of stream B	Mid-depth	1
F_DC	downstream of stream C	Mid-depth	1
F_Inland M	Downstream of the existing marsh (Inland)	Mid-depth	1
F_lake 1D	Irrigation Lake 1D	Mid-depth	1
F_Filter	Filter effluent point at Holes 5 / 6	Mid-depth	1

Monitoring Equipment

Dissolved Oxygen and Temperature Measuring Equipment

- 3.1.9 The instrument shall be a portable and weatherproof DO measuring instrument complete with cable and sensor, and use a DC power source. The equipment shall be capable of measuring:
- dissolved oxygen levels in the range of 0 - 20 mg L⁻¹ and 0 - 200% saturation; and
 - a temperature of 0 - 45 degrees Celsius.
- 3.1.10 It shall have a membrane electrode with automatic temperature compensation complete with a cable. Sufficient stocks of spare electrodes and cables shall be available for replacement where necessary. (For example, YSI model 59 meter, YSI 5739 probe, YSI 5795A submersible stirrer with reel and cable or an approved similar instrument).

- 3.1.11 Should salinity compensation not be built-in in the DO equipment, in-situ salinity shall be measured to calibrate the DO equipment prior to each DO measurement.

Turbidity Measurement Instrument

- 3.1.12 Turbidity shall be measured in situ by the nephelometric method. The instrument shall be portable and weatherproof turbidity measuring instrument using a DC power source complete with cable, sensor and comprehensive operation manuals. It shall have a photoelectric sensor capable of measuring turbidity between 0 - 1000 NTU (for example, Hach model 2100P or an approved similar instrument). The cable shall not be less than 25m in length. The meter shall be calibrated in order to establish the relationship between NTU units and the levels of suspended solids.

Suspended Solids

- 3.1.13 A water sample at least 2.5L in capacity with messenger and using a 10m line should be collected. Samples should be submitted to HOKLAS accredited laboratory as soon as possible for gravimetric analysis for suspended.

Sampler

- 3.1.14 A water sampler is required. It shall comprise a transparent PVC cylinder, with a capacity of not less than 2 litres, which can be effectively sealed with latex cups at both ends. The sampler shall have a positive latching system to keep it open and prevent premature closure until released by a messenger when the sampler is at the selected water depth (for example, Kahlsico Water Sampler or an approved similar instrument).

Water Depth Detector

- 3.1.15 A portable, battery-operated echo sounder shall be used for the determination of water depth at each designated monitoring station. This unit can either be hand held or affixed to the bottom of the work boat, if the same vessel is to be used throughout the monitoring programme.

Salinity

- 3.1.16 A portable salinometer capable of measuring salinity in the range of 0 - 40 parts per thousand (ppt) shall be provided for measuring salinity of the water at each monitoring location.

pH

- 3.1.17 The instrument shall consist of a potentiometer, a glass electrode, a reference electrode and a temperature-compensating device. It shall be readable to 0.1pH in a range of 0 to 14. Standard buffer solutions of at least pH 7 and pH 10 shall be used for calibration of the instrument before and after use. Details of the method shall comply with APHA, 19th ed. 4500-HTB.

Flow Rate Meter

- 3.1.18 A portable, battery-operated flow meter should be used for the determination of water depth at each designated monitoring location and record in m³/s. A hand held or meter fixed to the underside of the survey boat may be used.

Sample Containers and Storage

- 3.1.19 Water samples for laboratory analysis shall be stored in high density polythene bottles with no preservative added, packed in ice (cooled to 4°C without being frozen) and delivered to the laboratory and analysed as soon as possible after collection. Sufficient volume of samples shall be collected to achieve the required detection limit.

Monitoring Position Equipment

- 3.1.20 A hand-held or boat-fixed type digital Differential Global Positioning System (DGPS) with way point bearing indication or other equipment instrument of similar accuracy, shall be provided and used during marine water monitoring to ensure the monitoring vessel is at the correct location before taking measurements.

Monitoring Methodology and Calibration Details

- 3.1.21 Dissolved oxygen (DO), temperature, turbidity, pH and salinity were measured in situ at the designated water quality monitoring stations. General observation, weather conditions, with the sampling time, date and location were marked on the field record sheet.
- 3.1.22 Water samples were taken from each monitoring station for laboratory analysis. The sample identification number, sampling location, date, time, project name and analyses were required.
- 3.1.23 The samples were placed in a cooler with ice (to 4°C without being frozen) and kept away from sunlight. Samples were submitted to a Hong Kong Laboratory Accreditation Scheme (HOKLAS) or other international accredited laboratory for analysis within 24 hours of sampling.

Calibration of In-Situ Instruments

- 3.1.24 All in situ monitoring instruments were checked, calibrated and certified by a laboratory accredited under HOKLAS or any other international accreditation scheme before use and subsequently re-calibrated at three monthly intervals throughout all stages of the water quality monitoring programme. Responses of sensors and electrodes were checked with certified standard solutions before each use. Wet bulb calibration for a DO meter were carried out before measurement at each monitoring location.

Laboratory Analysis

- 3.1.25 All laboratory work were carried out by ALS Technichem Pty Ltd (HOKLAS accredited laboratory). Water samples were collected at the monitoring and control stations for carrying out the laboratory determinations. The determination work will start within 24 hours after collection of the water samples. The analysis shall follow the standard methods according to APHA Standard Methods for the Examination of Water and Wastewater, 19th Edition, or an equivalent method approved by EPD.

Table 3.9 Analytical Methods to be applied to Water Quality Samples

Determinant	Standard Method	Reporting Limit
Suspended Solids	APHA 2540 D	2 mg/L
Nitrate Nitrogen	APHA 4500-NO ₃ ⁻	0.01 mg/L
Nitrite Nitrogen	APHA 4500-NO ₂ ⁻	0.01 mg/L
Ammonia Nitrogen	APHA 4500-NH ₃ (D)	0.01 mg/L
Total phosphorus	ASTM D515-88B	0.02 mg/L*

Determinant	Standard Method	Reporting Limit
Chlorophyll a	APHA 10200 H2 &3	0.5 µg/L

Remarks: *After review baseline data, the detection limit report will be revised to 0.02 mg/L.

QA/QC Procedure

- 3.1.26 ALS Technichem Pty Ltd. has comprehensive quality assurance and quality control programmes. For QA/QC procedures of parameters, one duplicate sample was analysed for every batch of 20 samples as required by HOKLAS.

Event and Action Plans

- 3.1.27 The Event and Action Plan (EAP) for water quality monitoring is presented in **Annex B**.

3.2 Marine Ecology

Introduction

- 3.2.1 The marine ecological monitoring surveys are conducted in accordance with the EM&A manual.
- 3.2.2 As stipulated in the EM&A Manual, the ecological monitoring surveys for marine ecology included coral monitoring at both the eastern (Site C) and western (Site D2) coasts of Kau Sai Chau Island and Control Site. The purpose of the monitoring survey was to check the conditions of the tagged corals and the sites.

Monitoring Frequency and Schedule

- 3.2.3 At each of the Site C and a Control Site near the AFCD's Coral Buoy at Sharp Island (**Figure 3.2**), 20 natural coral colonies are already selected and tagged during construction phase. If the tagged coral is found die or not suitable for sequent operation phase monitoring during the first month survey, new coral will be selected, tagged and replaced for the damage one. The species of corals had been tagged included the following 15 species: *Cyphastrea serailia*, *Favia speciosa*, *Favites abdita*, *Favites pentagona*, *Goniastrea aspera*, *Goniopora columna*, *Hydnophora exesa*, *Leptastrea pruinosa*, *Lithophyllon undulatum*, *Pavona decussata*, *Platygyra acuta*, *Platygyra carnosus*, *Plesiastrea versipora*, *Psammocora superficialis*, and *Turbinaria peltata*. As the construction of the desalination plant intake and outfall at the existing pier was terminated, no dredging work had been carried out during the construction phase. According to the EM&A manual, no coral monitoring was required at Site D2 during the construction phase. As the original baseline coral monitoring at Site D2 was conducted 3.5 years ago (December 2005), most of the tags at the previous tagged corals were lost. Twenty (20) new corals were selected in Site D2 for operation phase monitoring purposes. The species of corals selected in Site D2 included the following 10 species: *Acropora tumida*, *Cyphastrea serailia*, *Favia speciosa*, *Favites chinensis*, *Goniastrea aspera*, *Goniopora columna*, *Gonipora stutchburyi*, *Pavona decussata*, *Porties lobata*, and *Turbinaria peltata*. The operation phase coral monitoring covering Site D2, Site C and the Control Site.
- 3.2.4 The coral monitoring will be conducted monthly for the first three months of the operation phase, and if no exceedance was recorded, the monitoring schedule will be changed to semi-annually (i.e. one dry season and one in wet season) during the rest of the operation phase. Monitoring survey will consist of checking tagged corals at both impact sites and control site. Percentages of survival, sedimentation and bleaching for each tagged corals will be recorded. The monitoring programme for the reporting period is shown in **Annex A**.

Event and Action Plans

- 3.2.5 The Event and Action Plan (EAP) for ecology monitoring is presented in **Annex B**.

3.3 Landscape and Visual

- 3.3.1 The EIA concluded that the landscape and visual impacts associated with the construction of the third golf course are anticipated to be acceptable with mitigation. In order to ensure that the effective management and implementation of landscape mitigation measures developed and defined in the EIA, regular site inspections on trees health will be conducted.
- 3.3.2 Landscape and Visual Audit conducted during the Operational Phase of the project to follow up the compensatory planting under the requirements of the EIA for Proposed Extension of Public Golf Course at Kau Sai Chau , Sai Kung.
- 3.3.3 Under the Environmental Impact Assessment for the above, the proposed mitigation measures included both the compensatory planting works and treatment to structures. As stated in paragraphs 8.3 of the EM&A Manual, the contractor shall maintain all soft landscape works for a period of 12 months after implementation. This period shall be the establishment period and will be year one of the operation phase. Auditing inspections and reporting shall be undertaken once every two months of the operation phase.

Scope of Audit

- 3.3.4 The broad scope of the audit on mitigation measures during operation phase of East Course is to monitor the maintenance operations of tree planting to ensure all compensatory plants are well developed and grow during the Establishment Period. The monitoring programme for the reporting period is shown in **Annex A**.

3.4 Soil Nutrient

- 3.4.1 Routine soil testing for nutrients at East Course will be conducted semi-annually to ensure that nutrient applications to the golf course are having the desired effect. Adjustments, if necessary, are made to the applications program approved by Golf Course Superintendent to amend any soil imbalances or deficiencies in nutrients. The details of the fertilizers and pesticides application will also be recorded.

4. Monitoring Results

4.1.1 Monitoring data are provided in **Annex C**.

4.1 Water Quality

4.1.2 Marine and freshwater water quality monitoring were conducted at the 9 and 6 designated monitoring stations respectively. The desalination plant commenced operation in December 2008.

4.1.3 Monitoring of marine and freshwater locations was conducted on 2 occasions in March (5th and 21st March 2009). The QA/QC results for laboratory testing in the reporting month are acceptable and summarised in **Annex D**. Rainstorm signal were hoisted on 5 and 24 March 2009 during the reporting month.

4.1.4 As there is no water discharge from the Holes 5 / 6 through the drainage system during sampling except during rainstorm event, no water sample for F_Filter was collected during the reporting month. Summary of fertilizer and pesticides applications are summarized in **Annex E**.

4.1.5 Chemical applications were applied during the reporting month. They are approved pesticides listed in the turfgrass management plan in the final EIA report.

Marine water

4.1.6 The marine water exceedance is summarised in **Table 4.1-1**.

4.1.7 Non-compliances of chlorophyll a (ranging from 1.9 to 3.9 µg/L) were recorded at TTC, M_Coral and KS stations. The non-compliance results were similar to the control stations M_A and M_B (ranging from 2.1 to 3.8 µg/L). It is believed that exceedances were caused by natural fluctuation/disturbance on marine water quality. Therefore, all exceedances are considered non-project related.

Table 4.1-1 Marine Water Exceedance Summary (February to March 2009)

Monitoring Location	Exceedance Level	Date	Parameters	Project-related
TTC	Limit Level	5 Mar 2009	Chl a	No
	Limit Level	24 Mar 2009	Chl a	No
M_Coral	Action Level	24 Mar 2009	Chl a	No
KS	Action Level	5 Mar 2009	Chl a	No
	Action Level	6 Mar 2009	Chl a	No
	Limit Level	24 Mar 2009	Chl a	No

Fresh water

4.1.8 The fresh water exceedances are summarised in **Table 4.1-2**.

Table 4.1-2 Fresh water Exceedance Summary (February to March 2009)

Monitoring Location	Exceedance Level	Date	Parameters	Project-related
F_DA	Limit Level	5 Mar 2009	NH ₃ -N, NO ₃ -N, TIN	No
	Action Level	6 Mar 2009	Chl a	No
	Limit Level	6 Mar 2009	NO ₃ -N, TIN	No
	Limit Level	21 Mar 2009	NO ₃ -N, TIN	No
	Limit Level	24 Mar 2009	NO ₃ -N, TIN	No
F_DB	Limit Level	5 Mar 2009	NO ₃ -N, TIN	No
	Limit Level	21 Mar 2009	NO ₃ -N, TIN	No
F_DC	Limit Level	5 Mar 2009	NH ₃ -N	No
	Action Level	6 Mar 2009	Chl a	No
F_Inland M	Limit Level	24 Mar 2009	Chl a	No
F_Filter	Limit Level	6 Mar 2009	NH ₃ -N, Chl a	No
Lake 1D	Limit Level	5 Mar 2009	NO ₂ -N, Ortho P	No
	Limit Level	21 Mar 2009	Ortho P, TP	No
	Limit Level	24 Mar 2009	Ortho P	No

4.1.9 Limit level exceedances of NH₃-N (average value at 0.02 mg/L), NO₃-N (average value at 0.16 mg/L) and TIN (average value at 0.19 mg/L) were recorded downstream A and B. Action and Limit level exceedances of chlorophyll a (average value 1.2 µg/L) were recorded at downstream C, F_Inland M and F_Filter.

4.1.10 Water quality of the streams before any commencement works were measured in April 2006 in order to indicate natural variation between dry and wet seasons. By taking into account the seasonal variation (wet season) together with the baseline monitoring data (dry season), 95%-ile and 99%-ile for NH₃-N are 0.08 mg/L and 0.21 mg/L, 95%-ile and 99%-ile for NO₃-N are 0.55 and 0.85 mg/L and 95%-ile and 99%-ile for TIN are 0.71 mg/L and 1.08 mg/L. NO₃-N and TIN concentrations are well within the wet season natural variation range. Therefore, it is considered that all exceedances are non-project related.

4.1.11 The lake 1D is designed for temporary storage to collect the runoff from East Course through the closed low flow drainage system. The water will be recycled and reused as one of the irrigation water sources for the East Course. Exceedances of Ortho-P (0.25 mg/L), NO₂-N (0.30 mg/L) and TP (0.50 mg/L) were recorded. As there is no overflow / discharge from the Lake 1D to marine or fresh water bodies, no further action has to be taken.

4.2 Marine Ecology

- 4.2.1 Semi-annual Coral monitoring was carried out during the reporting month. The upcoming semi-annual monitoring is scheduled in November 2009 during dry season.
- 4.2.2 The present Marine Ecological Monitoring Survey was the fourth operation phase coral monitoring and the first semi-annual monitoring, and conducted on 8th March 2009. The weather conditions were good, and the underwater visibility was also good (approximately 3m). At Site D2, the 20 colonies of natural corals selected during the July 08 Baseline Survey were recovered and checked for conditions, while at, Site C and the Control Site, the same coral colonies adopted for construction phase monitoring were continuously used for monitoring purposes in operation phase.
- 4.2.3 Some corals in Site C and the Control Site were found missing during the July 08 baseline monitoring, probably due to the wave actions. Replacement coral colonies were selected in August 2008 (two in Site C and one in Control site) to maintain the number of tagged corals in each site to be 20.
- 4.2.4 It was found in the third monthly monitoring in October 2008 that the Control Site and the coral communities inside were impacted by physical damages, possibly caused by severe adverse weather conditions in late September 2008. Three tagged corals in Control Site were missing (i.e. X-16, X-18 & X-19) and physical damages on other tagged corals in Control Site were also observed, including X-02 (obvious damage at the tip), X-06 (buried by other damaged corals), X-10 (60% of the colonies were lost), and X-17 (60% of the colonies were lost). Though the physical damages, no sedimentation or bleaching was found on any of the tagged corals. Given the distance from the golf course and the observations on site, the damages on the tagged corals in the Control Site would not be caused by the Project. 5 Replacement corals (of the same species and similar sizes of the original tagged corals) were identified in the present monitoring to replace the missing ones and those subject to serious damage (i.e. X-06, X-16, X-17, X-18 and X-19).
- 4.2.5 Site C was on the south-eastern coast of Kau Sai Chau Island and had a high coral coverage among the sites investigated during the EIA Study. The sizes of coral colonies at Site C were also larger than those at other sites. Site C was away from the boundary of the new golf course and would not be subject to direct impacts during construction. The site and its vicinity still remained similar conditions as during the Baseline Survey. Among the 20 tagged corals in Site C, C-04 and C-20 were found missing during the July 08 baseline survey. Replacement coral colonies were selected in August 2008. For all tagged corals, no mortality, bleaching or sedimentation was found. (see **Table 4.2-1** and **Annex E - Photo Plates 4.2-1 to 4.2-2**).
- 4.2.6 Site D2 is close to the desalination plant. The monitoring site was not within area to be directly impacted by the project, but was located about 80m to the south of the existing ferry pier, where an area of hard substrates (bedrock and boulders) was present. The seabed was covered by bedrock. The bedrock cover continued to over 100m south from the pier. It was estimated that the bedrock area was less than 5% coverage of corals, but the sizes of those colonies were fairly large (some reach 30cm). 20 natural corals were selected during the baseline survey in December 2005 (with codes ranging from D-01 to D-20). The distribution of these selected corals ran along the contour of the bedrock, rather than parallel with the coastline as most natural corals occurred along the bed rock edge. Due to no commencement of dredging work for the desalination plant during the construction phase, monitor at Site D2 were not required during the construction phase. As the original baseline monitoring for the corals in Site D2 were conducted over 3.5 years before in December 2005, the previously tagged corals at Site D2 have mostly lost the tags. 20 new corals were selected during the July 08 baseline monitoring

in Site D2 for operation phase monitoring purposes. The species of corals selected in Site D2 included the following 10 species: *Acropora tumida*, *Cyphastrea serailia*, *Favia speciosa*, *Favites chinensis*, *Goniastrea aspera*, *Goniopora columna*, *Goniopora stutchburyi*, *Pavona decussata*, *Porties lobata*, and *Turbinaria peltata*. The conditions, mortality, sedimentation and bleaching of these 20 corals were shown in **Table 4.2-2** and **Annex E - Photo Plates 4.2-3 to 4.2-4**). No mortality, bleaching or sedimentation was found on any of the tagged corals.

- 4.2.7 The occurrence of seagrasses at Site D2 and Site D3 were checked. No seagrasses were found at Site D2, and the seagrass colonies previously observed at Site D3 was not found.
- 4.2.8 The Control Site is the buoy of coral marker established by AFCD in Sharp Island. Similar with Site C, both the coral coverage percentage and the sizes of coral colonies were high at this site. This site would not be impacted by the Project, and its vicinity still remained similar conditions as during the Construction Phase Monitoring. Coral X-05 was lost in previous construction phase monitoring in June 2006. Replacement coral for X-05 was selected in the August 2008. 5 tagged corals were found lost or subject to serious physical damages in October 2008, possibly caused by previous severe adverse weather conditions. In the present monitoring, 5 Replacement corals (of the same species and similar sizes of the original tagged corals) were identified to replace the missing ones and those subject to serious damage. The conditions of the newly tagged replacement corals and the conditions, mortality, sedimentation and bleaching of the original tagged corals were show in **Table 4.2-3** and **Annex E - Photo Plates 4.2-5 to 4.2-6**. No mortality, sedimentation or bleaching was found on most of the original tagged corals (see **Table 4.2-3**). Except that physical damages was observed again on X-09 (about 30%). Given the distance from the golf course and the observations on site, the physical damages on X-09 in the Control Site were not be caused by the Project.
- 4.2.9 **Photo Plates 4.2-1 to 4.2-6** showed the photos of each tagged corals. The assigned numbers, species, mortality percentage, sedimentation coverage percentage and bleaching percentage of the baseline conditions of tagged corals and their present conditions were presented in **Tables 4.2-1 to 4.2-3** below.

Table 4.2-1 Conditions of tagged corals at Site C

Code of tagged corals	Species	Baseline Survey (July 2008)			Monitoring Survey (March 2009)		
		Mortality (%)	Sedimentation (%)	Bleaching (%)	Mortality (%)	Sedimentation (%)	Bleaching (%)
C-01	<i>Platygyra carnosus</i>	0	0	0	0	0	0
C-02	<i>Platygyra carnosus</i>	0	0	0	0	0	0
C-03	<i>Favia speciosa</i>	0	0	0	0	0	0
C-04*	<i>Favia speciosa</i>	0	0	0	0	0	0
C-05	<i>Turbinaria peltata</i>	0	0	0	0	0	0
C-06	<i>Favia speciosa</i>	0	0	0	0	0	0
C-07	<i>Platygyra acuta</i>	0	0	0	0	0	0
C-08	<i>Platygyra acuta</i>	0	0	0	0	0	0
C-09	<i>Favia speciosa</i>	0	0	0	0	0	0
C-10	<i>Platygyra acuta</i>	0	0	0	0	0	0
C-11	<i>Favia speciosa</i>	0	0	0	0	0	0
C-12	<i>Platygyra acuta</i>	0	0	0	0	0	0
C-13	<i>Platygyra carnosus</i>	0	0	0	0	0	0
C-14	<i>Favia speciosa</i>	0	0	0	0	0	0
C-15	<i>Goniopora columna</i>	0	0	0	0	0	0

Code of tagged corals	Species	Baseline Survey (July 2008)			Monitoring Survey (March 2009)		
		Mortality (%)	Sedimentation (%)	Bleaching (%)	Mortality (%)	Sedimentation (%)	Bleaching (%)
C-16	<i>Platygyra carnosus</i>	0	0	0	0	0	0
C-17	<i>Goniopora columna</i>	0	0	0	0	0	0
C-18	<i>Platygyra carnosus</i>	0	0	0	0	0	0
C-19	<i>Favites pentagona</i>	0	0	0	0	0	0
C-20**	<i>Goniopora columna</i>	0	0	0	0	0	0

*The original C-04 has been missing during the construction phase monitoring and a replacement colony of *Favia speciosa* was selected.

*The original C-20 has been missing during the construction phase monitoring and a replacement colony of *Goniopora columna* was selected.

Table 4.2-2 Conditions of tagged corals at Site D2

Code of tagged corals	Species	Baseline Survey (July 2008)			Monitoring Survey (March 2009)		
		Mortality (%)	Sedimentation (%)	Bleaching (%)	Mortality (%)	Sedimentation (%)	Bleaching (%)
D-01	<i>Goniopora columna</i>	0	0	0	0	0	0
D-02	<i>Goniastrea aspera</i>	0	0	0	0	0	0
D-03	<i>Favia speciosa</i>	0	0	0	0	0	0
D-04	<i>Favia speciosa</i>	0	0	0	0	0	0
D-05	<i>Goniastrea aspera</i>	0	0	0	0	0	0
D-06	<i>Goniastrea aspera</i>	0	0	0	0	0	0
D-07	<i>Goniopora stutchburyi</i>	0	0	0	0	0	0
D-08	<i>Turbinaria peltata</i>	0	0	0	0	0	0
D-09	<i>Goniastrea aspera</i>	0	0	0	0	0	0
D-10	<i>Goniastrea aspera</i>	0	0	0	0	0	0
D-11	<i>Favia speciosa</i>	0	0	0	0	0	0
D-12	<i>Turbinaria peltata</i>	0	0	0	0	0	0
D-13	<i>Turbinaria peltata</i>	0	0	0	0	0	0
D-14	<i>Favites chinensis</i>	0	0	0	0	0	0
D-15	<i>Porites lobata</i>	0	0	0	0	0	0
D-16	<i>Turbinaria peltata</i>	0	0	0	0	0	0
D-17	<i>Acropora tumida</i>	0	0	0	0	0	0
D-18	<i>Cyphastrea serailia</i>	0	0	0	0	0	0
D-19	<i>Cyphastrea serailia</i>	0	0	0	0	0	0
D-20	<i>Pavonna descussata</i>	0	0	0	0	0	0

Table 4.2-3 Conditions of tagged corals at Control Site

Code of tagged corals	Species	Baseline Survey (July 2008)			Monitoring Survey (March 2009)		
		Mortality (%)	Sedimentation (%)	Bleaching (%)	Mortality (%)	Sedimentation (%)	Bleaching (%)
X-01	<i>Platygyra carnosus</i>	0	0	0	0	0	0
X-02	<i>Platygyra carnosus</i>	0	0	0	0	0	0
X-03	<i>Platygyra carnosus</i>	0	0	0	0	0	0
X-04	<i>Pavona decussata</i>	0	0	0	0	0	0
X-05*	<i>Platygyra carnosus</i>	0	0	0	0	0	0
X-06**	<i>Platygyra carnosus</i>	0	0	0	0	0	0
X-07	<i>Platygyra carnosus</i>	0	0	0	0	0	0
X-08	<i>Favites abdita</i>	0	0	0	0	0	0
X-09	<i>Cyphastrea serailia</i>	0	0	0	30	0	0
X-10	<i>Cyphastrea serailia</i>	0	0	0	0	0	0
X-11	<i>Platygyra carnosus</i>	0	0	0	0	0	0
X-12	<i>Platygyra acuta</i>	0	0	0	0	0	0
X-13	<i>Platygyra acuta</i>	0	0	0	0	0	0
X-14	<i>Platygyra acuta</i>	0	0	0	0	0	0
X-15	<i>Platygyra acuta</i>	0	0	0	0	0	0
X-16**	<i>Platygyra acuta</i>	0	0	0	0	0	0
X-17**	<i>Favia speciosa</i>	0	0	0	0	0	0
X-18**	<i>Platygyra acuta</i>	0	0	0	0	0	0
X-19**	<i>Goniastrea aspera</i>	0	0	0	0	0	0
X-20	<i>Cyphastrea serailia</i>	0	0	0	0	0	0

* The original X-05 has been missing during the construction phase monitoring and a replacement colony of *Platygyra carnosus* was selected.

** The original X-06, X-16, X-17, X-18 and X-19 were found lost or seriously damaged by weather in October 2008. Replacement corals were identified in March 2009.

4.3 Landscape & Visual

4.3.1 Site audit was carried out in March 2009. General observation are shown as below:

Planting Works and Maintenance Operations

- In the previous monitoring, among the 841 trees to be planted in accordance with the planting plan, 582 dead individuals were observed. With the 114 additional trees planted in additional planting sites (the areas not previously planted with trees) as recorded during the previous monitoring, the total number of trees (i.e. 373) was still below the planting plan, and the Contractor was requested to perform replanting for dead trees after the previous monitoring.
- In the present monitoring, it was observed that a large number of shrubs (mainly *Raphirolepis indica*) were recently planted within the East Course, including the original planting locations, as well as some new areas not previously indicated on the landscape plan. In terms of number, the newly planted shrubs should be more than enough to replace all the dead trees recorded in previous monitoring.

- Major landscape maintenance operations were carried out by the Contractor recently as a large number of shrubs were planted, and some dead trees were removed.
- During the present audit, however, some dead trees (341 individuals) were still observed. These trees were part of the previously reported 582 dead trees. As the newly planted shrubs are sufficient in number to compensate the dead trees, the Contractor should either replaced these dead trees or removed them as maintenance works.
- Some stakes for trees were found in poor conditions or leaning.

4.3.2 Recommendations are shown as below:

- The Contractor was recommended to perform landscape maintenance operations, including replacing or removed all dead trees; providing stakes for leaning trees; re-staking all trees with broken/leaning tree stakes; pruning of die back tree branches; fertilizing of plants; and cutting of overgrown grass and removal of weeds on slopes, to ensure a healthy establishment of the compensatory planting.
- The Contractor was reminded to replace or remove 341 dead trees, and any other trees found to be in poor conditions prior to the next site inspection.
- The Contractor was reminded to carry out regular inspection of all tree stakes, especially trees on locations where it could be easily blown over in strong wind conditions, and rectify all defects as soon as possible.
- The Contractor was reminded to update the drawings to show the locations of replacement/replanting trees after the replanting is implemented.

4.4 Soil Nutrient

- 4.4.1 The previous soil testing sampling was completed in January 2009. The soil testing was carried out in March 2009 and the monitoring results will be available in April 2009.

5. Conclusions

- 5.1.1 The Environmental Monitoring and Audit (EM&A) Report presents the operational EM&A works undertaken during the period from 25th February to 24th March 2009 in accordance with EM&A Manual and the requirement under EP-224-2005/A.
- 5.1.2 Exceedances on marine stations and fresh water stations are recorded and considered non-project related. The exceedances are mainly due to the natural variation.
- 5.1.3 Dry season coral monitoring was conducted during the reporting month. The tentative upcoming monitoring schedule will be carried out in November 2009 during the dry season. For the soil nutrient, it was carried out in March 2009 and results will be available in April 2009.
- 5.1.4 The Contractor was reminded to replace or remove 341 dead trees, and any other trees found to be in poor conditions prior to the next site inspection. The next monitoring is scheduled in May 2009.
- 5.1.5 No environmental complaint / summon was received during the reporting month.