



Quarterly EM&A Compliance Report


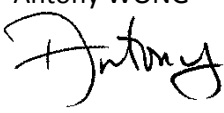
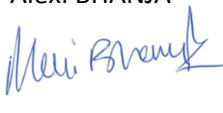
SkyCity Nine Eagles Golf Course

May to July 2015



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Report for:	Sky City Nine Eagles Golf Course

PREPARATION, REVIEW AND AUTHORISATION

Revision #	Date	Prepared by	Reviewed by	Approved by
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EXECUTIVE SUMMARY

The project comprises the construction and operation a 9-hole Golf Course at the east side of the North Commercial District (NCD) on the Airport Island as an interim arrangement prior to the area's future development as a business park. The golf facility, known as "SkyCity Nine Eagles Golf Course" serves airport passengers and workers as well as the general public.

According to the approved EM&A Manual, monthly compliance monitoring of lake water quality at four locations (W1 and W2 in Lake A and W3 and W4 in Lake B) is required during the Operation Period, with reporting on a quarterly basis. Parameters monitored comprise Suspended Solids (SS), Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD₅), nitrogen, phosphorous, temperature and salinity.

This is the thirty-third and final Quarterly Compliance report covering EM&A from May to July 2015 and complies with the reporting requirements stated in the approved EM&A Manual. Nine Eagles will close on 31 July 2015 and the site will be handed back to the Airport Authority in August 2015.

In May, two exceedances of Action Level for SS were recorded at monitoring locations W3 and W4. The SS concentration in the lakes is predominantly caused by naturally occurring algae in the water. There were no exceedances of any other parameters. Total nitrogen and total phosphorous concentrations remained below Action Levels, which indicate that application of organic nutrients is NOT the cause of exceedances.

In June, no exceedances of Action and Limit Level of any parameters were recorded.

In July, four exceedances of Limit Level for SS were recorded at monitoring locations W1, W2, W3 and W4, based on the samples taken on 3 July. The SS concentration in the lakes is predominantly caused by naturally occurring algae in the water. There were no exceedances of any other parameters. Total nitrogen and total phosphorous concentrations remained below Action Levels, which indicate that application of organic nutrients is NOT the cause of the exceedances. Since results of the water quality sampling carried out on 3 July became available, the Golf Course Operator has been dosing the lakes with Aqua Bio-Trol Liquid, in order to reduce the concentration of algae (which leads to the high suspended solids levels). Together with the heavy rain, this appeared to have significantly improved the water clarity. As such, the Golf Course Operator commissioned a second round of water quality sampling on 29 July to determine whether there had, in fact, been any reduction in suspended solids concentration. The results showed that there were no exceedances of Action or Limit Level for SS and, therefore, no exceedances of Action and Limit Level of any parameters by the end of July.

Water quality in May and for most of July was not considered to be of an acceptable quality for discharge and so the control valve could not be opened. No water was discharged off-site during May, June and July, but can be discharged from 29 July onwards, since the most recent results from monitoring of SS on 29 July indicate that lake water is of an acceptable quality for discharge.

There were no complaints, notifications of summons received during the reporting quarter.

1 PROJECT DESCRIPTION

1.1 Overview

The project comprises the construction and operation a 9-hole Golf Course at the east side of the North Commercial District (NCD) on the Airport Island as an interim arrangement prior to the area's future development as a business park (see *Figure 1-1*). The golf facility, known as "SkyCity Nine Eagles Golf Course" serves airport passengers and workers as well as the general public.

The Project is managed by SkyCity Nine Eagles Golf Course, who has engaged Asia Turf Solutions Ltd to establish and maintain the turfgrass of the Golf Course. SMEC Asia Ltd has been employed as the Environmental Team (ET) for the Operation Period since May 2010 and has engaged ALS Technichem Pty Ltd as the HOKLAS accredited testing laboratory to carry out lake water analysis.

Construction of the golf course was completed on 31 December 2006, the first phase of the Operation Period was completed on 30 April 2007, and the second (and current) phase commenced on 1 May 2007. Nine Eagles will close on 31 July 2015 and the site will be handed back to the Airport Authority in August 2015.

1.2 Operation

The Golf Course has been designed to contain water within two artificial lakes, which are linked together by two underwater pipes. The lakes provide a source of freshwater for irrigation. All rainwater and surplus irrigation water collected within the Golf Course will drain back into the lakes for reuse, through a sub-soil drainage system.

The lakes are maintained at a capacity of 15,000m³. This is not "full" but is the level that provides the required visual appearance. During the winter (dry) months, however, the lake water may fall below this level. The maximum capacity of the lakes is 20,000m³.

If the capacity of the lakes exceeds 20,000m³, then the Golf Course may flood. To avoid this, the Golf Course Supervisor can authorise the opening of a control valve to allow the water to overflow from the lakes into storm drains that discharge off-site via Outfall No. 8. However, the valve can only be opened if the lake water monitoring results indicate that water is of an acceptable quality. Under normal circumstances, the control valve remains closed and discharge off-site is not possible. All opening/closing of the control valve is logged on site.

If the latest lake water monitoring results indicate that water is not of an acceptable quality, then the valve cannot be opened, the lake water cannot overflow and the Golf Course may begin to flood. This is part of the mitigation design to prevent off-site discharge of water that does not meet the required standard.

The bund that surrounds the site is at least 1.5m high and up to 90,000m³ of floodwater can be retained within the Golf Course in addition to the 20,000m³ lake capacity. In this situation, water samples from the flooded Golf Course will be taken more frequently. Only when water has returned to an acceptable quality will the control valve be opened to allow water to overflow from the lake and into off-site storm drains that discharge via Outfall No. 8, thereby allowing the flood to recede.

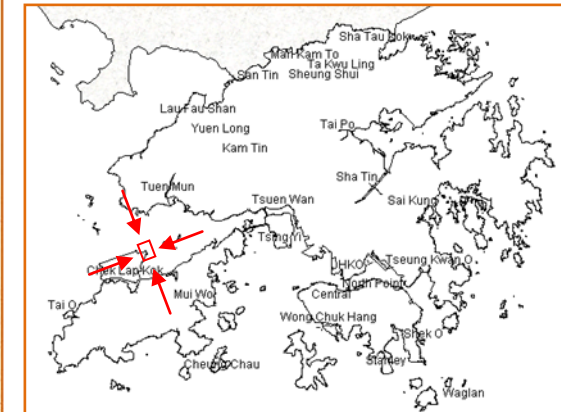
The system by which this water control is achieved is shown in *Figure 1-2*.

Figure 1-1 Location of SkyCity Golf Course on the Airport Island



Source: Image courtesy of Airport Authority.

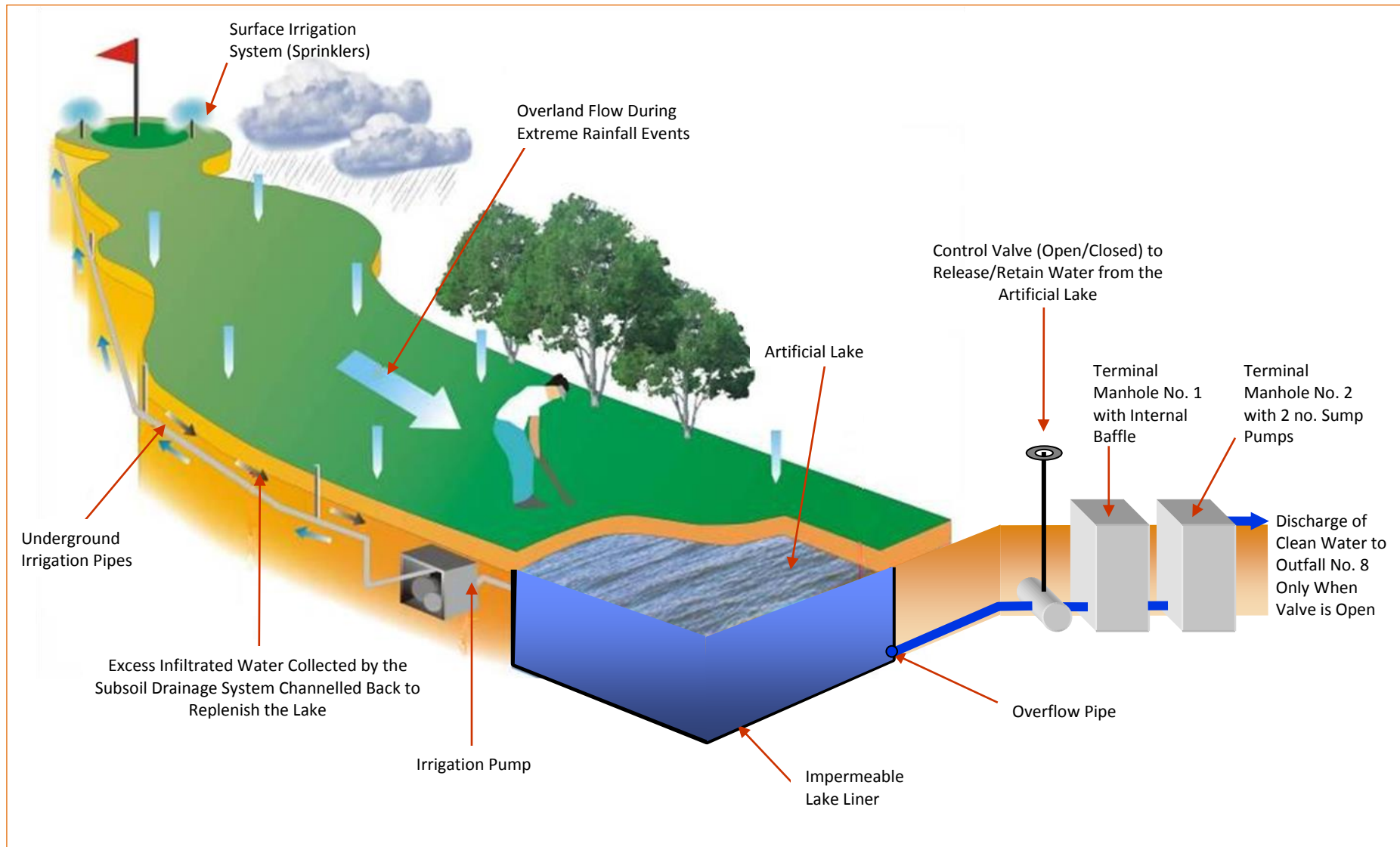
Location Map



Key

- 1 Terminal 2 & SkyPlaza
(Retail, F&B & Entertainment)
二號客運大樓及翔天廊(零售、食肆及娛樂區)
- 2 HKIA Tower
機場行政大樓
- 3 AsiaWorld - Expo
亞洲國際博覽館
- 4 2nd on-airport hotel
第二間機場酒店
- 5 SkyPier
海天客運碼頭
- 6 SkyCity Nine Eagles Golf Course
航天城高爾夫球場
- 7 Airport World Trade Centre
暫名:機場世界貿易中心

Figure 1-2 Schematic of Lake Water Control System



2 LAKE WATER QUALITY EM&A

2.1 EM&A Programme

Monitoring of Dissolved Oxygen (DO) in mg/ℓ, Suspended Solids (SS) in mg/ℓ, Biochemical Oxygen Demand (BOD₅) in mg/ℓ, Total Nitrogen in mg/ℓ, Total Phosphorous in mg/ℓ, Salinity in g/ℓ, and temperature in °C was carried out by the ET to ensure that any deterioration in lake water quality could be readily detected and timely action could be taken to rectify the situation if this was due to site operations.

DO, temperature and salinity were measured in-situ whilst other parameters were determined in a HOKLAS-accredited laboratory.

2.1.1 Monitoring This Quarter

The actual lake water monitoring schedule for this quarter (May to July 2015) is given in **Table 2-1**, below. As Nine Eagles will close on 31 July 2015, the monitoring in July is the last lake water quality monitoring for this project.

Table 2-1 Monitoring Schedule for This Quarter

Sampling Date	Sampling Locations
8 May 2015	W1 to W4
12 June 2015	W1 to W4
3 July 2015	W1 to W4
29 July 2015	W1 to W4 (SS only)

A second set of water sampling for SS analysis only was carried out on 29 July to update the previous results for 3 July in order to take into account the application of Aqua Bio-Trol Liquid and the high rainfall in the last two weeks of July.

2.2 Equipment and Methodology

Because of the relatively shallow water, in-situ measurements and water sampling were conducted at 0.5m from the surface (the mid-point of the 1m deep lake). Water samples for all monitoring parameters were collected, stored, preserved and analysed according to *APHA Standard Methods for the Examination of Water and Wastewater, 19th Ed, #17*.

In-situ monitoring was carried out using a DO concentration and DO saturation were carried out using a YSI Model 85 CE-C-M-Y multi-parameter meter and the range, resolution and accuracy of the equipment is provided in **Table 2-**.

Table 2-2 In-situ Monitoring Equipment Details

In-situ Parameters	Measuring Devices	Measurement Precision
Dissolved Oxygen	YSI Professional Plus	0.1mg/ℓ and 0.1%
Salinity		0.1ppt (or g/ℓ)
Temperature		0.1°C

A Kahlisco water sampler was used to obtain water samples for subsequent SS analysis in the laboratory. A sufficient volume of the sample is collected in clean, high density polythene bottles, packed in ice (cooled to 4°C without being frozen), and delivered to the ALS laboratory immediately after monitoring. The analysis of the collected samples starts by the next working day following APHA *Standard Methods #2540D*.

2.3 Maintenance and Calibration

All in-situ monitoring instruments are calibrated and certified by ALS at monthly intervals throughout all stages of the lake water quality monitoring programme.

The YSI Multi-purpose Meter is calibrated once per monitoring day by the wet bulb method. Calibration at the ALS laboratory is carried out once every month in a water sample of known dissolved oxygen concentration. The sensor is immersed in the water and after thermal equilibration, the known mg/ℓ value is keyed in and the calibration is carried out automatically. Calibration details are provided in *Appendix 1*.

2.4 Parameters Monitored

The following parameters are monitored and compared to Action/Limit (A/L) Levels:

- Dissolved Oxygen
- Suspended Solids
- BOD₅
- Total Nitrogen
- Total Phosphorous

There are no A/L Levels for temperature or salinity – these parameters are recorded for information only.

2.5 Monitoring Locations

Monitoring locations together with grid references are shown in *Figure 2-1*. Monitoring Stations are designated as W1, W2, W3 and W4.

2.6 Monitoring Date, Time, Frequency and Duration

In accordance with the EM&A Manual, the monitoring frequency of lake water quality is shown as *Table 2-*.

Table 2-3 Monitoring Frequency

	Operation Phase	
	Below A/L Level	A/L Level Exceedance
Monitoring Frequency	Monthly	Weekly

2.7 Action / Limit Levels

According to the approved EM&A manual, the A/L Levels for the compliance monitoring (for monitoring locations W1 to W4) are shown in **Table 2-**, below.

Table 2-4 Action and Limit Levels for Lake Water Quality

Parameter	Acceptable Standard (mg/ℓ)	
	Action Level	Limit Level
Suspended Solids	20	30
BOD ₅	13.5	20
Dissolved Oxygen	4	3
Total Nitrogen	20	30
Total Phosphorous	3.5	5

In case of exceedance of A/L Levels caused by the operation of the Golf Course, the ET shall immediately implement the Event/ Action Plan (E/AP), shown in **Table 2-**, below, in order to resolve lake water quality problems:

Table 2-5 Event/Action P for Lake Water Quality Monitoring

Event	Action
Exceedance of Action Level	<ul style="list-style-type: none"> Notify the Golf Course Supervisor of the exceedance, providing full details (time, location, parameter, level, etc.) Increase the frequency of monitoring of the particular parameter(s) to “Action/Limit Level Exceedance” as shown in Table 2- If water quality continues to worsen, it may be prudent to review the Turfgrass Management Plan (TMP) in terms of application of nutrients and agree any revisions with the Golf Facility Supervisor Notify the Golf Facility Supervisor when water quality falls below “Action Level” and reduce monitoring frequency to “Below Action/Limit Level” as shown in Table 2-
Exceedance of Limit Level	<ul style="list-style-type: none"> Notify EPD and Golf Course Supervisor of the exceedance, providing full details (time, location, parameter, level, etc.) Suspend any ongoing application of organic nutrients Determine the likely cause of the exceedance(s) Review the TMP in terms of application of nutrients and agree any revisions with the Golf Facility Supervisor Continue to irrigate the Golf Course using lake water Increase the frequency of monitoring of the particular parameter(s) to “Action/Limit Level Exceedance” as shown in Table 2- (if not already at this frequency) to demonstrate the effectiveness of remedial measures and to confirm that water quality has returned to acceptable levels Notify EPD and Golf Course Supervisor when water quality falls below “Action Level” (not “Limit Level”) and reduce monitoring frequency to “Below Action/Limit Level” as shown in Table 2-

Figure 2-1 **Locations for Lake Water Quality Monitoring**



3 MONITORING RESULTS

3.1 Summary of Results

A summary of scheduled lake water monitoring results for the reporting quarter is provided in **Table 3-1**, below. Detailed results are provided in **Appendix 2** and graphical plots since commencement of the second phase of Operation are given in **Appendix 3**.

Table 3-1 Summary of Compliance Monitoring Data during Reporting Quarter

Monitoring Location		Salinity (g/ℓ)	Temperature (°C)	SS (mg/ℓ)	BOD ₅ (mg/ℓ)	DO Saturation (%age)	DO Concentration (mg/ℓ)	Total Nitrogen (mg/ℓ)	Total Phosphorous (mg/ℓ)
W1	Mean	0.1	29.6	12	4.0	91.5	7.1	1.6	0.1
	Minimum	0.1	27.6	2	2.0	78.0	6.1	1.4	0.1
	Maximum	0.1	30.8	17	6.0	105.0	8.3	1.8	0.1
W2	Mean	0.1	29.6	12	5.0	89.3	6.8	1.7	0.1
	Minimum	0.1	27.7	2	3.0	80.0	6.2	1.5	0.1
	Maximum	0.1	30.6	17	8.0	102.0	8.0	1.9	0.1
W3	Mean	0.1	29.6	23	7.0	72.3	5.8	3.1	0.1
	Minimum	0.1	27.5	7	3.0	60.3	5.0	1.5	0.1
	Maximum	0.1	30.9	43	10.0	85.0	6.8	5.5	0.2
W4	Mean	0.1	29.6	21	7.0	76.1	6.0	3.1	0.1
	Minimum	0.1	27.7	2	40.0	64.4	5.0	1.9	0.1
	Maximum	0.1	30.6	40	10.0	94.0	7.3	5.4	0.2

Note: * A second set of SS sampling was carried out on 29 July, which supersedes that carried out on 3 July, and is reported above.

Bold indicates Action Level exceedance; **Bold** indicates Limit Level exceedance.

3.2 Discussion

3.2.1 May 2015

In May, two exceedances of Action Level for SS were recorded at monitoring locations W3 and W4. The SS concentration in the lakes is predominantly caused by naturally occurring algae in the water.

There were no exceedances of any other parameters. Total nitrogen and total phosphorous concentrations remained below Action Levels, which indicate that application of organic nutrients is NOT the cause of the exceedances.

3.2.2 June 2015

In June, no exceedances of Action and Limit Level of any parameters were recorded.

3.2.3 July 2015

In July, four exceedances of Limit Level for SS were recorded at monitoring locations W1, W2, W3 and W4, based on the samples taken on 3 July. The SS concentration in the lakes is predominantly caused by naturally occurring algae in the water.

There were no exceedances of any other parameters. Total nitrogen and total phosphorous concentrations remained below Action Levels, which indicate that application of organic nutrients is NOT the cause of the exceedances.

Under normal operating conditions, lake water is constantly “topped-up” to offset the loss due to infiltration and evaporation from pumping out the lake water for irrigation. However, after closure of the golf course on 31 July and prior to return of the Site to Airport Authority in August, the lakes will need to be empty to allow post-operation soil sampling beneath the lakes on 10 August.

In early July, the lake water levels were very low, but heavy rain increased the water level. The Operator has therefore stopped “topping-up” the lake water to allow the irrigation pumps to gradually drain the lakes so that by the time the soil sampling is to be carried out, the lakes will be empty. However, due to the heavy rain in the last two weeks of July the lake water level has increased further and it is unlikely that relying solely on infiltration and evaporation of lake water via the irrigation pumps will be able to empty the lakes in time for the soil sampling.

Since results of the water quality sampling carried out on 3 July became available, the Golf Course Operator has been dosing the lakes with Aqua Bio-Trol Liquid, in order to reduce the concentration of algae (which leads to the high suspended solids levels). Aqua Bio-Trol Liquid is an all-natural, microbial based product effective for improving poor water conditions. It is a concentration of naturally occurring microbes, which act to bring lake water into proper ecological balance (see [Appendix 4](#) for details).

Together with the heavy rain, this appeared to have significantly improved the water clarity. As such, the Golf Course Operator commissioned a second round of water quality sampling on 29 July to determine whether there had, in fact, been any reduction in suspended solids concentration.

The results showed that there were no exceedances of Action or Limit Level for SS and, therefore, no exceedances of Action and Limit Level of any parameters by the end of July.

3.3 Operational Practice

Table 3-2, below, shows the operational practice during the reporting quarter, i.e., the activities relating to the management of water in the lakes.

Table 3-2 Operational Results

Month	Month-end Lake Water Depth (m)	Can Control Valve Be Opened?	Was Control Valve Opened?	Quantity of Water Discharged (m ³)
May 2015	1.1	No	No	0
June 2015	0.7	Yes	No	0
July 2015	1.5	No (from 3 July to 28 July) Yes (from 29 July onwards)	No	0

Water quality in May and for most of July was not considered to be of an acceptable quality for discharge and so the control valve could not be opened. No water was discharged off-site during May, June and July, but can be discharged from 29 July onwards, since the most recent results from monitoring of SS on 29 July indicate that lake water is of an acceptable quality for discharge.

3.4 Complaints and Notifications of Summons

During the reporting quarter, there were no complaint received and no notifications of summons. There were also no openings of the control valve, emergency or otherwise.

4 COMMENTS, RECOMMENDATIONS AND CONCLUSIONS

According to the approved EM&A Manual, monthly compliance monitoring of lake water quality at four locations (W1 and W2 in Lake A and W3 and W4 in Lake B) is required during the Operation Period, with reporting on a quarterly basis. Parameters monitored comprise Suspended Solids (SS), Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD₅), nitrogen, phosphorous, temperature and salinity.

This is the thirty-third and final Quarterly Compliance report covering EM&A from May to July 2015 and complies with the reporting requirements stated in the approved EM&A Manual. Nine Eagles will close on 31 July 2015 and the site will be handed back to the Airport Authority in August 2015.

In May, two exceedances of Action Level for SS were recorded at monitoring locations W3 and W4. The SS concentration in the lakes is predominantly caused by naturally occurring algae in the water. There were no exceedances of any other parameters. Total nitrogen and total phosphorous concentrations remained below Action Levels, which indicate that application of organic nutrients is NOT the cause of exceedances.

In June, no exceedances of Action and Limit Level of any parameters were recorded.

In July, four exceedances of Limit Level for SS were recorded at monitoring locations W1, W2, W3 and W4, based on the samples taken on 3 July. The SS concentration in the lakes is predominantly caused by naturally occurring algae in the water. There were no exceedances of any other parameters. Total nitrogen and total phosphorous concentrations remained below Action Levels, which indicate that application of organic nutrients is NOT the cause of the exceedances. Since results of the water quality sampling carried out on 3 July became available, the Golf Course Operator has been dosing the lakes with Aqua Bio-Trol Liquid, in order to reduce the concentration of algae (which leads to the high suspended solids levels). Together with the heavy rain, this appeared to have significantly improved the water clarity. As such, the Golf Course Operator commissioned a second round of water quality sampling on 29 July to determine whether there had, in fact, been any reduction in suspended solids concentration. The results showed that there were no exceedances of Action or Limit Level for SS and, therefore, no exceedances of Action and Limit Level of any parameters by the end of July.

Water quality in May and for most of July was not considered to be of an acceptable quality for discharge and so the control valve could not be opened. No water was discharged off-site during May, June and July, but can be discharged from 29 July onwards, since the most recent results from monitoring of SS on 29 July indicate that lake water is of an acceptable quality for discharge.

There were no complaints, notifications of summons received during the reporting quarter.

APPENDIX 1

Equipment Calibration Details



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1-3 Wing Yip Street
Kwai Chung, N.T., Hong Kong
T: +852 2610 1044
F: +852 2610 2021
www.alsglobal.com

REPORT OF EQUIPMENT PERFORMANCE CHECK / CALIBRATION

CONTACT:	MR ALEXI BHANJA	WORK ORDER:	HK1522602
CLIENT:	SMEC ASIA LIMITED	SUB-BATCH:	1
ADDRESS:	27/F, FORD GLORY PLAZA, 37-39 WING HONG STREET, CHEUNG SHA WAN, KOWLOON, HONG KONG.	LABORATORY:	HONG KONG
PROJECT:	SKY CITY GOLF COURSE	DATE RECEIVED:	--
		DATE OF ISSUE:	11/07/2015

COMMENTS

It is certified that the item under calibration/checking has been calibrated/checked by corresponding calibrated equipment in the laboratory.

Maximum Tolerance and calibration frequency stated in the report, unless otherwise stated, the internal acceptance criteria of ALS will be followed.

The "Next Calibration Date" is recommended according to best practice principals as practised by the ALS Hong Kong laboratory or quoted from relevant international standards.

Scope of Test: Dissolved Oxygen and Temperature
Description: Multifunctional Meter
Brand Name: YSI
Model No.: YSI 550A
Serial No.: 14C103000
Equipment No.: --
Date of Calibration: 29 May, 2015

NOTES

This is the Final Report and supersedes any preliminary report with this batch number.

Results apply to sample(s) as submitted. All pages of this report have been checked and approved for release.


Mr. Fung Lim Chee, Richard
General Manager -
Greater China & Hong Kong

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Page 1 of 2

REPORT OF EQUIPMENT PERFORMANCE CHECK/CALIBRATION

Work Order: HK1522602
SUB-BATCH: 1
Date of Issue: 11/07/2015
Client: SMEC ASIA LIMITED



Description: Multifunctional Meter
Brand Name: YSI
Model No.: YSI 550A
Serial No.: 14C103000
Equipment No.: --
Date of Calibration: 29 May, 2015 **Date of next Calibration:** 29 August, 2015

Parameters:

Dissolved Oxygen

Method Ref: APHA (21st edition), 4500O: G

Expected Reading (mg/L)	Displayed Reading (mg/L)	Tolerance (mg/L)
2.41	2.49	+0.08
4.50	4.53	+0.03
6.37	6.47	+0.10
Tolerance Limit (mg/L)		±0.20

Temperature

Method Ref: Section 6 of International Accreditation New Zealand Technical

Guide No. 3 Second edition March 2008: Working Thermometer Calibration Procedure.

Expected Reading (°C)	Displayed Reading (°C)	Tolerance (°C)
10.0	10.4	+0.4
20.0	20.9	+0.9
36.0	36.8	+0.8
Tolerance Limit (°C)		±2.0


 Mr. Fung Lim Chee, Richard
 General Manager -
 Greater China & Hong Kong

APPENDIX 2

Lake Water Quality Monitoring Data

Date	Time	Station	Salinity (g/ℓ)	Temperature (°C)	SS (mg/ℓ)	BOD5 (mg/ℓ)	DO Sat (%Saturation)	DO Conc (mg/ℓ)	Total Nitrogen (mg/ℓ)	Total Phosphorous (mg/ℓ)
8-May-15	6:30	W1	0.1	27.6	16	2	105.0	8.3	1.7	0.1
	6:45	W2	0.1	27.7	17	3	102.0	8.0	1.7	0.1
	7:15	W3	0.1	27.5	43	8	85.0	6.8	2.2	0.1
	7:10	W4	0.1	27.7	40	7	94.0	7.3	1.9	0.1
12-Jun-15	6:40	W1	0.1	30.4	17	4	91.6	7.0	1.4	0.1
	7:00	W2	0.1	30.5	17	4	85.8	6.3	1.5	0.1
	7:15	W3	0.1	30.3	20	3	71.7	5.5	1.5	0.1
	7:30	W4	0.1	30.5	20	4	64.4	5.0	1.9	0.1
3-Jul-15	7:15	W1	0.1	30.8	2*	6	78.0	6.1	1.8	0.1
	7:16	W2	0.1	30.6	2*	8	80.0	6.2	1.9	0.1
	7:40	W3	0.1	30.9	7*	10	60.3	5.0	5.5	0.2
	7:31	W4	0.1	30.6	2*	10	70.0	5.8	5.4	0.2
Mean			0.1	29.6	17	6	82.3	6.4	2.4	0.1
Minimum			0.1	27.5	2	2	60.3	5.0	1.4	0.1
Maximum			0.1	30.9	43	10	105.0	8.3	5.5	0.2

Note: * A second set of SS sampling was carried out on 29 July, which supersedes that carried out on 3 July, and is reported above.

APPENDIX 3

Graphical Plots of Monitoring Data for the Past Four Months

