



# Updated Open-air Lagoon Show with Pyrotechnic Effects

Air Quality Sampling Report

PREPARED FOR



Ocean Park Corporation

DATE

2 July 2024

REFERENCE

0540005



## DOCUMENT DETAILS

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# Updated Open-air Lagoon Show with Pyrotechnic Effects

## Air Quality Sampling Report

0540005



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**Terence Fong**

Partner

ERM-Hong Kong, Limited  
2507, One Harbourfront  
18 Tak Fung Street  
Hung Hom, Kowloon  
Hong Kong  
T +852 2271 3000

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**Environmental Permit No. EP-249/2006/D**  
**Ocean Park Master Redevelopment Project**  
**Environmental Team Leader Certification**

**Reference Document/Plan**

Document/ <del>Plan</del> to be Certified/ <del>Verified</del> :	Air Quality Sampling Report
Date of Report:	2 July 2024

**Reference EP Condition**

Environmental Permit Condition:	2.38
<p>The Permit Holder shall, no later than one week before the trial PSEM displays, deposit with the Director four hard copies and one electronic copy of an air quality sampling plan. The sampling plan shall include:</p> <ul style="list-style-type: none"><li>(a) drawings in the scale of 1:1000 or other appropriate scale as agreed by the Director showing the locations and sampling height of the air quality monitoring stations;</li><li>(b) monitoring methodology and measurement parameters for respirable suspended particulates (RSP), hydrogen sulphide, dioxins, copper and other relevant chemical compositions of the PSEM;</li><li>(c) monitoring periods and frequency before and during the trial displays; and</li><li>(d) a contingency plan for remedial actions, such as reduction in scale and/or frequency of the PSEM displays, adjustment to the content and/or design of the PSEM, etc., as well as proposal for additional trial PSEM displays and associated air quality monitoring. This contingency plan shall be implemented in the event that the air quality sampling results during the trial PSEM displays show exceedance in any of the air quality criteria monitored.</li></ul> <p>The monitoring results of the trial PSEM displays shall be submitted to the Director within 2 weeks after the trial PSEM displays. Before submission to the Director, the above submissions shall be certified by the ET Leader and verified by the IEC as conforming to the information and recommendations contained in the VEP Application Document (VEP-326/2010).</p>	

**ETL Certification**

I hereby certify that the above referenced document/ <del>plan</del> complies with the above referenced condition of EP-249/2006/D.	
	
Ms Mandy To	Date: 2 July 2024
Environmental Team Leader	

Our ref: 0540005\_ETL Certification Cert\_AQSR\_20240702.docx

**Ocean Park Master Redevelopment Project**

**Environmental Permit No. EP-249/2006/D - Condition 2.38**

**Updated Open-air Lagoon Show with Pyrotechnic Effects  
Air Quality Sampling Report**

**Submitted by ERM-Hong Kong, Limited dated 02-07-2024**

**This is to verify that**

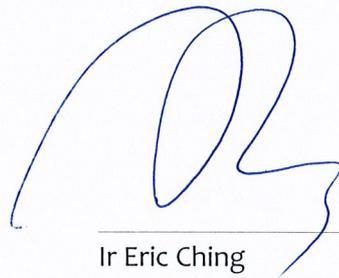
**Updated Open-air Lagoon Show with Pyrotechnic Effects  
Air Quality Sampling Report**

**Submitted by ERM-Hong Kong, Limited**

**dated 02-07-2024**

**Has been verified by the undersigned.**

Signed



\_\_\_\_\_  
Ir Eric Ching  
Independent Environmental Checker (IEC)  
Retained by Ocean Park Corporation  
pursuant to Environmental Permit No. EP-249/2006/D

Date

\_\_\_\_\_  
2 July 2024

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FIGURE 2.2 LOCATION OF AIR QUALITY MONITORING STATION AMA1A

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FIGURE 2.4 LOCATION OF AIR QUALITY MONITORING STATION AMA3

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FIGURE 2.5 LOCATION OF AIR QUALITY MONITORING STATION AMA4A

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# 1. INTRODUCTION

## 1.1 BACKGROUND

The potential air quality impact of the Ocean Park Master Redevelopment Plan (MRP) was assessed and presented in the approved *Environmental Impact Assessment Report for Repositioning and Long Term Operation Plan of Ocean Park* (AEIAR-101/2006) and an Environmental Permit (EP) (i.e. EP-249/2006) for the MRP was granted on 28 July 2006. The EP was subsequently varied and the latest version, EP-249/2006/D, was issued by the Environmental Protection Department (EPD) on 2 July 2014.

The EP holder, Ocean Park Corporation (OPC), is proposed to continue the open-air lagoon night show, namely Soul of the Ocean (SOTO) on 6 July 2024. There is a change in the number of the Pyrotechnic Special Effects Material (PSEM) displays.

According to Condition 2.39 to the current EP (i.e. EP-249/2006/D), the EP holder (i.e. OPC) shall, prior to implementing any changes, deposit with the Director of Environmental Protection (DEP) an Air Quality Sampling Plan (AQSP) and carry out air samplings under the requirements as set out in Condition 2.38 to the current EP. As per Condition 2.38 to the current EP, the monitoring results of the trial PSEM displays shall be submitted to the DEP within 2 weeks after the trial PSEM displays. The AQSP was deposited to EPD on 11 June 2024 (see **Appendix A**) and the trial PSEM displays were carried out on 18 June 2024.

## 1.2 PURPOSE OF THE AQSP

ERM-Hong Kong, Limited (ERM) has been appointed by the OPC to prepare the Air Quality Sampling Report (AQSR). The objectives of this AQSR are as follows:

- To provide air quality sampling results before and during the trial PSEM displays;
- To determine the significance of impacts from the trial PSEM displays; and
- To fulfil the requirements stated in Conditions 2.38 and 2.39 to the current EP.

## 1.3 STRUCTURE OF THE REPORT

Following this introductory section, the remainder of this AQSR is set out as follows:

- **Section 2** - Sampling Methodology;
- **Section 3** – Sampling Results and Discussion; and
- **Section 4** – Conclusion.

## 2. SAMPLING METHODOLOGY

### 2.1 SAMPLING PARAMETERS

The parameters of the air quality sampling are as follows:

- Respirable Suspended Particulates (RSP);
- Metals (i.e. Aluminium (Al), Barium (Ba), Calcium (Ca), Copper (Cu), Iron (Fe), Magnesium (Mg) and Titanium (Ti)); and
- Odour.

According to the approved *Environmental Impact Assessment Report of Construction of an International Theme Park in Penny's Bay of North Lantau together with its Essential Associated Infrastructures* (AEIAR-032/2000), it was concluded that the proposed fireworks displays would not significantly contribute to atmospheric dioxin emissions. Furthermore, the *Air Quality and Noise Monitoring During Trial Fireworks Displays Monitoring Report*, conducted under the previous EP of The Theme Park at Penny's Bay, Lantau (i.e. EP-01/059/2000/A), revealed a very low measured concentration of dioxin during the trial fireworks displays in May 2005. As a result, the monitoring of dioxin was excluded from the fireworks dress rehearsal in August 2005. Considering the similar nature between fireworks and PSEM, it is anticipated that PSEM would not be a significant source of dioxins. As a result, the sampling of dioxin has been excluded.

Odour monitoring, which primarily relies on the sense of smell, is a sensitive method for detecting the presence of odorous compounds, such as Hydrogen Sulphide (H<sub>2</sub>S). This approach is more representative for measuring odour emissions from PSEM instead of solely considering H<sub>2</sub>S emissions from PSEM.

### 2.2 SAMPLING LOCATIONS

There are four air quality monitoring stations (AQMS) for air quality sampling of the trial PSEM displays. The list of the AQMS is provided in **Table 2.1** below. The locations of the AQMS are presented in **Figures 2.1** to **2.5**. The photos of the air quality monitoring equipment setup are provided in **Appendix B**.

**TABLE 2.1 AIR QUALITY MONITORING STATIONS**

AQMS ID	AQMS Location	Sampling Height	Approx. Dist. between Lagoon Boundary and AQMS	Sampling Parameters
		(mAG)	(m)	
AMA1a (a)	Rooftop of Shops in Ocean Park (Northwest of the lagoon)	10	45	RSP, Metals, Odour
AMA2 (b)	Rooftop of Coral Building in Ocean Park	10	230	RSP, Metals
AMA3 (b)	Rooftop of Explorer R in Ocean Park	10	345	RSP, Metals

AQMS ID	AQMS Location	Sampling Height	Approx. Dist. between Lagoon Boundary and AQMS	Sampling Parameters
		(mAG)	(m)	
AMA4a (c)	Rooftop of Hong Kong Ocean Park Marriott Hotel	25	85	RSP, Metals, Odour

**Notes:**

- (a) An AQMS (ANA1) was located on the rooftop of Graham Hospital for trial PSEM displays held in December 2010. Due to the visit restriction of Graham Hospital, ANA1 has been replaced by AMA1a, which is also located northwest of the lagoon and is closer to the lagoon boundary.
- (a) AMA2 to AMA3 were the AQMS in the air quality monitoring for trial PSEM displays in December 2010.
- (b) AMA4a is a new air sensitive receiver in the vicinity of the lagoon since October 2018.

The distances between the boundary of the lagoon and AMA2 and AMA3 are much further compared to AMA1a and AMA4a. The odour concentration is inversely proportional to the distance between the boundary of the lagoon and AQMS. Therefore, it is considered that the odour concentration in AMA2 and AMA3 is relatively less representative and excluded from the odour sampling.

### 2.3 LABORATORY FOR SAMPLING AND ANALYSIS

The laboratory for analysing the air quality samples is ALS Technichem (HK) Pty Limited. The address of the laboratory is 11/F, Chung Shun Knitting Centre, 1 - 3 Wing Yip Street, Kwai Chung, New Territories, Hong Kong.

### 2.4 SAMPLING AND TESTING METHOD

The sampling and testing methods for the parameters listed in **Section 2.1** are listed in **Table 2.2**. Calibration of the equipment set out in the sampling method in **Table 2.2** has been conducted before any measurement starts.

**TABLE 2.2 SUMMARY OF THE SAMPLING AND TESTING METHOD**

Monitoring Parameters	Sampling and Testing Method	Equipment
24-hour RSP	EPA IO-2.1	High volume sampler (HVS)
24-hour Metals (Al, Ba, Ca, Cu, Fe, Mg, Ti) (a)	EPA IO-3.1 & IO-3.5	High volume sampler (HVS)
Odour (b)	BS EN 13725:2022	Plastic drum with sampling pump

**Notes:**

- (a) The samples of metals (i.e. Al, Ba, Ca, Cu, Fe, Mg, Ti) were collected from the RSP filter samples.
- (b) The US NIOSH P&CAM method, as stated in AQSP in Appendix A, is applicable for chemical measurements only, such as Hydrogen Sulphide (H<sub>2</sub>S). Most odour consist of organic compounds, but some simple compounds such as H<sub>2</sub>S and Ammonia (NH<sub>3</sub>), are also odorants. In order to include all odorants into measurements, olfactometry is conducted in accordance with the British Standards BS EN 13725:2022.

24-hour RSP sampling was conducted at four AQMS. Baseline 24-hour RSP samples were also collected from four AQMS prior to the trial PSEM displays. Additionally, metals were collected from the RSP filter samples since the detonation of PSEM generates RSP. The associated metal emissions are expected to be within this particle size range. Field blanks for RSP and metals were also collected prior to the trial PSEM displays.

Odour concentration was determined by a Forced-choice Dynamic Olfactometer under the European Standard Method (BS EN 13725:2022). This method determines the odour concentration of a gas sample using human assessors. The unit of measurement is the odour unit per cubic metre: OU<sub>E</sub>/m<sup>3</sup> (European Odour Unit). The testing involved at least five qualified panellists selected through an n-butanol odour screening test. Samples were analysed within 24 hours of collection.

## 2.5 SAMPLING PERIOD

Air sampling have been conducted before and during the trial PSEM displays. Details of the sampling periods are listed in **Table 2.3** below.

**TABLE 2.3 DETAILS ON THE SAMPLING PERIODS**

Monitoring Parameters	Baseline Monitoring (Before Trial PSEM Displays)	Impact Monitoring (During Trial PSEM Displays on 18 June 2024)
24-hour RSP and Metals (a)	<p><u>AMA1a, AMA3, AMA4a:</u> 16:00 14 June 2024 – 16:00 15 June 2024</p> <p><u>AMA2 (b):</u> 11:54 17 June 2024 – 11:54 18 June 2024</p>	<p><u>AMA1a, AMA2, AMA3, AMA4a:</u> 13:00 18 June 2024 – 13:00 19 June 2024</p>
Odour (d)	<p><u>AMA1a, AMA4a:</u> 12:49 14 June 2024 – 13:01 14 June 2024</p>	<p><u>AMA1a, AMA4a (c):</u> 19:38 18 June 2024 – 19:51 18 June 2024</p>

**Notes:**

- (a) The samples of metals (i.e. Al, Ba, Ca, Cu, Fe, Mg, Ti) were collected from the RSP filter samples.
- (b) Due to technical issues encountered during the RSP and metals sampling on 14 June 2024, RSP and metals sampling for AMA2 was re-conducted on 17 June 2024.
- (c) The trial PSEM displays have been carried out on 19:30, 18 June 2024. The first PSEM was released at about 19:40 on 18 June 2024.
- (d) The proposed collection period of 1-hour period in AQSP in Appendix A is based on US NIOSH P&CAM method. Since the sampling and testing method has been revised to BS EN 13725:2022, the monitoring periods have been revised accordingly to comply with the standard. The coverage period for baseline monitoring and impact monitoring were already conservative as it covered the whole period of trial PSEM displays.

## 3. SAMPLE RESULTS AND DISCUSSION

### 3.1 24-HOUR RSP MONITORING

24-hour RSP was monitored at four AQMS using HVS. The monitored 24-hour RSP results are summarised in **Table 3.1**.

The ambient 24-hour RSP concentrations measured were  $28\mu\text{g}/\text{m}^3$ ,  $24\mu\text{g}/\text{m}^3$ ,  $29\mu\text{g}/\text{m}^3$  and  $34\mu\text{g}/\text{m}^3$  at AMA1a, AMA2, AMA3 and AMA4a, respectively. During the background monitoring, the measured 24-hour RSP concentration was contributed by the background air quality in Wong Chuk Hang area. No construction activities were observed in the vicinity of the sampling locations.

The 24-hour RSP concentrations measured during the trial PSEM displays were  $22\mu\text{g}/\text{m}^3$ ,  $26\mu\text{g}/\text{m}^3$ ,  $25\mu\text{g}/\text{m}^3$  and  $28\mu\text{g}/\text{m}^3$  at AMA1a, AMA2, AMA3 and AMA4a, respectively. During the sampling period of the trial PSEM displays, no construction activities were observed in the vicinity of the sampling locations.

24-hour RSP concentrations measured at the EPD's Southern AQMS were used to provide the background 24-hour RSP concentration as a reference. The background 24-hour RSP concentrations measured at EPD's Southern AQMS were  $28\mu\text{g}/\text{m}^3$  <sup>(1)</sup> and  $14\mu\text{g}/\text{m}^3$  <sup>(2)</sup>, whereas those measured during the period of the trial PSEM displays were  $25\mu\text{g}/\text{m}^3$  <sup>(3)</sup>.

The measured RSP concentrations at AMA1a, AMA2, AMA3 and AMA4a were found to be similar to the background RSP concentration at the EPD's Southern AQMS and are far below the AQO criteria for 24-hour RSP. Therefore, the contribution of the trial PSEM displays to the 24-hour RSP concentration is considered limited and would not cause adverse air quality impact.

The laboratory analysis reports for RSP monitoring have been provided in **Appendix C**.

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(1) The 24-hour RSP data was retrieved from 'Past 24-hour Pollutant Concentration of individual Air Quality Monitoring stations (English)' in 'data.gov.hk' and then averaged based on the hourly RSP data in Southern AQMS collected from 17:00 on 14 June 2024, to 16:00 on 15 June 2024.

(2) The 24-hour RSP data was retrieved from 'Past 24-hour Pollutant Concentration of individual Air Quality Monitoring stations (English)' in 'data.gov.hk' and then averaged based on the hourly RSP data in Southern AQMS collected from 12:00 on 17 June 2024, to 11:00 on 18 June 2024. Some RSP data within the period are unavailable.

(3) The 24-hour RSP data was retrieved from 'Past 24-hour Pollutant Concentration of individual Air Quality Monitoring stations (English)' in 'data.gov.hk' and then averaged based on the hourly RSP data in Southern AQMS collected from 14:00 on 18 June 2024, to 13:00 on 19 June 2024.

**TABLE 3.1 SUMMARY OF RSP MONITORING RESULTS**

Sampling Location	Sampling Period	Amount in RSP Filter	24-hr RSP Conc. Extracted from Report	24-hr RSP Conc.	24-hr RSP Conc. at EPD's Southern AQMS <sup>(c)</sup>	AQO Criteria (24-hour RSP)
		(g)	(mg/m <sup>3</sup> )	(µg/m <sup>3</sup> )	(µg/m <sup>3</sup> )	(µg/m <sup>3</sup> )
AMA1a	Baseline	0.0451	0.028	28	28	100
	Impact	0.0338	0.022	22	25	100
AMA2	Baseline	0.0384	0.024	24	14	100
	Impact	0.0420	0.026	26	25	100
AMA3	Baseline	0.0468	0.029	29	28	100
	Impact	0.0396	0.025	25	25	100
AMA4a	Baseline	0.0545	0.034	34	28	100
	Impact	0.0446	0.028	28	25	100

**Notes:**

- (a) No blank-correction on the results.
- (b) Limit of Reporting: 0.010mg/m<sup>3</sup>.
- (c) Reference to 'Past 24-hour Pollutant Concentration of individual Air Quality Monitoring stations (English)' in 'data.gov.hk'. 24-hour RSP concentrations are calculated by averaging the hourly RSP concentrations measured at EPD's Southern AQMS from the respective monitoring period in each sampling location.

### 3.2 METALS

Metals were measured at four AQMS, and the results were obtained from the RSP filter samples. The measured metals results are summarised in **Table 3.2**. The concentrations of Al, Ba, Ca, Fe, Mg and Ti are below the limit of reporting (LOR). The measured Cu concentrations showed a very low concentration. The fluctuations of the results between each AQMS are likely attributed to the background levels.

In the absence of statutory guidelines for short-term measured metals concentrations in Hong Kong, Occupational Exposure Limits (OEL) are adopted for reference based on the approved *Environmental Impact Assessment Report of Construction of an International Theme Park in Penny's Bay of North Lantau together with its Essential Associated Infrastructures* (AEIAR-032/2000). The adopted OEL are summarised in **Table 3.2**.

With reference to the OEL for all metals, the measured results during baseline and impact monitoring are well below the respective OEL. Therefore, the contribution of the trial PSEM displays to the metal concentrations is considered limited and would not cause adverse air quality impact.

The laboratory analysis reports for metals concentrations have been provided in **Appendix D**.

TABLE 3.2 SUMMARY OF METAL CONCENTRATIONS

Sampling Location	Sampling Period	Metal Concentrations						
		Al	Ba	Ca	Cu	Fe	Mg	Ti
		(µg/m <sup>3</sup> )	(µg/m <sup>3</sup> )	(µg/m <sup>3</sup> )	(µg/m <sup>3</sup> )	(µg/m <sup>3</sup> )	(µg/m <sup>3</sup> )	(µg/m <sup>3</sup> )
AMA1a	Baseline	<0.5	<0.2	<4	0.08	<5	<4	<0.01
	Impact	<0.5	<0.2	<4	0.07	<5	<4	<0.01
AMA2	Baseline	<0.5	<0.2	<4	<0.02	<5	<4	<0.01
	Impact	<0.5	<0.2	<4	0.03	<5	<4	<0.01
AMA3	Baseline	<0.5	<0.2	<4	0.05	<5	<4	<0.01
	Impact	<0.5	<0.2	<4	0.04	<5	<4	<0.01
AMA4a	Baseline	<0.5	<0.2	<4	0.15	<5	<4	<0.01
	Impact	<0.5	<0.2	<4	0.22	<5	<4	<0.01
Limit of Reporting (LOR) (µg/m <sup>3</sup> )		0.5	0.2	4	0.02	5	4	0.01
Occupation Exposure Limit (8-hour) <sup>(b)</sup>	(mg/m <sup>3</sup> )	4	0.5	4 <sup>(c)</sup>	1	1	4	4
	(µg/m <sup>3</sup> )	4,000	500	4,000	1,000	1,000	4,000	4,000

**Notes:**

- (a) No blank-correction on the results.
- (b) Reference to *EH40/2005 Workplace Exposure Limit 4th Edition (2020)*, Health & Safety Executive, UK.
- (c) Calcium as Calcium carbonate.

### 3.3 ODOUR

Odour was measured at two AQMS (i.e. AMA1a, AMA4a). The measured results are summarised in **Table 3.3**.

The measured ambient odour levels at AMA1a and AMA4a during the baseline monitoring period were 15OU<sub>E</sub>/m<sup>3</sup> and 54OU<sub>E</sub>/m<sup>3</sup>, respectively. It should be noted that the measurement of AMA4a during baseline monitoring is influenced by the grassy smell that occurs after rain. The smell originates from the grass planted on the rooftop of Hong Kong Ocean Park Marriott Hotel. The measured odour levels during the trial PSEM displays at AMA1a and AMA4a are lower than the baseline monitoring. Therefore, it can be concluded that the odour contribution from the trial PSEM displays is insignificant and would not cause adverse air quality impact.

The laboratory analysis reports for odour concentrations have been provided in **Appendix E**.

**TABLE 3.3 SUMMARY OF ODOUR MONITORING RESULTS**

Sampling Location	Sampling Period	Odour Concentration	Weather Condition
		(OU <sub>E</sub> /m <sup>3</sup> )	
AMA1a	Baseline	15	Raining
	Impact	14	Cloudy
AMA4a	Baseline	54 <sup>(c)</sup>	Raining
	Impact	20	Cloudy

**Notes:**

- (a) No blank-correction on the results.
- (b) Limit of Reporting: 11OU<sub>E</sub>/m<sup>3</sup>.
- (c) Smell description from the laboratory analysis: Grassy.

## 4. CONCLUSION

Based on the sampling results presented in **Section 3**, measurements were taken for RSP, metals, and odour before and during the trial PSEM displays.

The measured RSP concentrations during the trial PSEM displays were similar to the background RSP concentration at the EPD's Southern AQMS and are far below the AQO criteria for 24-hour RSP. Therefore, the 24-hour RSP contribution from the trial PSEM displays is considered limited and adverse air quality impact on RSP is not expected.

Regarding metals, the measured results for Cu showed very low concentrations, likely due to the fluctuations in the background levels. Concentrations for Al, Ba, Ca, Fe, Mg and Ti were below LOR. Since there are no specific statutory guidelines for short-term metal concentrations in Hong Kong, OEL referenced from the previously approved EIA Report was adopted. All measured metal concentrations are well below the referenced OEL. Therefore, the contribution of metals from the trial PSEM displays is considered limited. It can be concluded that the adverse air quality impact on metals is not expected.

In terms of odour contribution, the measured odour levels during the trial PSEM displays were lower than the baseline monitoring. Thus, the odour contribution from the trial PSEM displays is insignificant and adverse air quality impact due to the trial PSEM displays is not expected.

Based on the monitoring results of the trial PSEM displays, it can be concluded that the open-air lagoon night show "Soul of the Ocean" (SOTO) would not cause any significant air quality impacts on the surrounding environment.

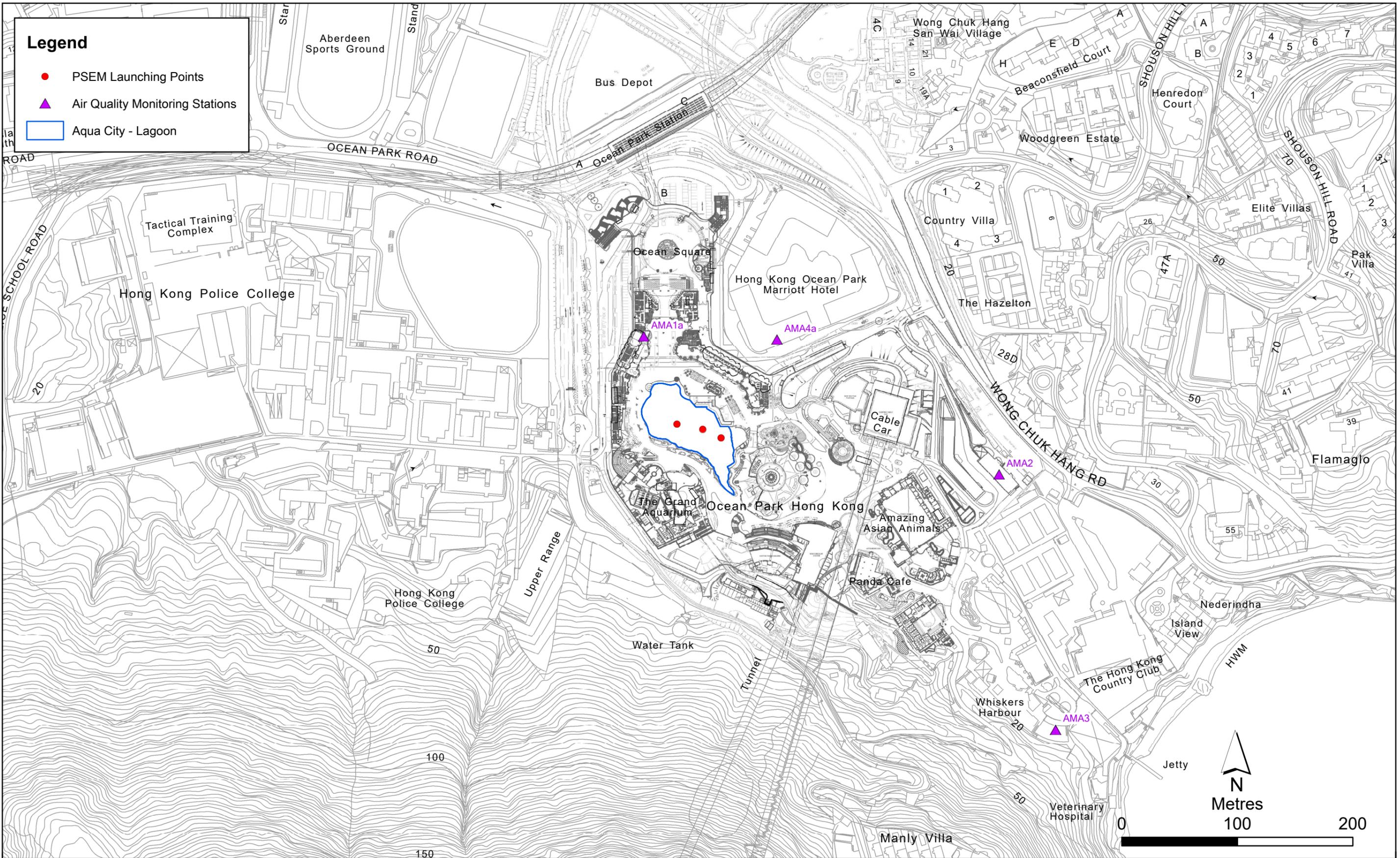


Figure 2.1

Locations of Air Quality Monitoring Stations



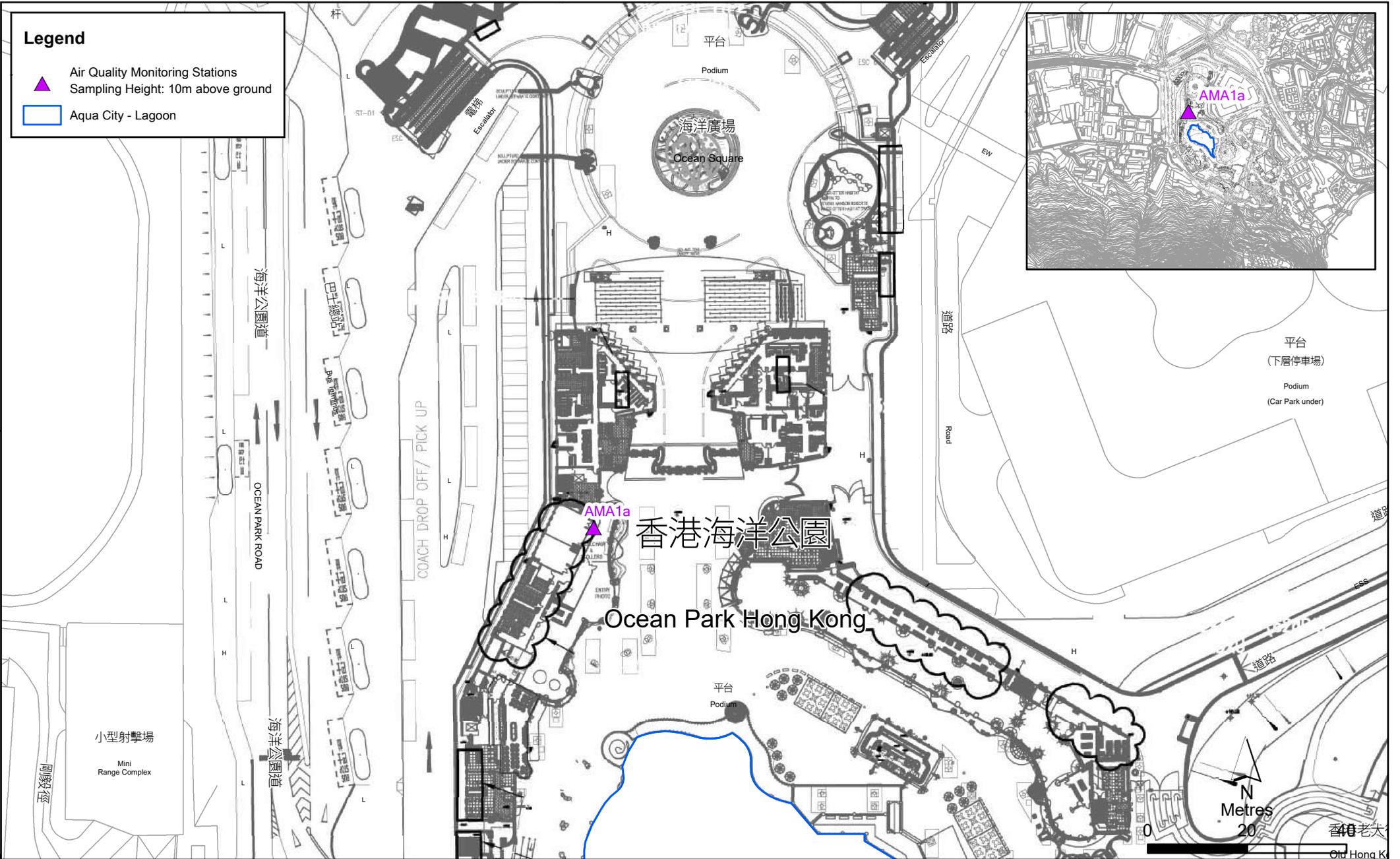


Figure 2.2

Location of Air Quality Monitoring Station AMA1a

Scale: 1:1000





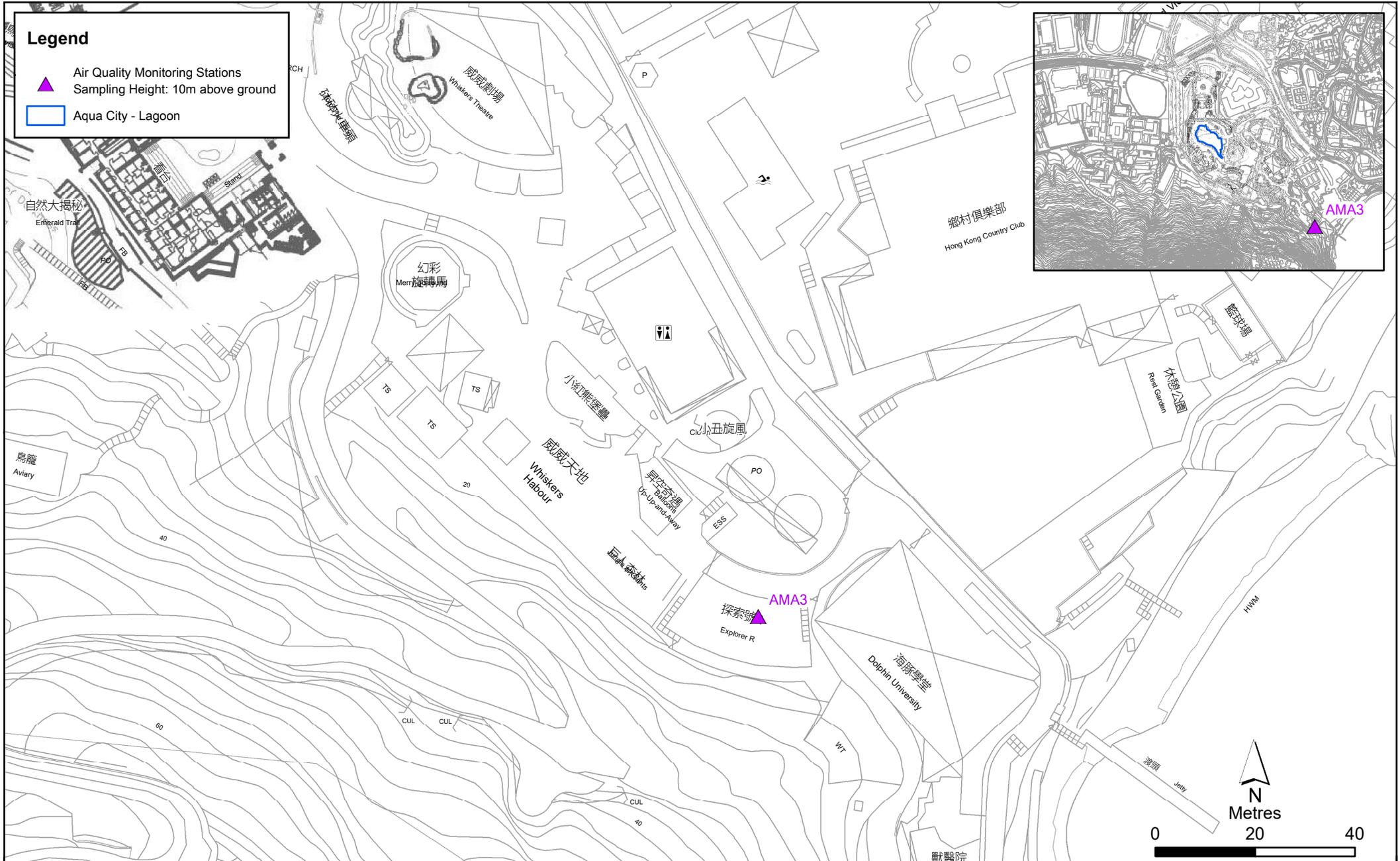


Figure 2.4

Location of Air Quality Monitoring Station AMA3

Scale: 1:1000







APPENDIX A AIR QUALITY SAMPLING PLAN



# Updated Open-air Lagoon Show with Pyrotechnic Effects

Air Quality Sampling Plan

PREPARED FOR



Ocean Park Corporation

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6 June 2024

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**Reference EP Condition**

Environmental Permit Condition: 2.39

The PSEM displays as part of the open-air lagoon show in Aqua City shall be designed and operated in accordance with the VEP Application Document (VEP-326/2010). If there are any changes proposed to the PSEM displays, such as scale, frequency and/or design of the PSEM display including the chemical content, launch location and launch height of PSEM, the Permit Holder shall, prior to implementing any such changes, deposit with the Director an air quality sampling plan and carry out air samplings according to the requirements as set out in Condition 2.38 above.

**ETL Certification**

I hereby certify that the above referenced document/~~plan~~ complies with the above referenced condition of EP-249/2006/D.

Ms Mandy To  
Environmental Team Leader

Date: 11 June 2024

*Our ref: 0540005\_ETL Certification Cert\_AQSP\_20240611.docx*

**Ocean Park Master Redevelopment Project**

**Environmental Permit No. EP-249/2006/D - Condition 2.39**

**Updated Open-air Lagoon Show with Pyrotechnic Effects  
Air Quality Sampling Plan**

**Submitted by ERM-Hong Kong, Limited dated 06-06-2024**

**This is to verify that**

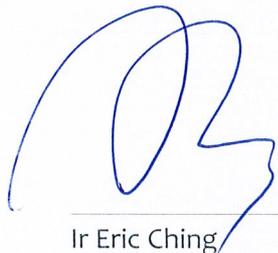
**Updated Open-air Lagoon Show with Pyrotechnic Effects  
Air Quality Sampling Plan**

**Submitted by ERM-Hong Kong, Limited**

**dated 06-06-2024**

**Has been verified by the undersigned.**

Signed



Ir Eric Ching  
Independent Environmental Checker (IEC)  
Retained by Ocean Park Corporation  
pursuant to Environmental Permit No. EP-249/2006/D

Date

11 June 2024

SIGNATURE PAGE

# Updated Open-air Lagoon Show with Pyrotechnic Effects

## Air Quality Sampling Plan

0540005



---

**Terence Fong**

Partner

ERM-Hong Kong, Limited  
2507, One Harbourfront  
18 Tak Fung Street  
Hung Hom, Kowloon  
Hong Kong  
T +852 2271 3000

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## 1. INTRODUCTION

### 1.1 BACKGROUND

The potential air quality impact of the Ocean Park Master Redevelopment Plan (MRP) has been assessed and presented in the *Environmental Impact Assessment Report for Repositioning and Long Term Operation Plan of Ocean Park* (AEIAR-101/2006) (hereinafter referred to as the approved EIA Report), and an Environmental Permit (EP), number EP-249/2006, for the MRP was granted on 28 July 2006. The EP was varied subsequently with the latest version, number EP-249/2006/D, issued by the Environmental Protection Department (EPD) on 2 July 2014.

The EP holder, Ocean Park Corporation (OPC), is proposed to continue to perform the open-air lagoon night show, namely Soul of the Ocean (SOTO), on 6 July 2024. There is a change in the number of uses of the Pyrotechnic Special Effects Material (PSEM) displays.

According to Condition 2.39 to the current EP (i.e. EP-249/2006/D), OPC shall, prior to implementing any changes, deposit with the Director of Environmental Protection (DEP) an air quality sampling plan (AQSP) and carry out air samplings according to the requirements as set out in Condition 2.38 to the current EP.

### 1.2 PURPOSE OF THE AQSP

ERM-Hong Kong, Limited (ERM) has been appointed by the OPC to prepare the AQSP. The objective of this AQSP is to fulfil the submission requirements for Condition 2.39 to the current EP for mitigating air quality impacts. This AQSP details the air quality monitoring before and during the trial PSEM displays.

### 1.3 STRUCTURE OF THE REPORT

Following this introductory section, the remainder of this AQSP is set out as follows:

- Section 2 - Air Quality Sampling Locations;
- Section 3 - Monitoring Methodology;
- Section 4 - Results and Reporting; and
- Section 5 – Contingency Plan.

## 2. AIR QUALITY SAMPLING LOCATIONS

### 2.1 SAMPLING LOCATIONS

It is proposed to carry out the air quality monitoring at four (4) air quality monitoring stations (AQMS). The list of the AQMS is provided in **Table 2.1** below. The figures of the AQMS are presented in **Figures 2.1** to **2.5**.

**TABLE 2.1 AIR QUALITY MONITORING STATIONS**

AQMS ID	AQMS Location	Sampling Height (mAG)
AMA1a	Rooftop of Shops in Ocean Park (North-west of the lagoon)	10
AMA2	Rooftop of Coral Building in Ocean Park	10

AQMS ID	AQMS Location	Sampling Height (mAG)
AMA3	Rooftop of Explorer R in Ocean Park	10
AMA4a	Rooftop of Hong Kong Ocean Park Marriott Hotel	25

**Notes:**

- (a) Due to the visit restriction of AMA1 Graham Hospital, AMA1a is proposed which is in the vicinity of the lagoon.
- (b) AMA2 to AMA3 are the AQMS in the air quality monitoring for trial displays in December 2010.
- (c) AMA4a is a new air sensitive receiver in the vicinity of the lagoon since October 2018.

### 3. MONITORING METHODOLOGY

#### 3.1 MONITORING PARAMETERS AND MONITORING CRITERIA

The parameters of the air quality monitoring are as follows:

- Respirable Suspended Particulates (RSP);
- Metals (i.e. Aluminium (Al), Barium (Ba), Calcium (Ca), Copper (Cu), Iron (Fe), Magnesium (Mg) and Titanium (Ti)); and
- Odour.

The sampling and testing method and the number of samples for the above parameters are listed in **Table 3.1**. Calibration of the equipment set out in the sampling method in **Table 3.1** will be conducted before the measurement starts.

**TABLE 3.1 SAMPLING METHOD AND NUMBER OF SAMPLES**

Monitoring Parameters	Monitoring Frequency	Sampling and Testing Method	Monitoring Locations	Number of Baseline Samples	Number of Samples During Trial Displays
RSP	24-hour	EPA IO-2.1	AMA1a, AMA2, AMA3, AMA4a	4	4
Metals (Al, Ba, Cu, Ca, Fe, Mg, Ti) <sup>(a)</sup>	24-hour	EPA IO-3.1 & IO-3.5		4	4
Odour	1-hour	US NIOSH P&CAM Method	AMA1a, AMA4a	2	2

**Note:** (a) 24-hour RSP filter samples will be extracted for metal analysis for all events.

#### 3.2 MONITORING PERIOD AND MONITORING FREQUENCY

Two (2) sampling periods, which are before the trial displays, and during the trial displays, will be established. The trial displays are proposed to start at 19:00hrs on 18 June 2024.

RSP will be measured for 24 hours before the trial displays (i.e. no PSEM displays) to obtain the RSP background level. The impact of 24-hour RSP levels during the trial displays will be measured starting from 6 hours before the trial displays (i.e. 13:00hrs, 18 June 2024). In addition, the sample of metals (i.e. Al, Ba, Cu, Ca, Fe, Mg, Ti) will also be collected from the RSP filter sample.

For odour measurement, two (2) samples (i.e. for baseline monitoring and impact monitoring) will be collected over a 1-hour period in each sampling period (i.e. before the trial displays,

and during the trial displays) at monitoring locations AMA1a and AMA4a. The baseline sampling will be conducted from 17:00hrs to 18:00hrs on 18 June 2024. The impact monitoring sampling (i.e. during the trial displays) will be started at least 10 minutes before the trial displays start.

General weather information, such as air temperature, relative humidity, wind speed and wind direction measured at Wong Chuk Hang Weather Station operated by the Hong Kong Observatory on the measurement date will be provided as reference.

## 4. RESULTS AND REPORTING

### 4.1 MONITORING REPORT

The *Monitoring Report* will describe the above monitoring requirements and weather data and present the monitoring results. The laboratory analysis reports will be appended to the *Monitoring Report*.

The monitoring results during trial displays will be compared with the baseline monitoring results. Monitored data measured at the relevant EPD'S AQMSs will also be referenced in the *Monitoring Report*.

## 5. CONTINGENCY PLAN

Should the impact monitoring results of any of the parameters stated in **Table 3.1** exceed the relevant AQOs or acute reference exposure levels, notice of exceedance will be issued to the ET Leader, IEC and OPC. Investigations will be taken, and if the exceedance is confirmed due to the trial displays, it is proposed to carry out additional trial displays and re-measure the parameters which show exceedance to confirm the exceedance. The monitoring method and period will follow that described in **Section 3**.

Should the re-measurements show exceedance and confirm that it is due to the trial displays, ET Leader, IEC and OPC will be notified and OPC will review the chemical composition or content of the PSEM and/or design of the PSEM displays. Monitoring of all parameters will be performed during the adjusted trial displays. Should the measurements still show exceedances after reviewing the chemical composition or content of the PSEM and /or design of the PSEM displays, OPC should consider a reduction in scale and/or frequency of the PSEM displays.

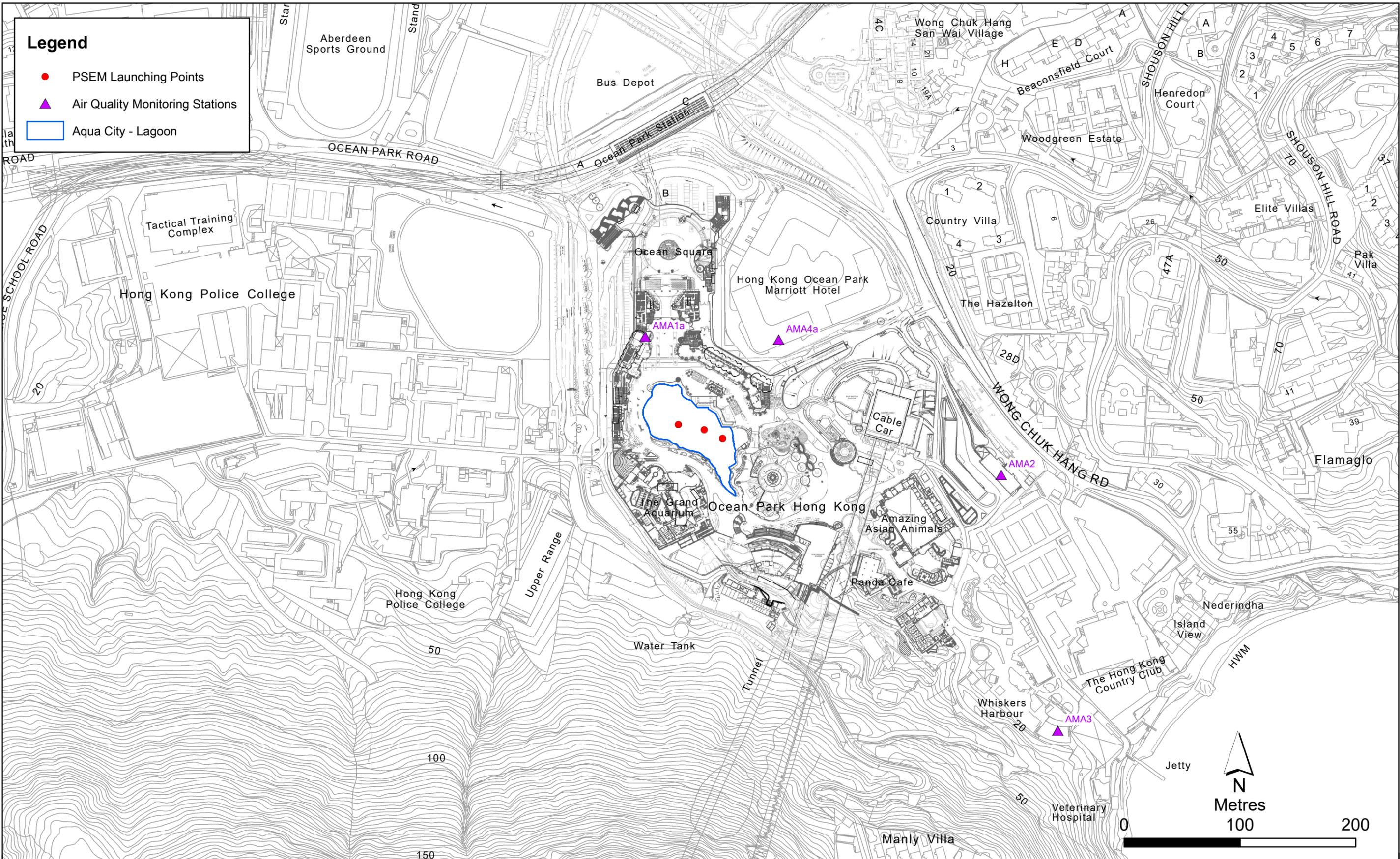
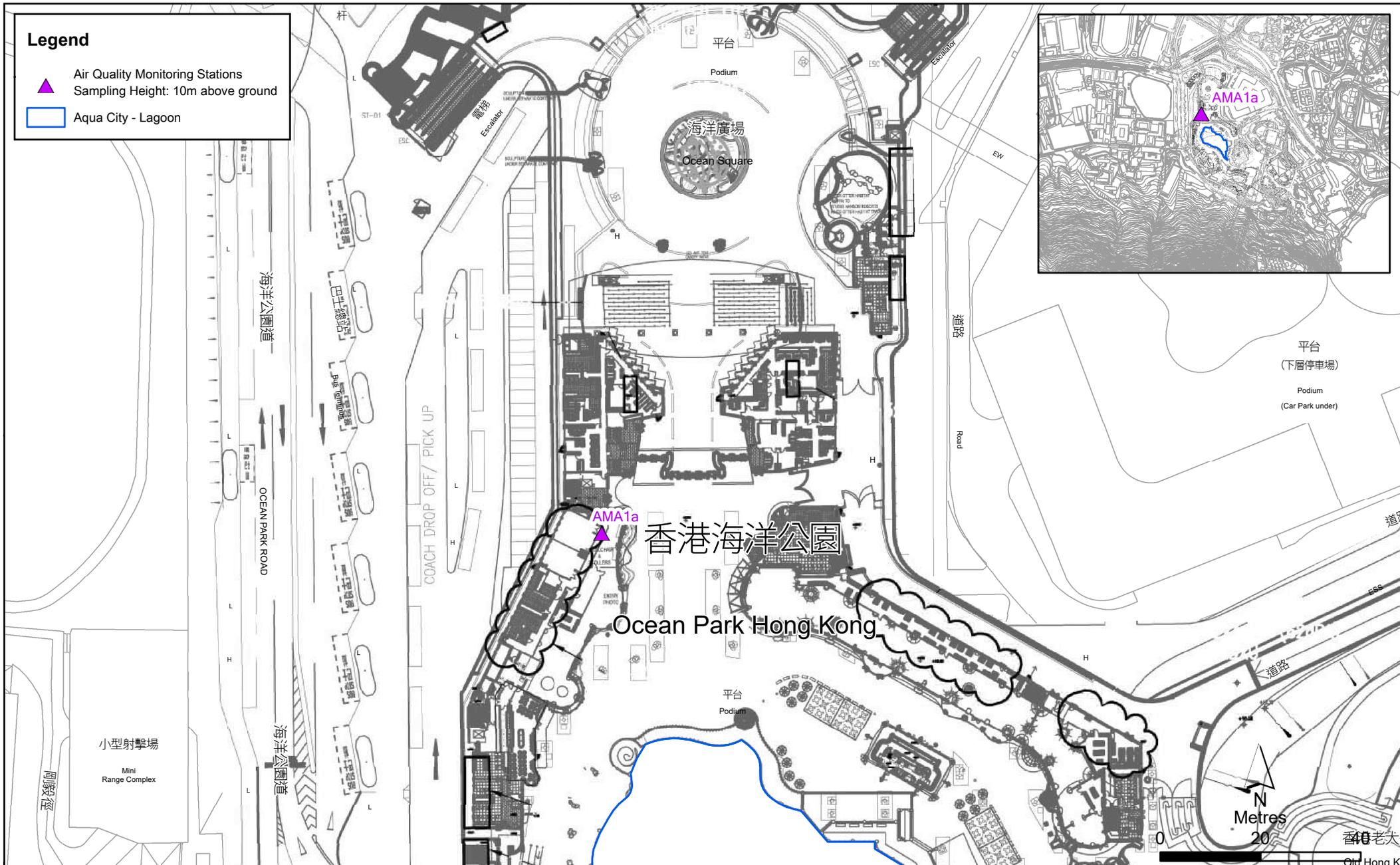


Figure 2.1

Locations of Air Quality Monitoring Stations





APPENDIX A - AIR QUALITY SAMPLING PLAN

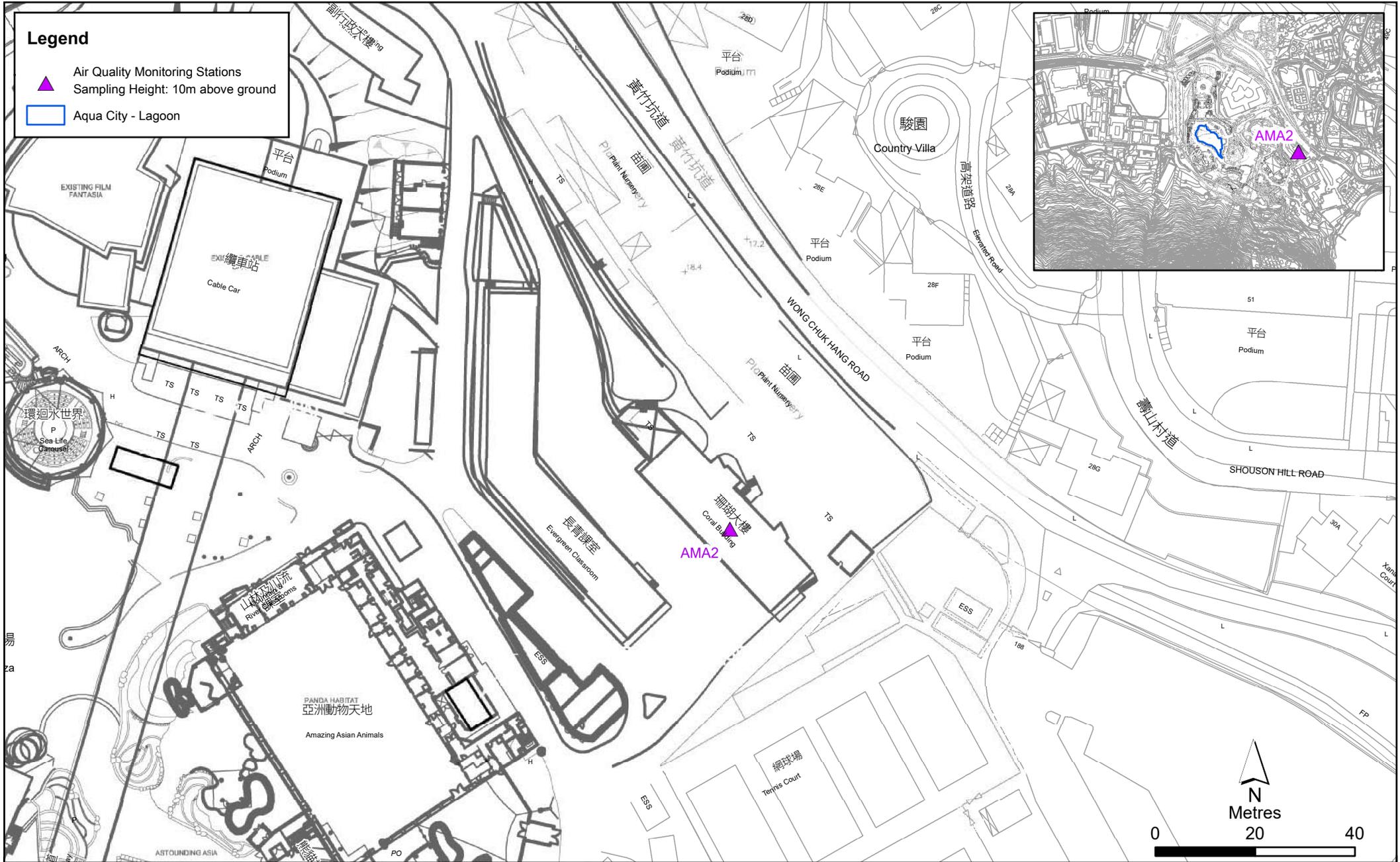


Figure 2.3

Location of Air Quality Monitoring Station AMA2

Scale: 1:1000



APPENDIX A - AIR QUALITY SAMPLING PLAN

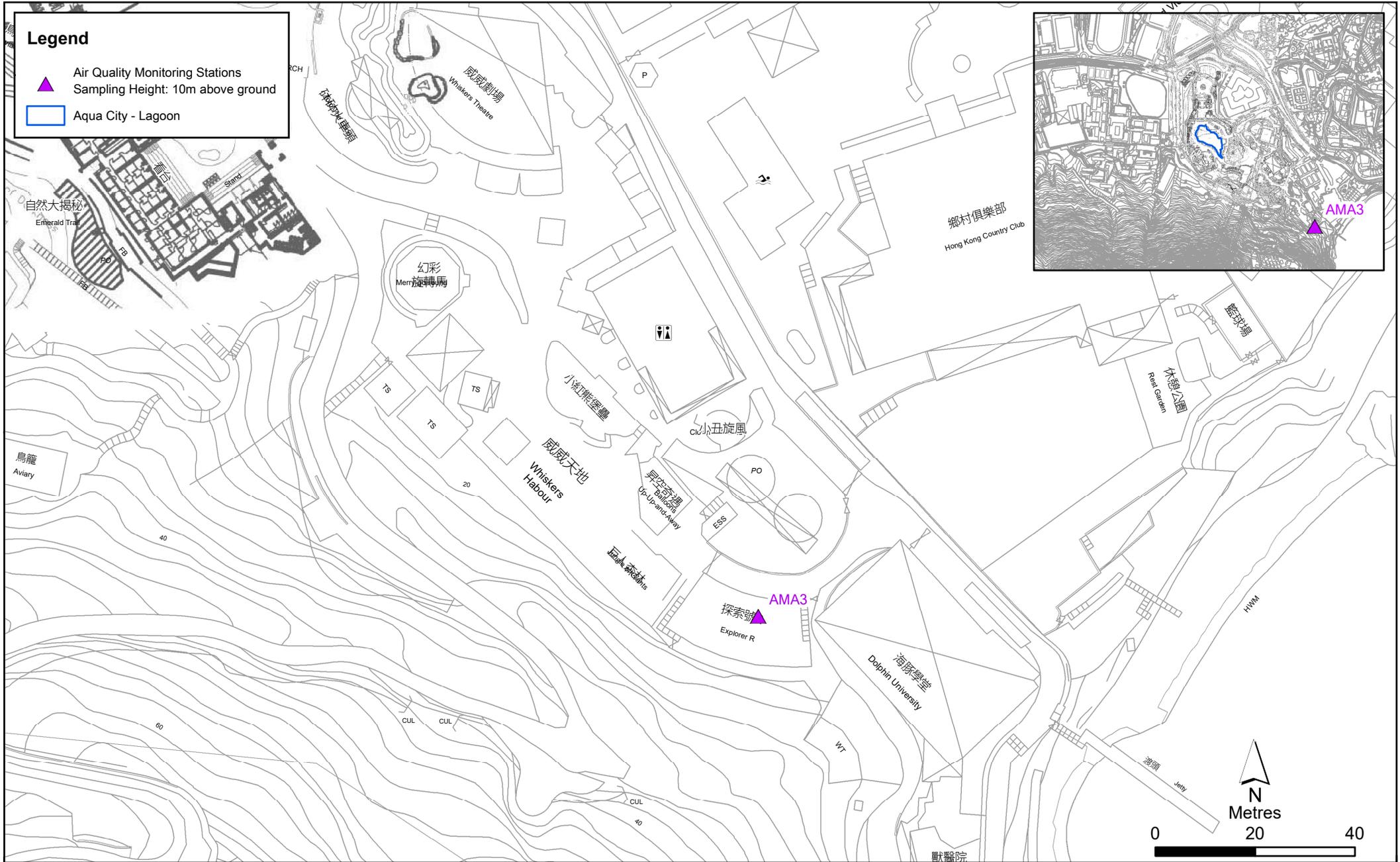
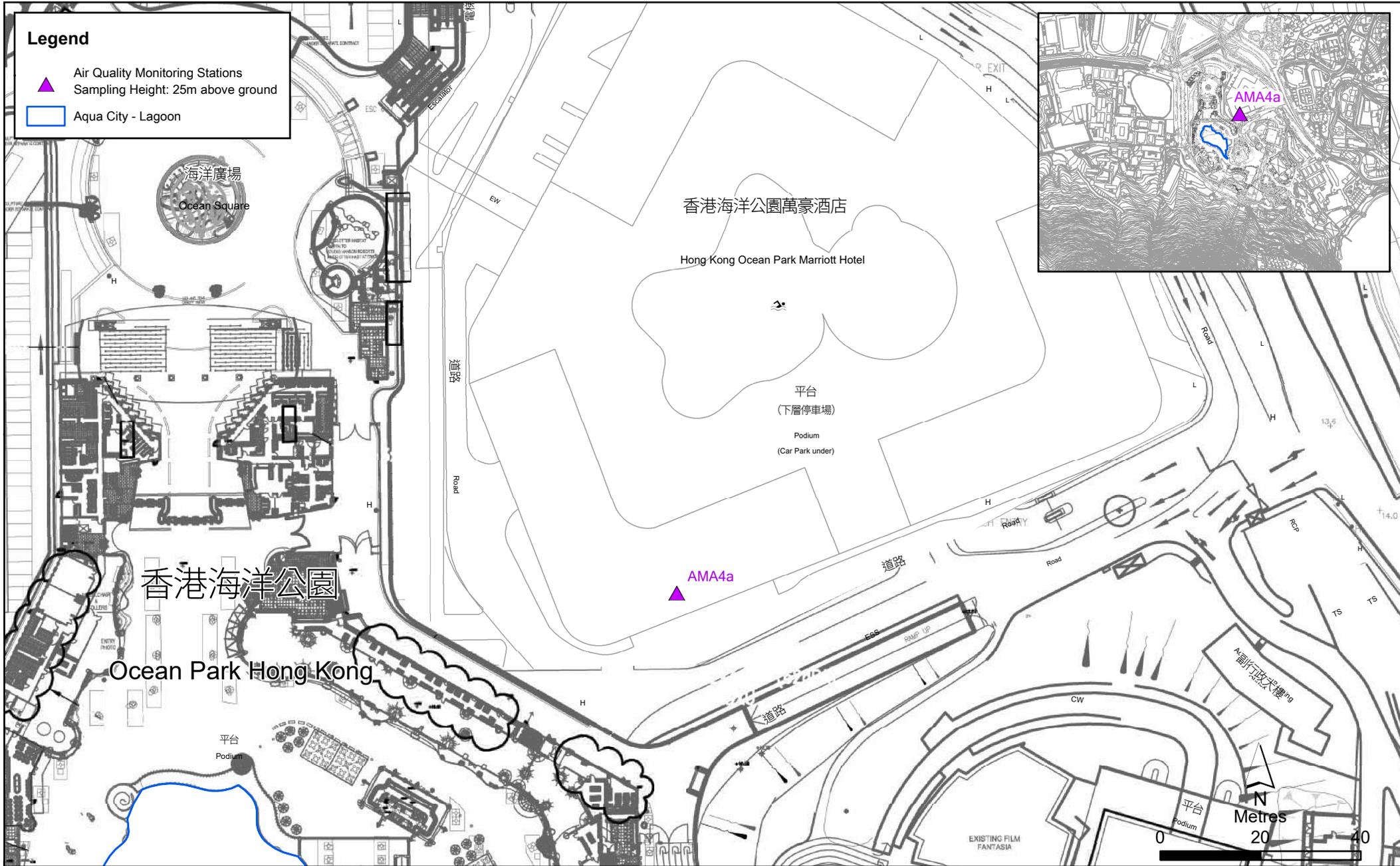


Figure 2.4

Location of Air Quality Monitoring Station AMA3

Scale: 1:1000







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Guyana	South Korea
Hong Kong	Spain
India	Switzerland
Indonesia	Taiwan
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Italy	Thailand
Japan	UAE
Kazakhstan	UK
Kenya	US
Malaysia	Vietnam
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**ERM Hong Kong**

2507, One Harbourfront  
18 Tak Fung Street  
Hung Hom, Kowloon  
Hong Kong

T: +852 2271 3000

F: +852 3015 8052

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APPENDIX B

PHOTO OF AIR QUALITY MONITORING  
EQUIPMENT SET-UP

**APPENDIX B - PHOTO OF AIR QUALITY MONITORING EQUIPMENT SET-UP**

**AMA1a**

Rooftop of Shops in Ocean Park  
(Northwest of the lagoon)



**AMA2**

Rooftop of Coral Building in Ocean Park



**AMA3**

Rooftop of Explorer R in Ocean Park



**AMA4a**

Rooftop of Hong Kong Ocean Park Marriott Hotel





APPENDIX C

LABORATORY RESULT REPORT  
(24-HOUR RSP MONITORING)



### CERTIFICATE OF ANALYSIS

Client	: ERM HONG KONG	Laboratory	: ALS Technichem (HK) Pty Ltd	Page	: 1 of 3
Contact	: CHRIS HOI	Contact	: Richard Fung	Work Order	: HK2424087
Address	: 2507, 25/F, ONE HARBOURFRONT, 18 TAK FUNG STREET, HUNG HOM, KOWLOON, HONG KONG	Address	: 11/F., Chung Shun Knitting Centre, 1 - 3 Wing Yip Street, Kwai Chung, N.T., Hong Kong		
E-mail	: Chris.Hoi@erm.com	E-mail	: richard.fung@alsglobal.com		
Telephone	: +852 2271 3118	Telephone	: +852 2610 1044		
Facsimile	: +852 2723 5660	Facsimile	: +852 2610 2021		
Project	: AIR QUALITY SAMPLING PLAN OF UPDATED OPEN-AIR LAGOON SHOW WITH PYROTECHNIC EFFECTS			Date Samples Received	: 17-Jun-2024
Order number	: ---	Quote number	: HKE/1741/2024_V4	Issue Date	: 27-Jun-2024
C-O-C number	: ---			No. of samples received	: 5
Site	: HONG KONG OCEAN PARK			No. of samples analysed	: 4

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<i>Signatories</i>	<i>Position</i>	<i>Authorised results for</i>
		
Fung Lim Chee, Richard	Managing Director	Inorganics



### **General Comments**

This report supersedes any previous report(s) with the same work order number. All pages of this report have been checked and approved for release. When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes. Testing period is from 17-Jun-2024 to 27-Jun-2024.

Key: LOR = Limit of reporting; CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.

### **Specific Comments for Work Order: HK2424087**

Sample information (Project name, Sample ID, Sampling date/time, etc.) is provided by client.

Result(s) of sample(s) is/are reported on as received basis, unless otherwise specified. The result(s) is/are related only to the item(s) tested.

Sample(s) was/ were submitted by client. Sample(s) arrived laboratory in ambient condition.

---



**Analytical Results**

Sub-Matrix: FILTER (TSP/RSP)

				Sample ID	AMA1a	AMA3	AMA4a	Field Blank	---
				Sampling date / time	14-Jun-2024	14-Jun-2024	14-Jun-2024	14-Jun-2024	---
Compound	CAS Number	LOR	Unit		HK2424087-001	HK2424087-003	HK2424087-004	HK2424087-005	-----
<b>EA/ED: Physical and Aggregate Properties</b>									
HK-RSP: Respirable Suspended Particulate	----	0.010	mg/m <sup>3</sup>		0.028	0.029	0.034	<0.010	----
HK-RSP: Respirable Suspended Particulate	----	0.0010	g		0.0451	0.0468	0.0545	<0.0010	----
HK-RSP: Initial Weight	----	0.0010	g		4.4336	4.4276	4.4280	4.4288	----
HK-RSP: Final Weight	----	0.0010	g		4.4787	4.4744	4.4825	4.4290	----

----- END OF REPORT -----



### CERTIFICATE OF ANALYSIS

Client	: ERM HONG KONG	Laboratory	: ALS Technichem (HK) Pty Ltd	Page	: 1 of 3
Contact	: CHRIS HOI	Contact	: Richard Fung	Work Order	: HK2424261
Address	: 2507, 25/F, ONE HARBOURFRONT, 18 TAK FUNG STREET, HUNG HOM, KOWLOON, HONG KONG	Address	: 11/F., Chung Shun Knitting Centre, 1 - 3 Wing Yip Street, Kwai Chung, N.T., Hong Kong		
E-mail	: Chris.Hoi@erm.com	E-mail	: richard.fung@alsglobal.com		
Telephone	: +852 2271 3118	Telephone	: +852 2610 1044		
Facsimile	: +852 2723 5660	Facsimile	: +852 2610 2021		
Project	: AIR QUALITY SAMPLING PLAN OF UPDATED OPEN-AIR LAGOON SHOW WITH PYROTECHNIC EFFECTS			Date Samples Received	: 18-Jun-2024
Order number	: ---	Quote number	: HKE/1741/2024_V4	Issue Date	: 27-Jun-2024
C-O-C number	: ---			No. of samples received	: 1
Site	: HONG KONG OCEAN PARK			No. of samples analysed	: 1

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<i>Signatories</i>	<i>Position</i>	<i>Authorised results for</i>
		
Fung Lim Chee, Richard	Managing Director	Inorganics



### ***General Comments***

This report supersedes any previous report(s) with the same work order number. All pages of this report have been checked and approved for release. When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes. Testing period is from 18-Jun-2024 to 27-Jun-2024.

Key: LOR = Limit of reporting; CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.

### **Specific Comments for Work Order: HK2424261**

Sample information (Project name, Sample ID, Sampling date/time, etc.) is provided by client.

Result(s) of sample(s) is/are reported on as received basis, unless otherwise specified. The result(s) is/are related only to the item(s) tested.

---



**Analytical Results**

Sub-Matrix: FILTER (TSP/RSP)

Sample ID

AMA2

---

---

---

---

Sampling date / time

17-Jun-2024

---

---

---

---

Compound	CAS Number	LOR	Unit	AMA2	---	---	---	---
				HK2424261-001	-----	-----	-----	-----

**EA/ED: Physical and Aggregate Properties**

HK-RSP: Respirable Suspended Particulate	----	0.010	mg/m <sup>3</sup>	0.024	---	---	---	---
HK-RSP: Respirable Suspended Particulate	----	0.0010	g	0.0384	---	---	---	---
HK-RSP: Initial Weight	----	0.0010	g	4.3906	---	---	---	---
HK-RSP: Final Weight	----	0.0010	g	4.4290	---	---	---	---

----- END OF REPORT -----



### CERTIFICATE OF ANALYSIS

Client	: ERM HONG KONG	Laboratory	: ALS Technichem (HK) Pty Ltd	Page	: 1 of 3
Contact	: CHRIS HOI	Contact	: Richard Fung	Work Order	: HK2424446
Address	: 2507, 25/F, ONE HARBOURFRONT, 18 TAK FUNG STREET, HUNG HOM, KOWLOON, HONG KONG	Address	: 11/F., Chung Shun Knitting Centre, 1 - 3 Wing Yip Street, Kwai Chung, N.T., Hong Kong		
E-mail	: Chris.Hoi@erm.com	E-mail	: richard.fung@alsglobal.com		
Telephone	: +852 2271 3118	Telephone	: +852 2610 1044		
Facsimile	: +852 2723 5660	Facsimile	: +852 2610 2021		
Project	: AIR QUALITY SAMPLING PLAN OF UPDATED OPEN-AIR LAGOON SHOW WITH PYROTECHNIC EFFECTS			Date Samples Received	: 19-Jun-2024
Order number	: ---	Quote number	: HKE/1741/2024_V4	Issue Date	: 27-Jun-2024
C-O-C number	: ---			No. of samples received	: 5
Site	: HONG KONG OCEAN PARK			No. of samples analysed	: 5

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### **Specific Comments for Work Order: HK2424446**

Sample information (Project name, Sample ID, Sampling date/time, etc.) is provided by client.

Result(s) of sample(s) is/are reported on as received basis, unless otherwise specified. The result(s) is/are related only to the item(s) tested.

Sample(s) was/ were submitted by client. Sample(s) arrived laboratory in ambient condition.

---



**Analytical Results**

Sub-Matrix: FILTER (TSP/RSP)

				AMA1a	AMA2	AMA3	AMA4a	Field blank
				18-Jun-2024	18-Jun-2024	18-Jun-2024	18-Jun-2024	18-Jun-2024
Compound	CAS Number	LOR	Unit	HK2424446-001	HK2424446-002	HK2424446-003	HK2424446-004	HK2424446-005
<b>EA/ED: Physical and Aggregate Properties</b>								
HK-RSP: Respirable Suspended Particulate	----	0.010	mg/m <sup>3</sup>	0.022	0.026	0.025	0.028	<0.010
HK-RSP: Respirable Suspended Particulate	----	0.0010	g	0.0338	0.0420	0.0396	0.0446	<0.0010
HK-RSP: Initial Weight	----	0.0010	g	4.4310	4.4128	4.4091	4.4144	4.4051
HK-RSP: Final Weight	----	0.0010	g	4.4648	4.4548	4.4487	4.4590	4.4060

----- END OF REPORT -----



APPENDIX D

LABORATORY RESULT REPORT  
(24-HOUR METAL MONITORING)



ALS Technichem (HK) Pty Ltd

11/F., Chung Shun Knitting Centre,

1 - 3 Wing Yip Street,

Kwai Chung, N.T., Hong Kong

T: +852 2610 1044

F: +852 2610 2021

www.alsglobal.com

## CERTIFICATE OF ANALYSIS

**CONTACT:** CHRIS HOI  
**CLIENT:** ERM HONG KONG  
**ADDRESS:** 2507, 25/F, ONE HARBOURFRONT,  
18 TAK FUNG STREET, HUNG HOM,  
KOWLOON, HONG KONG  
**PROJECT:** AIR QUALITY SAMPLING PLAN OF UPDATED OPEN-  
AIR LAGOON SHOW WITH PYROTECHNIC EFFECTS

**WORK ORDER:** HK2424087  
**SUB BATCH:** 1  
**LABORATORY:** HONG KONG  
**DATE RECEIVED:** 17-Jun-2024  
**DATE OF ISSUE:** 27-Jun-2024  
**SAMPLE TYPE:** AIR  
**NO. OF SAMPLES:** 4

### SPECIFIC COMMENTS

Sample information (Project name, Sample ID, Sampling date/time, etc.) is provided by client.  
Result(s) of sample(s) is/are reported on as received basis, unless otherwise specified.  
The result(s) related only to the item(s) tested.  
Samples(s) was/ were submitted by client. Sample(s) arrived laboratory in ambient condition.  
Testing period is from 17-Jun-2024 to 24-Jun-2024.  
LOR denotes Limit of Reporting.

### GENERAL COMMENTS

This report superseded any previous report(s) with same work order number.

Mr Leung Chak Cheong, Mike  
Assistant Manager - Metals

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# CERTIFICATE OF ANALYSIS



**Work Order:** HK2424087  
**Sub-Batch:** 1  
**Date of Issue:** 27-Jun-2024  
**Client:** ERM HONG KONG

METHOD REFERENCE	ANALYSIS DESCRIPTION	LABORATORY I.D. :		HK2424087-001	HK2424087-003	HK2424087-004	--
		DATE SAMPLED :		14-Jun-2024	14-Jun-2024	14-Jun-2024	--
		UNIT	LOR	AMA1a	AMA3	AMA4a	--
USEPA IO-3.1 USEPA 6020A/ ICPMS	Aluminium (Al)	µg/m <sup>3</sup>	0.5	<0.5	<0.5	<0.5	--
USEPA IO-3.1 USEPA 6020A/ ICPMS	Barium (Ba)	µg/m <sup>3</sup>	0.2	<0.2	<0.2	<0.2	--
USEPA IO-3.1 USEPA 6020A/ ICPMS	Copper (Cu)	µg/m <sup>3</sup>	0.02	0.08	0.05	0.15	--
USEPA IO-3.1 USEPA 6020A/ ICPMS	Calcium (Ca)	µg/m <sup>3</sup>	4	<4	<4	<4	--
USEPA IO-3.1 USEPA 6020A/ ICPMS	Iron (Fe)	µg/m <sup>3</sup>	5	<5	<5	<5	--
USEPA IO-3.1 USEPA 6020A/ ICPMS	Magnesium (Mg)	µg/m <sup>3</sup>	4	<4	<4	<4	--
USEPA IO-3.1 USEPA 6020A/ ICPMS	Titanium (Ti)	µg/m <sup>3</sup>	0.01	<0.01	<0.01	<0.01	--

# CERTIFICATE OF ANALYSIS



**Work Order:** HK2424087  
**Sub-Batch:** 1  
**Date of Issue:** 27-Jun-2024  
**Client:** ERM HONG KONG

METHOD REFERENCE	ANALYSIS DESCRIPTION	LABORATORY I.D. :		HK2424087-005	--	--	--
		DATE SAMPLED :		14-Jun-2024	--	--	--
		UNIT	LOR	Field Blank	--	--	--
USEPA IO-3.1 USEPA 6020A/ ICPMS	Aluminium (Al)	µg/sample	500	<500	--	--	--
USEPA IO-3.1 USEPA 6020A/ ICPMS	Barium (Ba)	µg/sample	200	<200	--	--	--
USEPA IO-3.1 USEPA 6020A/ ICPMS	Copper (Cu)	µg/sample	20	<20	--	--	--
USEPA IO-3.1 USEPA 6020A/ ICPMS	Calcium (Ca)	µg/sample	4000	<4000	--	--	--
USEPA IO-3.1 USEPA 6020A/ ICPMS	Iron (Fe)	µg/sample	5000	<5000	--	--	--
USEPA IO-3.1 USEPA 6020A/ ICPMS	Magnesium (Mg)	µg/sample	4000	<4000	--	--	--
USEPA IO-3.1 USEPA 6020A/ ICPMS	Titanium (Ti)	µg/sample	10	<10	--	--	--



## Air Quality (RSP) Monitoring Data Sheet

Location ID: **AMA1a**

ALS Lab ID: **HK2424087 -001**

Details of Location: **Rooftop of shops in Ocean Park (north-west of the lagoon)**

<b>Filter Identification No.</b>		<b>QM13</b>
Start	Date	14/6/2024
	Time	16:00
Finish	Date	15/6/2024
	Time	16:00
Elapse Time	Initial	3487.25
	Final	3511.25
Total Sampling Time (hrs)		24 Hrs
Weather Conditions		Rainy
Pressure (mmHg)	Initial	753.1
	Final	753.5
Temperature (°C)	Initial	29.7
	Final	28.2
Flow Rate (m <sup>3</sup> /min.)	Initial	1.12
	Final	1.12
	Average	1.12
Total Volume (Std m <sup>3</sup> )		1616
Filter Weight (g)	Initial	4.4336
	Final	4.4787
Measured RSP Level (mg/m <sup>3</sup> )		0.028

Sampling by:

Signatory:

Name In Block:

Gary Ng

Company:

Action-United Environmental Services & Consulting

Date:

25/6/2024

Data Checked by:

Signatory:

Name In Block:

Martin Li

Company:

Action-United Environmental Services & Consulting

Date:

25/6/2024



# Air Quality (RSP) Monitoring Data Sheet

Location ID: **AMA3**

ALS Lab ID: **HK2424087 -003**

Details of Location: **Rooftop of Pinniped House in Ocean Park**

<b>Filter Identification No.</b>		QM12
Start	Date	14/6/2024
	Time	16:00
Finish	Date	15/6/2024
	Time	16:00
Elapse Time	Initial	31572.83
	Final	31596.83
Total Sampling Time (hrs)		24 Hrs
Weather Conditions		Rainy
Pressure (mmHg)	Initial	753.1
	Final	753.5
Temperature (°C)	Initial	29.7
	Final	28.2
Flow Rate (m <sup>3</sup> /min.)	Initial	1.12
	Final	1.12
	Average	1.12
Total Volume (Std m <sup>3</sup> )		1613
Filter Weight (g)	Initial	4.4276
	Final	4.4744
Measured RSP Level (mg/m <sup>3</sup> )		0.029

Sampling by:

Signatory:

Name In Block:

Gary Ng

Company:

Action-United Environmental Services & Consulting

Date:

25/6/2024

Data Checked by:

Signatory:

Name In Block:

Martin Li

Company:

Action-United Environmental Services & Consulting

Date:

25/6/2024



# Air Quality (RSP) Monitoring Data Sheet

Location ID: **AMA4a**

ALS Lab ID: **HK2424087 -004**

Details of Location: **Rooftop of Hong Kong Ocean Park Marriott Hotel**

<b>Filter Identification No.</b>		QM14
Start	Date	14/6/2024
	Time	16:00
Finish	Date	15/6/2024
	Time	16:00
Elapse Time	Initial	0.15
	Final	24.15
Total Sampling Time (hrs)		24 Hrs
Weather Conditions		Rainy
Pressure (mmHg)	Initial	753.1
	Final	753.5
Temperature (°C)	Initial	29.7
	Final	28.2
Flow Rate (m <sup>3</sup> /min.)	Initial	1.13
	Final	1.13
	Average	1.13
Total Volume (Std m <sup>3</sup> )		1623
Filter Weight (g)	Initial	4.4280
	Final	4.4825
Measured RSP Level (mg/m <sup>3</sup> )		0.034

Sampling by:

Signatory:

Name In Block:

Gary Ng

Company:

Action-United Environmental Services & Consulting

Date:

25/6/2024

Data Checked by:

Signatory:

Name In Block:

Martin Li

Company:

Action-United Environmental Services & Consulting

Date:

25/6/2024

## RSP SAMPLER CALIBRATION CALCULATION SPREADSHEET

Location : Rooftop of shops in Ocean Park (north-west of the lagoon)      Date of Calibration: 14-Jun-24  
 Location ID : AMA1      Next Calibration Date: 14-Aug-24

### CONDITIONS

Sea Level Pressure (hPa)	1004.2	Corrected Pressure (mm Hg)	753.2
Temperature (°C)	29.4	Temperature (K)	302

### CALIBRATION ORIFICE

Make->	TISCH	Qa Slope ->	1.33479
Model->	5025A	Qa Intercept ->	-0.02217
Calibration Date->	15-Dec-23	Expiry Date->	14-Dec-24

### CALIBRATION

Plate No.	H2O (L) (in)	H2O (R) (in)	H2O (in)	Qa (m3/min)	I (chart)	IC corrected	LINEAR REGRESSION
18	6.1	6.1	12.2	1.675	53	33.58	Slope = 16.6855 Intercept = 5.5322 Corr. coeff. = 0.9990
13	4.8	4.8	9.6	1.487	48	30.42	
10	3.8	3.8	7.6	1.325	43	27.25	
7	2.4	2.4	4.8	1.057	37	23.45	
5	1.4	1.4	2.8	0.811	30	19.01	

**Calculations :**

$$Qa = 1/m[\text{sqrt}(H2O(Ta/Pa))-b]$$

$$IC = I[\text{sqrt}(Ta/Pa)]$$

Qa = actual flow rate

IC = corrected chart responses

I = actual chart response

m = calibrator Qa slope

b = calibrator Qa intercept

Ta = actual temperature during calibration ( deg K )

Pa = actual pressure during calibration ( mm Hg )

**For subsequent calculation of sampler flow:**

$$1/m(( I )[\text{sqrt}(Tav/Pav)]-b)$$

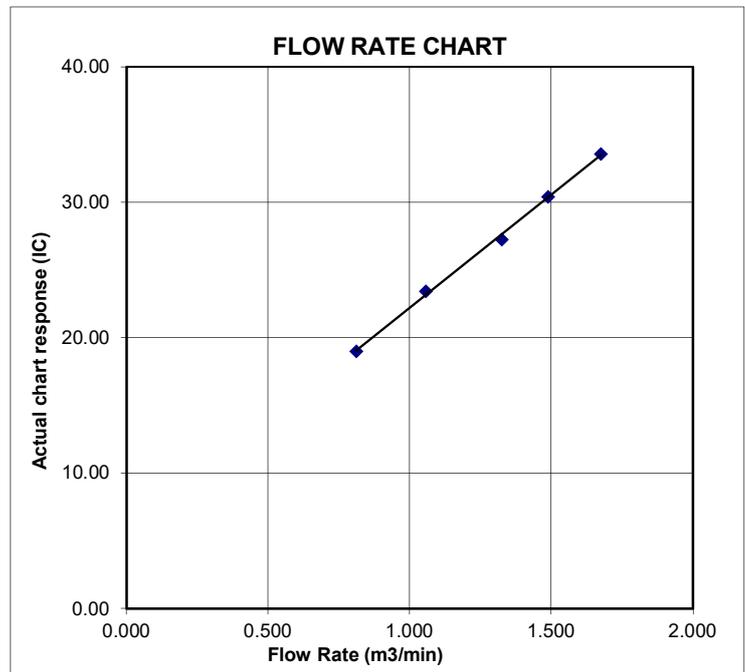
m = sampler slope

b = sampler intercept

I = chart response

Tav = daily average temperature

Pav = daily average pressure



## RSP SAMPLER CALIBRATION CALCULATION SPREADSHEET

Location : Rooftop of Pinniped House in Ocean Park      Date of Calibration: 14-Jun-24  
 Location ID : AMA3      Next Calibration Date: 14-Aug-24

### CONDITIONS

Sea Level Pressure (hPa)	1004.2	Corrected Pressure (mm Hg)	753.2
Temperature (°C)	29.4	Temperature (K)	302

### CALIBRATION ORIFICE

1941

Make->	TISCH	Qa Slope ->	1.33479
Model->	5025A	Qa Intercept ->	-0.02217
Calibration Date->	15-Dec-23	Expiry Date->	14-Dec-24

### CALIBRATION

Plate No.	H2O (L) (in)	H2O (R) (in)	H2O (in)	Qa (m3/min)	I (chart)	IC corrected	LINEAR REGRESSION
18	6.2	6.2	12.4	1.688	56	35.48	Slope = 24.9148 Intercept = -6.4057 Corr. coeff. = 0.9946
13	5	5	10.0	1.518	50	31.68	
10	3.8	3.8	7.6	1.325	43	27.25	
7	2.5	2.5	5.0	1.078	30	19.01	
5	1.5	1.5	3.0	0.839	24	15.21	

**Calculations :**

$$Qa = 1/m[\text{sqrt}(H2O(Ta/Pa))-b]$$

$$IC = I[\text{sqrt}(Ta/Pa)]$$

Qa = actual flow rate

IC = corrected chart responses

I = actual chart response

m = calibrator Qa slope

b = calibrator Qa intercept

Ta = actual temperature during calibration ( deg K )

Pa = actual pressure during calibration ( mm Hg )

**For subsequent calculation of sampler flow:**

$$1/m(( I )[\text{sqrt}(Tav/Pav)]-b)$$

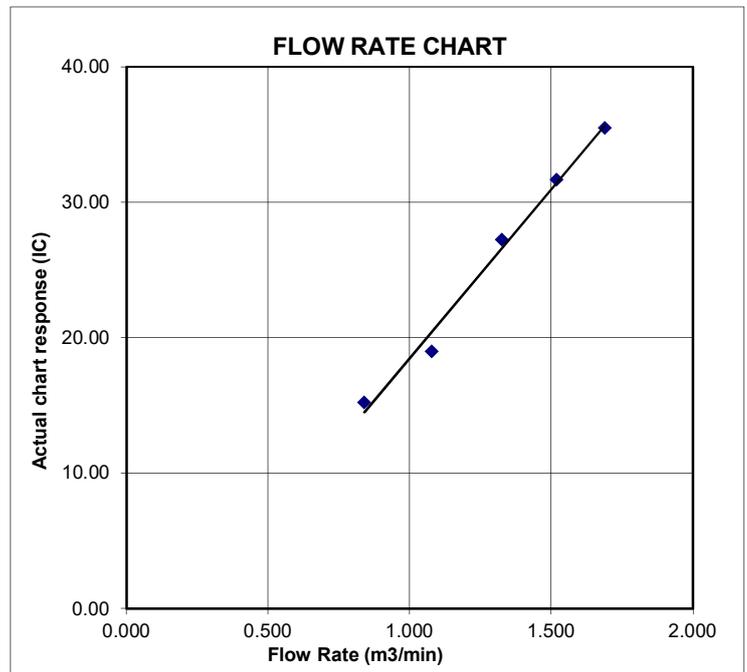
m = sampler slope

b = sampler intercept

I = chart response

Tav = daily average temperature

Pav = daily average pressure



## RSP SAMPLER CALIBRATION CALCULATION SPREADSHEET

Location : Rooftop of Hong Kong Ocean Park Marriott Hotel      Date of Calibration: 14-Jun-24  
 Location ID : AMA4      Next Calibration Date: 14-Aug-24

### CONDITIONS

Sea Level Pressure (hPa)	1004.2	Corrected Pressure (mm Hg)	753.2
Temperature (°C)	29.4	Temperature (K)	302

### CALIBRATION ORIFICE

1941

Make->	TISCH	Qa Slope ->	1.33479
Model->	5025A	Qa Intercept ->	-0.02217
Calibration Date->	15-Dec-23	Expiry Date->	14-Dec-24

### CALIBRATION

Plate No.	H2O (L) (in)	H2O (R) (in)	H2O (in)	Qa (m3/min)	I (chart)	IC corrected	LINEAR REGRESSION
18	6	6	12.0	1.661	48	30.42	Slope = 21.2267 Intercept = -4.2288 Corr. coeff. = 0.9936
13	4.8	4.8	9.6	1.487	43	27.25	
10	3.8	3.8	7.6	1.325	39	24.71	
7	2.4	2.4	4.8	1.057	30	19.01	
5	1.5	1.5	3.0	0.839	20	12.67	

**Calculations :**

$$Qa = 1/m[\text{sqrt}(H2O(Ta/Pa))-b]$$

$$IC = I[\text{sqrt}(Ta/Pa)]$$

Qa = actual flow rate

IC = corrected chart responses

I = actual chart response

m = calibrator Qa slope

b = calibrator Qa intercept

Ta = actual temperature during calibration ( deg K )

Pa = actual pressure during calibration ( mm Hg )

**For subsequent calculation of sampler flow:**

$$1/m(( I )[\text{sqrt}(Tav/Pav)]-b)$$

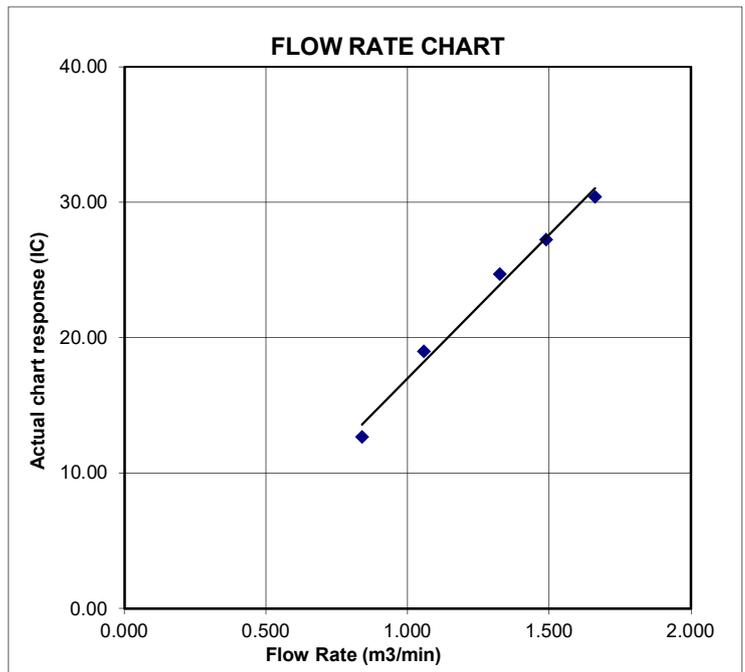
m = sampler slope

b = sampler intercept

I = chart response

Tav = daily average temperature

Pav = daily average pressure





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ALS Technichem (HK) Pty Ltd

11/F., Chung Shun Knitting Centre,

1 - 3 Wing Yip Street,

Kwai Chung, N.T., Hong Kong

T: +852 2610 1044

F: +852 2610 2021

www.alsglobal.com

## CERTIFICATE OF ANALYSIS

**CONTACT:** CHRIS HOI  
**CLIENT:** ERM HONG KONG  
**ADDRESS:** 2507, 25/F, ONE HARBOURFRONT,  
18 TAK FUNG STREET, HUNG HOM,  
KOWLOON, HONG KONG  
**PROJECT:** AIR QUALITY SAMPLING PLAN OF UPDATED OPEN-  
AIR LAGOON SHOW WITH PYROTECHNIC EFFECTS

**WORK ORDER:** HK2424261  
**SUB BATCH:** 1  
**LABORATORY:** HONG KONG  
**DATE RECEIVED:** 18-Jun-2024  
**DATE OF ISSUE:** 27-Jun-2024  
**SAMPLE TYPE:** AIR  
**NO. OF SAMPLES:** 1

---

### SPECIFIC COMMENTS

Sample information (Project name, Sample ID, Sampling date/time, etc.) is provided by client.  
Result(s) of sample(s) is/are reported on as received basis, unless otherwise specified.  
The result(s) related only to the item(s) tested.  
Sample(s) was/ were sampled by ALS staff. Sample(s) arrived laboratory in ambient condition.  
Testing period is from 18-Jun-2024 to 27-Jun-2024.  
LOR denotes Limit of Reporting.

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### GENERAL COMMENTS

This report superseded any previous report(s) with same work order number.

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Mr Leung Chak Cheong, Mike  
Assistant Manager - Metals

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# CERTIFICATE OF ANALYSIS



**Work Order:** HK2424261  
**Sub-Batch:** 1  
**Date of Issue:** 27-Jun-2024  
**Client:** ERM HONG KONG

METHOD REFERENCE	ANALYSIS DESCRIPTION	LABORATORY I.D. :		HK2424261-001	--	--	--
		DATE SAMPLED :		17-Jun-2024	--	--	--
		UNIT	LOR	AMA2	--	--	--
USEPA IO-3.1 USEPA 6020A/ ICPMS	Aluminium (Al)	µg/m <sup>3</sup>	0.5	<0.5	--	--	--
USEPA IO-3.1 USEPA 6020A/ ICPMS	Barium (Ba)	µg/m <sup>3</sup>	0.2	<0.2	--	--	--
USEPA IO-3.1 USEPA 6020A/ ICPMS	Copper (Cu)	µg/m <sup>3</sup>	0.02	<0.02	--	--	--
USEPA IO-3.1 USEPA 6020A/ ICPMS	Calcium (Ca)	µg/m <sup>3</sup>	4	<4	--	--	--
USEPA IO-3.1 USEPA 6020A/ ICPMS	Iron (Fe)	µg/m <sup>3</sup>	5	<5	--	--	--
USEPA IO-3.1 USEPA 6020A/ ICPMS	Magnesium (Mg)	µg/m <sup>3</sup>	4	<4	--	--	--
USEPA IO-3.1 USEPA 6020A/ ICPMS	Titanium (Ti)	µg/m <sup>3</sup>	0.01	<0.01	--	--	--

----- END OF REPORT -----



# Air Quality (RSP) Monitoring Data Sheet

Location ID: **AMA2**

ALS Lab ID: **HK2424261 -001**

Details of Location: **Rooftop of Coral Building in Ocean Park**

<b>Filter Identification No.</b>		QM15
Start	Date	17/6/2024
	Time	11:54
Finish	Date	18/6/2024
	Time	11:54
Elapse Time	Initial	24.23
	Final	48.23
Total Sampling Time (hrs)		24 Hrs
Weather Conditions		Fine
Pressure (mmHg)	Initial	755.0
	Final	754.4
Temperature (°C)	Initial	28.8
	Final	30.1
Flow Rate (m <sup>3</sup> /min.)	Initial	1.11
	Final	1.11
	Average	1.11
Total Volume (Std m <sup>3</sup> )		1594
Filter Weight (g)	Initial	4.3906
	Final	4.4290
Measured RSP Level (mg/m <sup>3</sup> )		0.024

Sampling by:

Signatory:

Name In Block:

Gary Ng

Company:

Action-United Environmental Services & Consulting

Date:

25/6/2024

Data Checked by:

Signatory:

Name In Block:

Martin Li

Company:

Action-United Environmental Services & Consulting

Date:

25/6/2024

## RSP SAMPLER CALIBRATION CALCULATION SPREADSHEET

Location : Rooftop of Coral Building in Ocean Park Date of Calibration: 14-Jun-24  
 Location ID : AMA2 Next Calibration Date: 14-Aug-24

### CONDITIONS

Sea Level Pressure (hPa)	1004.2	Corrected Pressure (mm Hg)	753.2
Temperature (°C)	29.4	Temperature (K)	302

### CALIBRATION ORIFICE

Make->	TISCH	Qa Slope ->	1.33479
Model->	5025A	Qa Intercept ->	-0.02217
Calibration Date->	15-Dec-23	Expiry Date->	14-Dec-24

### CALIBRATION

Plate No.	H2O (L) (in)	H2O (R) (in)	H2O (in)	Qa (m3/min)	I (chart)	IC corrected	LINEAR REGRESSION
18	6.8	6.8	13.6	1.767	56	35.48	Slope = 23.5318 Intercept = -5.7447 Corr. coeff. = 0.9962
13	5.3	5.3	10.6	1.562	50	31.68	
10	4.2	4.2	8.4	1.392	43	27.25	
7	2.6	2.6	5.2	1.099	30	19.01	
5	1.6	1.6	3.2	0.866	24	15.21	

**Calculations :**

$$Qa = 1/m[\text{sqrt}(H2O(Ta/Pa))-b]$$

$$IC = I[\text{sqrt}(Ta/Pa)]$$

Qa = actual flow rate

IC = corrected chart responses

I = actual chart response

m = calibrator Qa slope

b = calibrator Qa intercept

Ta = actual temperature during calibration ( deg K )

Pa = actual pressure during calibration ( mm Hg )

**For subsequent calculation of sampler flow:**

$$1/m(( I )[\text{sqrt}(Tav/Pav)]-b)$$

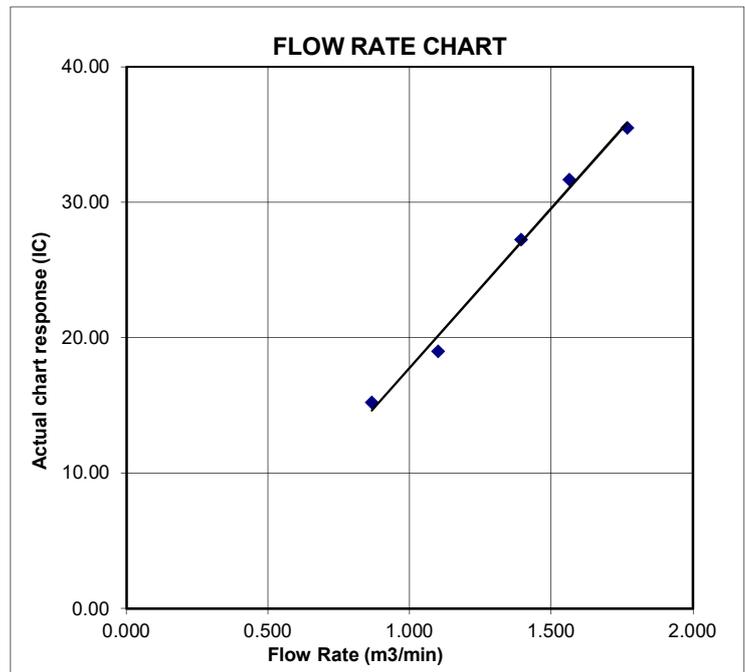
m = sampler slope

b = sampler intercept

I = chart response

Tav = daily average temperature

Pav = daily average pressure





ALS Technichem (HK) Pty Ltd

11/F., Chung Shun Knitting Centre,

1 - 3 Wing Yip Street,

Kwai Chung, N.T., Hong Kong

T: +852 2610 1044

F: +852 2610 2021

www.alsglobal.com

## CERTIFICATE OF ANALYSIS

**CONTACT:** CHRIS HOI  
**CLIENT:** ERM HONG KONG  
**ADDRESS:** 2507, 25/F, ONE HARBOURFRONT,  
18 TAK FUNG STREET, HUNG HOM,  
KOWLOON, HONG KONG  
**PROJECT:** AIR QUALITY SAMPLING PLAN OF UPDATED OPEN-  
AIR LAGOON SHOW WITH PYROTECHNIC EFFECTS

**WORK ORDER:** HK2424446  
**SUB BATCH:** 1  
**LABORATORY:** HONG KONG  
**DATE RECEIVED:** 19-Jun-2024  
**DATE OF ISSUE:** 27-Jun-2024  
**SAMPLE TYPE:** AIR  
**NO. OF SAMPLES:** 5

### SPECIFIC COMMENTS

Sample information (Project name, Sample ID, Sampling date/time, etc.) is provided by client.  
Result(s) of sample(s) is/are reported on as received basis, unless otherwise specified.  
The result(s) related only to the item(s) tested.  
Samples(s) was/ were submitted by client. Sample(s) arrived laboratory in ambient condition.  
Testing period is from 19-Jun-2024 to 27-Jun-2024.  
LOR denotes Limit of Reporting.

### GENERAL COMMENTS

This report superseded any previous report(s) with same work order number.

Mr Leung Chak Cheong, Mike  
Assistant Manager - Metals

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# CERTIFICATE OF ANALYSIS



**Work Order:** HK2424446  
**Sub-Batch:** 1  
**Date of Issue:** 27-Jun-2024  
**Client:** ERM HONG KONG

METHOD REFERENCE	ANALYSIS DESCRIPTION	LABORATORY I.D. :		HK2424446-001	HK2424446-002	HK2424446-003	HK2424446-004
		DATE SAMPLED :		18-Jun-2024	18-Jun-2024	18-Jun-2024	18-Jun-2024
		UNIT	LOR	AMA1a	AMA2	AMA3	AMA4a
USEPA IO-3.1 USEPA 6020A/ ICPMS	Aluminium (Al)	µg/m <sup>3</sup>	0.5	<0.5	<0.5	<0.5	<0.5
USEPA IO-3.1 USEPA 6020A/ ICPMS	Barium (Ba)	µg/m <sup>3</sup>	0.2	<0.2	<0.2	<0.2	<0.2
USEPA IO-3.1 USEPA 6020A/ ICPMS	Copper (Cu)	µg/m <sup>3</sup>	0.02	0.07	0.03	0.04	0.22
USEPA IO-3.1 USEPA 6020A/ ICPMS	Calcium (Ca)	µg/m <sup>3</sup>	4	<4	<4	<4	<4
USEPA IO-3.1 USEPA 6020A/ ICPMS	Iron (Fe)	µg/m <sup>3</sup>	5	<5	<5	<5	<5
USEPA IO-3.1 USEPA 6020A/ ICPMS	Magnesium (Mg)	µg/m <sup>3</sup>	4	<4	<4	<4	<4
USEPA IO-3.1 USEPA 6020A/ ICPMS	Titanium (Ti)	µg/m <sup>3</sup>	0.01	<0.01	<0.01	<0.01	<0.01

# CERTIFICATE OF ANALYSIS



**Work Order:** HK2424446  
**Sub-Batch:** 1  
**Date of Issue:** 27-Jun-2024  
**Client:** ERM HONG KONG

METHOD REFERENCE	ANALYSIS DESCRIPTION	LABORATORY I.D. :		HK2424446-005	--	--	--
		DATE SAMPLED :		18-Jun-2024	--	--	--
		UNIT	LOR	Field blank	--	--	--
USEPA IO-3.1 USEPA 6020A/ ICPMS	Aluminium (Al)	µg/sample	500	<500	--	--	--
USEPA IO-3.1 USEPA 6020A/ ICPMS	Barium (Ba)	µg/sample	200	<200	--	--	--
USEPA IO-3.1 USEPA 6020A/ ICPMS	Copper (Cu)	µg/sample	20	<20	--	--	--
USEPA IO-3.1 USEPA 6020A/ ICPMS	Calcium (Ca)	µg/sample	4000	<4000	--	--	--
USEPA IO-3.1 USEPA 6020A/ ICPMS	Iron (Fe)	µg/sample	5000	<5000	--	--	--
USEPA IO-3.1 USEPA 6020A/ ICPMS	Magnesium (Mg)	µg/sample	4000	<4000	--	--	--
USEPA IO-3.1 USEPA 6020A/ ICPMS	Titanium (Ti)	µg/sample	10	<10	--	--	--

----- END OF REPORT -----



# Air Quality (RSP) Monitoring Data Sheet

Location ID: **AMA1a**

ALS Lab ID: **HK2424446 -001**

Details of Location: **Rooftop of shops in Ocean Park (north-west of the lagoon)**

<b>Filter Identification No.</b>		<b>QM20</b>
Start	Date	18/6/2024
	Time	13:00
Finish	Date	19/6/2024
	Time	13:00
Elapse Time	Initial	3511.25
	Final	3535.25
Total Sampling Time (hrs)		24 Hrs
Weather Conditions		Fine
Pressure (mmHg)	Initial	754.4
	Final	754.3
Temperature (°C)	Initial	29.9
	Final	30.0
Flow Rate (m <sup>3</sup> /min.)	Initial	1.09
	Final	1.09
	Average	1.09
Total Volume (Std m <sup>3</sup> )		1564
Filter Weight (g)	Initial	4.4310
	Final	4.4648
Measured RSP Level (mg/m <sup>3</sup> )		0.022

Sampling by:

Signatory:

Name In Block:

Gary Ng

Company:

Action-United Environmental Services & Consulting

Date:

25/6/2024

Data Checked by:

Signatory:

Name In Block:

Martin Li

Company:

Action-United Environmental Services & Consulting

Date:

25/6/2024



# Air Quality (RSP) Monitoring Data Sheet

Location ID: **AMA2**

ALS Lab ID: **HK2424446 -002**

Details of Location: **Rooftop of Coral Building in Ocean Park**

<b>Filter Identification No.</b>		QM18
Start	Date	18/6/2024
	Time	13:00
Finish	Date	19/6/2024
	Time	13:00
Elapse Time	Initial	48.23
	Final	72.23
Total Sampling Time (hrs)		24 Hrs
Weather Conditions		Fine
Pressure (mmHg)	Initial	754.4
	Final	754.3
Temperature (°C)	Initial	29.9
	Final	30.0
Flow Rate (m <sup>3</sup> /min.)	Initial	1.11
	Final	1.11
	Average	1.11
Total Volume (Std m <sup>3</sup> )		1593
Filter Weight (g)	Initial	4.4128
	Final	4.4548
Measured RSP Level (mg/m <sup>3</sup> )		0.026

Sampling by:

Signatory:

Name In Block:

Gary Ng

Company:

Action-United Environmental Services & Consulting

Date:

25/6/2024

Data Checked by:

Signatory:

Name In Block:

Martin Li

Company:

Action-United Environmental Services & Consulting

Date:

25/6/2024



# Air Quality (RSP) Monitoring Data Sheet

Location ID: **AMA3**

ALS Lab ID: **HK2424446 -003**

Details of Location: **Rooftop of Pinniped House in Ocean Park**

<b>Filter Identification No.</b>		QM16
Start	Date	18/6/2024
	Time	13:00
Finish	Date	19/6/2024
	Time	13:00
Elapse Time	Initial	31596.83
	Final	31620.83
Total Sampling Time (hrs)		24 Hrs
Weather Conditions		Fine
Pressure (mmHg)	Initial	754.4
	Final	754.3
Temperature (°C)	Initial	29.9
	Final	30.0
Flow Rate (m <sup>3</sup> /min.)	Initial	1.10
	Final	1.10
	Average	1.10
Total Volume (Std m <sup>3</sup> )		1578
Filter Weight (g)	Initial	4.4091
	Final	4.4487
Measured RSP Level (mg/m <sup>3</sup> )		0.025

Sampling by:

Signatory:

Name In Block:

Gary Ng

Company:

Action-United Environmental Services & Consulting

Date:

25/6/2024

Data Checked by:

Signatory:

Name In Block:

Martin Li

Company:

Action-United Environmental Services & Consulting

Date:

25/6/2024



# Air Quality (RSP) Monitoring Data Sheet

Location ID: **AMA4a**

ALS Lab ID: **HK2424446 -004**

Details of Location: **Rooftop of Hong Kong Ocean Park Marriott Hotel**

<b>Filter Identification No.</b>		QM17
Start	Date	18/6/2024
	Time	13:00
Finish	Date	19/6/2024
	Time	13:00
Elapse Time	Initial	24.15
	Final	48.15
Total Sampling Time (hrs)		24 Hrs
Weather Conditions		Fine
Pressure (mmHg)	Initial	754.4
	Final	754.3
Temperature (°C)	Initial	29.9
	Final	30.0
Flow Rate (m <sup>3</sup> /min.)	Initial	1.10
	Final	1.10
	Average	1.10
Total Volume (Std m <sup>3</sup> )		1582
Filter Weight (g)	Initial	4.4144
	Final	4.4590
Measured RSP Level (mg/m <sup>3</sup> )		0.028

Sampling by:

Signatory:

Name In Block:

Gary Ng

Company:

Action-United Environmental Services & Consulting

Date:

25/6/2024

Data Checked by:

Signatory:

Name In Block:

Martin Li

Company:

Action-United Environmental Services & Consulting

Date:

25/6/2024

## RSP SAMPLER CALIBRATION CALCULATION SPREADSHEET

Location : Rooftop of shops in Ocean Park (north-west of the lagoon)      Date of Calibration: 14-Jun-24  
 Location ID : AMA1      Next Calibration Date: 14-Aug-24

### CONDITIONS

Sea Level Pressure (hPa)	1004.2	Corrected Pressure (mm Hg)	753.2
Temperature (°C)	29.4	Temperature (K)	302

### CALIBRATION ORIFICE

Make->	TISCH	Qa Slope ->	1.33479
Model->	5025A	Qa Intercept ->	-0.02217
Calibration Date->	15-Dec-23	Expiry Date->	14-Dec-24

### CALIBRATION

Plate No.	H2O (L) (in)	H2O (R) (in)	H2O (in)	Qa (m3/min)	I (chart)	IC corrected	LINEAR REGRESSION
18	6.1	6.1	12.2	1.675	53	33.58	Slope = 16.6855 Intercept = 5.5322 Corr. coeff. = 0.9990
13	4.8	4.8	9.6	1.487	48	30.42	
10	3.8	3.8	7.6	1.325	43	27.25	
7	2.4	2.4	4.8	1.057	37	23.45	
5	1.4	1.4	2.8	0.811	30	19.01	

**Calculations :**

$$Qa = 1/m[\text{sqrt}(H2O(Ta/Pa))-b]$$

$$IC = I[\text{sqrt}(Ta/Pa)]$$

Qa = actual flow rate

IC = corrected chart responses

I = actual chart response

m = calibrator Qa slope

b = calibrator Qa intercept

Ta = actual temperature during calibration ( deg K )

Pa = actual pressure during calibration ( mm Hg )

**For subsequent calculation of sampler flow:**

$$1/m(( I )[\text{sqrt}(Tav/Pav)]-b)$$

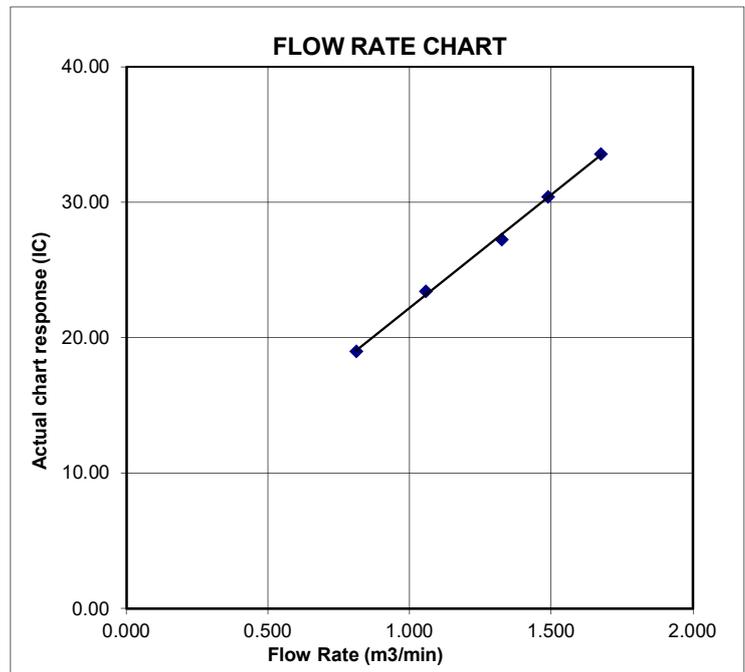
m = sampler slope

b = sampler intercept

I = chart response

Tav = daily average temperature

Pav = daily average pressure



## RSP SAMPLER CALIBRATION CALCULATION SPREADSHEET

Location : Rooftop of Coral Building in Ocean Park      Date of Calibration: 14-Jun-24  
 Location ID : AMA2      Next Calibration Date: 14-Aug-24

### CONDITIONS

Sea Level Pressure (hPa)	1004.2	Corrected Pressure (mm Hg)	753.2
Temperature (°C)	29.4	Temperature (K)	302

### CALIBRATION ORIFICE

Make->	TISCH	Qa Slope ->	1.33479
Model->	5025A	Qa Intercept ->	-0.02217
Calibration Date->	15-Dec-23	Expiry Date->	14-Dec-24

### CALIBRATION

Plate No.	H2O (L) (in)	H2O (R) (in)	H2O (in)	Qa (m3/min)	I (chart)	IC corrected	LINEAR REGRESSION
18	6.8	6.8	13.6	1.767	56	35.48	Slope = 23.5318 Intercept = -5.7447 Corr. coeff. = 0.9962
13	5.3	5.3	10.6	1.562	50	31.68	
10	4.2	4.2	8.4	1.392	43	27.25	
7	2.6	2.6	5.2	1.099	30	19.01	
5	1.6	1.6	3.2	0.866	24	15.21	

**Calculations :**

$$Qa = 1/m[\text{sqrt}(H2O(Ta/Pa))-b]$$

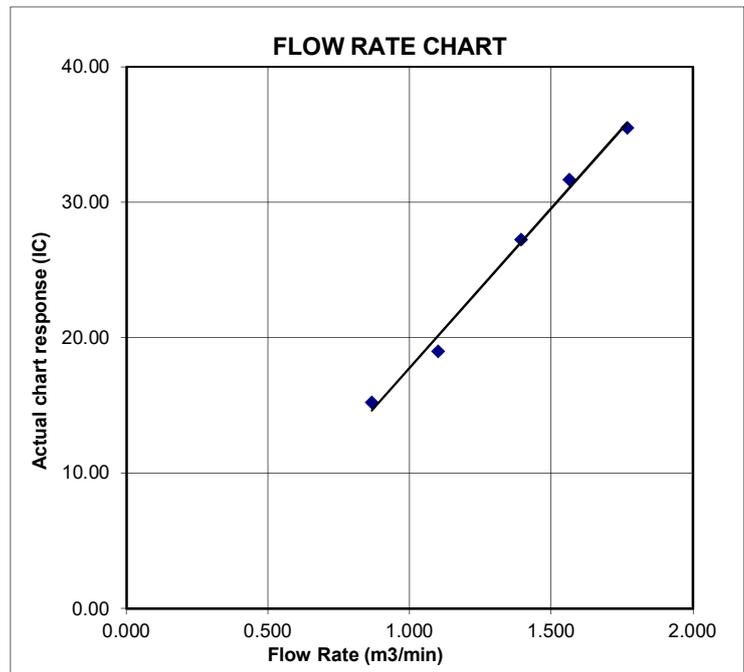
$$IC = I[\text{sqrt}(Ta/Pa)]$$

Qa = actual flow rate  
 IC = corrected chart responses  
 I = actual chart response  
 m = calibrator Qa slope  
 b = calibrator Qa intercept  
 Ta = actual temperature during calibration ( deg K )  
 Pa = actual pressure during calibration ( mm Hg )

**For subsequent calculation of sampler flow:**

$$1/m(( I )[\text{sqrt}(Tav/Pav)]-b)$$

m = sampler slope  
 b = sampler intercept  
 I = chart response  
 Tav = daily average temperature  
 Pav = daily average pressure



## RSP SAMPLER CALIBRATION CALCULATION SPREADSHEET

Location : Rooftop of Pinniped House in Ocean Park      Date of Calibration: 14-Jun-24  
 Location ID : AMA3      Next Calibration Date: 14-Aug-24

### CONDITIONS

Sea Level Pressure (hPa)	1004.2	Corrected Pressure (mm Hg)	753.2
Temperature (°C)	29.4	Temperature (K)	302

### CALIBRATION ORIFICE

1941

Make->	TISCH	Qa Slope ->	1.33479
Model->	5025A	Qa Intercept ->	-0.02217
Calibration Date->	15-Dec-23	Expiry Date->	14-Dec-24

### CALIBRATION

Plate No.	H2O (L) (in)	H2O (R) (in)	H2O (in)	Qa (m3/min)	I (chart)	IC corrected	LINEAR REGRESSION
18	6.2	6.2	12.4	1.688	56	35.48	Slope = 24.9148 Intercept = -6.4057 Corr. coeff. = 0.9946
13	5	5	10.0	1.518	50	31.68	
10	3.8	3.8	7.6	1.325	43	27.25	
7	2.5	2.5	5.0	1.078	30	19.01	
5	1.5	1.5	3.0	0.839	24	15.21	

**Calculations :**

$$Qa = 1/m[\text{sqrt}(H2O(Ta/Pa))-b]$$

$$IC = I[\text{sqrt}(Ta/Pa)]$$

Qa = actual flow rate

IC = corrected chart responses

I = actual chart response

m = calibrator Qa slope

b = calibrator Qa intercept

Ta = actual temperature during calibration ( deg K )

Pa = actual pressure during calibration ( mm Hg )

**For subsequent calculation of sampler flow:**

$$1/m(( I )[\text{sqrt}(Tav/Pav)]-b)$$

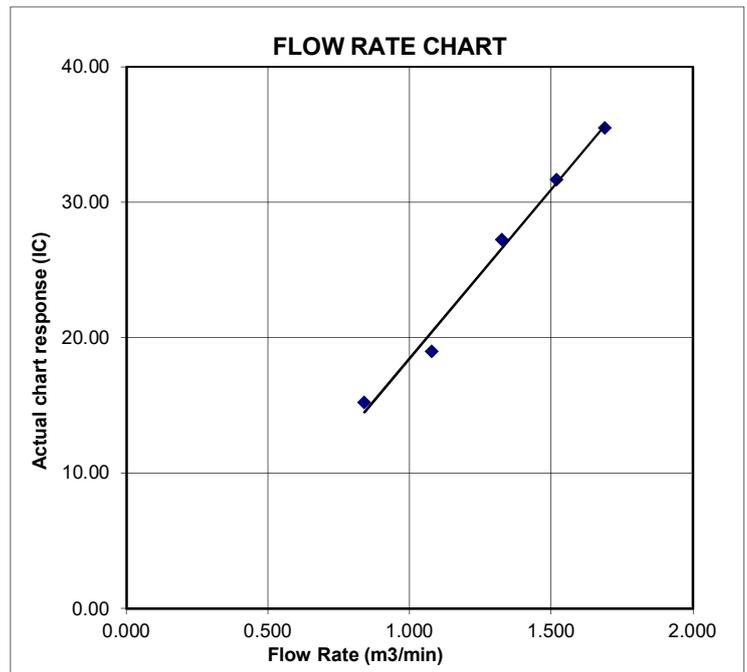
m = sampler slope

b = sampler intercept

I = chart response

Tav = daily average temperature

Pav = daily average pressure



## RSP SAMPLER CALIBRATION CALCULATION SPREADSHEET

Location : Rooftop of Hong Kong Ocean Park Marriott Hotel      Date of Calibration: 14-Jun-24  
 Location ID : AMA4      Next Calibration Date: 14-Aug-24

### CONDITIONS

Sea Level Pressure (hPa)	1004.2	Corrected Pressure (mm Hg)	753.2
Temperature (°C)	29.4	Temperature (K)	302

### CALIBRATION ORIFICE

1941

Make->	TISCH	Qa Slope ->	1.33479
Model->	5025A	Qa Intercept ->	-0.02217
Calibration Date->	15-Dec-23	Expiry Date->	14-Dec-24

### CALIBRATION

Plate No.	H2O (L) (in)	H2O (R) (in)	H2O (in)	Qa (m3/min)	I (chart)	IC corrected	LINEAR REGRESSION
18	6	6	12.0	1.661	48	30.42	Slope = 21.2267 Intercept = -4.2288 Corr. coeff. = 0.9936
13	4.8	4.8	9.6	1.487	43	27.25	
10	3.8	3.8	7.6	1.325	39	24.71	
7	2.4	2.4	4.8	1.057	30	19.01	
5	1.5	1.5	3.0	0.839	20	12.67	

**Calculations :**

$$Qa = 1/m[\text{sqrt}(H2O(Ta/Pa))-b]$$

$$IC = I[\text{sqrt}(Ta/Pa)]$$

Qa = actual flow rate

IC = corrected chart responses

I = actual chart response

m = calibrator Qa slope

b = calibrator Qa intercept

Ta = actual temperature during calibration ( deg K )

Pa = actual pressure during calibration ( mm Hg )

**For subsequent calculation of sampler flow:**

$$1/m(( I )[\text{sqrt}(Tav/Pav)]-b)$$

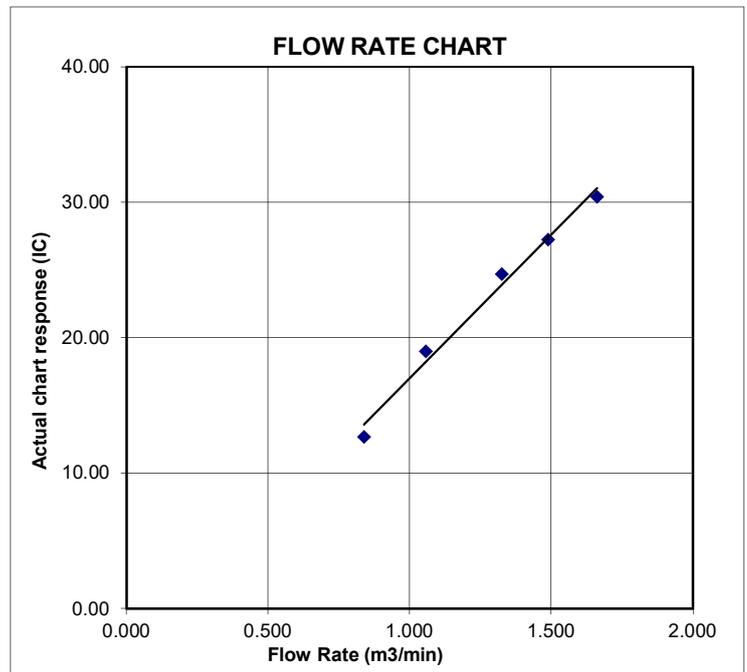
m = sampler slope

b = sampler intercept

I = chart response

Tav = daily average temperature

Pav = daily average pressure





APPENDIX E

LABORATORY RESULT REPORT  
(ODOUR MONITORING)



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### CERTIFICATE OF ANALYSIS

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CLIENT:	ERM HONG KONG LIMITED	WORK ORDER:	HK2423996
CONTACT:	MR. CHRIS HOI		
ADDRESS:	2507, ONE HARBOURFRONT, 18 TAK FUNG STREET, HUNG HOM, KOWLOON	LABORATORY:	HONG KONG
		SUB-BATCH:	0
		DATE RECEIVED:	14 JUNE 2024
		DATE OF ISSUE:	17 JUNE 2024
PROJECT:	BASELINE AIR QUALITY MONITORING FOR THE FIREWORK SHOW - OLFACTORY SAMPLING AND ANALYSIS	SAMPLE TYPE:	AIR
SITE:	OCEAN PARK, WONG CHUK HANG	NO. OF SAMPLES:	2
PO:	---		

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### COMMENTS

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Odour sampling was conducted by ALS Technichem (HK) staff on 14<sup>th</sup> June 2024 at two locations which were selected by the client. Collected samples were sent back to ALS HK for olfactometry analysis.

Sample information (Project name, Sample ID) is provided by the client.

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### NOTES

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

The results related only to the items tested. All pages of this report have been checked and approved for release.

---

  
Fung Lim Chee, Richard  
Managing Director - Hong Kong



### 1. SUMMARY OF WORK

Samples were collected at two selected locations for determination of odour concentration. The scope is to test the air quality before the firework show planned on 18 June 2024. Odour samples collected by using passive sampling technique were delivered to ALS Hong Kong laboratory for Olfactometry Analysis.

### 2. SAMPLING INFORMATION

Testing Parameter	Client's Location ID	Location Description	Sampling Period	Odour Source
Odour	AMA1a	Rooftop of Shops in Ocean Park (Noth-West of Lagoon)	14 June 2024 12:49 - 13:01	Ambient Air
	AMA4a	Rooftop of Hong Kong Ocean Park Marriott Hotel		Ambient Air

### 3. ODOUR SAMPLING SUMMARY

#### 3.1 Odour Sampling



Figure 1a: Sampling Bag & Air-tightened Sampler

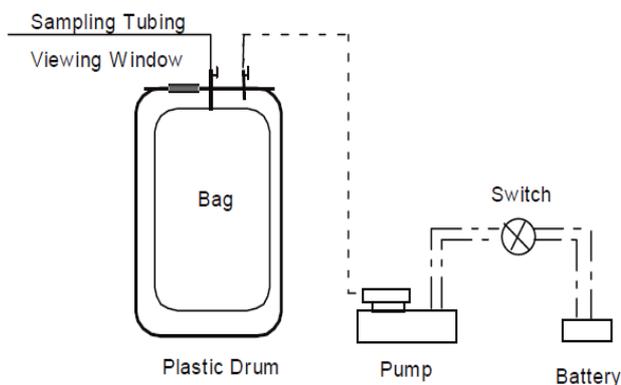


Figure 1b: Schematic Diagram of Sampling Device

Odour gas samples were collected by using the passive sampling technique. Nalophan™ sampling bag was placed inside an air-tight sampler which was drawn to vacuum by using a sampling pump. Approximately 60 litres of gas sample was collected into the sampling bag for testing. Diagram of the passive sampling equipment that was used was shown in Figure 1.



### 3.2 Olfactometry Analysis

Odour concentration was determined by a Forced-choice Dynamic Olfactometer in accordance with the European Standard Method (BS EN 13725: 2022).

This European Standard specifies a method for the objective determination of the odour concentration of a gaseous sample using dynamic olfactometry with human assessors and the emission rate of odours emanating from point sources, area sources with outward flow and area sources without outward flow.

This European Standard is applicable to the measurement of odour concentration of pure substances, defined mixtures and undefined mixtures of gaseous odorants in air or nitrogen, using dynamic olfactometry with a panel of human assessors being the sensor.

The unit of measurement is the odour unit per cubic metre:  $ou_E/m^3$ . The odour concentration was measured by determining the dilution factor required to reach the detection threshold. The odour concentration at the detection threshold was by the definition as  $1\ ou_E/m^3$ . The odour concentration was then expressed in terms of multiples of the detection threshold. The range of measurement including pre-dilution prior to the olfactometry analysis is typically from  $10^1\ ou_E/m^3$  to  $10^5\ ou_E/m^3$ .

Olfactometry analysis was performed by using the Olfasense TO9 Olfactometer. The testing was performed by at least five qualified panellists who have been selected through an n-butanol odour screening test.

All samples were analysed within 24 hours after sampling.

### 4. ON SITE METEOROLOGICAL DATA

Location ID	Time	Temp (°C)	Relative Humidity (%)	Wind Direction (Degree)	Wind Speed (m/s)	Weather Condition
AMA1a	12:49	28.9	85.3	024	0.5	Raining
AMA4a	12:49	28.8	83.2	140	0.3	Raining

**5. RESULT**

Testing Parameter	Location ID	Unit	LOR	Odour Concentration
Odour	AMA1a	ou <sub>E</sub> /m <sup>3</sup>	11	15
	AMA4a			54
	Blank			<11

Note:

[1] Blank sample containing odourless pure nitrogen gas filled by ALS.

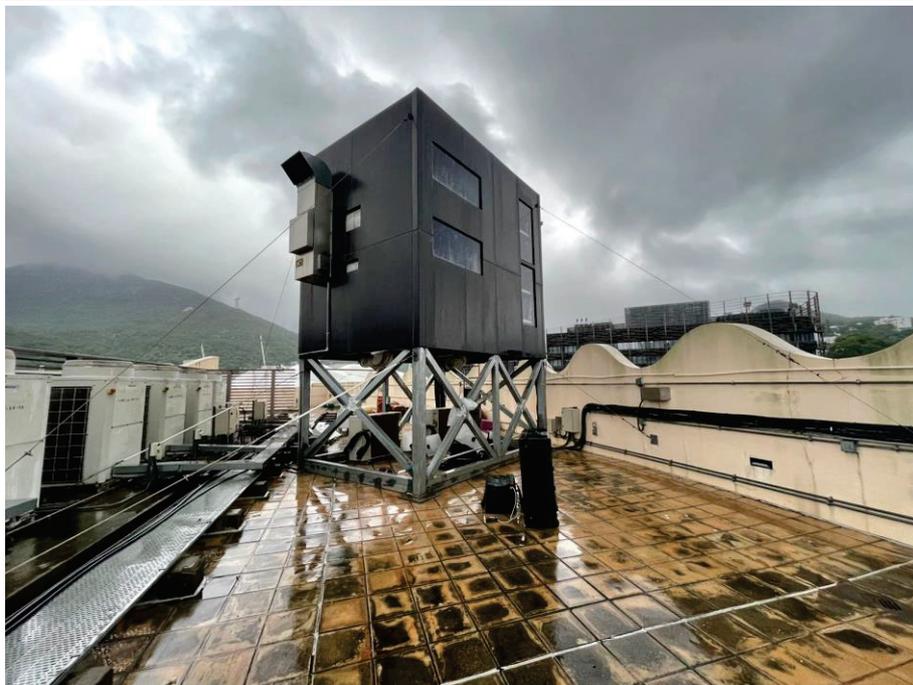
[2] The collected sample volume of the gas bag was sufficient for olfactometry analysis.

*LOR denotes Limit of Reporting*



## APPENDIX 1

### Photos of the Sampling Locations



**AMA1a**



**AMA4a**



## APPENDIX 2

### Performance Checking of the Odour Measurement for Olfactometry Analysis (QA/QC Information)

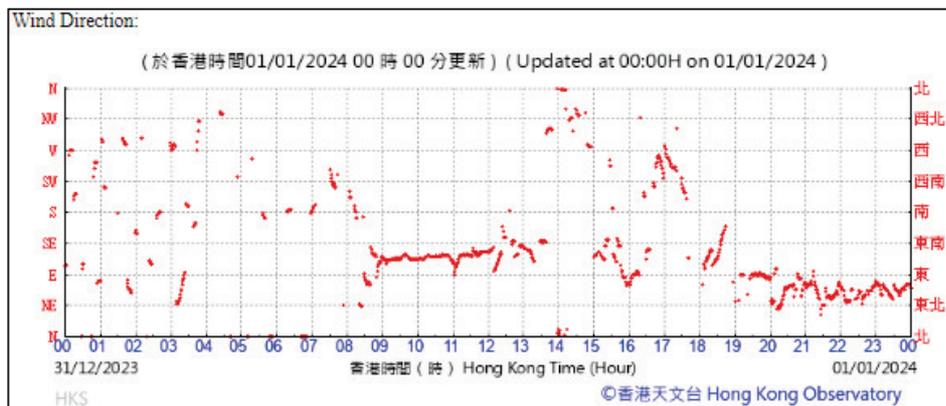
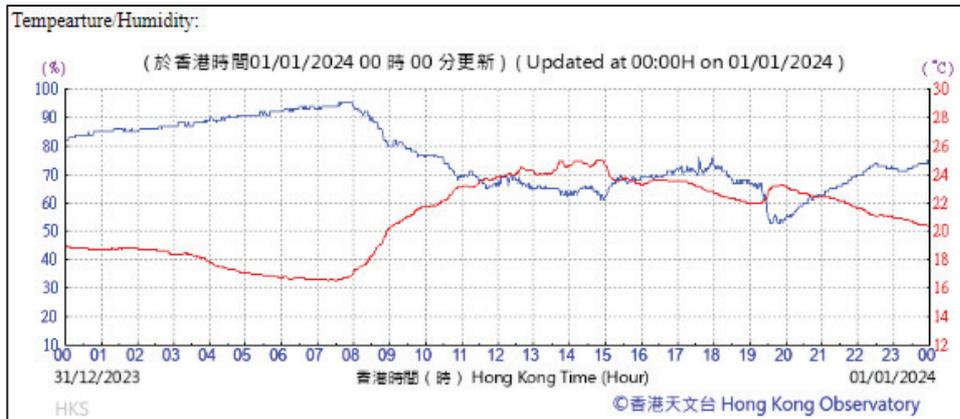
<b>Olfactometer ID:</b>	HK2147
<b>Calibration Due Date:</b>	26 June 2024
<b>Reference Odorant:</b>	50.0 ppm N-Butanol
<b>Accepted Reference Value:</b>	40 ppbv
<b>Pre-dilution Equipment:</b>	No
<b>Presentation Mode:</b>	Forced Choice
<b>Analysis Date:</b>	14 June 2024

Parameters	Acceptance Criteria	Testing Room Environmental Conditions / Laboratory Quality Performance
Laboratory Temperature (°C)	>21°C and Fluctuation $\pm 2^\circ\text{C}$	21.5 - 22.6
Laboratory Relative Humidity (%)	20 - 80%	55 - 64
Carbon Dioxide (CO <sub>2</sub> )	<0.15%	0.06 - 0.09
Accuracy, A <sub>od</sub>	$\leq 0.217$	0.106
Repeatability, r	$\leq 0.477$	0.331



### APPENDIX 3

#### Extract of Meteorological Observations from Hong Kong Observatory Station - Wong Chuk Hang



----- END OF REPORT-----



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### CERTIFICATE OF ANALYSIS

---

CLIENT:	ERM HONG KONG LIMITED	WORK ORDER:	HK2424212
CONTACT:	MR. CHRIS HOI		
ADDRESS:	2507, ONE HARBOURFRONT, 18 TAK FUNG STREET, HUNG HOM, KOWLOON	LABORATORY:	HONG KONG
		SUB-BATCH:	0
		DATE RECEIVED:	18 JUNE 2024
		DATE OF ISSUE:	24 JUNE 2024
PROJECT:	IMPACT AIR QUALITY MONITORING FOR THE FIREWORK SHOW - OLFACTORY SAMPLING AND ANALYSIS	SAMPLE TYPE:	AIR
SITE:	OCEAN PARK, WONG CHUK HANG	NO. OF SAMPLES:	2
PO:	---		

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### COMMENTS

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Odour sampling was conducted by ALS Technichem (HK) staff on 18<sup>th</sup> June 2024 at two locations which were selected by the client. Collected samples were sent back to ALS HK for olfactometry analysis.

Sample information (Project name, Sample ID) is provided by the client.

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### NOTES

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

The results related only to the items tested. All pages of this report have been checked and approved for release.

---

  
Fung Lim Chee, Richard  
Managing Director - Hong Kong



### 1. SUMMARY OF WORK

Samples were collected at two selected locations for the determination of odour concentration. The scope is to test the impact of the air quality during the firework show. Odour samples collected by using passive sampling technique were delivered to ALS Hong Kong laboratory for Olfactometry Analysis.

### 2. SAMPLING INFORMATION

Testing Parameter	Client's Location ID	Location Description	Sampling Date	Odour Source
Odour	AMA1a	Rooftop of Shops in Ocean Park (Noth-West of Lagoon)	18 June 2024 19:38 - 19:51	Ambient Air
	AMA4a	Rooftop of Hong Kong Ocean Park Marriott Hotel		Ambient Air

### 3. ODOUR SAMPLING SUMMARY

#### 3.1 Odour Sampling

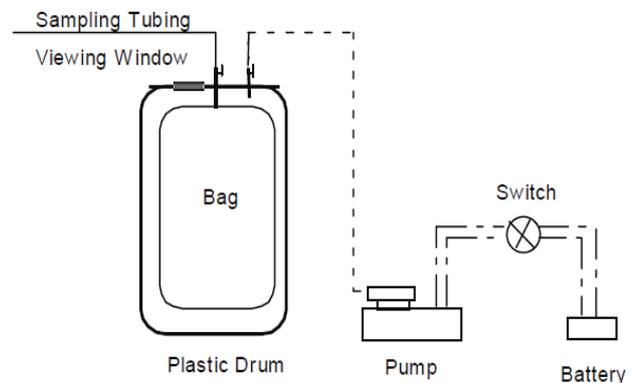


Figure 1a: Sampling Bag & Air-tightened Sampler

Figure 1b: Schematic Diagram of Sampling Device

Odour gas samples were collected by using the passive sampling technique. Nalophan™ sampling bag was placed inside an air-tight sampler which was drawn to vacuum by using a sampling pump. Approximately 60 litres of gas sample was collected into the sampling bag for testing. Diagram of the passive sampling equipment that was used was shown in Figure 1.



### 3.2 Olfactometry Analysis

Odour concentration was determined by a Forced-choice Dynamic Olfactometer in accordance with the European Standard Method (BS EN 13725: 2022).

This European Standard specifies a method for the objective determination of the odour concentration of a gaseous sample using dynamic olfactometry with human assessors and the emission rate of odours emanating from point sources, area sources with outward flow and area sources without outward flow.

This European Standard is applicable to the measurement of odour concentration of pure substances, defined mixtures and undefined mixtures of gaseous odorants in air or nitrogen, using dynamic olfactometry with a panel of human assessors being the sensor.

The unit of measurement is the odour unit per cubic metre:  $ou_E/m^3$ . The odour concentration was measured by determining the dilution factor required to reach the detection threshold. The odour concentration at the detection threshold was by the definition as 1  $OU_E/m^3$ . The odour concentration was then expressed in terms of multiples of the detection threshold. The range of measurement including pre-dilution prior to the olfactometry analysis is typically from  $10^1 ou_E/m^3$  to  $10^5 ou_E/m^3$ .

Olfactometry analysis was performed by using the Olfasense TO9 Olfactometer. The testing was performed by at least five qualified panellists who have been selected through an n-butanol odour screening test.

All samples were analysed within 24 hours after sampling.

### 4. ON SITE METEOROLOGICAL DATA

Location ID	Time	Temp (°C)	Relative Humidity (%)	Wind Direction (Degree)	Wind Speed (m/s)	Weather Condition
AMA1a	19:40	29.8	87.3	315	0.9	Cloudy
AMA4a	19:38	28.4	86.1	147	0.3	Cloudy

**5. RESULT**

Testing Parameter	Location ID	Unit	LOR	Odour Concentration
Odour	AMA1a	ou <sub>E</sub> /m <sup>3</sup>	11	14
	AMA4a			20
	Blank			<11

Note:

[1] Blank sample containing odourless pure nitrogen gas filled by ALS.

[2] The collected sample volume of the gas bag was sufficient for olfactometry analysis.

*LOR denotes Limit of Reporting*



## APPENDIX 1

### Photos of the Sampling Locations



**AMA1a**



**AMA4a**



## APPENDIX 2

### Performance Checking of the Odour Measurement for Olfactometry Analysis (QA/QC Information)

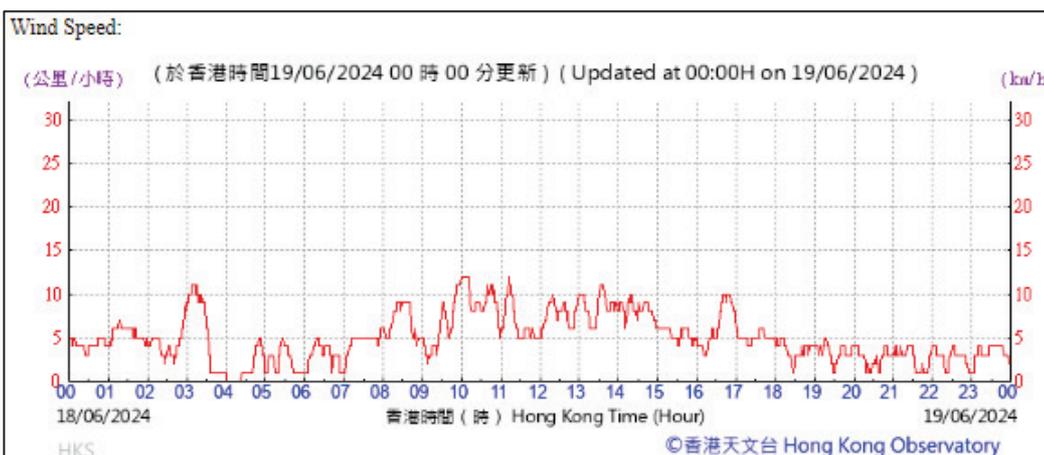
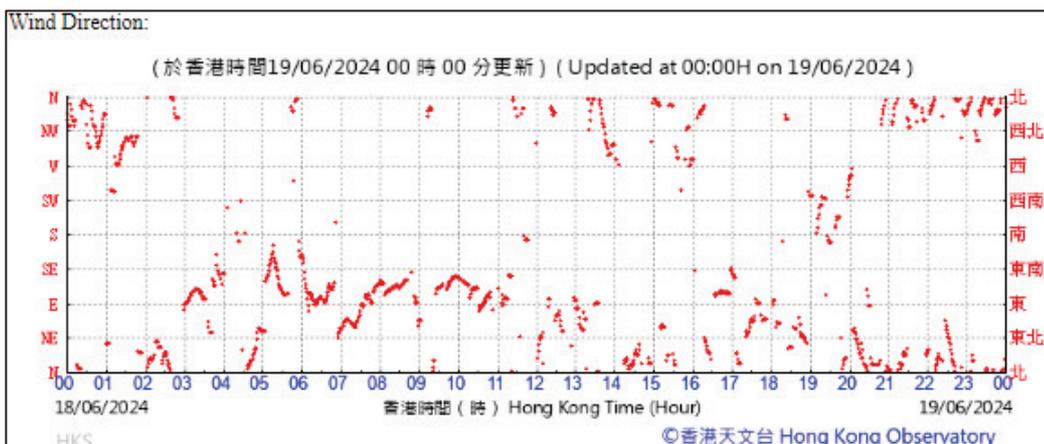
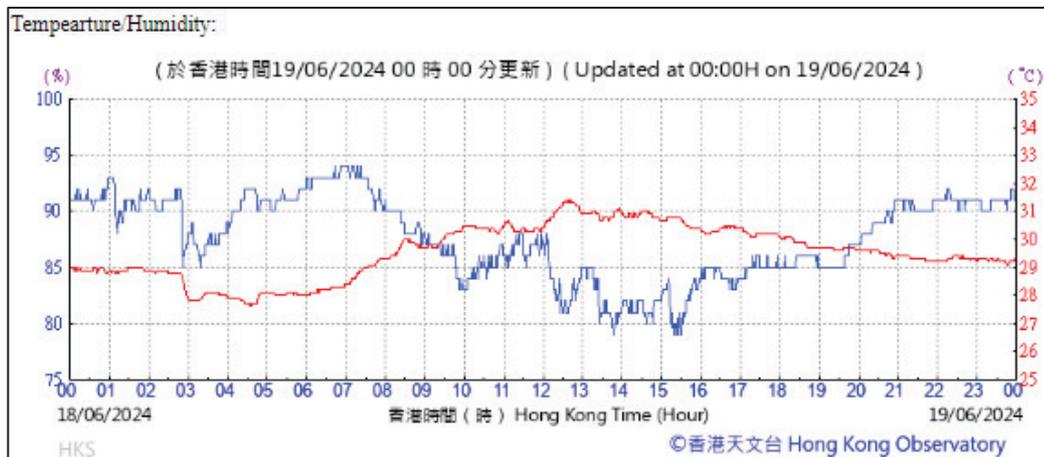
<b>Olfactometer ID:</b>	HK2147
<b>Calibration Due Date:</b>	26 June 2024
<b>Reference Odorant:</b>	50.0 ppm N-Butanol
<b>Accepted Reference Value:</b>	40 ppbv
<b>Pre-dilution Equipment:</b>	No
<b>Presentation Mode:</b>	Forced Choice
<b>Analysis Date:</b>	19 June 2024

Parameters	Acceptance Criteria	Testing Room Environmental Conditions / Laboratory Quality Performance
Laboratory Temperature (°C)	>21°C and Fluctuation $\pm 2^\circ\text{C}$	21.3 - 21.9
Laboratory Relative Humidity (%)	20 - 80%	60 - 68
Carbon Dioxide (CO <sub>2</sub> )	<0.15%	0.06 - 0.10
Accuracy, A <sub>od</sub>	$\leq 0.217$	0.108
Repeatability, r	$\leq 0.477$	0.331



### APPENDIX 3

#### Extract of Meteorological Observations from Hong Kong Observatory Station - Wong Chuk Hang



----- END OF REPORT -----



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2507, One Harbourfront  
18 Tak Fung Street  
Hung Hom, Kowloon  
Hong Kong

T: +852 2271 3000  
F: +852 3015 8052

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