

For Ove Arup & Partners Hong Kong Limited

Odour Assessment Service at Lok Ma Chau Loop

A Summary Report

30 August 2010

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On behalf of
PolyU Technology & Consultancy Co. Ltd

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1. Background

An odour assessment service was required by Ove Arup & Partners Hong Kong Limited to collect odour samples from the water surface of Shenzhen River at Lok Ma Chau Loop using a hood method and also to conduct laboratory olfactometry measurement with the European Standard Method (EN13725) to determine the specific odour emission rate (SOER) from the water surface and odour concentration in air samples.

2. Scope of the Work

Seven sampling locations on the water surface of Shenzhen River and three ambient air sampling locations were previously identified by the client and a sampling map with the exact sampling locations is shown in Appendix A.

The scope of the work needs to:

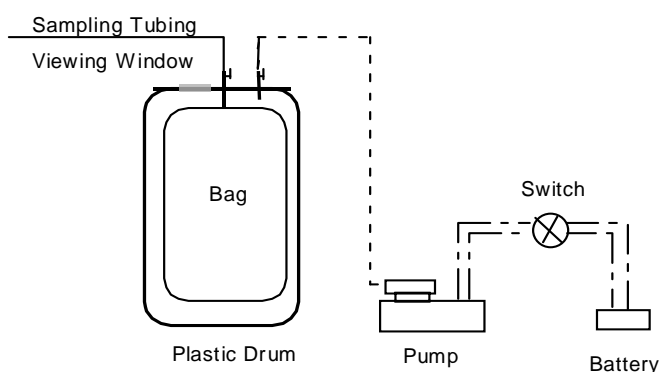
- collect 7 odour samples from water surface at the designated locations using a hood method;
- measure and record the on-site weather conditions including air temperature, relative humidity, wind direction and wind speed on the site during the sampling;
- deliver the collected odour samples to the Odour Laboratory of Poly and conduct laboratory olfactometry analysis to determine the odour concentrations and the specific odour emission rates from water surface;
- and to prepare a summary report.

3. Methodology

3.1. Odour Sampling

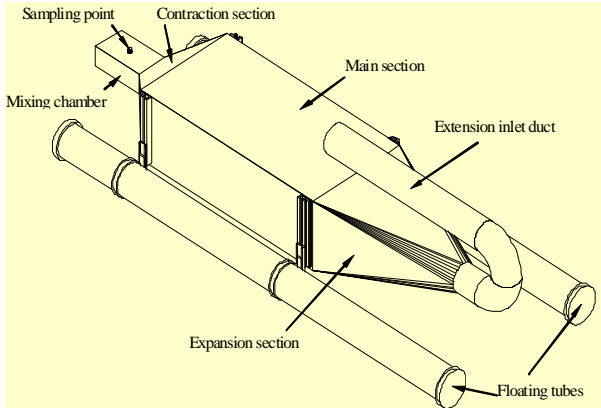
Gaseous odour sample is collected using an odour sampling system, which includes a battery-operated air pump, a sampling vessel, and a Nalophane (NATM) odour bag as shown below. During air sampling, an empty sample bag is placed in the vessel, a rigid plastic container, and the container is then evacuated at a controlled rate and the bag is filled with foul gas. About 60 L of foul gas is collected for each sample.

A scheme of odour sampling system



In order to determine a specific odour emission rate from an area source such as water surface, air sampling can use a “hood” method, whereby a wind tunnel is placed on the odour emission surface of selected locations and a stream of odour-free nitrogen gas from a certified gas cylinder is supplied into the wind tunnel to simulate a parallel wind blowing on the main section of sampling

hood. The emission rate is then determined by the air flow through the hood and the odour concentration of the exit air. Air samples shall be collected using the above sampling vessel and odour bags. The wind tunnel system is shown below.

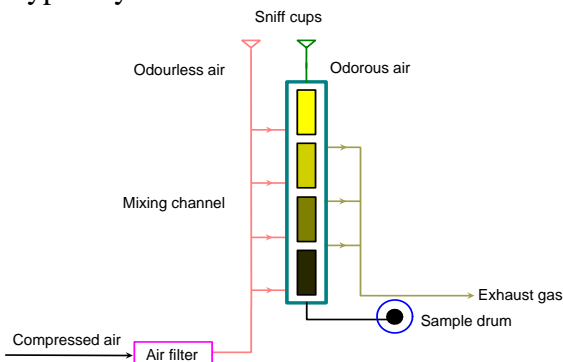


Wind tunnel for odour sampling

Dimension: L = 0.80 m, W = 0.40 m, and H = 0.25 m (Effective height above water surface = 0.23 m)

3.2 Odour Measurement by Olfactometry

Odour concentration is determined by a Forced-choice Dynamic Olfactometer (Olfakton-n2) in accordance with the European Standard Method (EN13725). The unit of measurement is the odour unit per cubic metre: ou/m³. The odour concentration is measured by determining the dilution factor required to reach the detection threshold. The odour concentration at the detection threshold is defined as 1 ou/m³. The odour concentration is 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 10¹ ou/m³ to 10⁷ ou/m³.



Forced-choice dynamic olfactometer



Olfactometer in PolyU (Olfakton-n2)

3.3. Specific Odour Emission Rate

A wind tunnel system as a “hood” is employed in sampling work to collect odour samples from water surface, in which an odour-free gas from a nitrogen gas cylinder is supplied to generate an air inflow at a fixed velocity of 0.01 m/s inside the hood. A specific odour emission rate (SOER) at each area source can be calculated by the following equation:

$$SOER \text{ (ou/m}^2\text{/s)} = \frac{\text{Odour concentration (ou/m}^3\text{)} \times \text{Air flow rate inside hood (m}^3\text{/s)}}{\text{Covered water surface area (m}^2\text{)}}$$

4. Odour Sampling and Olfactometry Measurements

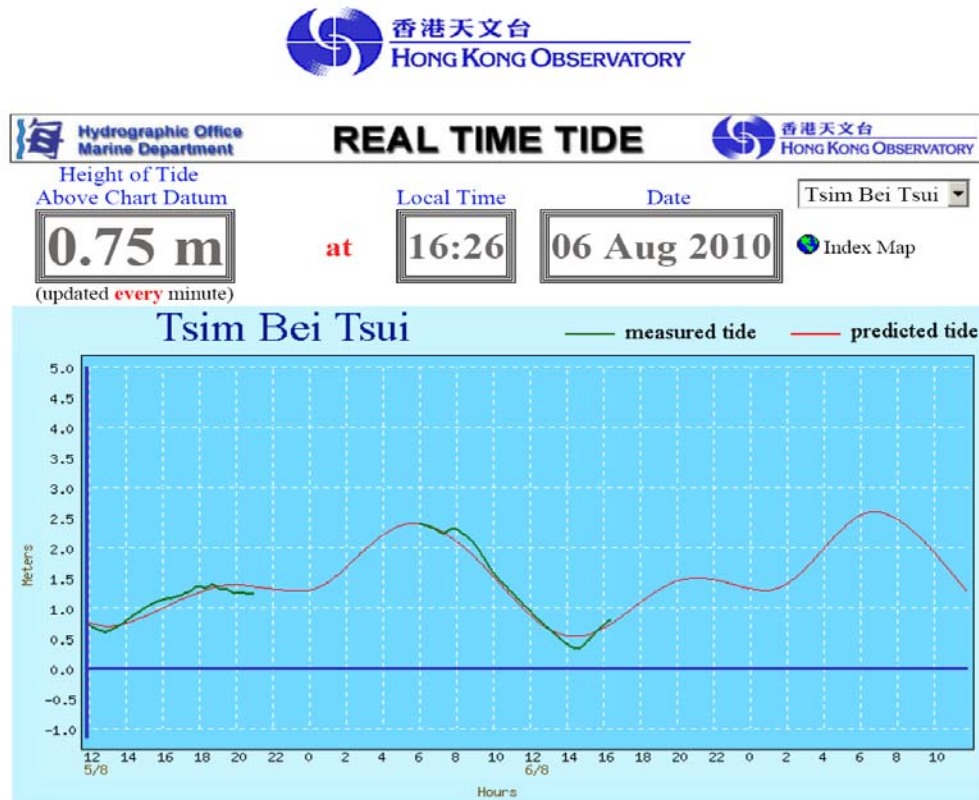
4.1. Sampling Activities

The sampling was conducted on 6 August 2010 to collect 7 odour samples from the water surface of Shenzhen River at the Lok Ma Chau Loop, in which a M4 class marine vessel (wooden boat) was used to reach the designated sampling locations on seawater surface, as specified by the Engineer to carry out sampling work under the guidance/observation from the representatives of the Engineer. The odour samples were taken from water surface using a wind tunnel, where a stream of odour-free nitrogen gas from a certified gas cylinder is supplied into the wind tunnel to simulate parallel winds blowing on the main section of sampling hood at a gas flow velocity of 0.01 m/s and about 60 L of outlet gas from the wind tunnel was taken as odour samples.

The weather conditions on the sampling day are summarized below:

Date	Time	Weather	Ambient temperature	Humidity	Wind direction
6 Aug 2010	11:30 – 14:30	Cloudy	25.0-32.2°C	69-91%	E-NE

A diagram of real time tide on the sampling day was obtained from the Tsim Bei Tsui station of HK Observatory and is presented as follows:



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During the sampling period, relevant weather conditions including air temperature, relative humidity, wind direction and wind speed were measured on site using an anemometer (Lutron AM-4201) and recorded accordingly for references.

A total of 7 odour samples were collected and immediately transported to the Odour Laboratory of PolyU after the sampling.

Some photos about the odour sampling from water surface are presented below:



HK-W-1



HK-W-2





HK-W-3



HK-W-4



HK-W-5



HK-W-6



HK-W-7

4.2 . Olfactometry Measurements

A total of 10 odour samples were transported to the Odour Laboratory of PolyU and olfactometry analysis was conducted within 24 hours after sampling using a forced-choice dynamic olfactometer in accordance with the European Standard Method (EN13725). Five qualified panellists participated in the odour testing session, who were previously selected through a set of screening tests using a certified n-butanol gas as a standard reference.

4.3. Determination of Specific Odour Emission Rate

$$SOER \text{ (ou/m}^2\text{/s)} = \frac{\text{Odour concentration (ou/m}^3\text{)} \times \text{Air flow rate inside hood (0.00092 m}^3\text{/s)}}{\text{Covered water surface area (0.32 m}^2\text{)}}$$

Where air flow rate inside hood = 0.01 m/s (Flow velocity) x 0.4 m (W) x 0.23 m (H) = 0.00092 m³/s, and covered surface area = 0.8 m (L) x 0.4 m (W) = 0.32 m².

5. Results of odour assessment

The results of odour assessment for odour emission rates from water surface of Shezhen River are presented in the following table:

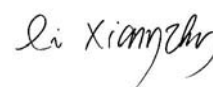
Summary of specific odour emission rates from water surface at 7 sampling locations

Sample ID	Location coordinate		Date	Time	AT (°C)	RH (%)	WS (m/s)	WD	WT (°C)	WD (m)	OC (ou/m ³)	SOER (ou/m ² /s)
	Easting	Northing										
HK-W-1	825605.8	842074.3	6-Aug-2010	13:40	33.5	62.9	0.6	E-NE	29.6	3.5	200	0.58
HK-W-2	825874.6	842545.1	6-Aug-2010	13:24	32.8	64.0	0.7	E-NE	29.5	2.2	88	0.25
HK-W-3	826039.7	843063.8	6-Aug-2010	13:06	32.4	65.5	1.6	E-NE	29.8	1.0	84	0.24
HK-W-4	826542.2	843493.3	6-Aug-2010	12:47	32.9	63.2	1.2	E-NE	29.4	2.5	72	0.21
HK-W-5	827110.9	843918.3	6-Aug-2010	12:30	33.0	63.5	0.4	E-NE	30.0	1.1	98	0.28
HK-W-6	827476.0	844103.9	6-Aug-2010	12:12	32.3	63.8	0.9	E-NE	29.5	0.8	104	0.30
HK-W-7	827774.3	843984.5	6-Aug-2010	11:48	32.1	64.5	0.3	E-NE	29.1	2.2	257	0.74

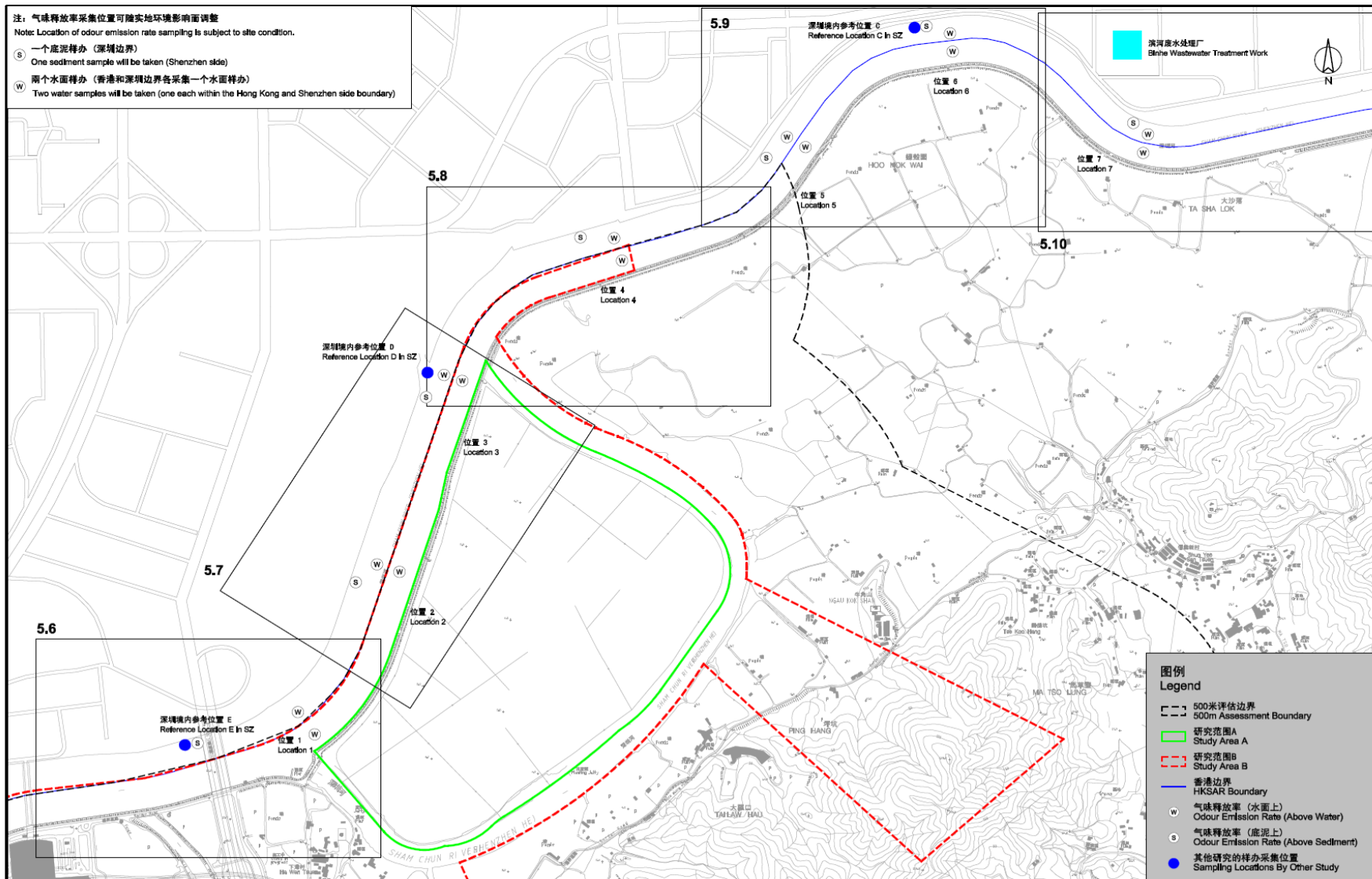
Remark: AT: Ambient temperature; RH: Relative humidity; WS: Wind speed; WD: Wind direction; OC: Odour concentration; SOER: Specific odour emission rate

Prepared by: Professor X. Z. LI

Signed:



Appendix A: Odour Sampling Locations at Lok Ma Chau Loop



 土木工程拓展署 CIVIL ENGINEERING AND DEVELOPMENT DEPARTMENT	 规划署 PLANNING DEPARTMENT	 奥雅纳工程顾问 Ove Arup & Partners Hong Kong Limited	研究项目 Job Title: 合约编号 Agreement No. CE 53/2008 (CE) 落马洲河套地区发展规划及工程研究 - 勘察研究 Planning and Engineering Study on Development of Lok Ma Chau Loop - Investigation	图则项目 Title: 建议气味调查及空气样办采集位置 (索引图) Proposed Odour and Air Sampling Locations (Key Plan)	图则编号 Figure No. <b style="font-size: 1.2em;">1 图例 Scale: 1:10000 on A3 修订编号 Rev. -
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