FORM 5

Application No.: VEP-595/2021
Reference No.:
(For official use)

FORM 5
ENVIRONMENTAL IMPACT ASSESSMENT ORDINANCE
(CHAPTER 499)
SECTION 13(1)

Application for Variation of an Environmental Permit

PART A PREVIOUS APPLICATIONS

- [x] No previous application for variation of an environmental permit.
- [ ] The environmental permit was previously amended.

Application No. : ....

PART B DETAILS OF APPLICANT

B1. Name : (person or company)

Civil Engineering and Development Department

[Note : In accordance with section 13(1) of the Ordinance, the person holding an environmental permit or a person who assumes responsibility for the designated project may apply for variation of the environmental permit.]

B2. Business Registration No. :
(if applicable) ☐☐☐☐☐☐☐☐ – ☐☐☐ – ☐☐ – ☐☐ – ☐

B3. Correspondence Address :

[redacted]

B4. Name of Contact Person : [redacted]

B5. Position of Contact Person : [redacted]

B6. Telephone No. : [redacted]

B7. Fax No. : [redacted]

B8. E-mail Address : (if any) [redacted]

PART C DETAILS OF CURRENT ENVIRONMENTAL PERMIT

C1. Name of the Current Environmental Permit Holder :

Civil Engineering and Development Department

C2. Application No. of the Current Environmental Permit : EP-477/2013

C3. The Current Environmental Permit was Issued in : month / year

11 / 2013

Important Notes : Please submit the application together with
(a) 3 copies of this completed form; and
(b) appropriate fee as stipulated in the Environmental Impact Assessment (Fees) Regulation
to the Environmental Protection Department at the following address :
The EIA Ordinance Register Office,
27th floor, Southorn Centre,130 Hennessy Road,
Wan Chai, Hong Kong.

RECEIVED
16 JUL 2021
EIAO Register Office, E.P.D.

☐ Tick (✓) the appropriate box

EPD185

PART D PROPOSED VARIATIONS TO THE CONDITIONS IN CURRENT ENVIRONMENTAL PERMIT

D1. Condition(s) in the Current Environmental Permit :	D2. Proposed Variation(s) :	D3. Reason for Variation(s) :	D4. Describe the environmental changes arising from the proposed variation(s) :	D5. Describe how the environment and the community might be affected by the proposed variation(s) :	D6. Describe how and to what extent the environmental performance requirements set out in the EIA report previously approved or project profile previously submitted for this project may be affected :	D7. Describe any additional measures proposed to eliminate, reduce or control any adverse environmental impact arising from the proposed variation(s) and to meet the requirements in the Technical Memorandum on Environmental Impact Assessment Process :
EP Condition 2.13 When bioremediation works for odour remediation as mentioned in Condition 2.24 of this Permit is conducted at the Shenzhen River, no more than one working vessel shall be allowed to work concurrently and the maximum injection area shall be less than 10,000 m2 per day to mitigate water quality impact.	**EP Condition 2.13** When odour mitigation works at the Shenzhen River is recommended in the Odour Mitigation Measures and Monitoring Plan (OMMMP) deposited under Condition 2.24 of this Permit, the Permit Holder shall, no later than six months before the commencement of the odour mitigation works at the Shenzhen River, deposit with the Director 3 hard copies and 1 electronic copy of the detailed proposal of the odour mitigation works. The proposal shall include the details of the location, scale, scope, working arrangements, water quality mitigation measures and water quality monitoring and audit requirements of carrying out the odour mitigation works at the Shenzhen River. Before submission to the Director, the detailed proposal shall be certified by the ET Leader and verified by the IEC as conforming to the relevant information and recommendations contained in the EIA Report and application document for variation of an environmental permit. All measures as recommended in the detailed proposal of odour mitigation works at the Shenzhen River shall be fully and properly implemented.	Please refer to the attached Environmental Review Report for Variation of Environmental Permit Application on Odour Remediation at Shenzhen River supporting this VEP application	Please refer to the attached Environmental Review Report for Variation of Environmental Permit Application on Odour Remediation at Shenzhen River supporting this VEP application	Please refer to the attached Environmental Review Report for Variation of Environmental Permit Application on Odour Remediation at Shenzhen River supporting this VEP application	Please refer to the attached Environmental Review Report for Variation of Environmental Permit Application on Odour Remediation at Shenzhen River supporting this VEP application	Please refer to the attached Environmental Review Report for Variation of Environmental Permit Application on Odour Remediation at Shenzhen River supporting this VEP application

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EP Condition 2.24 To mitigate the cumulative odour impact, bioremediation with 98% odour removal efficiency shall be implemented along a section of Shenzhen River, about 4.2 km in length, next to/near the LMC Loop, as shown in Figure 7 of this Permit. If necessary, the bioremediation shall be repeated in accordance with the recommendation of the odour monitoring and audit results which shall be certified by the ET Leader and verified by the IEC as conforming to the relevant information and recommendations contained in the EIA Report. **Figure 7**	**EP Condition 2.24** To manage and mitigate the potential odour impact at the LMC Loop, the Permit Holder shall, no later than six months before the commencement of operation of the Project to intake population, deposit with the Director 3 hard copies and 1 electronic copy of the Odour Mitigation Measures and Monitoring Plan (OMMMP). The OMMMP shall include : a) a detailed proposal of odour monitoring to detect and manage any potential odour impact at the air sensitive receivers in the Project; and b) a detailed proposal of mitigation measures for the identified odour emission sources and operational arrangements at the affected air sensitive receivers to minimize the odour impact. Before submission to the Director, the OMMMP shall be certified by the ET Leader and verified by the IEC as conforming to the relevant information and recommendations contained in the EIA Report and application document for variation of an environmental permit. All measures as recommended in the OMMMP shall be fully and properly implemented. Deleted	Please refer to the attached Environmental Review Report for Variation of Environmental Application on Odour Remediation at Shenzhen River supporting this VEP application	Please refer to the attached Environmental Review Report for Variation of Environmental Application on Odour Remediation at Shenzhen River supporting this VEP application	Please refer to the attached Environmental Review Report for Variation of Environmental Application on Odour Remediation at Shenzhen River supporting this VEP application	Please refer to the attached Environmental Review Report for Variation of Environmental Application on Odour Remediation at Shenzhen River supporting this VEP application	Please refer to the attached Environmental Review Report for Variation of Environmental Application on Odour Remediation at Shenzhen River supporting this VEP application

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Condition 2.22 (a) To mitigate operation stage noise impact, the following noise mitigation measures shall be implemented during the operation stage of the Project: (a) noise barriers shall be installed to screen road traffic noise during the operation stage of the Project as described in Table 3 and Figures 6a, 6b and 6c of this Permit;	**Condition 2.22 (a)** To mitigate operation stage noise impact, the following noise mitigation measures shall be implemented during the operation stage of the Project: (a) traffic noise mitigation measures including noise barriers and low noise road surfacing at the connecting roads including Ha Wan Tsuen Road, Lok Ma Chau Road and Direct Link for the Project. The Permit Holder shall, no later than one month before the commencement of construction of the traffic noise mitigation measures for the Project, deposit with the Director 3 hard copies and 1 electronic copy of Traffic Noise Mitigation Plan (TNMP). The TNMP shall include design details of the traffic noise mitigation measures, locations of noise barriers and low noise road surfacing, dimensions of noise barriers, traffic noise mitigation performance with the traffic noise mitigation measures in place and aesthetic design of noise barriers. The TNMP shall demonstrate that the traffic noise performance requirements set out in the approved EIA report (Register No.: AEIAR-176/2013) will not be exceeded or violated with the mitigation measures in place. Before submission to the Director, the TNMP shall be certified by the ET Leader and verified by the IEC as conforming to the relevant information and recommendations contained in the EIA Report and application document for variation of an environmental permit. All measures as recommended in the TNMP shall be fully and properly implemented and maintained;	Various reasons including: - - To avoid causing sight-line issue to traffic; - Local stakeholder comment; - To match with the proposed pedestrian crossing - Changes of noise sensitive receivers Details please refer to the attached Environmental Review Report for Variation of Environmental Permit Application on Western Connection Road supporting this VEP application	No adverse environmental impact would be expected. Details please refer to the attached Environmental Review Report for Variation of Environmental Permit Application on Western Connection Road supporting this VEP application	No adverse environmental impact would be anticipated and the community would not be affected by the proposed variations. Details please refer to the attached Environmental Review Report for Variation of Environmental Permit Application on Western Connection Road supporting this VEP application	Environmental performance requirements set out in the approved EIA report would still be valid. Details please refer to the attached Environmental Review Report for Variation of Environmental Permit Application on Western Connection Road supporting this VEP application	Please refer to the attached Environmental Review Report for Variation of Environmental Permit Application on Western Connection Road supporting this VEP application

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Condition 2.22 (b) (b) noise mitigation measures such as silencers, acoustic louvers and acoustic enclosures for fixed plant noise as described in Table 3 and with reference to the typical designs as shown in Figure 4 of this Permit; **Table 3** For the on-site Sewage Treatment Works: • Noise mitigation measures including silencers, acoustic louvers and acoustic enclosures shall be installed. **Figures 6a, 6b and 6c**	**Condition 2.22 (b)** (b) the total sound power level of the fixed plant noise generated from the on-site Sewage Treatment Works during operation shall not be more than 75dB(A). Deleted Deleted	To allow consideration of cost-effectiveness in designing/procuring the LMCLSTW with good acoustic performance, potentially include build-in noise insulation design, such that the need of installing noise mitigation measures may not be required. Details please refer to the attached Environmental Review Report for Variation of Environmental Permit Application on Western Connection Road supporting this VEP application	No adverse environmental impact would be expected. Details please refer to the attached Environmental Review Report for Variation of Environmental Permit Application on Western Connection Road supporting this VEP application	No adverse environmental impact would be anticipated and the community would not be affected by the proposed variations. Details please refer to the attached Environmental Review Report for Variation of Environmental Permit Application on Western Connection Road supporting this VEP application	Environmental performance requirements set out in the approved EIA report would still be valid. Details please refer to the attached Environmental Review Report for Variation of Environmental Permit Application on Western Connection Road supporting this VEP application	Please refer to the attached Environmental Review Report for Variation of Environmental Permit Application on Western Connection Road supporting this VEP application

PART E DECLARATION BY APPLICANT

E1. I hereby certify that the particulars given above are correct and true to the best of my knowledge and belief. I understand the environmental permit may be suspended, varied or cancelled if any information given above is false, misleading, wrong or incomplete.

[redacted]	[redacted]	[redacted]
Signature of Applicant	Full Name in Block Letters	Position

on behalf of Civil Engineering and Development Department 16.7.21

Company Name and Chop (as appropriate) Date

NOTES :

1. A person who constructs or operates a designated project in Part I of Schedule 2 of the Ordinance or decommissions a designated project listed in Part II of Schedule 2 of the Ordinance without an environmental permit or contrary to the permit conditions commits an offence under the Ordinance and is liable to a maximum fine of $5,000,000 and to a maximum imprisonment for 2 years.

2. A person for whom a designated project is constructed, operated or decommissioned and who permits the carrying out of the designated project in contravention of the Ordinance commits an offence and is liable to a maximum fine of $5,000,000 and to a maximum imprisonment for 2 years.

土木工程拓展署
Civil Engineering and
Development Department

Agreement No. CE 5/2018 (CE)

Development of Lok Ma Chau Loop: Main Works Package 1 – Design and Construction

Environmental Review Report for Variation of Environmental Permit Application on Odour Remediation at Shenzhen River (Final)

(Ref. A22-03)

July 2021

AECOM Imagine it. Delivered.

CEDD 土木工程拓展署
Civil Engineering and Development Department

Agreement No. CE 5/2018 (CE)

Development of Lok Ma Chau Loop: Main Works Package 1 – Design and Construction

Environmental Review Report for Variation of Environmental Permit Application on Odour Remediation at Shenzhen River (Final) (Ref. A22-03)

July 2021

Reviewed:	Kelvin Cheng	14 July 2021
Approved for Issue:	pp Conrad Ng	14 July 2021

AECOM ASIA COMPANY LIMITED

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1. INTRODUCTION

1.1 Background

1.1.1 As a result of the training of Shenzhen (SZ) River, which serves as the administrative boundary between Hong Kong Special Administrative Region (HKSAR) and SZ, an area of about 87 hectares, previously lying to the north of the river course, became situated to the south of the re-aligned river and therefore within the boundary of the HKSAR. This area, commonly known as the Loop, was once used as a dumping ground for mud dredged from the river regulation works.

1.1.2 The Loop is located near several major cross-boundary transport nodes including the Lok Ma Chau Boundary Control Point, the MTR Lok Ma Chau Station of the Lok Ma Chau Spur Line and the San Tin Interchange. To the north across SZ River is the Huanggang Control Point of SZ. To the southwest is the Mai Po Nature Reserve and to the east is Hoo Hok Wai, comprising fish ponds of high ecological value.

1.1.3 The Loop development is one of the ten major infrastructure projects announced in the 2007-08 Policy Address for economic growth. The Planning and Engineering Study (P&E Study), Agreement No. CE 53/2008 (CE) “Planning and Engineering Study on Development of Lok Ma Chau Loop – Investigation”, funded under PWP Item No. 735CL, was completed in 2014. The P&E Study investigated the feasibility of and formulated a comprehensive development plan for the Loop, taking into account the prevailing planning circumstances and public views collected through public engagement.

1.1.4 The P&E Study development plan is a Designated Project under Schedule 3 of the Environmental Impact Assessment Ordinance (EIAO). In October 2013, the Environmental Impact Assessment (EIA) Report for the Loop development (AEIAR-176/2013) was approved by Director of Environmental Protection (DEP) pursuant to the EIAO. The Environmental Permit (EP) (EP No. EP-477/2013) for the Loop to construct and operate the relevant Designated Projects (DP) was granted by DEP on 22 November 2013.

1.1.5 On 3 January 2017, the Government of Hong Kong Special Administrative Region (HKSARG) and Shenzhen Municipal People’s Government (SZMPG) signed a Memorandum of Understanding (the MoU) on “Jointly Developing the Lok Ma Chau Loop by Hong Kong and Shenzhen between the Hong Kong Special Administrative Region Government and Shenzhen Municipal People’s Government.” The MoU outlined the intention to jointly develop the Loop into the Hong Kong-Shenzhen Innovation and Technology Park (HSITP) under the "one country, two systems" principle and in accordance with the Basic Law. The HSITP will establish a key base for Information & Technology (I&T) industries, co-operation in scientific research with related higher education, cultural & creative and other complementary facilities. According to the MoU, HKSARG will be responsible for the construction of the infrastructure within the Loop (including site formation and infrastructural facilities) and the provision of supporting infrastructure outside the Loop.

1.1.6 The draft Lok Ma Chau Loop Outline Zoning Plan (OZP) was approved by Chief Executive in Council on 30 January 2018. The approved Lok Ma Chau Loop OZP was exhibited for public inspection on 9 February 2018. The old SZ River meander which has been included in the approved OZP as “CA” zone (Conservation Area zoned in statuary OZP).

1.1.7 The development of the Loop into the HSITP is being taken forward by the Innovation and Technology Bureau (ITB) as the lead policy bureau. The Development Bureau (DEVB) and the Civil Engineering and Development Department (CEDD) support the development by undertaking the associated site formation and infrastructure works to provide the formed land to ITB/ HKSTPC for development of the HSITP as well as the supporting infrastructural facilities.

<u>Work Packaging</u>

1.1.8 The Loop has been planned to be developed into a sustainable, environmentally friendly, energy efficient and people-oriented community. According to the recommendations in the P&E Study, the Loop development will be implemented in three works packages: Advance Works, Main Works Package 1 and Main Works Package 2. Advance Works (covered by PWP item No. 748CL – Development of Lok Ma Chau Loop – Land Decontamination and Advance Engineering Works), is to pave way for the ensuing construction works within the Loop. Main Works Package 1 pertinent to this Project, covered by PWP item No. 760CL – Development of Lok Ma Chau Loop – Main Works Package 1, is to form the site for the subsequent development of buildings and associated facilities for Phase 1 of HSITP, as well as providing the infrastructure and supporting facilities for Phase 1 of the Loop development. Main Works Package 2, to be covered by PWP item yet to be created, is to provide the infrastructure and supporting facilities for the remaining development of the Loop.

1.1.9 The Advance Works under PWP Item No. 748CL include the provision of construction access to the Loop, land decontamination required for proposed land uses within the Loop, creating and establishing an Ecological Area (EA) zone and other associated environmental mitigation measures. The detailed design for the Advance Works was completed under another consultancy, with construction works commencing on 22 June 2018.

1.2 The Project

1.2.1 AECOM Asia Co Ltd (hereafter refers as the *Consultant*) was commissioned by CEDD to undertake Agreement No. CE5/2018 (CE) – Development of Lok Ma Chau Loop: Main Works Package 1 – Design and Construction. The *starting date* of *services* is 14 September 2018 and the *completion date* for the whole of the *services* is the date of 101 months after the *starting date*.

1.2.2 A layout plan of the project is enclosed in **Appendix 1.1**.

1.3 Scope of this Report

1.3.1 This Environmental Review Report (ERR) is prepared to review the potential odour impact within Lok Ma Chau Loop (LMCL) taking into account the latest information regarding the design of the proposed Lok Ma Chau Loop Sewage Treatment Works (LMCLSTW), the latest information of the Shenzhen Binhe Waste Water Treatment Plant (BHWWTP) and the latest condition of Shenzhen River (SZ) River. The odour mitigation measures requirements stipulated in the Environment Permit (EP-477/2013) (the EP) and the relevant environmental monitoring and audit (EM&A) requirements in the approved EIA Report would also be reviewed.

1.3.2 This report will form part of the submission to the Environmental Protection Department (EPD) for the application of a Variation of Environmental Permit (EP) of the current EP (EP-477/2013) on condition 2.13, condition 2.24 and Figure 7. The proposed changes of EP conditions are presented in **Section 2** of this Report.

1.4 Structure of this Report

1.4.1 Apart from this introductory section, there will be other sections in this Report as follows:

- Section 2 – Proposed Variations to the Environment Permit;
- Section 3 – Changes of Odour Situations since the Approval of EIA Report;
- Section 4 – Review on Operation Phase Odour Impacts;
- Section 5 – Review on Environmental Permit Conditions;
- Section 6 – Review on Environmental Monitoring and Audit (EM&A) Requirements associated with the Proposed Variations to the Environmental Permit; and
- Section 7 – Conclusion.

2. PROPOSED VARIATIONS OF ENVIRONMENTAL PERMIT

2.1.1 The application for variation of environmental permit (VEP) would include variations to the environmental permit (EP) (EP-477/2013) regarding condition 2.13, condition 2.24 and Figure 7. Condition 2.13 would not be still valid and another requirement regarding the water quality mitigation measures is proposed. The proposed EP conditions are listed in below **Table 2.1**.

Table 2.1 Proposed Variations of the Environmental Permit

EP Condition	Original Condition	Proposed Condition
2.13	When bioremediation works for odour remediation as mentioned in Condition 2.24 of this Permit is conducted at the Shenzhen River, no more than one working vessel shall be allowed to work concurrently and the maximum injection area shall be less than 10,000 m2 per day to mitigate water quality impact.	When odour mitigation works at the Shenzhen River is recommended in the Odour Mitigation Measures and Monitoring Plan (OMMMP) deposited under Condition 2.24 of this Permit, the Permit Holder shall, no later than six months before the commencement of the odour mitigation works at the Shenzhen River, deposit with the Director 3 hard copies and 1 electronic copy of the detailed proposal of the odour mitigation works. The proposal shall include the details of the location, scale, scope, working arrangements, water quality mitigation measures and water quality monitoring and audit requirements of carrying out the odour mitigation works at the Shenzhen River. Before submission to the Director, the detailed proposal shall be certified by the ET Leader and verified by the IEC as conforming to the relevant information and recommendations contained in the EIA Report and application document for variation of an environmental permit. All measures as recommended in the detailed proposal of odour mitigation works at the Shenzhen River shall be fully and properly implemented.

2.24	To mitigate the cumulative odour impact, bioremediation with 98% odour removal efficiency shall be implemented along a section of Shenzhen River, about 4.2 km in length, next to/near the LMC Loop, as shown in Figure 7 of this Permit. If necessary, the bioremediation shall be repeated in accordance with the recommendation of the odour monitoring and audit results which shall be certified by the ET Leader and verified by the IEC as conforming to the relevant information and recommendations contained in the EIA Report.	To manage and mitigate the potential odour impact at the LMC Loop, the Permit Holder shall, no later than six months before the commencement of operation of the Project to intake population, deposit with the Director 3 hard copies and 1 electronic copy of the Odour Mitigation Measures and Monitoring Plan (OMMMP). The OMMMP shall include: a) a detailed proposal of odour monitoring to detect and manage any potential odour impact at the air sensitive receivers in the Project; and b) a detailed proposal of mitigation measures for the identified odour emission sources and operational arrangements at the affected air sensitive receivers to minimize the odour impact. Before submission to the Director, the OMMMP shall be certified by the ET Leader and verified by the IEC as conforming to the relevant information and recommendations contained in the EIA Report and application document for variation of an environmental permit. All measures as recommended in the OMMMP shall be fully and properly implemented.
Figure 7	As shown in **Appendix 2.1**.	Deleted.

3. CHANGES OF ODOUR SITUATIONS SINCE THE APPROVAL OF EIA REPORT

3.1 Introduction

3.1.1 Since the approval of the EIA Report for Development of Lok Ma Chau Loop (AEIAR-176/2013) (hereinafter referred as “the EIA Report”) in October 2013 and subsequent issuance of Environmental Permit (EP-477/2013) (hereinafter referred as “the EP”)in November 2013, substantial improvement to the major odour sources near or within LMCL including Lok Ma Chau Loop Sewage Treatment Works, Binhe Waste Water Treatment Plant and Shenzhen River.

3.1.2 This chapter presents the odour emission strength of the major odour sources assumed in the EIA Report and their latest situation.

3.2 Findings in the Environmental Impact Assessment Report

Overall Odour Assessment Findings in the Environmental Impact Assessment Report

3.2.1 With reference to Section 3, Figure 3.5 and Appendix 3-12 of the EIA Report, three major odour emission sources were identified affecting operation phase of the Development of LMCL, including:

- Lok Ma Chau Loop Sewage Treatment Works (LMCLSTW)
- Binhe Waste Water Treatment Plant (BHWWTP); and
- Shenzhen River (SZR)

3.2.2 Based on the EPD’s approved modelling methodology at the time of the EIA Study, a quantitative odour impact assessment has been conducted. Assumption was made for the BHWWTP and LMCLSTW that deodourisers of at least 95% odour removal efficiency would be installed. Without mitigation measures on SZR, the overall predicted maximum cumulative odour concentrations at the representative ASRs under unmitigated scenario was found to be 153.5 OU, exceeding the EIAO-TM criterion of 5 OU. With the recommended bioremediation of 98% odour removal efficiency under the short-to-medium term scenario, the overall predicted maximum cumulative odour concentrations at the representative ASRs was found to be 14.5 OU, exceeding the EIAO-TM criterion of 5 OU. Under the long-term scenario with the recommended bioremediation of 98% odour removal efficiency together with the SZ Municipal Government's improvement works along SZR and its tributaries and centralised sewage treatment, the overall predicted maximum cumulative odour concentrations at the representative ASRs was found to be 4.7 OU, complying with the EIAO-TM criterion of 5 OU.

3.2.3 The assumptions adopted in the EIA Study for the three major odour emission sources are detailed as below.

Lok Ma Chau Loop Sewage Treatment Works

3.2.4 The LMCLSTW was proposed to locate at the northeast corner within the LMCL. It adopted a decentralized design, which is similar to the Sha Tin Sewage Treatment Works (STSTW) at the time of the EIA study. As the proposed LMCLSTW is to be built, the specific odour emission rate of each treatment process was referenced to that of the STSTW. The LMCLSTW would be designed fully enclosed with two deodourisers to minimise the potential odour emission. Each deodouriser would equip with its own exhausts. Based on the design capacity, the specific odour emission rate from STSTW and a 95% odour removal efficiency from the deodourisers, the overall odour emission from LMCLSTW were calculated in the EIA study as about 2,431 OU/s.

Binhe Waste Water Treatment Plant

3.2.5 BHWWTP is located at about 1.8km upstream from the boundary of LMCL on Shenzhen side. With reference to the EIA Report, BHWWTP was built in Year 1983 and was being upgraded since 2007 aiming to ultimately meet the Class IA Standard in Discharge Standard of Pollutants for Municipal Wastewater Treatment Plant (GB 18918-2002), i.e. odour concentration of 10 OU at the boundary of BHWWTP.

3.2.6 During the EIA Study, no data was available for BHWWTP. Thus, odour emission for odour modelling purpose were adopted from STSTW, given that BHWWTP has a similar design with STSTW on their secondary treatment level using activated sludge process and the similar treatment capacity of 300,000 to 340,000 m^3/day. The overall odour emission from BHWWTP were calculated in the EIA study as about 14,521 OU/s.

Shenzhen River

3.2.7 An odour survey was conducted at 7 points in Year 2010 along Hong Kong side of SZR, with reference to Appendix 3-9 of the EIA Report. The specific odour emission rates were determined between 0.21 to 0.74 OU/m^2/s along the relevant Hong Kong side section of SZR, whereas the odour emission rates of Shenzhen side of SZR were omitted from the EIA Report due to data confidentiality reason.

3.2.8 With reference to Appendix 3-12 of the EIA Report, odour emission along a 10km long section of SZR were included in the air dispersion model to predict the odour concentration within LMCL. The SZR odour sources were assumed as area sources representing the water surface and exposed sediment surface. The odour emission rate of SZR (both Hong Kong and Shenzhen sides and both water surface and exposed sediment surface) were between 0.21 and 7.25 OU/m^2/s.

3.2.9 Due to the high odour contribution from SZR, implementation of bioremediation with 98% odour removal efficiency was recommended along a section of SZR approximately 1km upstream of, 1.9km downstream of and 1.3km along LMCL (approximately 4.2km in total). Hence, the bioremediation works is considered as an odour mitigation measures for short to medium term. The predicted maximum odour concentrations at the representative ASRs were found to be 14.5 OU under the short to medium term scenario, still exceeding the EIAO-TM criterion of 5 OU. The residual odour impact was then alleviated by installing central air conditioning and activated carbon filter for the representative ASRs.

3.2.10 Under the long-term scenario, the residual impact would be further reduced by continual improvement of the Shenzhen River odour issues by the improvement works implemented in the major tributaries of the SZR and the Shenzhen 12th 5-year plan on centralised sewage treatment for Shenzhen, which was assumed to provide a 92% odour removal efficiency for the whole SZR.

3.3 Latest Odour Situation

3.3.1 The potential odour impact from the three major odour emission sources have been improved and summarised below, before going into detail quantitative assessment in **Section 4**.

Lok Ma Chau Loop Sewage Treatment Works

3.3.2 The latest LMCLSTW design will still be fully enclosed and the enclosed area are connected to deodouriser, which treat all odourous air from inside the LMCLSTW prior to discharge to the atmosphere. Odour treatment arrangement with three deodourisation units with 95% odour removal efficiency and their respective relocated exhausts was proposed to suit the latest design layout, instead of the EIA assumption of two deodourisation units. The layout plan of LMCLSTW is presented in **Appendix 4.1**.

3.3.3 Regarding the base emission rates for the odour assessment, as the LMCLSTW is a planned treatment works without any available odour data, the EIA Report adopted the odour emission rates of the STSTW which were measured in 2006. However, in order to update the reference with a more similar treatment process and recent data, it is proposed in this ERR to make reference to the odour emission rates adopted in the EIA Report for the Shek Wu Hui Sewage Treatment Works (SWHSTW) (Register No.: AEIAR-175/2013), which is planned to adopt the same biological treatment process as the LMCLSTW (i.e. membrane bioreactor) with the odour emission rates measured in 2011. In addition, the SWHSTW mainly collects sewage of 81,000m^3/day from Sheung Shui and Fanling in a distance of around 4 km, while the STSTW mainly collects sewage of 250,000m^3/day from Sha Tin and Ma On Shan in a distance of around 7 km. Considering the design capacity of 18,000m^3/day for the LMCLSTW and the sewage collected from the LMCL is within a distance of about 1 km, the influent quality of LMCLSTW is expected to be rather more similar to that in SWHSTW than in STSTW. Therefore, the 2011 measurement of SWHSTW would be a more appropriate assumption for estimation of LMCLSTW odour emission rates.

3.3.4 The overall odour emission from the latest design of LMCLSTW will be reduced to about 787 OU/s. The detailed emission rates are also presented in **Section 4.4.2**.

Binhe Waste Water Treatment Plant

3.3.5 In Year 2020, BHWWTP has been installed with 6 sets of deodourising facilities, including 22 biological deodourising towers (生物除臭塔), 4 chemical deodourising systems (化學除臭系統) and 2 washing towers (洗滌塔), providing an overall deodourising capacity of 290,000 m^3/h. In addition, 5 sets of deodourant agent dosing devices (除臭菌劑投加裝置) were included for the fully covered WWTP. The monthly environmental monitoring data in Year 2020 indicated the odour concentration at down-wind control point would be less than 10 OU throughout the whole year, complying with the Class 2 Standard in Discharge Standard of Pollutants for Municipal Wastewater Treatment Plant (GB 18918-2002), i.e. 20 OU at the boundary of BHWWTP.

3.3.6 Apart from the 20 OU odour concentration standard and Year 2020 record at the BHWWTP boundary, i.e. the odour emission rate, the other odour emission parameters of BHWWTP assumed in the EIA Report would still be valid. Thus, the odour emission rate of BHWWTP has been updated via a backward modelling exercise as stated in **Section 4.4.4**.

Shenzhen River

3.3.7 As presented in the EIA Report, SZR improvement works, including the centralised sewage treatment stated in the Shenzhen 12^{th} 5-year plan, have been carried out in various projects. Below present a summary and status of the SZR improvement works.

Shenzhen River Improvement Works

3.3.8 With reference to Table 3.21 of the EIA Report, a number of remediation works were proposed to the tributaries to SZR, including Buji River, Futian River, Xinzhou River and SZR. These remediation works included sewage interception works, water environment enhancement works, sewage collection and centralised treatment works, and comprehensive river remediation works, were completed substantially in or before 2017.

3.3.9 Apart from the river remediation works as presented in the EIA Report, Shenzhen Government conducted various additional water environment improvement works, which would improve the water quality as well as the odour emission from SZR. These works include comprehensive river water quality improvement works along 5 major river channels of Shenzhen (including SZR and Futian River), sewage mains provision for villages, sewage collection works and drainage improvement works, sewage interception of Huanggang River, improvement works of over 2,700 sewage outlet along rivers and different water bodies, sewage outlet improvement works of “black and odourous water bodies” (黑臭水體) in different regions of Shenzhen (such as Futian， Luohu，Baoan，Longgang，Longhua，Pingshan，Guangming and Dapeng New Region, etc.), desilting works of various rivers in Shenzhen. As of the year end of 2020, 121 relevant sewage/water quality improvement works projects were completed, while 102 works projects were in progress, and preliminary works has been started for another 44 works projects. A total length of over 182km sewage mains have been newly built as of April 2021, while a total of over 266km sewage mains have been repaired.

3.3.10 Eight water quality purification plants (水質淨化廠) (新建固戍二期水質淨化廠, 壩光水質淨化廠, 民治水質淨化廠, 埔地嚇三期水質淨化廠, 布吉三期水質淨化廠, 沙井三期水質淨化廠, 公明二期水質淨化廠 and 福永二期水質淨化廠) were under improvement works as of April 2021, while the improvement works for 東涌廠 is about to be started further to its tendering procedure in April 2021. More details of the Shenzhen City water pollution remediation works are available in its website[1].

[1] http://swj.sz.gov.cn/ztzl/ndmsss/szswrzl/gzjz/

3.3.11 Numerous projects on the water quality and sewage treatment improvement works of Shenzhen City have been completed over these years, while some further projects are on-going, it is expected that the overall odour emission from SZR would be improved and the improvement trend will continue in the near future.

Emission from Shenzhen River

3.3.12 In view of the improvement of the SZR environment, the Project Proponent conducted odour survey in Years 2018 and 2019 along SZR (4.2km section recommended for bioremediation). The methodology of the Years 2018 and 2019 odour survey was the same as that in Year 2010 for the EIA Study. The odour survey results indicated a substantial improvement on the odour emission rates from both the SZR river water and SZR exposed sediment, when compared to Year 2010. The sampling locations of 2019 odour survey are presented in **Appendix 3.1**, summary of the odour emission rates are presented in below **Table 3.1**.

Table 3.1 Specific Odour Emission Rate Measured in Years 2010 and 2019 at Sampling Points along Shenzhen River

Sampling Location	Sampling Type	Specific Odour Emission Rate (OU/m2/s)		
		2010 Survey	2018 Survey	2019 Survey
HK-W-1	Water	0.58	0.087	0.030
HK-W-2	Water	0.25	0.117	0.104
HK-W-3	Water	0.24	0.117	0.027
HK-W-4	Water	0.21	0.091	0.032
HK-W-5	Water	0.28	0.085	0.032
HK-W-6	Water	0.30	0.096	0.051
HK-W-7	Water	0.74	0.097	0.025
SZ-W-1	Water	N/A	0.145	0.024
SZ-W-2	Water	N/A	0.112	0.024
SZ-W-3	Water	N/A	0.063	0.106
SZ-W-4	Water	N/A	0.125	0.027
SZ-W-5	Water	N/A	0.125	0.025
SZ-W-6	Water	N/A	0.110	0.025
SZ-W-7	Water	N/A	0.104	0.030
SZ-S-1	Sediment	N/A	0.288	0.029
SZ-S-2	Sediment	N/A	0.309	0.387
SZ-S-3	Sediment	N/A	0.332	0.361
SZ-S-4	Sediment	N/A	0.382	0.293
SZ-S-5	Sediment	N/A	1.261	0.314
SZ-S-6	Sediment	N/A	1.259	0.733
SZ-S-7	Sediment	N/A	1.348	0.647

Note:
- N/A indicates the data not shown in the EIA Report

3.3.13 A more comprehensive odour survey has been conducted in Year 2020 along the 10km section of SZR (the full 10km section included in the odour assessment of the EIA Study). Along the 10km SZR, 19 locations were selected as the sampling points. Similar to that in the EIA Study, the Year 2020 odour survey methodology has been detailed in its odour survey report which is attached in **Appendix 3.2**.

3.3.14 The specific odour emission rates (SOER) from the Year 2020 survey is compared against to that of the Year 2010 survey and presented in below **Table 3.2**. It is noted that the highest SOER of 0.115 ou/m^2/s from SZR river water in Year 2020 would be lower than the respective lowest SOER of 0.21 ou/m^2/s in Year 2010. Similarly, the highest SOER of 0.241 ou/m^2/s from SZR exposed sediment in Year 2020 is again lower than the lowest SOER of 0.55 ou/m^2/s in Year 2010. Hence, a huge improvement regarding the odour emission from SZR over the years is observed.

Table 3.2 Odour Emission Rate from Shenzhen River in Years 2010 and 2020

Odour Sources from Shenzhen River	Specific Odour Emission Rate (OU/m2/s)	
	Unmitigated Scenario of the EIA Study Year 2010	Latest Information Year 2020
River Water	0.21 – 7.25	0.016 – 0.115
River Exposed Sediment	0.55 – 3.07	0.024 – 0.241
Overall Shenzhen River Odour Emission (OU/s)	2,215,638	53,924

3.4 In-situ Trial Test of Bioremediation

3.4.1 As recommended in the EIA Report, to establish the relationship between acid volatile sulphide (AVS) reduction percentage and odour removal efficiency, in-situ trial test of bioremediation was carried out from 31 December 2019 and substantially completed on 23 January 2021.

3.4.2 Summary of the in-situ trial test are presented in **Appendix 3.3**. Based on the results, no strong correlation can be derived between odour emissions and AVS levels.

4. REVIEW ON OPERATION PHASE ODOUR IMPACTS

4.1 Introduction

4.1.1 As described above in **Section 3.2** and **Section 3.3**, a number of update to the odour-related information were identified and hence the operation phase odour assessment in the approved LMCL EIA Report should be reviewed. This section reviews and addresses potential odour impact related to the proposed variations via a quantitative odour impact assessment.

4.2 Environmental Legislation, Standards and Guidelines

4.2.1 Annex 4 of the Technical Memorandum on Environmental Impact Assessment Process (EIAO-TM) stipulates that the odour level at air sensitive receiver should meet 5 odour units based on an averaging time of 5 seconds for odour prediction assessment.

4.2.2 Guidelines for conducting air quality assessment are stipulated in Annex 12 of EIAO-TM, including the determination of air sensitive receivers (ASRs), the assessment methodology, baseline study and impact prediction and assessment.

4.3 Air Sensitive Receivers

4.3.1 Representative air sensitive receivers (ASRs) within the Lok Ma Chau Loop (LMCL) Development were identified in the EIA Report (AEIAR-176/2013), with reference to Annex 12 of the EIAO-TM. The representative ASRs relevant to odour impact are listed in Table 3.22 of the EIA Report. Based on the latest design of the development, these representative ASRs are considered still valid. They are listed in below **Table 4.1** and their locations are shown in **Figure 4.1** for easy reference.

Table 4.1 Representative Air Sensitive Receivers

Location of ASRs	Assessment Points	Assessment Height, mAG
LMC Loop	LMCL-P1	1.5, 5, 10, 15, 20
	LMCL-P2	1.5, 5, 10, 15, 20
	LMCL-P4	1.5, 5, 10, 15, 20
	LMCL-P6	1.5, 5, 10, 15, 20
	LMCL-P7	1.5, 5, 10, 15, 20
	LMCL-P8	1.5, 5, 10, 15, 20
	LMCL-P9	1.5, 5, 10, 15, 20
	LMCL-P11	1.5, 5, 10, 15, 20
	LMCL-P12	1.5, 5, 10, 15, 20
	LMCL-P15	1.5, 5, 10, 15, 20
	LMCL-P16	1.5, 5, 10, 15, 20
	LMCL-P17	1.5, 5, 10, 15, 20
	LMCL-P18	1.5, 5, 10, 15, 20
	LMCL-P19	1.5, 5, 10, 15, 20
	LMCL-P21	1.5, 5, 10, 15, 20
	LMCL-P23	1.5, 5, 10, 15, 20
	LMCL-P24	1.5, 5, 10, 15, 20
	LMCL-P25	1.5, 5, 10, 15, 20
	LMCL-P26	1.5, 5, 10, 15, 20

Location of ASRs	Assessment Points	Assessment Height, mAG
	LMCL-P27	1.5, 5, 10, 15, 20
	LMCL-P28	1.5, 5, 10, 15, 20
Proposed Fire Station and Ambulance Depot	FS-P1	1.5, 5, 10, 15, 20

4.4 Identification of Odour Sources

4.4.1 With reference to the EIA Report, three major odour emission sources were identified in the vicinity of the Development of LMCL, namely the proposed LMCLSTW, BHWWTP and SZR.

Lok Ma Chau Loop Sewage Treatment Works

4.4.2 As discussed in **Section 3.3.2**, the design of the LMCLSTW has been revised after the approval of the EIA Report. The exhaust locations of the deodourisers have been changed and the odour emission rates adopted in the modelling have been reduced referring to the odour emission rate of the Shek Wu Hui Sewage Treatment Works. The designed odour emission rates of LMCLSTW and associated emission parameters are presented in **Appendix 4.1** and summarized in **Table 4.2**.

Binhe Waste Water Treatment Plant

4.4.3 As discussed in Sections 3.3.5 to 3.3.6, BHWWTP has been upgraded to meet the odour concentration requirement of 20 OU at plant boundary as stated in the "Discharge Standard of Pollutants for Municipal Wastewater Treatment Plant" (GB 18918-2002). No change to the other emission parameters has been received. As there is no odour emission inventory provided by the operator of BHWWTP, a backward calculation exercise has been performed to obtain the maximum odour emission rate of BHWWTP in this assessment.

4.4.4 Based on the emission parameters in the EIA Report, the modelling methodology as presented in below **Section 4.5** and the associated AERMET assumptions presented in **Appendix 4.4b**, a quantitative odour assessment has been conducted. The predicted maximum 5-second average odour concentration at the boundary of the BHWWTP would be about 118 OU/m^3. The predicted odour concentration would be higher than the monitoring data (less than 20 OU). Thus, the odour emission rates for BHWWTP assumed in the EIA Study were over-estimating the current odour impact of BHWWTP. Thus, for estimation of existing emission rates from BHWWTP, a pro-rata approach was used to align the predicted odour concentration and the measured odour concentration at the boundary of BHWTTP. The estimated odour emission rates of BHWWTP and associated emission parameters are presented in **Appendix 4.2** and summarized in **Table 4.2**.

Shenzhen River

4.4.5 Since the approval of the EIA Report, various odour and/or water quality mitigation measures have been applied to SZR by Shenzhen Government as discussed in **Section 3**.

4.4.6 In the EIA study, a 10 km long section of SZR was included in the odour modelling exercise to predict the odour concentration within LMCL. To have a fair comparison, an odour survey of the same 10 km long section of SZR has been conducted in August 2020, as discussed in **Sections 3.3.7 to 3.3.14**, to collect the latest odour emission rate from river water and exposed sediment area of SZR. **Appendix 3.2** presents the odour survey report for Year 2020 detailing the survey methodology and results.

4.4.7 In the EIA Study, SZR odour emissions were classified to be either emission from river water or emission from exposed sediment (i.e. sediment of the riverbed exposed to ambient air due to low river water level). Referring to the findings of site visit in Year 2020, reedbed is also found within the river area on the exposed sediment near the edges of SZR, which was not classified in the EIA Study. Thus, the Year 2020 odour survey also determined whether the odour from reedbed area of the 10km long section of SZR is offensive/unpleasant causing odour nuisance or neutral. A hedonic tone test was conducted to determine any unpleasant smell from the reedbed area. From the odour survey findings, except two sampling locations at very downstream (117 and 119), all the odour samples collected from reedbed area and nearby ambient were found not unpleasant. In fact, the smell was reported as “smoky” smell at these two sampling locations, which was potentially due to nearby industrial emission and/or marine emission, and was unrelated to river water/sediment/reed. Thus, it is considered that the emission from reedbed is not unpleasant and hence would not cause odour nuisance to nearby ASRs. Therefore, the reedbed area are not considered as odour emission sources in this assessment.

4.4.8 The measured odour emission rates of river water surface and exposed sediment surface of SZR as well as other emission parameters are presented in **Appendix 4.3**.

Overall Odour Emissions in the Vicinity of LMCL

4.4.9 Below **Table 4.2** summarises the latest odour emission rates from the odour emission sources. The overall odour emission of the three odour sources are significantly reduced by 68% to 87% when compared against the EIA long-term modelling scenario, or 68% to 98% when compared against the EIA unmitigated scenario.

Table 4.2 Comparison of Odour Emission Rates in EIA Study and Year 2020 Survey/Design

Odour Sources	Odour Emission Rate (OU/s)			
	EIA Odour Modelling Scenarios			Latest 2020 Survey / Design
	Unmitigated	Short-medium Term	Long Term	
LMCLSTW	2,431	2,431	2,431	787
BHWWTP	14,521	14,521	14,521	2,470
SZ River	2,215,638	1,217,586	422,511	53,924

4.5 Assessment Methodology

4.5.1 The odour sources as identified in the EIA Study includes the proposed LMCLSTW, BHWWTP and SZR. Quantitative assessment for the potential cumulative odour impact due to these odour sources have been conducted. The predicted odour concentration at LMCL were compared against the EIAO-TM odour criterion of 5 OU for compliance check.

4.5.2 It was assumed that the odour emission from LMCLSTW, BHWWTP and SZR would be in steady state on a 24-hour-per-day, 7-day-per-week basis in the assessment. The emission parameters and odour emission rate of the odour sources are detailed in **Appendices 4.1, 4.2 and 4.3**.

4.5.3 The EPD approved air dispersion model, AERMOD was used to predict the odour impact from these odour sources at the representative ASRs within LMCL. Odour emission from the exhaust outlet of the deodouriser units of BHWWTP and LMCLSTW were modelled as point source, while the SZR emission sources and the tanks of BHWWTP were modelled as area source.

4.5.4 Hourly meteorological conditions including wind data, temperature, relative humidity, pressure cloud cover and mixing height of Year 2010 were extracted from the WRF meteorological data adopted in the PATH-2016 system. The minimum wind speed was capped at 1 metre per second. The mixing height was capped between 121 metres and 1667 metres according to the observation in Year 2010 by Hong Kong Observatory (HKO). The height of the input data was assumed to be 9 above ground for the first layer of the WRF data as input. The meteorological data was inputted as on-site data into AERMET.

4.5.5 Surface characteristic parameters such as albedo, Bowen ratio and surface roughness are required in the AERMET (the meteorological pre-processor of AERMOD). The land use characteristics of the surrounding are classified and these parameters of each land use are then suggested by AERMET by default according to its land use characteristics, with the exception on the roughness length of water surface[2] being set to 0.001m instead of the default value of 0.0001m. The detailed assumptions are presented in **Appendix 4.1**.

4.5.6 Flat terrain in AERMOD was adopted for the model run of BHWWTP and LMCLSTW odour sources, which are located at the same ground level as the ASRs in LMCL. Elevated terrain in AERMOD was adopted for the model run of SZR odour sources, which are located at 3m below the site formation level of the LMCL development.

4.5.7 Considering that the locations of the odour source and the representative ASRs are located at the boundary of Hong Kong and Shenzhen, urban heat island effect of AERMOD has been adopted. The population is conservatively set as 2,000,000[3], while the actual populations of Hong Kong and Shenzhen are more than 2,000,000.

[2] Stull, R. B., 1988. An Introduction to Boundary Layer Meteorology. Kluwer Academic Publishers, The Netherlands, 666pp.
3 AERMOD: Description of Model Formulation (EPA-454/R-03-004)

4.5.8 According to the latest design, the building height of the LMCLSTW would be about 9.3mAG, while the deodorizer exhaust would be located at 10mAG. Similarly, building height of the BHWWTP would be about 4mAG, while the deodorizer exhaust would be located at 5mAG. Building wake effect would be expected for LMCLSTW and BHWWTP, and have been included in the AERMOD model.

4.5.9 According to the EIAO-TM, the odour criterion is 5 OU units based on an averaging time of 5 seconds. Therefore, it is required to convert the predicted odour concentration in 1-hour averaging time from the AERMOD model to 5-second average. Reference was made to the peak-to-mean ratio stipulated in "Approved Methods for Modelling and Assessment of Air Pollutants in New South Wales" published by the Department of Environment and Conservation, New South Wales, Australia (NSW Approved Method). In accordance with the NSW Approved Method, the conversion factors for converting 1-hour average concentration to 1-second average concentration were adopted as a conservative approach. The conversion relevant factors under Pasquill Stability Class of A to F are listed in **Table 4.3**.

Table 4.3 Peak-to-Mean Ratio for Odour Concentration Prediction

Source Type	Pasquill Stability Class	Ratio of peak 1-second average concentration to mean 1-hour average concentration
Area	A, B, C, D	2.5
	E, F	2.3
Wake-affected Point	A-F	2.3

4.5.10 PCRAMMET was applied to generate Pasquill-Gifford stability class hour by hour based on the WRF meteorological data. The hourly emission rate was multiplied by the conversion factor corresponding to the estimated stability class in order to predict the 5-second average odour concentrations.

4.6 Evaluation on Operation Phase Odour Impact

4.6.1 The odour impact due to the three major odour sources were assessed based on abovementioned quantitative assessment methodology. The predicted maximum 5-second average odour concentrations at the representative ASRs at various heights are presented in below **Table 4.4**. The locations of the ASRs are presented in **Appendix 4.4**. Compared against the EIAO-TM odour criterion of 5-second average of 5 OU, the predicted odour concentrations at all representative ASR would comply with the criterion. Therefore, no adverse odour impact is anticipated.

Table 4.4 Predicted Odour Concentration at Representative Air Sensitive Receivers

ASR	Predicted Maximum 5-second Average Odour Concentration (OU/m^3)				
	1.5mAG	5mAG	10mAG	15mAG	20mAG
LMCL-P1	4.77	4.80	4.27	3.28	2.29
LMCL-P2	4.62	4.58	4.11	3.24	2.30
LMCL-P4	2.89	3.02	3.00	2.72	2.29
LMCL-P6	1.66	1.76	1.81	1.74	1.57
LMCL-P7	1.48	1.48	1.40	1.27	1.11
LMCL-P8	1.00	1.07	1.08	0.98	0.78
LMCL-P9	1.06	1.14	1.23	1.20	1.06

ASR	Predicted Maximum 5-second Average Odour Concentration (OU/m^3)				
	1.5mAG	5mAG	10mAG	15mAG	20mAG
LMCL-P11	1.49	1.58	1.64	1.58	1.41
LMCL-P12	4.25	4.25	3.86	3.13	2.34
LMCL-P15	1.95	2.06	2.14	2.03	1.71
LMCL-P16	1.69	1.87	1.99	1.90	1.65
LMCL-P17	2.26	2.38	2.42	2.30	2.06
LMCL-P18	1.99	2.11	2.19	2.14	1.96
LMCL-P19	1.70	1.84	1.94	1.92	1.79
LMCL-P21	1.76	1.89	1.98	1.94	1.78
LMCL-P23	2.01	2.15	2.23	2.16	1.95
LMCL-P24	2.41	2.53	2.55	2.38	2.07
LMCL-P25	3.20	3.30	3.22	2.89	2.41
LMCL-P26	1.56	1.65	1.70	1.65	1.52
LMCL-P27	1.67	1.79	1.89	1.86	1.73
LMCL-P28	1.68	1.82	1.92	1.90	1.77
FS-P1	1.36	1.39	1.54	1.57	1.50

4.6.2 The highest odour concentration of 4.80 OU/m^3 among representative ASRs is predicted at 5 mAG at ASR LMCL-P1 in **Table 4.4**. The predicted odour concentration contour at the worst-affected level of 5 mAG is presented in **Figure 4.2**. The exceedance zone identified in the contour plot is planned for the provision of open space in the form of riverside promenade with landscape areas. No air sensitive uses of existing and the planned development will be located within the exceedance zone as indicated in the contour. Therefore, no adverse odour impact would be anticipated. Additional odour mitigation measure, such as the EIA recommended bioremediation, would no longer be required.

4.7 Summary

4.7.1 A quantitative odour assessment has been conducted based on the latest design information for Lok Ma Chau Loop Sewage Treatment Works, the latest operational requirement for Binhe Waste Water Treatment Plant and the latest available information for Shenzhen River. The predicted maximum odour concentration at the representative air sensitive receivers within Lok Ma Chau Loop would be below 5 OU EIAO-TM criterion. Thus, no adverse cumulative odour impact would be anticipated within Lok Ma Chau Loop. Additional odour mitigation measure, such as the EIA recommended bioremediation, would no longer be required.

5. REVIEW ON ENVIRONMENTAL PERMIT CONDITIONS

5.1.1 Referring to the Environmental Permit (EP No.: EP-477/2013) (the EP) for the Development of Lok Ma Chau Loop issued on 22 Nov 2013, EP condition 2.13, condition 2.24 and Figure 7 are relevant to the bioremediation works recommended in the EIA report.

5.1.2 With reference to the findings of quantitative odour assessment in **Section 4**, the predicted odour concentration for representative air sensitive receivers within LMCL would comply with the EIAO-TM criterion of 5 OU. Bioremediation would no longer be required for Shenzhen River. Therefore, an application for variation of relevant conditions in the EP is required. The proposed variations to the EP are summarized in **Section 2**.

6. REVIEW ON ENVIRONMENTAL MONITORING AND AUDIT REQUIREMENTS

6.1 Introduction

6.1.1 With reference to Section 4 of the Environmental Monitoring and Audit (EM&A) Manual of the EIA Report, a set of EM&A requirements have been recommended for the potential odour impact. In view of the latest odour impact situation at LMCL and the potential change in Environmental Permit (EP) requirement regarding the bioremediation along Shenzhen River (SZR), update to EM&A requirements is also required.

6.2 Proposed Update in the EM&A Manual

6.2.1 Section 4 of the EM&A Manual presents the detail monitoring requirement of odour emission, acid volatile sulfite (AVS) and redox potential in the sediment of Shenzhen River. The details include the parameters, equipment, laboratory measurement and analysis, as well as the monitoring locations, etc. In addition, odour patrol within the LMCL was proposed to determine the potential odour impacts.

6.2.2 The above requirements are related to the EP requirement of conducting bioremediation along a section of 4.2km of SZR. Since no strong correlation can be derived between odour emission and AVS levels, as mentioned in **Section 3.4**, the latest odour modelling exercise demonstrated odour compliance at LMCL without the implementation of bioremediation as mentioned in **Section 4**, it is recommended to remove below odour monitoring requirements in the EM&A Manual:

- Monitoring of odour emission of SZR;
- Monitoring of AVS in sediment of SZR;
- Monitoring of redox potential in sediment of SZR; and
- Sediment Sampling

6.2.3 Section 4.9.2 of the EM&A Manual proposed the requirement of conducting odour patrol during operation phase of the Development of LMCL. It is proposed to update the EM&A Manual, subject to the Odour Mitigation Measures and Monitoring Plan.

6.3 Odour Mitigation Measures and Monitoring Plan

6.3.1 As stated in **Sections 2 and 5**, it is proposed not to conduct bioremediation along a section of 4.2km of SZR. Instead, an Odour Mitigation Measures and Monitoring Plan (OMMMP) is proposed with reference to **Table 2.1** to detail the odour mitigation measures to be implemented and relevant monitoring requirements.

6.3.2 The odour mitigation measures for the proposed LMCLSTW are presented in Sections 3.3.2 to 3.3.4. These mitigation measures including the fully enclosed design and the deodouriser with 95% odour removal efficiency will be included in the OMMMP to ensure proper implementation.

6.3.3 Section 4.9.2 of the EM&A Manual proposed the requirement of conducting odour patrol during operation phase of the Development of LMCL. It is proposed that the OMMMP should detail the odour patrol requirement, such as the following:

- Odour patrol route should be located within the area of LMCL (with reference to Section 4.3.2 of the EM&A Manual);
- Sniffing locations of the odour patrol route should be designed to include locations near the dominant odour source(s);
- Odour patrol should be conducted for a two-year period. Continuation of the odour patrol should be subject to the patrol findings;
- Odour patrol should be conducted during summer to capture the period of worst-case scenario of odour impact;
- Odour patrol should cover at least the morning, afternoon and late evening periods of a day to capture the worst-case scenario of odour impact;
- A report documenting the odour patrol findings should be submitted to IEC for endorsement and to EPD for review; and
- Should the odour environment in the vicinity of LMCL subject to major changes, odour patrol may be conducted to identify the odour sources.

6.3.4 The OMMMP should also present detail proposal and requirements of odour monitoring to detect and manage any potential odour impact in the LMCL, audit and action plan in response to detected odour, mitigation measures to minimize odour impact from the detected sources and operational/management arrangements for the areas/receivers with detected odour, etc. The OMMMP shall be submitted to EPD for agreement before population intake of the LMCL. This requirement has been proposed in the revised EP conditions as presented in **Table 2.1**.

7. CONCLUSION

7.1.1 Since the approval of the Environmental Impact Assessment Report of the Development of Lok Ma Chau Loop (LMCL), significant improvement of the environmental odour nuisance is identified over the recent years, thanks to the improvement works on Shenzhen River (SZR) and Binhe Waste Water Treatment Plant (BHWWTP) conducted by the Shenzhen Government.

7.1.2 Based on the odour survey of SZR in Year 2020, the latest odour emission standard of the BHWWTP and the latest design of the proposed LMCLSTW, a quantitative odour assessment has been conducted. The predicted odour concentrations at all representative air sensitive receivers within LMCL would be below the EIAO-TM odour criterion of 5 OU. No adverse odour impact is anticipated. Hence, bioremediation along a section of 4.2km SZR as odour mitigation measures recommended in the EIA Report would no longer be needed.

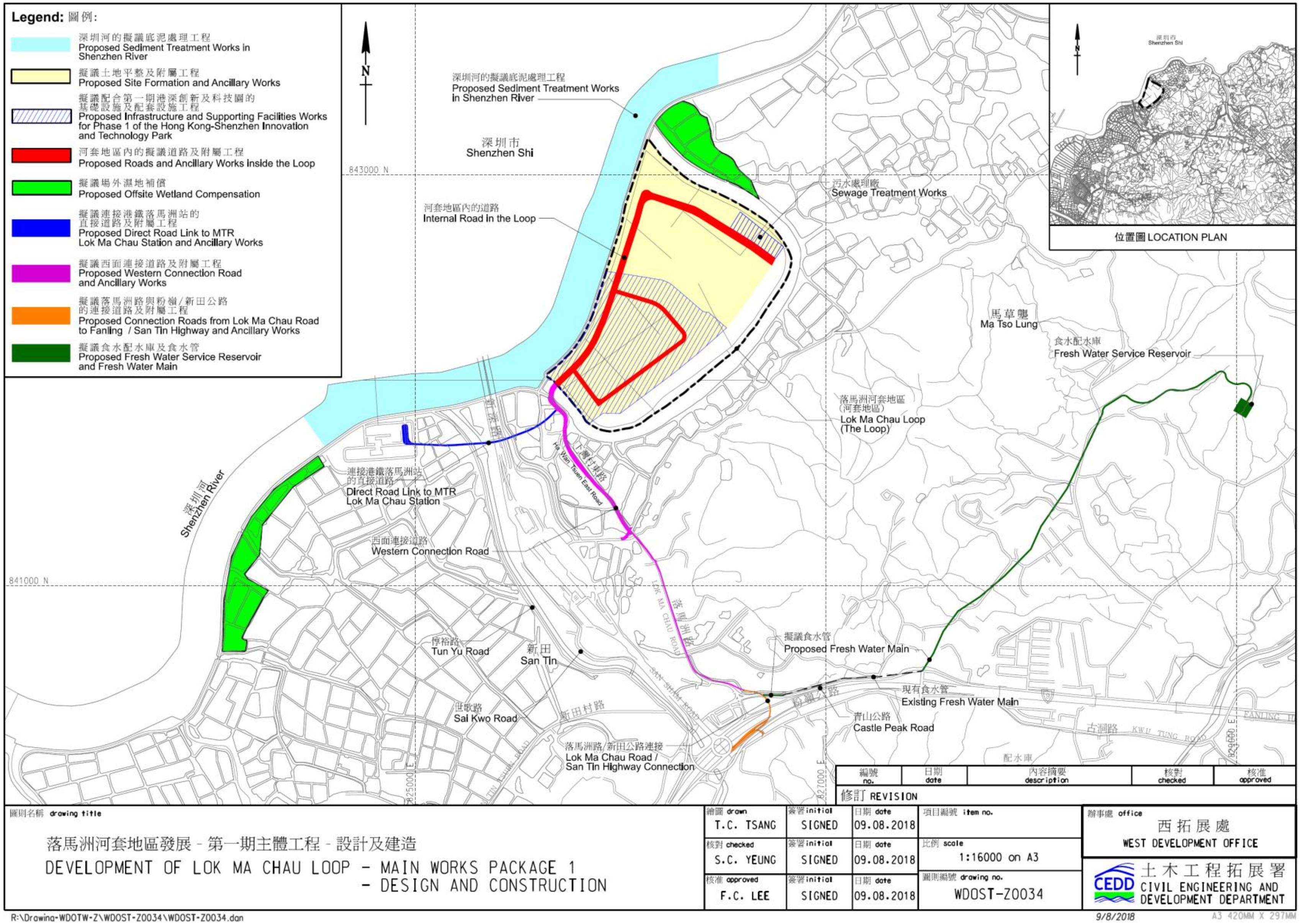
7.1.3 Given the compliance of the predicted odour concentration at representative air sensitive receivers within LMCL, application for variation of the EP with respect to the revised odour mitigation measures for the Development of Lok Ma Chau Loop would be proceeded. An Odour Mitigation Measure and Monitoring Plan (OMMMP) is recommended to be submitted to EPD for agreement before the first population intake of LMCL.

Environmental Review Report for Variation of Environmental Permit Application on Odour Remediation at Shenzhen River

Appendices

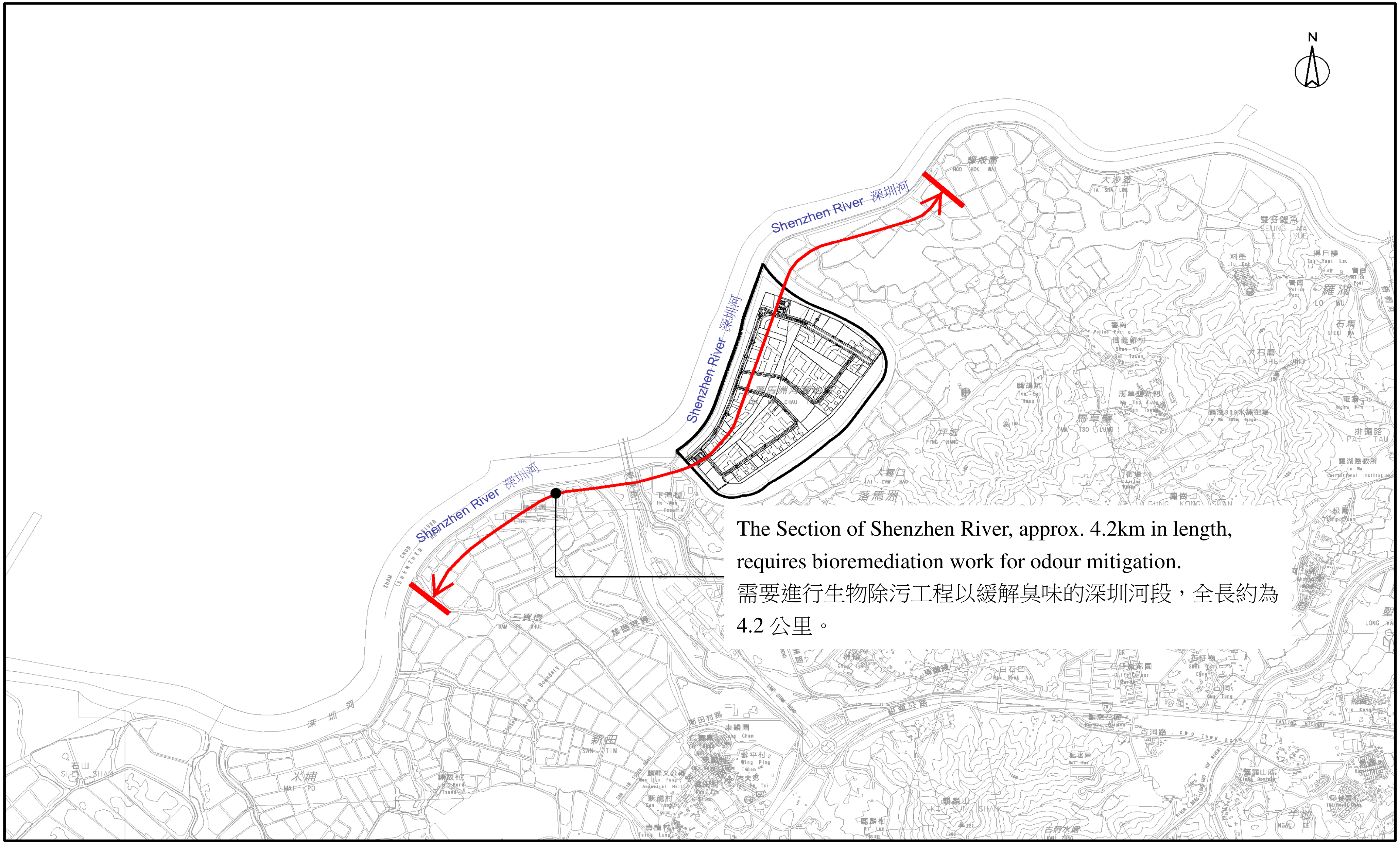
Appendix 1.1

Project Layout Plan


Legend: 圖例:
深圳河的擬議底泥處理工程
Proposed Sediment Treatment Works in Shenzhen River
擬議土地平整及附屬工程
Proposed Site Formation and Ancillary Works
擬議配合第一期港深創新及科技園的基礎設施及配套設施工程
Proposed Infrastructure and Supporting Facilities Works for Phase 1 of the Hong Kong-Shenzhen Innovation and Technology Park
河套地區內的擬議道路及附屬工程
Proposed Roads and Ancillary Works inside the Loop
擬議場外濕地補償
Proposed Offsite Wetland Compensation
擬議連接港鐵落馬洲站的直接道路及附屬工程
Proposed Direct Road Link to MTR Lok Ma Chau Station and Ancillary Works
擬議西面連接道路及附屬工程
Proposed Western Connection Road and Ancillary Works
擬議落馬洲路與粉嶺/新田公路的連接道路及附屬工程
Proposed Connection Roads from Lok Ma Chau Road to Fanling / San Tin Highway and Ancillary Works
擬議食水配水庫及食水管
Proposed Fresh Water Service Reservoir and Fresh Water Main
深圳河的擬議底泥處理工程
Proposed Sediment Treatment Works in Shenzhen River
深圳市
Shenzhen Shi
843000 N
河套地區內的道路
Internal Road in the Loop
污水處理廠
Sewage Treatment Works
馬草壟
Ma Tso Lung
食水配水庫
Fresh Water Service Reservoir
落馬洲河套地區(河套地區)
Lok Ma Chau Loop (The Loop)
深圳河
Shenzhen River
連接港鐵落馬洲站的直接道路
Direct Road Link to MTR Lok Ma Chau Station
西面連接道路
Western Connection Road
841000 N
惇裕路
Tun Yu Road
新田
San Tin
擬議食水管
Proposed Fresh Water Main
現有食水管
Existing Fresh Water Main
青山公路
Castle Peak Road
世歌路
Sai Kwo Road
新田村路
落馬洲路/新田公路連接
Lok Ma Chau Road / San Tin Highway Connection
古洞路
KWU TUNG ROAD
位置圖 LOCATION PLAN
深圳市
Shenzhen Shi
編號 no.
日期 date
內容摘要 description
核對 checked
核准 approved
修訂 REVISION
圖則名稱 drawing title
落馬洲河套地區發展－第一期主體工程－設計及建造
DEVELOPMENT OF LOK MA CHAU LOOP - MAIN WORKS PACKAGE 1 - DESIGN AND CONSTRUCTION
繪圖 drawn T.C. TSANG 簽署 initial SIGNED 日期 date 09.08.2018
核對 checked S.C. YEUNG 簽署 initial SIGNED 日期 date 09.08.2018
核准 approved F.C. LEE 簽署 initial SIGNED 日期 date 09.08.2018
項目編號 item no.
比例 scale 1:16000 on A3
圖則編號 drawing no. WDOST-Z0034
辦事處 office
西拓展處
WEST DEVELOPMENT OFFICE
土木工程拓展署
CIVIL ENGINEERING AND DEVELOPMENT DEPARTMENT
R:\Drawing-WDOTW-Z\WDOST-Z0034\WDOST-Z0034.dgn
9/8/2018
A3 420MM X 297MM

Appendix 2.1

Figure 7 of the Current Environmental Permit (EP-477/2013)



Project Title: Development of Lok Ma Chau Loop 工程項目名稱: 落馬洲河套地區發展

Figure 7 Location Plan of Bioremediation Works at Shenzhen River

圖7 位於深圳河的生物除污工程位置圖

(Source: Based on Figure 3.23c of the approved EIA Report No. AEIAR-176/2013)

(資料來源：根據環評報告編號 AEIAR-176/2013，圖 3.23c 編制)

Environmental Permit No.
EP-477/2013
環境許可證編號
EP-477/2013

Appendix 3.1

Survey Report of Shenzhen River Odour Survey 2019

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

CERTIFICATE OF ANALYSIS

EMPLOYER:	Civil Engineering and Development Department	WORK ORDER:	HK1943834
ENGINEER:	Aecom Asia Company Limited		
CONTRACTOR:	Chung Shun Boring Engineering Company Limited	LABORATORY:	Hong Kong
		SUB-BATCH:	0
		DATE RECEIVED:	18 September 2019
		DATE OF ISSUE:	29 October 2019
PROJECT:	Contract No. YL/2018/02 Development of Lok Ma Chau Loop: Main Works Package 1 Sub-package A - Ground Investigation and Laboratory Testing	SAMPLE TYPE:	Air
SITE:	Shenzhen River	No. of SAMPLES:	49
PO:	---		

COMMENTS

Air sample(s) were collected by ALS Technichem (HK) staff from 18th September to 4th October 2019 at the Shenzhen River of Lok Ma Chau Loop.

The sample(s) were analysed and reported on as received basis. Sample information (Project name, Sample ID) was provided by the client.

NOTES

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

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

Richard Fung
Managing Director - Hong Kong

1. SUMMARY OF WORK

A total of forty-nine (49) odour samples were collected at the Shenzhen River of Lok Ma Chau Loop from 18 September to 4 October 2019.

During odour sampling, air samples were collected by using a wind tunnel and flux hood chamber which were placed on the odour emission source surface. Collected samples were then delivered to ALS Hong Kong laboratory for Olfactometry Analysis.
Odour sampling were also proceeded from undisturbed sediment samples. Detailed sampling and post treatment procedures were shown in Section 3.3.

2. SAMPLING LOCATION AND SAMPLING DATE

Sample ID	Location ID	Sampling Date	Sampling Device	Sampling Type	Co-ordinates	
					Easting	Northing
HK1943834-001	ASZR1	20-Sep-19	Wind Tunnel	Water Surface	825840.52	842384.34
HK1943834-002		20-Sep-19	K-B Core	Sediment Core		
HK1943834-003	ASZR2	19-Sep-19	Wind Tunnel	Water Surface	826055.02	843043.40
HK1943834-004		19-Sep-19	K-B Core	Sediment Core		
HK1943834-005	ASZR3	19-Sep-19	Wind Tunnel	Water Surface	825903.16	842570.33
HK1943834-006		19-Sep-19	K-B Core	Sediment Core		
HK1943834-007	HK-W-1-19	23-Sep-19	Wind Tunnel	Water Surface	825627.02	842121.85
HK1943834-008		23-Sep-19	K-B Core	Sediment Core		
HK1943834-009	HK-W-2-19	18-Sep-19	Wind Tunnel	Water Surface	825879.86	842569.96
HK1943834-010		18-Sep-19	K-B Core	Sediment Core		
HK1943834-011	HK-W-3-19	03-Oct-19	Wind Tunnel	Water Surface	826061.34	843131.12
HK1943834-012		03-Oct-19	K-B Core	Sediment Core		
HK1943834-013	HK-W-4-19	02-Oct-19	Wind Tunnel	Water Surface	826507.99	843486.34
HK1943834-014		02-Oct-19	K-B Core	Sediment Core		
HK1943834-015	HK-W-5-19	02-Oct-19	Wind Tunnel	Water Surface	827045.90	843816.77
HK1943834-016		02-Oct-19	K-B Core	Sediment Core		
HK1943834-017	HK-W-6-19	27-Sep-19	Wind Tunnel	Water Surface	827464.65	844100.48
HK1943834-018		27-Sep-19	K-B Core	Sediment Core		
HK1943834-019	HK-W-7-19	27-Sep-19	Wind Tunnel	Water Surface	828016.70	843794.19
HK1943834-020		27-Sep-19	K-B Core	Sediment Core		
HK1943834-021	SZ-W-1-19	23-Sep-19	Wind Tunnel	Water Surface	825588.00	842133.11
HK1943834-022		23-Sep-19	K-B Core	Sediment Core		
HK1943834-023	SZ-W-2-19	20-Sep-19	Wind Tunnel	Water Surface	825811.11	842591.02
HK1943834-024		20-Sep-19	K-B Core	Sediment Core		
HK1943834-025	SZ-W-3-19	04-Oct-19	Wind Tunnel	Water Surface	826017.03	843185.03
HK1943834-026		04-Oct-19	K-B Core	Sediment Core		
HK1943834-027	SZ-W-4-19	02-Oct-19	Wind Tunnel	Water Surface	826491.75	843545.55
HK1943834-028		02-Oct-19	K-B Core	Sediment Core		
HK1943834-029	SZ-W-5-19	02-Oct-19	Wind Tunnel	Water Surface	826988.00	843843.65
HK1943834-030		02-Oct-19	K-B Core	Sediment Core		
HK1943834-031	SZ-W-6-19	03-Oct-19	Wind Tunnel	Water Surface	827464.62	844144.70
HK1943834-032		03-Oct-19	K-B Core	Sediment Core		
HK1943834-033	SZ-W-7-19	27-Sep-19	Wind Tunnel	Water Surface	828024.79	843856.47

Sample ID	Location ID	Sampling Date	Sampling Device	Sampling Type	Co-ordinates	
HK1943834-034		27-Sep-19	K-B Core	Sediment Core		
Sample ID	Location ID	Sampling Date	Sampling Device	Sampling Type	Easting	Northing
HK1943834-035	SZ-S-1-19	23-Sep-19	Flux Hood Chamber	Sediment Surface	825384.65	842081.07
HK1943834-036	SZ-S-2-19	04-Oct-19	Flux Hood Chamber	Sediment Surface	825841.42	842737.63
HK1943834-037	SZ-S-3-19	04-Oct-19	Flux Hood Chamber	Sediment Surface	826046.41	843144.09
HK1943834-038	SZ-S-4-19	04-Oct-19	Flux Hood Chamber	Sediment Surface	826632.02	843578.72
HK1943834-039	SZ-S-5-19	04-Oct-19	Flux Hood Chamber	Sediment Surface	826999.19	843763.97
HK1943834-040	SZ-S-6-19	04-Oct-19	Flux Hood Chamber	Sediment Surface	827443.49	844092.01
HK1943834-041	SZ-S-7-19	04-Oct-19	Flux Hood Chamber	Sediment Surface	827954.82	843913.05
HK1943834-042	Blank 1	18-Sep-19	-	-	-	-
HK1943834-043	Blank 2	19-Sep-19	-	-	-	-
HK1943834-044	Blank 3	20-Sep-19	-	-	-	-
HK1943834-045	Blank 4	23-Sep-19	-	-	-	-
HK1943834-046	Blank 5	27-Sep-19	-	-	-	-
HK1943834-047	Blank 6	02-Oct-19	-	-	-	-
HK1943834-048	Blank 7	03-Oct-19	-	-	-	-
HK1943834-049	Blank 8	04-Oct-19	-	-	-	-

Note:

[1] Sampling points locations were set out with an aid of Differential Global Positioning System (DGPS) device by the contractor.

[2] Field Blank samples filling with pure nitrogen gas was collected by ALS staff as QA/QC purpose.

[3] Sampling location plan and photos were shown in Appendix 1 and 2 respectively.

3. ODOUR SAMPLING METHOD

3.1 Air Sample from Water Surface by Wind Tunnel

A wind tunnel (Figure 1) was placed on the odour emission surface of the sampling location. A stream of odour-free nitrogen gas, at a flow velocity of 0.01 m/s, was introduced into the wind tunnel to simulate parallel wind blowing on the surface of the sampling location.

Odour gas sample was collected by passive sampling technique. A Nalophan sampling bag was placed inside an air-tightened sampler (Figure 2a) and then drawn to vacuum (Figure 2b). Approximately 60 Litres of gas sample was collected into the sampling bag for testing. The specific odour emission rate was then determined by the air flow through the device and the odour concentration of the exit air.

Figure 1: Wind Tunnel used for Odour sampling (Covering Area: 0.384m^2)

Figure 2a: Sampling Bag & Air-tightened Sampler

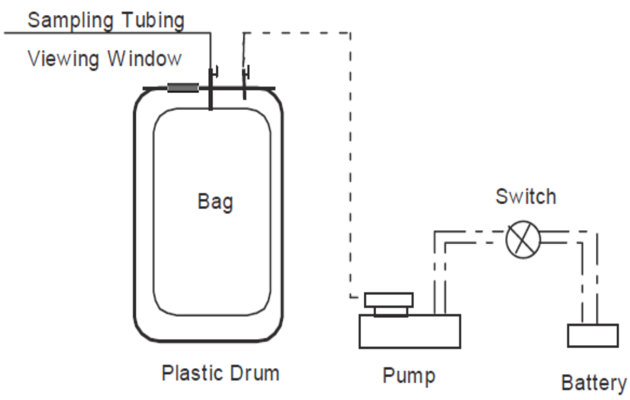


Figure 2b: Schematic Diagram of Sampling Device

3.2 Air Sample from the Sediment Surface by Flux Hood Chamber

A flux hood chamber (Figure 3) was placed on the odour emission surfaces of the sampling location. A stream of odour-free nitrogen gas, at an air flow rate (approximate 20L/min), was introduced into the flux hood to simulate wind blowing on the surface of the sampling location.
Odour gas sample was collected by passive sampling technique. A Nalophan sampling bag was placed inside an air-tightened sampler (Figure 2a) and then drawn to vacuum (Figure 2b). Approximately 60 Litres of gas sample was collected into the sampling bag for testing. The specific odour emission rate was then determined by the air flow through the hood and the odour concentration of the exit air.

Figure 3: Dynamic Flux hood used for Odour sampling (Covering Area: $0.155m^2$)

3.3 Air Sample collected from K-B Core Sediment Sample

After the collection of the sediment sample by using the K-B core, capped samples were shipped back to ALS (HK) Laboratory for post treatment. Detailed treatment procedures of the sediment samples in the core before odour analysis were as below:

a. The sediment core caps were opened and transferred to a clean container for mixing;
b. About 2-3 kg of thoroughly mixed sediment sample was filled in a pre-weighed aluminium container;
c. The aluminium container together with the mixed sediment sample was put inside a clean odour bag which was then filled with 40L odourless dry nitrogen gas;
d. The odour bag was kept 3 hours under a temperature of 30°C;
e. Olfactometry analysis was conducted for the odour bag collected in Step ‘d’ to determine the odour concentration from the sediment sample after 3 hours and
f. After the olfactometry analysis, the sediment sample in the aluminium container was dried in an oven keeping at 80°C for 48 hours to determine the dry mass of the sediment sample. Odour Potential of the sediment core sample was calculated as below:

$$OP = OC \times V/DM$$

Where

OP = Odour Potential, ou_E/kg

OC = Odour Concentration, ou_E/m^3

V = Volume of gas inside the odour bag, $0.04m^3$

DM = Dry mass of sediment sample inside the odour bag, kg

4. OLFACTOMETRY TESTING

Odour concentration was determined by a Forced-choice Dynamic Olfactometer in accordance with the European Standard Method (EN13725).

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 is measured by determining the dilution factor required to reach the detection threshold. The odour concentration at the detection threshold is by definition 1 OU_E/m^3. 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 10^1 OU_E/m^3 to 10^7 OU_E/m^3.

Olfactometry Testing was performed by using the Scentroid™ SS6000 Olfactometer. The testing was performed by at least five qualified panellists who have been selected through an n-butanol screening test.

The specific odour emission rate (SOER) was then determined by the air flow through the hood and the odour concentration of the exit air.

The SOER at each area source can be calculated by the following equation:

$$SOER\ \left(\frac{OU_E}{m^2 s}\right) = \frac{Odour\ Concentration\ (OU_E/m^3) \times Air\ Flow\ Rate\ Inside\ Hood\ (m^3/s)}{Covered\ Water\ Surface\ Area\ (m^2)}$$

Where:

Air Flow Rate Inside Hood for Wind Tunnel = 0.0004 m^3/s
Air Flow Rate Inside Hood for Flux Chamber = 0.0003 m^3/s

Covered Water Surface for Flux Chamber = 0.155 m^2
Covered Water Surface for Wind Tunnel = 0.384 m^3

All testing was finished within 24 hours after sampling.

5. HYDROGEN SULPHIDE TESTING

At each of the sampling location, Hydrogen Sulphide concentration was measured by using a portable H_2S analyzer. The analyzer (Jerome J605) measurement range is 3 ppbv – 10 ppmv. The H_2S in air was trapped by the gold film sensor and the amount absorbed was determined as the concentration of H_2S.

Figure 4: H_2S Analyzer

6. METEOROLOGICAL AND ODOUR CONDITIONS DURING SAMPLING

The following information were obtained or recorded during the sampling period:

a. Meteorological conditions (including ambient temperature, wind speed, wind direction, relative humidity) were collected from Hong Kong Wetland Park Observatory Weather Station during the monitoring period, as it is near the sampling locations and sufficient records could be obtained;
b. Any odour detected during sampling and the flavours of odour with detail description of characteristics;
c. Duration of odour during sampling;
d. Wind direction was recorded on site and tidal conditions at Tsim Bei Tsui were collected from Hong Kong Observatory Station during sampling and
e. Whether any abnormal observation, namely any odour generating activities observed at adjacent areas during monitoring.

7. RESULT

7.1 Detailed Meteorological and Odour Sampling Conditions during the Monitoring Period

Location ID	Sampling Date	Time	Temp (°C)	Relative Humidity (%)	Wind Direction (Deg)	Wind Speed (m/s)	Weather Condition	Odour Characteristics	Odour Source	Duration of odour	Observation
ASZR1	20-Sep-19	17:16	31.6	40.6	337	2.2	Sunny	Minor Sewer Smell	SZ River	Continuous	Nil
ASZR2	19-Sep-19	16:05	33.2	55.3	342	0.2	Sunny	Minor Sewer Smell	SZ River	Continuous	Nil
ASZR3	19-Sep-19	15:41	32.7	53.5	343	1.8	Sunny	Minor Sewer Smell	SZ River	Continuous	Nil
HK-W-1-19	23-Sep-19	15:34	31.0	72.5	349	1.5	Sunny	Minor Sewer Smell	SZ River	Continuous	Nil
HK-W-2-19	18-Sep-19	16:35	33.0	56.8	343	2.1	Sunny	Minor Sewer Smell	SZ River	Continuous	Nil
HK-W-3-19	03-Oct-19	17:10	31.5	60.0	296	2.3	Sunny	Minor Sewer Smell	SZ River	Continuous	Nil
HK-W-4-19	02-Oct-19	16:25	33.2	49.5	302	2.3	Sunny	Minor Sewer Smell	SZ River	Continuous	Nil
HK-W-5-19	02-Oct-19	17:12	31.7	59.3	304	3.5	Sunny	Minor Sewer Smell	SZ River	Continuous	Nil
HK-W-6-19	27-Sep-19	15:07	32.4	46.7	296	0.7	Sunny	Minor Sewer Smell	SZ River	Continuous	Nil
HK-W-7-19	27-Sep-19	15:35	31.1	49.8	345	0.9	Sunny	Minor Sewer Smell	SZ River	Continuous	Nil

Remark:
Nil – No specific activities were observed during the sampling period.

Location ID	Sampling Date	Time	Temp (°C)	Relative Humidity (%)	Wind Direction (Deg)	Wind Speed (m/s)	Weather Condition	Odour Characteristics	Odour Source	Duration of odour	Observation
SZ-W-1-19	23-Sep-19	15:00	30.3	77.5	345	2.2	Sunny	Minor Sewer Smell	SZ River	Continuous	Nil
SZ-W-2-19	20-Sep-19	16:29	32.5	41.9	344	1.9	Sunny	Minor Sewer Smell	SZ River	Continuous	Nil
SZ-W-3-19	04-Oct-19	08:48	30.3	72.4	342	0.7	Sunny	Minor Sewer Smell	SZ River	Continuous	Nil
SZ-W-4-19	02-Oct-19	16:45	31.9	58.4	305	3.6	Sunny	Minor Sewer Smell	SZ River	Continuous	Nil
SZ-W-5-19	02-Oct-19	17:35	31.1	66.7	298	2.1	Sunny	Minor Sewer Smell	SZ River	Continuous	Nil
SZ-W-6-19	03-Oct-19	17:50	30.0	71.5	300	1.5	Sunny	Minor Sewer Smell	SZ River	Continuous	Nil
SZ-W-7-19	27-Sep-19	15:52	32.2	53.6	319	0.5	Sunny	Minor Sewer Smell	SZ River	Continuous	Nil
SZ-S-1-19	23-Sep-19	16:43	30.6	72.3	343	1.4	Sunny	Minor Sewer Smell	SZ River	Continuous	Nil
SZ-S-2-19	04-Oct-19	11:47	36.0	48.9	295	0.8	Sunny	Minor Sewer Smell	SZ River	Continuous	Nil
SZ-S-3-19	04-Oct-19	09:37	30.5	69.4	33.5	0.5	Sunny	Minor Sewer Smell	SZ River	Continuous	Nil
SZ-S-4-19	04-Oct-19	09:58	35.5	60.0	--	0.0	Sunny	Minor Sewer Smell	SZ River	Continuous	Nil
SZ-S-5-19	04-Oct-19	10:20	33.8	63.1	337	1.2	Sunny	Minor Sewer Smell	SZ River	Continuous	Nil
SZ-S-6-19	04-Oct-19	10:41	34.6	57.0	326	0.8	Sunny	Minor Sewer Smell	SZ River	Continuous	Nil
SZ-S-7-19	04-Oct-19	11:03	34.5	44.3	307	1.1	Sunny	Minor Sewer Smell	SZ River	Continuous	Nil

Remark:
Nil - No specific activities were observed during the sampling period.

7.2 Odour Concentration, Specific Odour Emission Rate (SOER) and Odour Potential Result

Location ID	Sampling Type	Sampling Date	Sampling Time	LOR (ou_E/m^3)	Odour Concentration (ou_E/m^3)	SOER (ou_E/m^2s)	Odour Potential (ou_E/kg)
ASZR1	Water Surface	20-Sep-19	17:19	11	33	0.037	-
	Sediment Core		-	11	84	-	3.0×10^{-6}
ASZR2	Water Surface	19-Sep-19	16:09	11	36	0.041	-
	Sediment Core		-	11	146	-	5.2×10^{-6}
ASZR3	Water Surface	19-Sep-19	15:44	11	67	0.076	-
	Sediment Core		-	11	217	-	6.9×10^{-6}
HK-W-1-19	Water Surface	23-Sep-19	15:35	11	26	0.030	-
	Sediment Core		-	11	157	-	4.8×10^{-6}
HK-W-2-19	Water Surface	18-Sep-19	16:39	11	92	0.104	-
	Sediment Core		-	11	204	-	7.6×10^{-6}
HK-W-3-19	Water Surface	03-Oct-19	17:11	11	24	0.027	-
	Sediment Core		-	11	87	-	2.4×10^{-6}
HK-W-4-19	Water Surface	02-Oct-19	16:30	11	29	0.032	-
	Sediment Core		-	11	136	-	5.2×10^{-6}
HK-W-5-19	Water Surface	02-Oct-19	17:16	11	28	0.032	-
	Sediment Core		-	11	109	-	3.3×10^{-6}
HK-W-6-19	Water Surface	27-Sep-19	15:12	11	45	0.051	-
	Sediment Core		-	11	57	-	2.6×10^{-6}
HK-W-7-19	Water Surface	27-Sep-19	15:39	11	23	0.025	-
	Sediment Core		-	11	45	-	1.9×10^{-6}

Location ID	Sampling Type	Sampling Date	Sampling Time	LOR (ou_E/m^3)	Odour Concentration (ou_E/m^3)	SOER (ou_E/m^2s)	Odour Potential (ou_E/kg)
SZ-W-1-19	Water Surface	23-Sep-19	15:01	11	21	0.024	–
	Sediment Core		–	11	119	-	$3.7x10^{-6}$
SZ-W-2-19	Water Surface	20-Sep-19	16:32	11	21	0.024	–
	Sediment Core		–	11	68	-	$2.1x10^{-6}$
SZ-W-3-19	Water Surface	04-Oct-19	08:52	11	94	0.106	–
	Sediment Core		–	11	230	-	$7.9x10^{-6}$
SZ-W-4-19	Water Surface	02-Oct-19	16:49	11	24	0.027	–
	Sediment Core		–	11	53	-	$1.9x10^{-6}$
SZ-W-5-19	Water Surface	02-Oct-19	17:39	11	23	0.025	–
	Sediment Core		–	11	157	-	$3.3x10^{-6}$
SZ-W-6-19	Water Surface	03-Oct-19	17:54	11	23	0.025	–
	Sediment Core		–	11	68	-	$2.7x10^{-6}$
SZ-W-7-19	Water Surface	27-Sep-19	15:54	11	26	0.030	–
	Sediment Core		–	11	95	-	$4.1x10^{-6}$

Location ID	Sampling Type	Sampling Date	Sampling Time	LOR (ou_E/m^3)	Odour Concentration (ou_E/m^3)	SOER (ou_E/m^2s)	Odour Potential (ou_E/kg)
SZ-S-1-19	Sediment Surface	23-Sep-19	16:44	11	13	0.029	-
SZ-S-2-19	Sediment Surface	04-Oct-19	11:51	11	180	0.387	-
SZ-S-3-19	Sediment Surface	04-Oct-19	09:37	11	168	0.361	-
SZ-S-4-19	Sediment Surface	04-Oct-19	10:02	11	136	0.293	-
SZ-S-5-19	Sediment Surface	04-Oct-19	10:24	11	146	0.314	-
SZ-S-6-19	Sediment Surface	04-Oct-19	10:45	11	341	0.733	-
SZ-S-7-19	Sediment Surface	04-Oct-19	11:07	11	301	0.647	-
Blank 1	-	18-Sep-19	-	11	<11	-	-
Blank 2	-	19-Sep-19	-	11	<11	-	-
Blank 3	-	20-Sep-19	-	11	<11	-	-
Blank 4	-	23-Sep-19	-	11	<11	-	-
Blank 5	-	27-Sep-19	-	11	<11	-	-
Blank 6	-	20-Sep-19	-	11	<11	-	-
Blank 7	-	03-Oct-19	-	11	<11	-	-
Blank 8	-	04-Oct-19	-	11	<11	-	-

Remark:
1. LOR denotes limit of reporting.
2. All the collected sample volume of the gas bags was enough for olfactometry analysis.
3. Field Blank sample filling with pure nitrogen gas was collected by ALS staff as QA/QC purpose.

7.3 Other Measured Parameters at each of the Sampling Location

Location ID	Sampling Date	Sampling Time	Water Temperature (°C)	Ambient Air Temperature [1] (°C)	Water Depth (m)	Salinity (ppt)	Redox Potential (mV)	pH	H_2S [1] (ppbv)
ASZR1	20-Sep-19	17:19	30.1	31.6	2.8	1.50	111	6.89	<3
ASZR2	19-Sep-19	16:05	31.9	33.2	1.1	1.50	154	7.07	<3
ASZR3	19-Sep-19	15:44	30.6	32.7	2.2	1.50	207	6.91	<3
HK-W-1-19	23-Sep-19	15:30	30.2	31.0	3.3	1.50	101	6.97	<3
HK-W-2-19	18-Sep-19	16:35	29.2	33.0	3.6	1.50	220	7.50	<3
HK-W-3-19	03-Oct-19	17:13	30.8	31.5	0.5	1.90	113	7.22	<3
HK-W-4-19	02-Oct-19	16:30	31.0	33.2	3.2	1.80	130	7.27	<3
HK-W-5-19	02-Oct-19	17:40	30.2	31.7	3.5	1.60	85.0	7.06	<3
HK-W-6-19	27-Sep-19	15:10	30.0	32.4	1.1	1.50	146	6.63	<3
HK-W-7-19	27-Sep-19	15:35	30.0	31.1	2.1	1.50	119	6.92	<3
SZ-W-1-19	23-Sep-19	14:58	30.0	30.3	0.9	1.50	94.0	7.14	<3
SZ-W-2-19	20-Sep-19	16:29	30.4	32.5	1.8	1.50	202	6.88	<3
SZ-W-3-19	04-Oct-19	16:05	30.2	30.3	3.5	1.40	17.0	7.30	<3
SZ-W-4-19	02-Oct-19	12:25	30.6	31.9	4.3	1.90	73.0	7.13	<3
SZ-W-5-19	02-Oct-19	17:10	30.8	31.1	0.8	0.18	80.0	7.00	<3
SZ-W-6-19	03-Oct-19	17:51	30.2	30.0	3.9	1.60	110	7.12	<3
SZ-W-7-19	27-Sep-19	15:50	30.0	32.2	3.2	1.50	135	6.89	<3

Note:
[1] The Ambient Air Temperature and Hydrogen Sulphide reading were measured on site by ALS during odour sampling and other parameters were provided by the contractor.

8. INTERPRETATION OF THE MONITORING RESULT

From the EIA report stated odour emission sampling and testing in Shenzhen River had been performed in 2010. Seven locations were selected for odour measurements. At each sampling location, the following samples had been collected.

For Shenzhen Side:
1 odour sample for exposed sediment and 1 odour sample for water surface.

For Hong Kong Side:
1 odour sample for water surface.

Odour sampling had been carried out at these seven locations during the low tide periods and the ambient temperatures were above 32 °C. At each sampling location, the odour concentration and the specific odour emission rate were measured. Meteorological data such as ambient temperature, relative humidity, wind speed, wind direction and tidal data were taken from Hong Kong Observatory or recorded on site.

Air samples were collected by positioning a wind tunnel device on the selected odour emitting surface (i.e. on water or sediment surface). Nitrogen gas from a certified gas cylinder was then directed into the hood to simulate parallel air flow at a fixed velocity through the wind tunnel device.

Collected air samples had been undergone olfactometry analysis in the laboratory to determine odour concentrations by following EN13725. The odour measurement report for Hong Kong side of the Shenzhen River by Hong Kong Polytechnic University, whereas the report for Shenzhen side of the Shenzhen River by Zhongshan University had been provided.

Due to the confidentiality reason, the Shenzhen side's results were omitted in the EIA report. Hence, only the Hong Kong side results (odour sample on water surface) could be compared.
The odour measurement results from water surface of Shenzhen River (Hong Kong side) in 2010 and 2019 was presented in Table 8.1 and 8.2.

According to the Tables below, the odour concentrations and the specific odour emission rates at the seven locations in 2019 were generally lower than that in 2010, except the odour concentration of HK-W-2, but their results were similar.
In 2019's measurement, no special observation has been found during sampling. Only small correlation was found between odour concentration of water surface and that of sediment core, i.e. all the odour concentrations of sediment core at the seven locations were higher than that of water surfaces, but their differences did not show a specific trend/correlation.

For the values of odour concertation or SOER of the sediment surface, the results of SZ-S-1-19 (Page 12 of Section 7.2) was significantly lower (13 ou_E/m^3 and 0.029 ou_E/m^2s) as compared with the other odour results. Although no significant observation was found when performing sampling, two sampling conditions were different with the other results. Firstly, the ambient temperature for SZ-S-1-19 was lower than the other sampling locations (the second lower, 30.6 °C) and the second was, the sediment surface condition of SZ-S-1-19 was dry comparing with the other sampling locations to be observed from the field sampling team (Refer to Appendix 2 Photo SZ-S-1-19).

Table 8.1 Odour measurement results at Shenzhen River in 2010

(Reference to Planning and Engineering Study on Development of Lok Ma Chau Loop Investigation, July 2013)

Sample ID	Location coordinate		Date	Time	AT (°C)	RH (%)	WS (m/s)	WD	WT (°C)	WD (m)	OC (ou_E/m^3)	SOER (ou_E/m^2s)
	Easting	Northing										
HK-W-1	825605.8	842074.3	06-Aug-10	13:40	33.5	62.9	0.6	E-NE	29.6	3.5	200	0.58
HK-W-2	825874.6	842545.1	06-Aug-10	13:24	32.8	64.0	0.7	E-NE	29.5	2.2	88	0.25
HK-W-3	826039.7	843063.8	06-Aug-10	13:06	32.4	65.5	1.6	E-NE	29.8	1.0	84	0.24
HK-W-4	826542.2	843493.3	06-Aug-10	12:47	32.9	63.2	1.2	E-NE	29.4	2.5	72	0.21
HK-W-5	827110.9	843918.3	06-Aug-10	12:30	33.0	63.5	0.4	E-NE	30.0	1.1	98	0.28
HK-W-6	827476.0	844103.9	06-Aug-10	12:12	32.3	63.8	0.9	E-NE	29.5	0.8	104	0.30
HK-W-7	827774.3	843984.5	06-Aug-10	11:48	32.1	64.5	0.3	E-NE	29.1	2.2	257	0.74

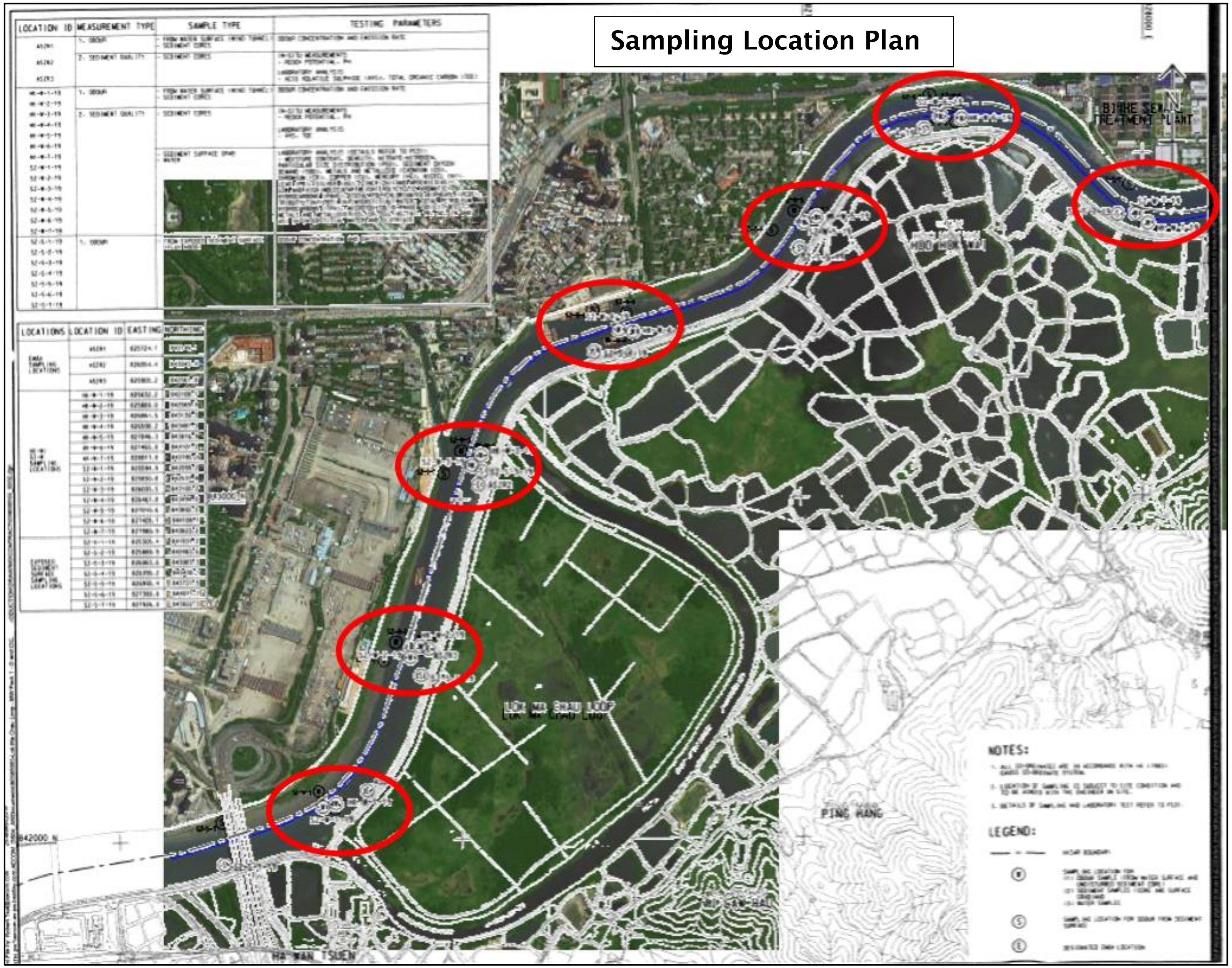
Table 8.2 Odour measurement results at Shenzhen River in 2019

Sample ID	Location coordinate		Date	Time	AT (°C)	RH (%)	WS (m/s)	WD (Deg)	WT (°C)	WD (m)	OC (ou_E/m^3)	SOER (ou_E/m^2s)
	Easting	Northing										
HK-W-1-19	825627.0	842121.9	23-Sep-19	15:34	31.0	72.5	1.5	349	30.2	3.3	26	0.030
HK-W-2-19	825879.9	842570.0	18-Sep-19	16:35	33.0	56.8	2.1	343	29.2	3.6	92	0.104
HK-W-3-19	826061.3	843131.1	03-Oct-19	17:10	31.5	60.0	2.3	296	30.8	0.5	24	0.027
HK-W-4-19	826508.0	843486.3	02-Oct-19	16:25	33.2	49.5	2.3	302	31.0	3.2	29	0.032
HK-W-5-19	827045.9	843816.8	02-Oct-19	17:12	31.7	59.3	3.5	304	30.2	3.5	28	0.032
HK-W-6-19	827464.7	844100.5	27-Sep-19	15:07	32.4	46.7	0.7	296	30.0	1.1	45	0.051
HK-W-7-19	828016.7	843794.2	27-Sep-19	15:35	31.1	49.8	0.9	345	30.0	2.1	23	0.025

Remark:
AT: Ambient Temperature; RH: Relative Humidity; WS: Wind Speed; WD: Wind Direction; WT: Water Temperature; OC: Odour Concentration;
SOER: Specific Odour Emission Rate

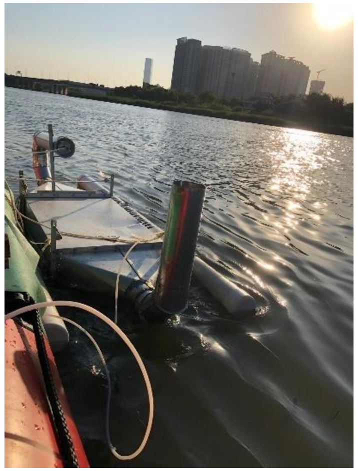
APPENDIX 1

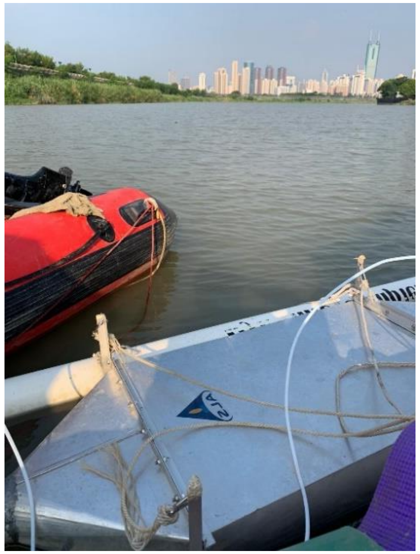
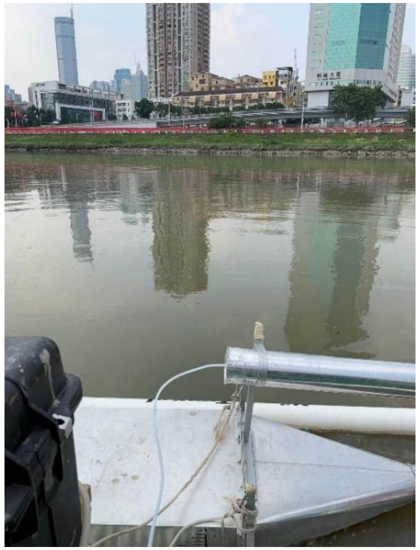
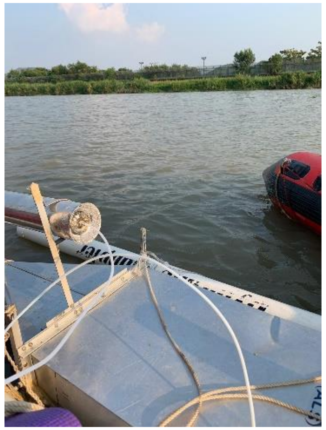
Sampling Location Plan

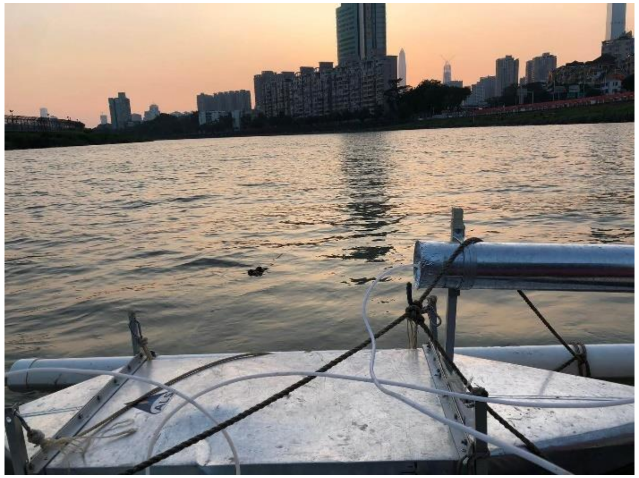
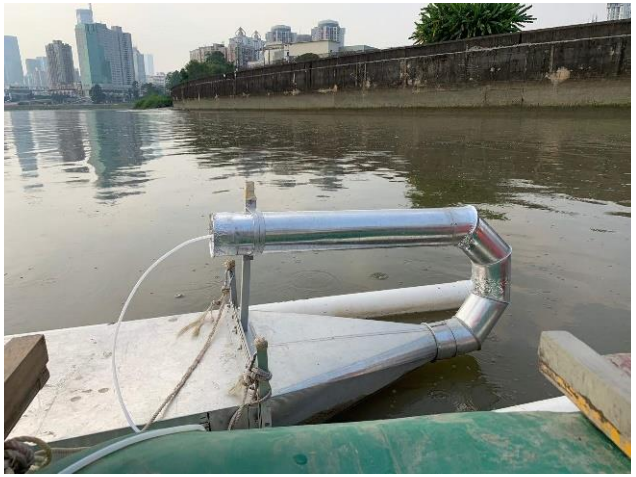

Sampling Location Plan
LOK MA CHAU LOOP
PING HANG
HA WAN TSUEN
NOTES:
LEGEND:

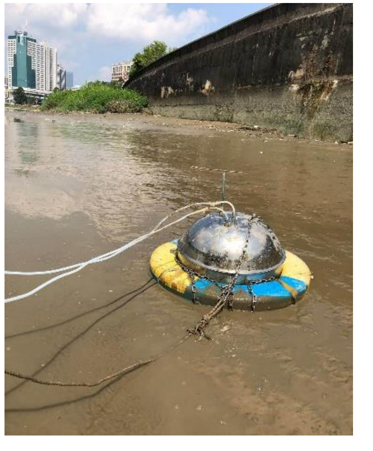
APPENDIX 2

Location Photos for Odour / Sediment Sampling

		
ASZR1	ASZR2	ASZR3
		
HK-W-1-19	HK-W-2-19	HK-W-3-19

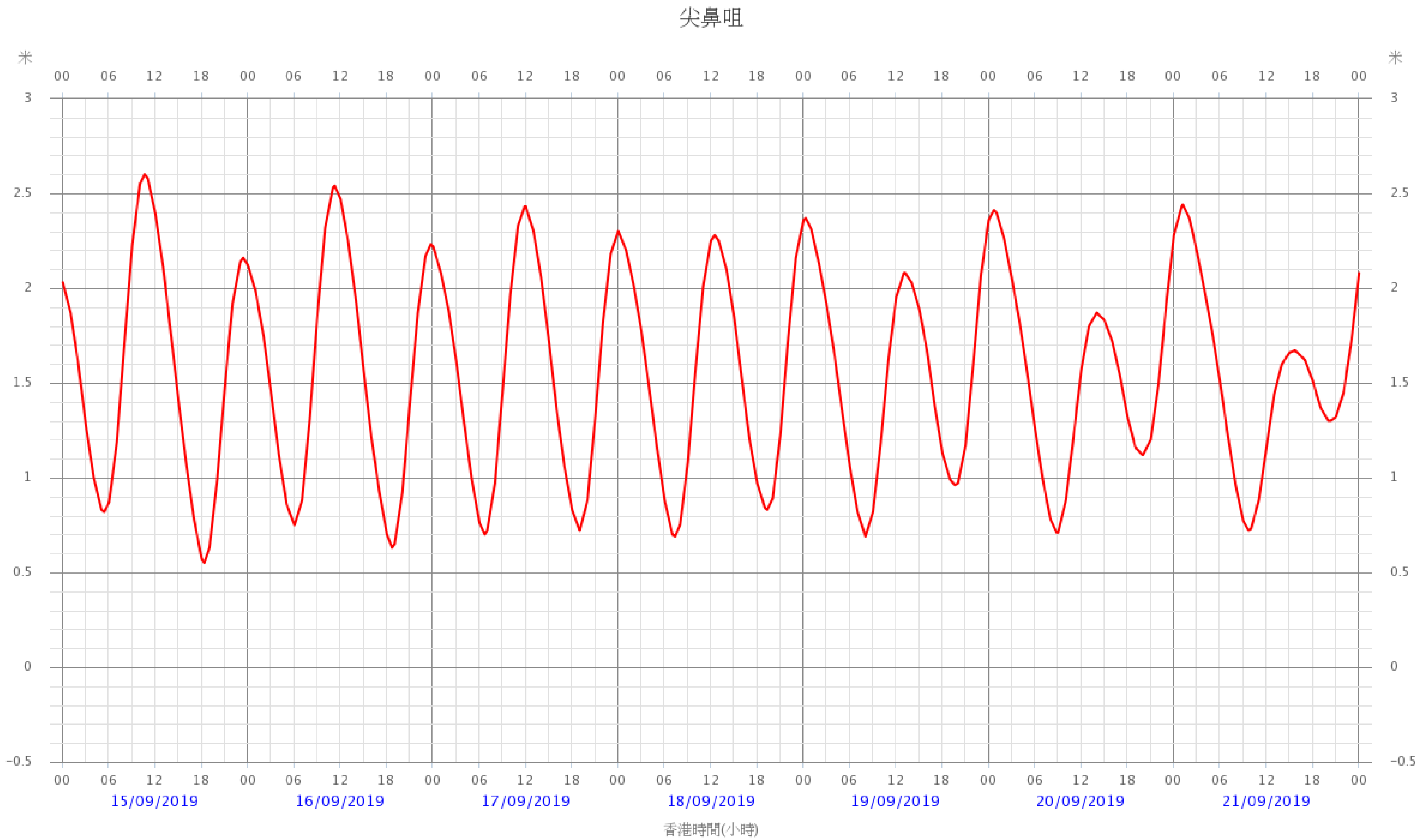
			
HK-W-4-19	HK-W-5-19	HK-W-6-19	HK-W-7-19
			
SZ-W-1-19	SZ-W-2-19	SZ-W-3-19	SZ-W-4-19

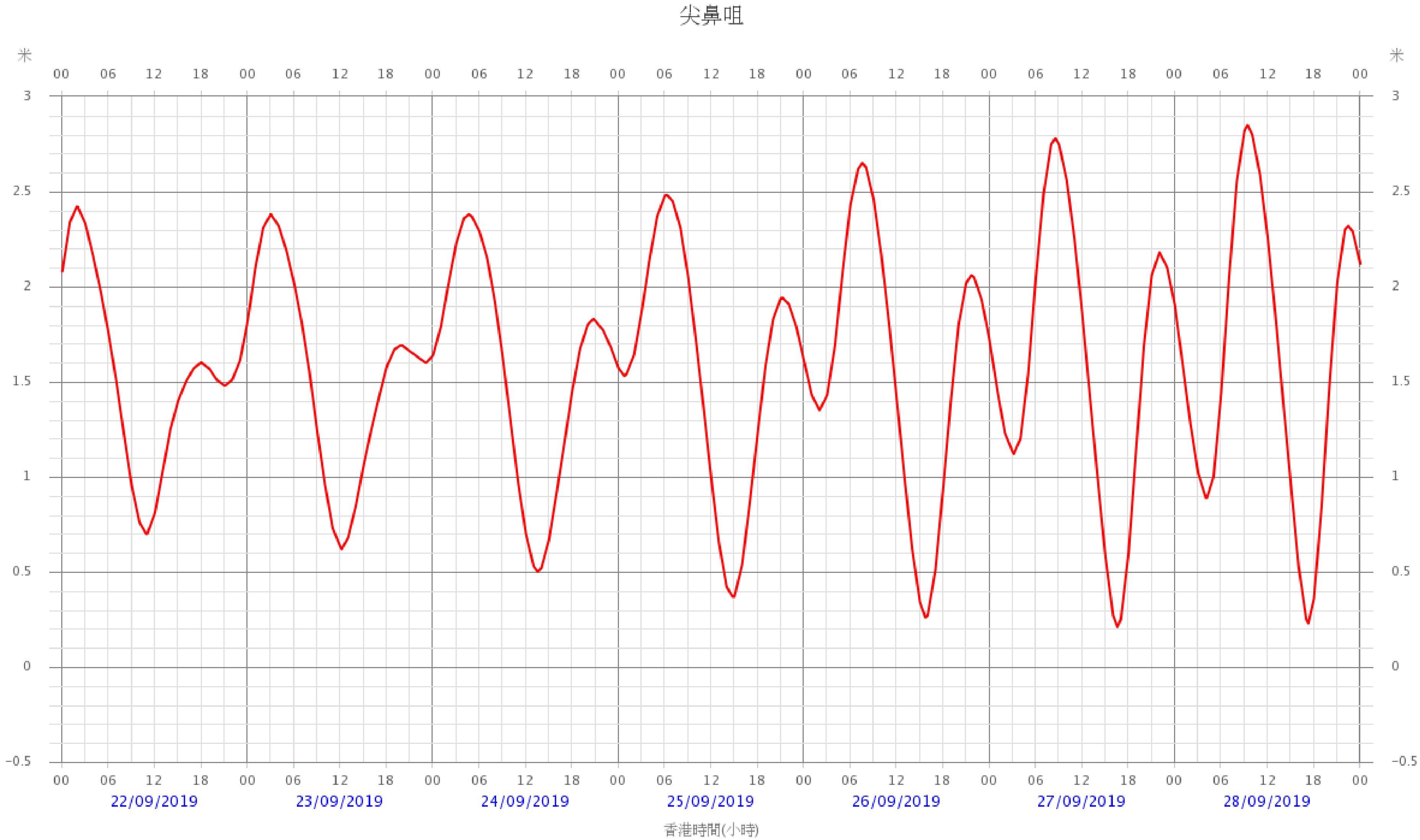
		
SZ-W-5-19	SZ-W-6-19	SZ-W-7-19
		
SZ-S-1-19	SZ-S-2-19	HK-S-3-19

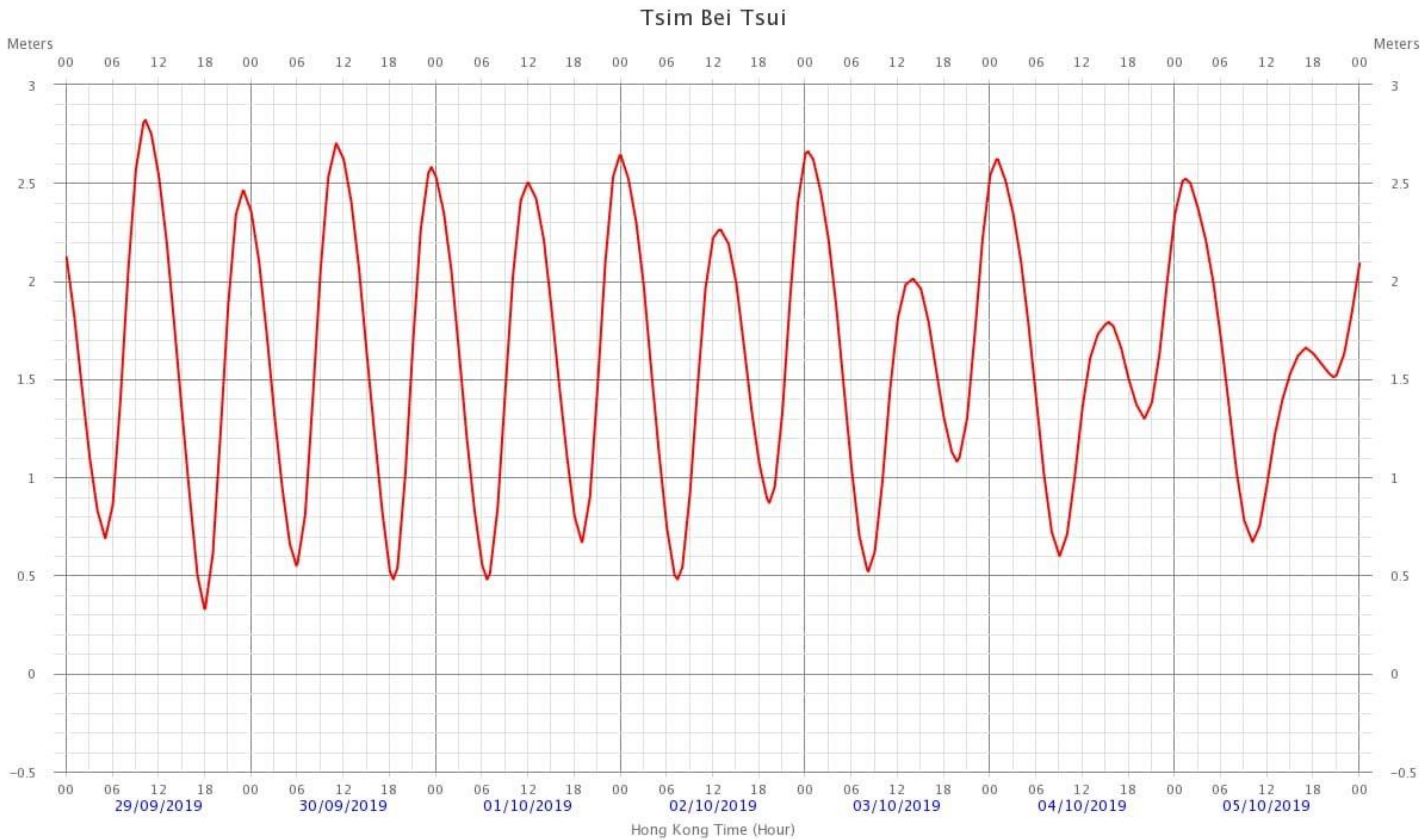
	
SZ-S-4-19	HK-S-5-19
	
HK-S-6-19	HK-S-7-19

APPENDIX 3

Tidal information extracted from the Tsim Bei Tsui Station of Hong Kong Observatory



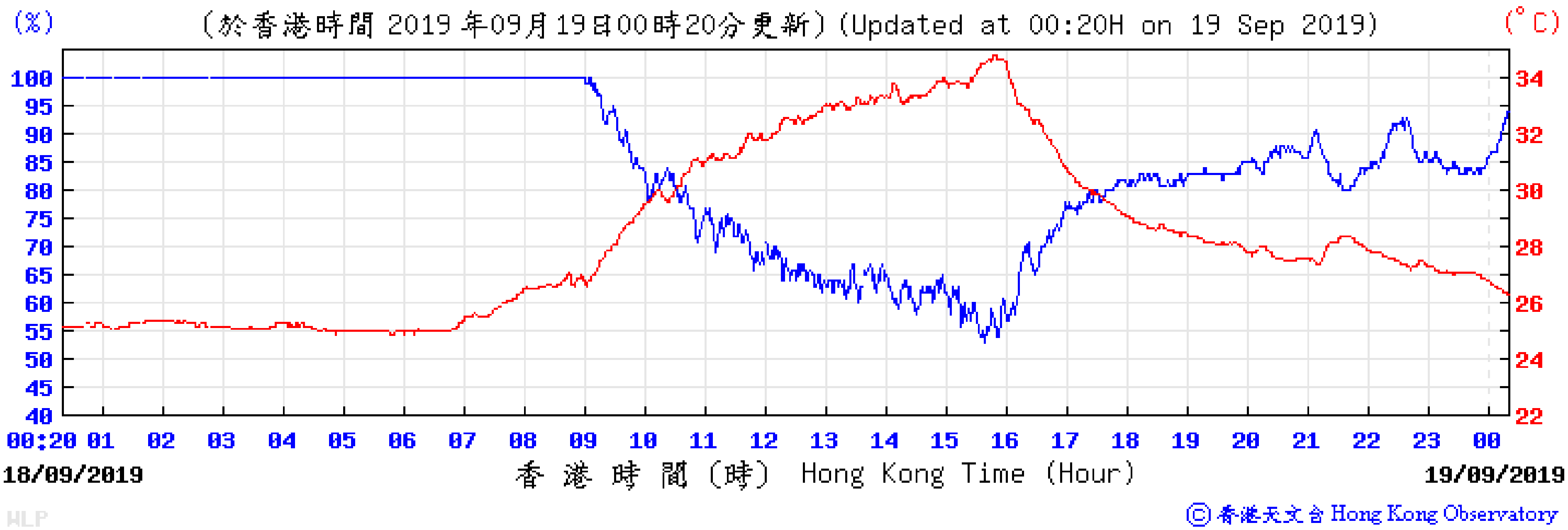

尖鼻咀
米
00 06 12 18 00 06 12 18 00 06 12 18 00 06 12 18 00 06 12 18 00 06 12 18 00 06 12 18 00
3
2.5
2
1.5
1
0.5
0
-0.5
22/09/2019
23/09/2019
24/09/2019
25/09/2019
26/09/2019
27/09/2019
28/09/2019
香港時間(小時)


Tsim Bei Tsui
Meters
Meters
00 06 12 18 00 06 12 18 00 06 12 18 00 06 12 18 00 06 12 18 00 06 12 18 00 06 12 18 00
3
2.5
2
1.5
1
0.5
0
-0.5
29/09/2019
30/09/2019
01/10/2019
02/10/2019
03/10/2019
04/10/2019
05/10/2019
Hong Kong Time (Hour)

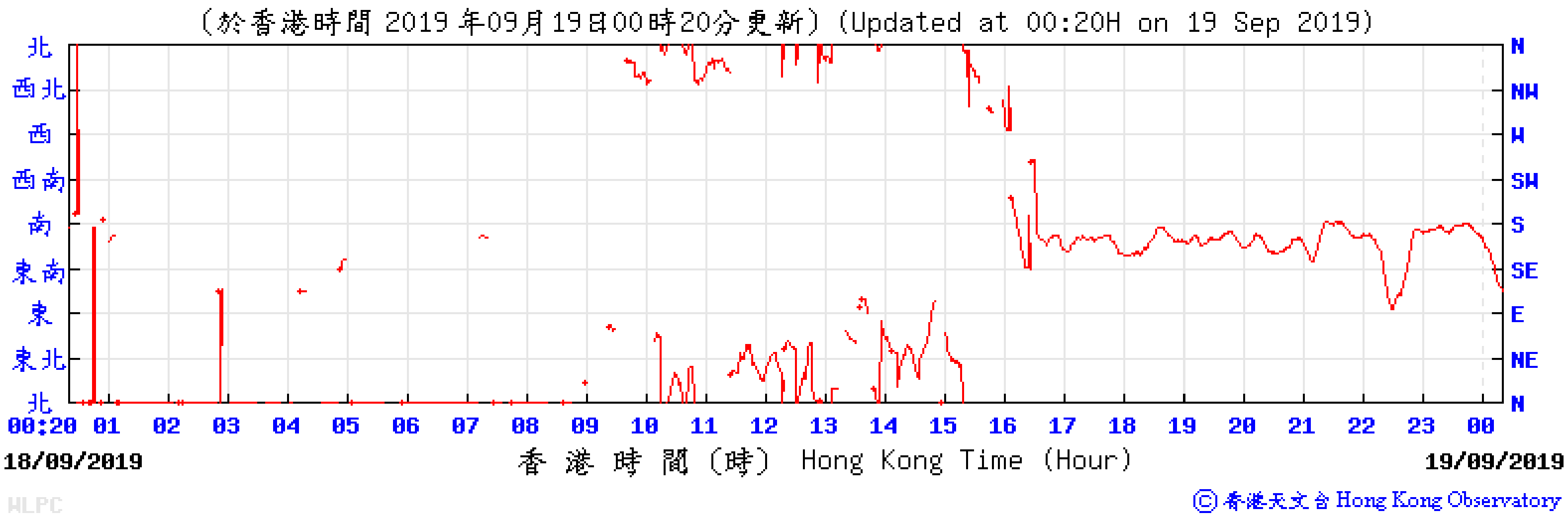
APPENDIX 4

Meteorological conditions collected from the Hong Kong Wetland Park Weather Station

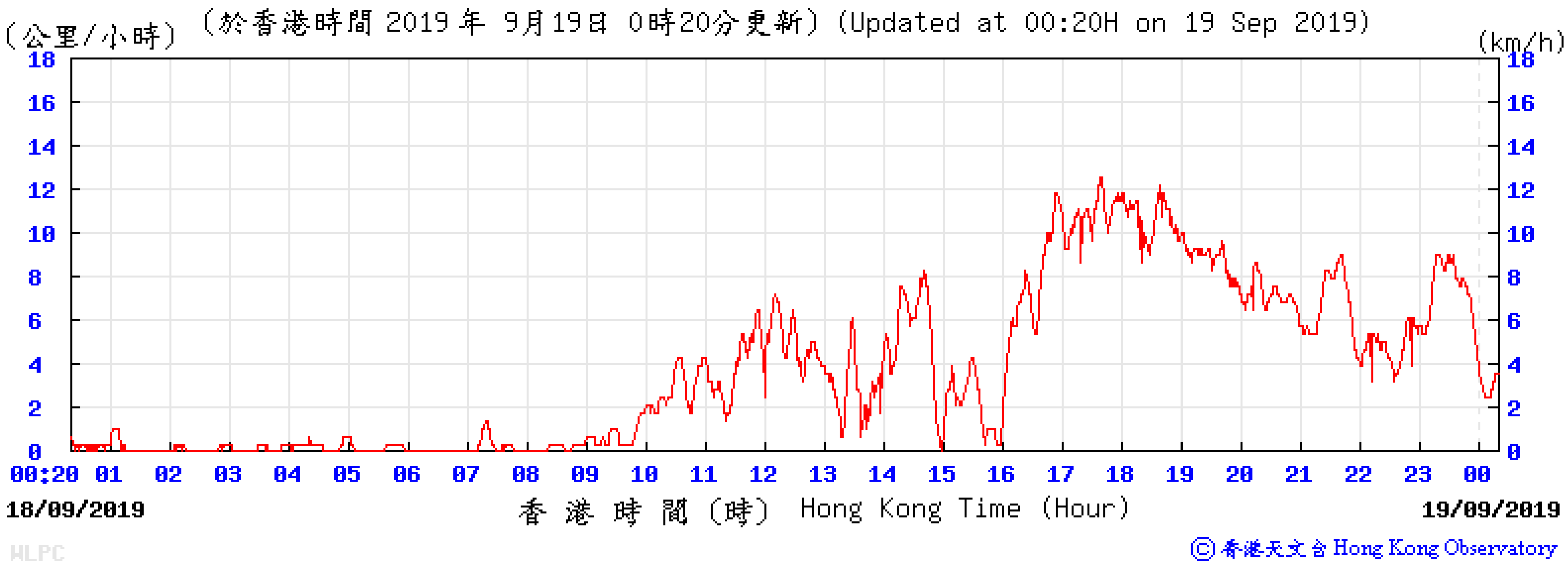
Tempearture/Humidity:



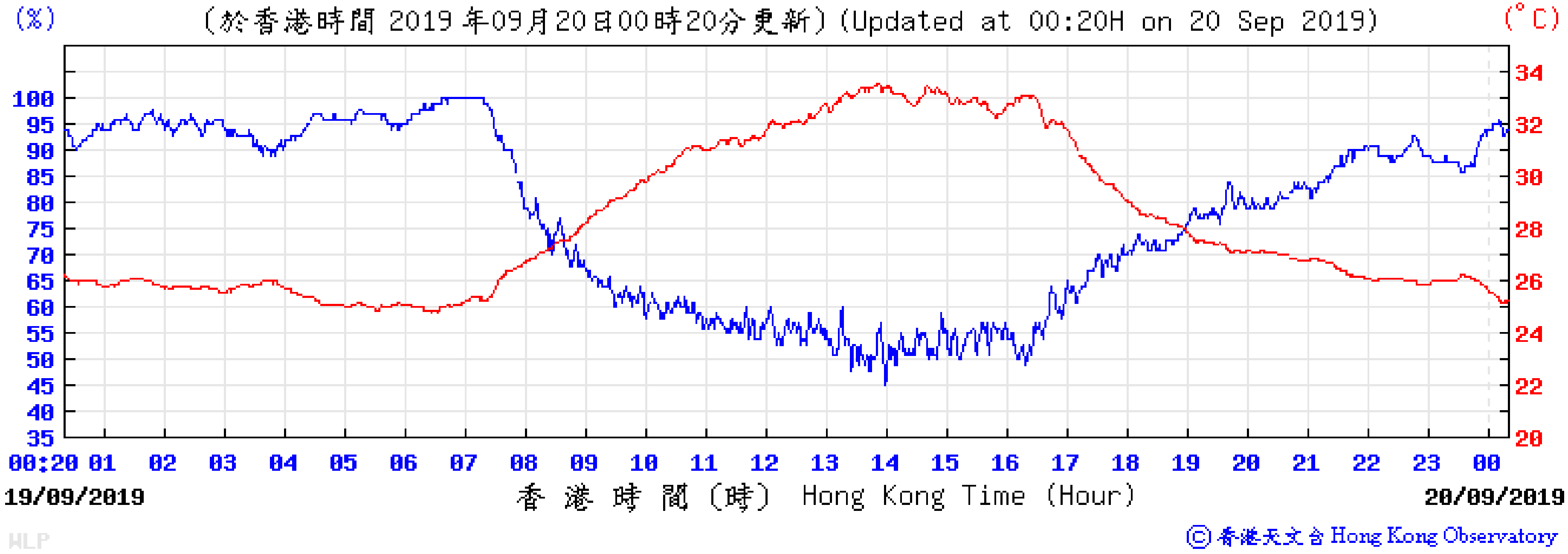
Wind Direction:



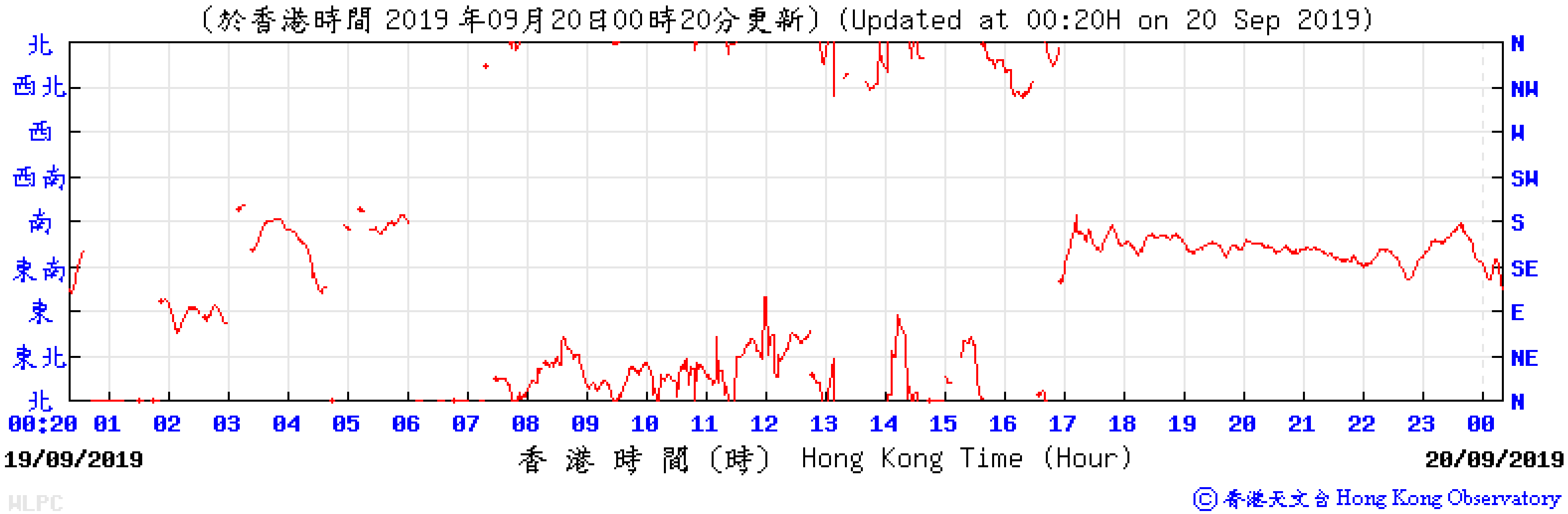
Wind Speed:



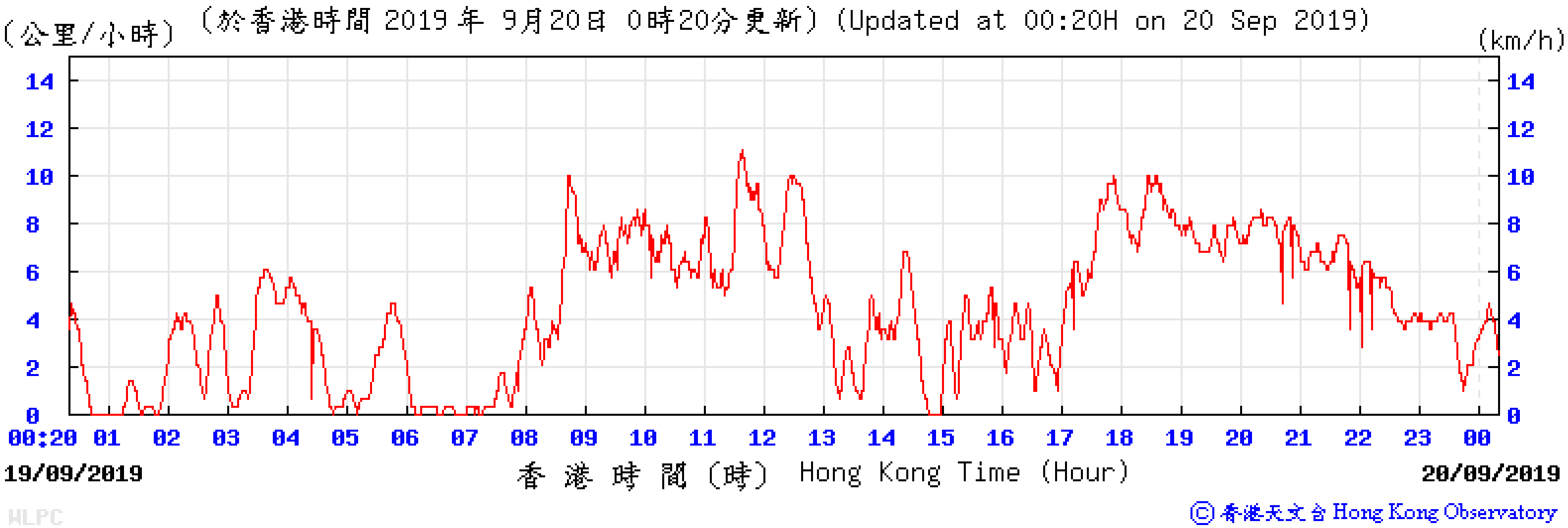
Tempearture/Humidity:



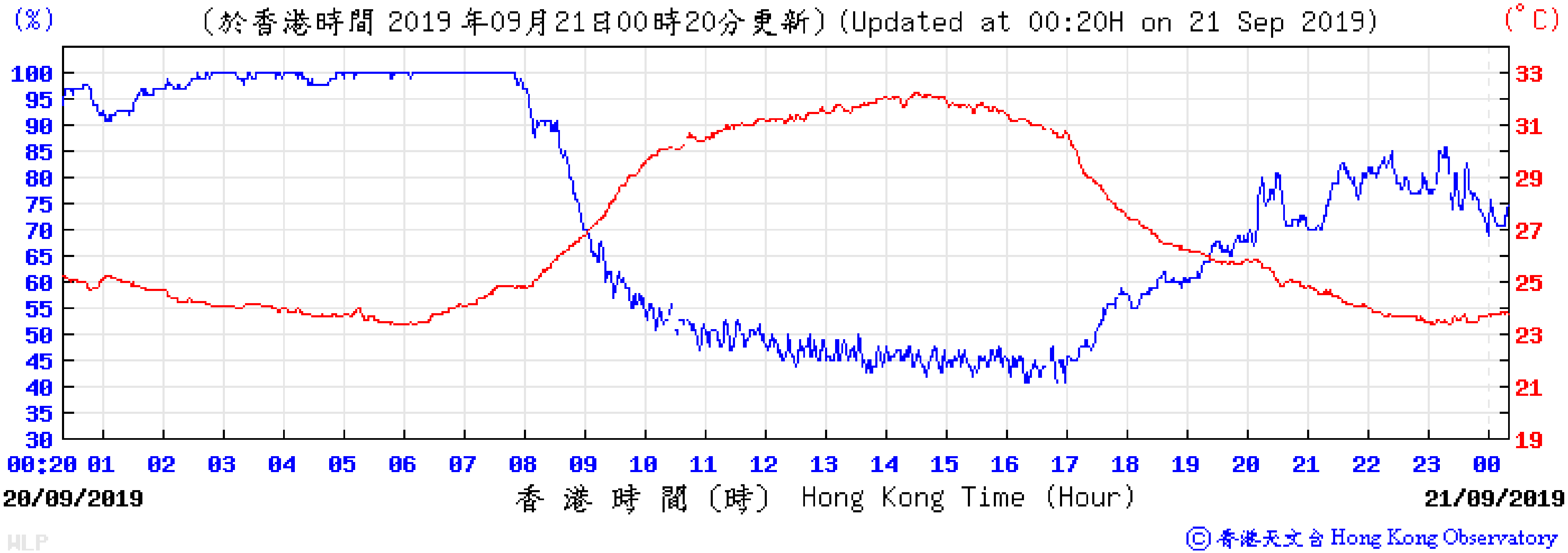
Wind Direction:



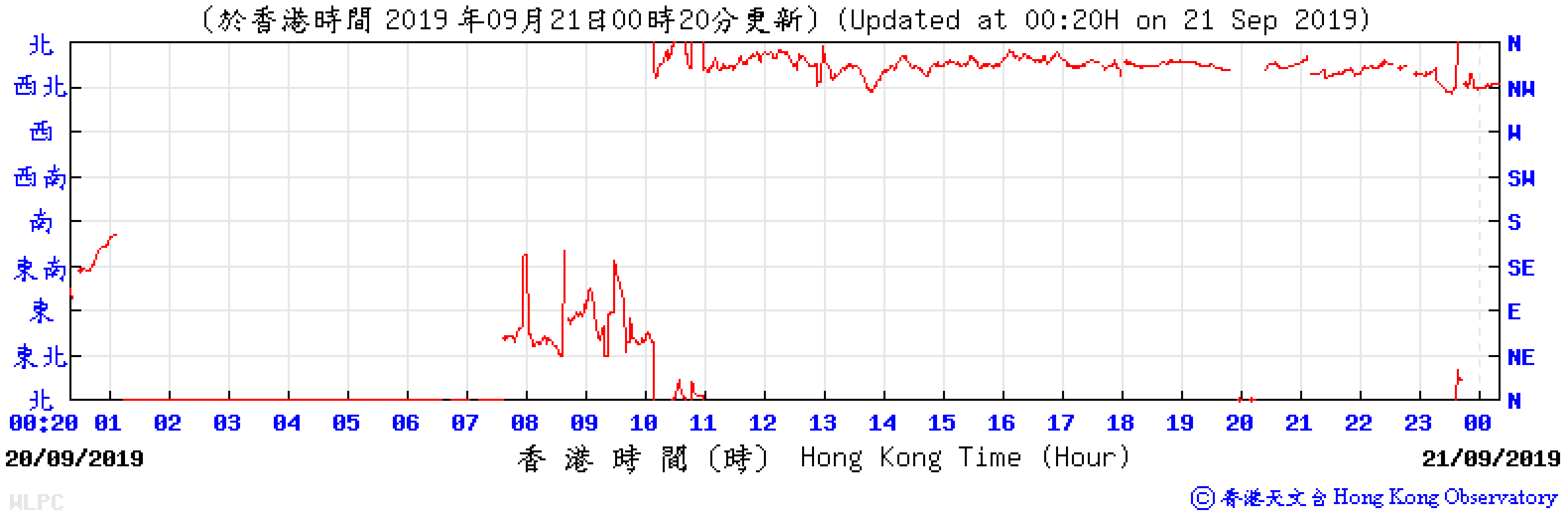
Wind Speed:



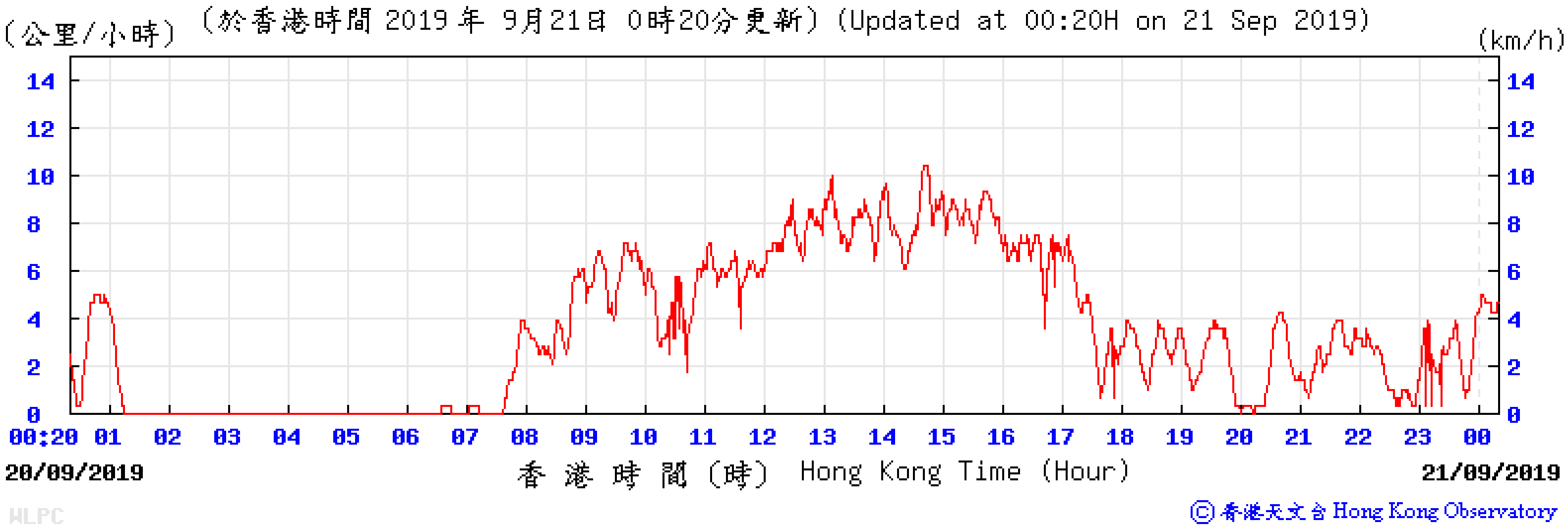
Tempearture/Humidity:



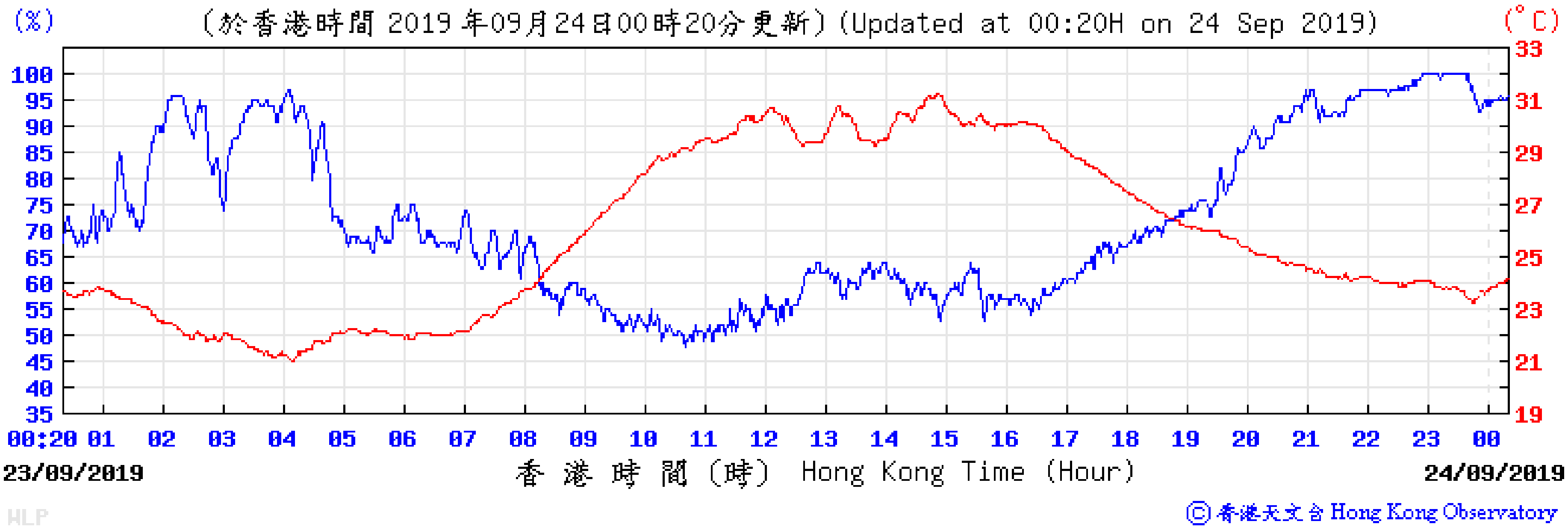
Wind Direction:



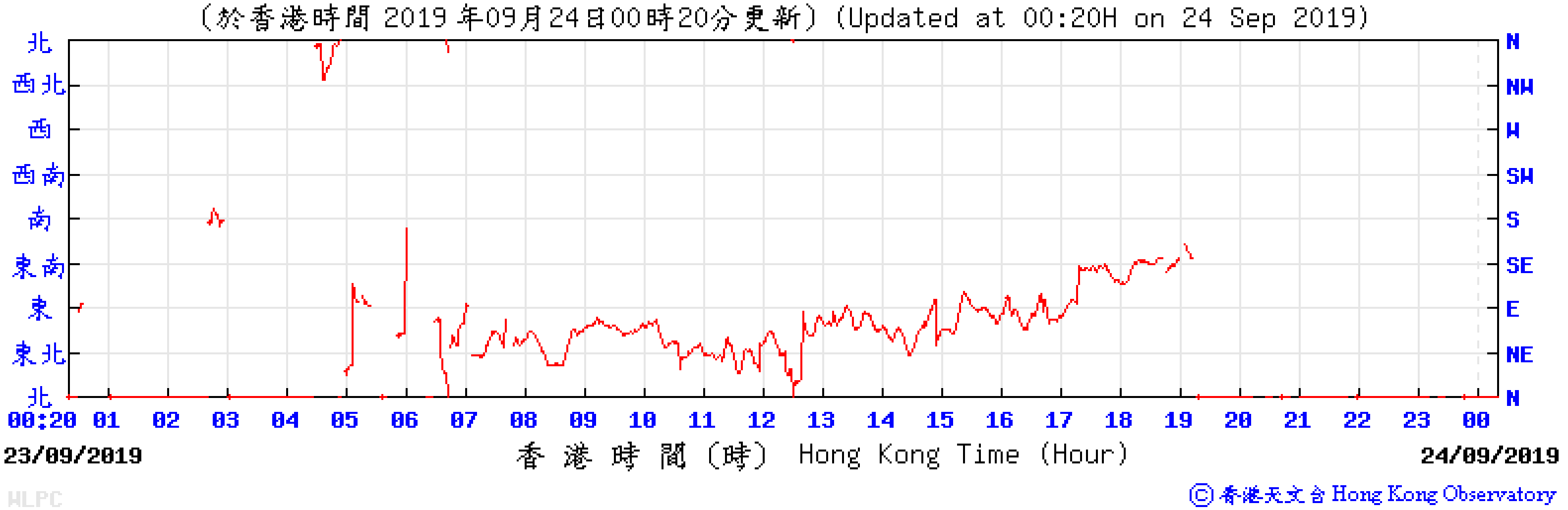
Wind Speed:



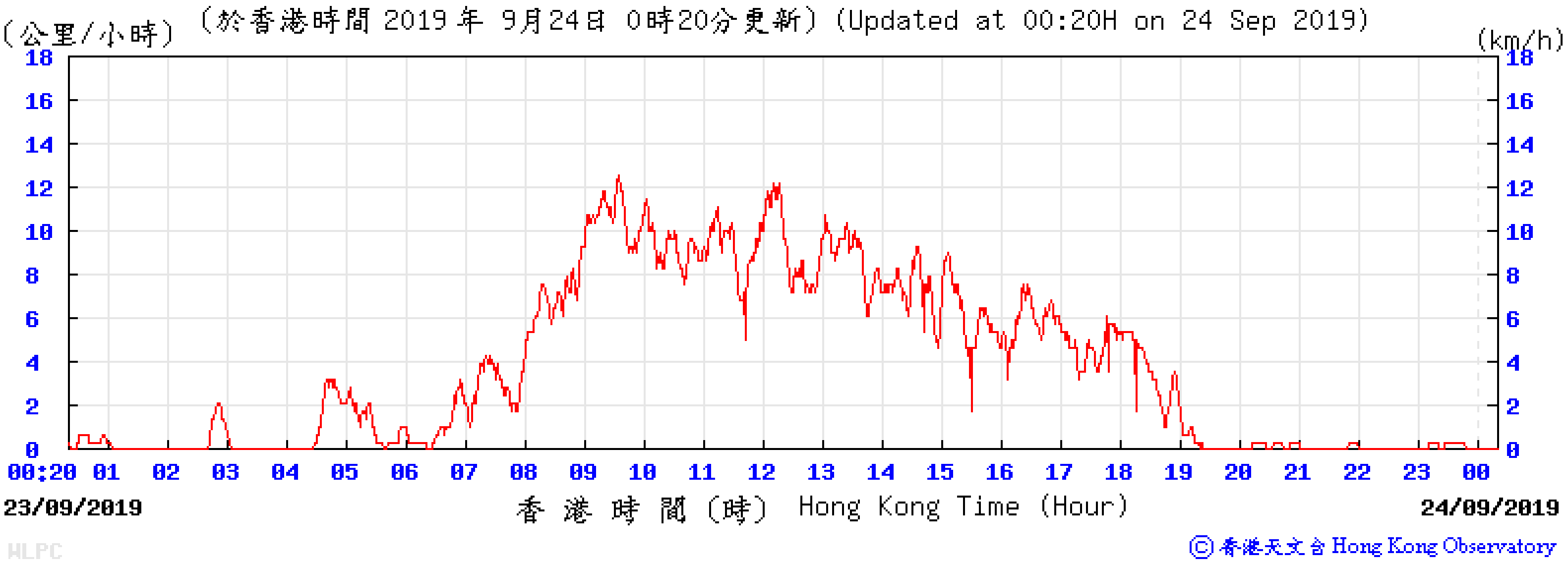
Tempearture/Humidity:



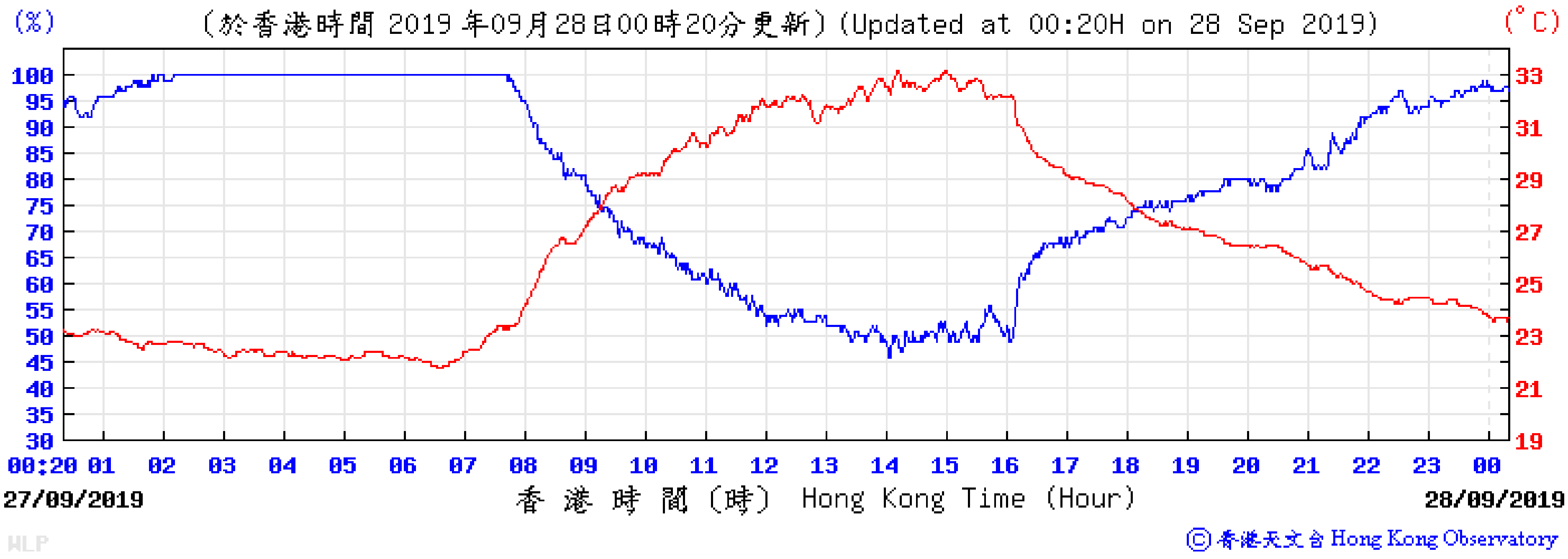
Wind Direction:



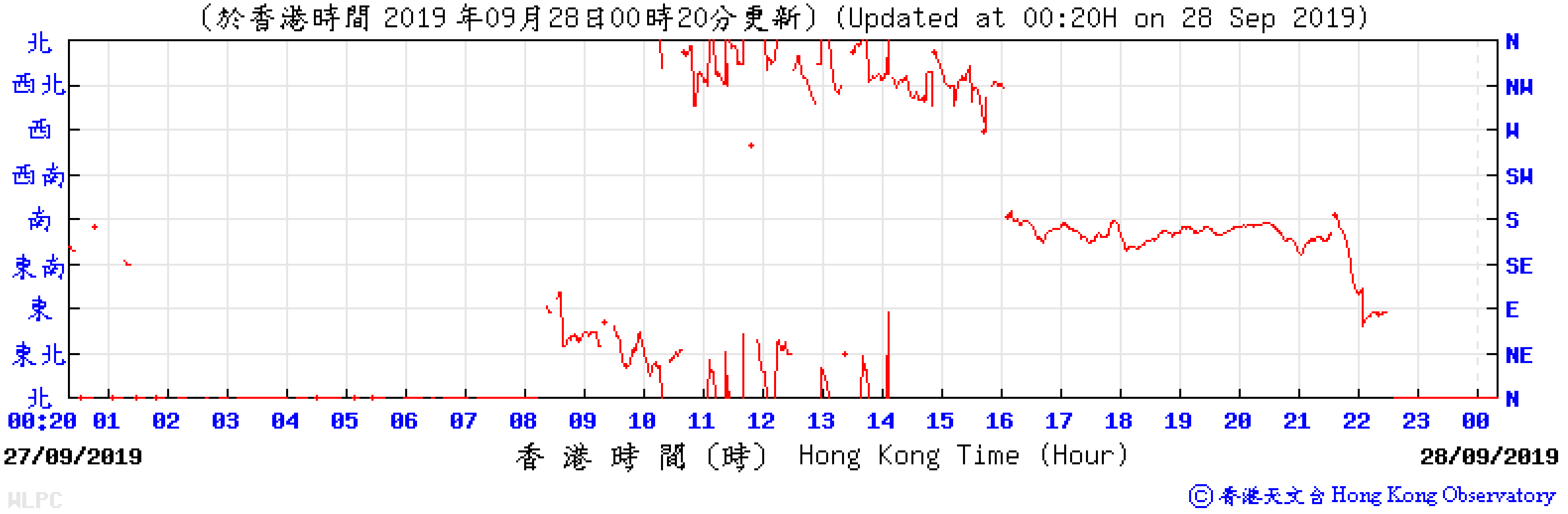
Wind Speed:



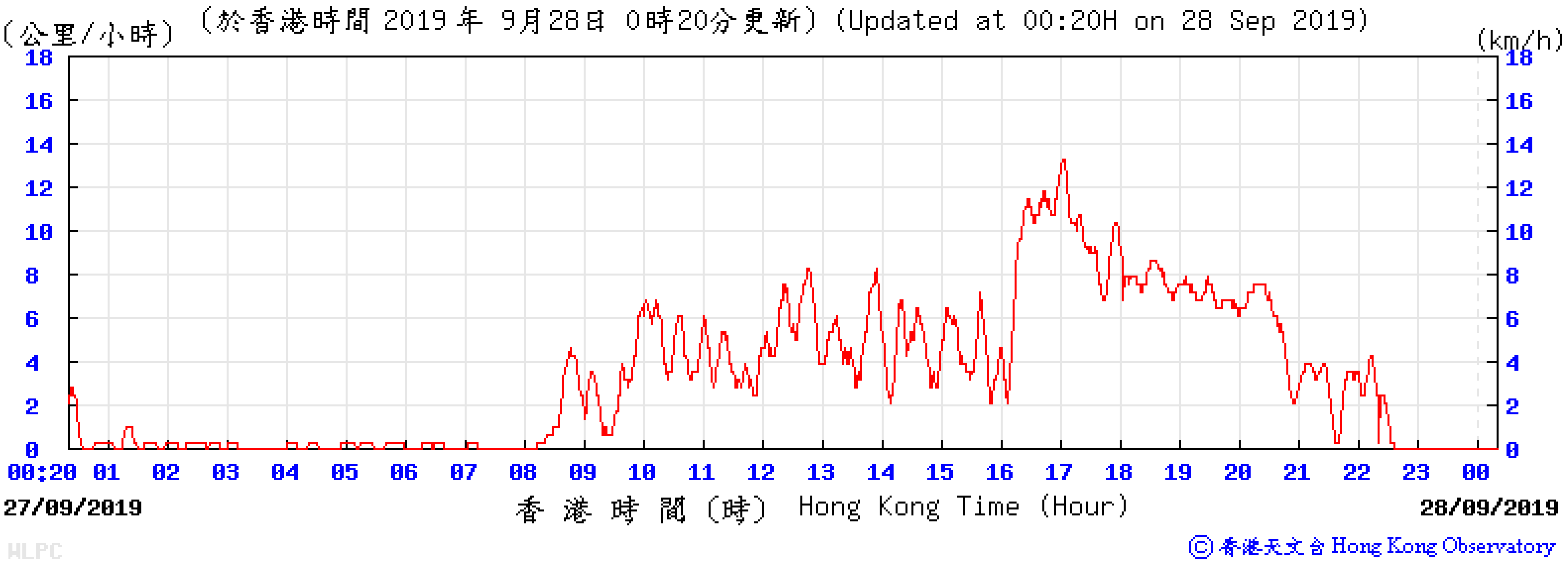
Tempearture/Humidity:



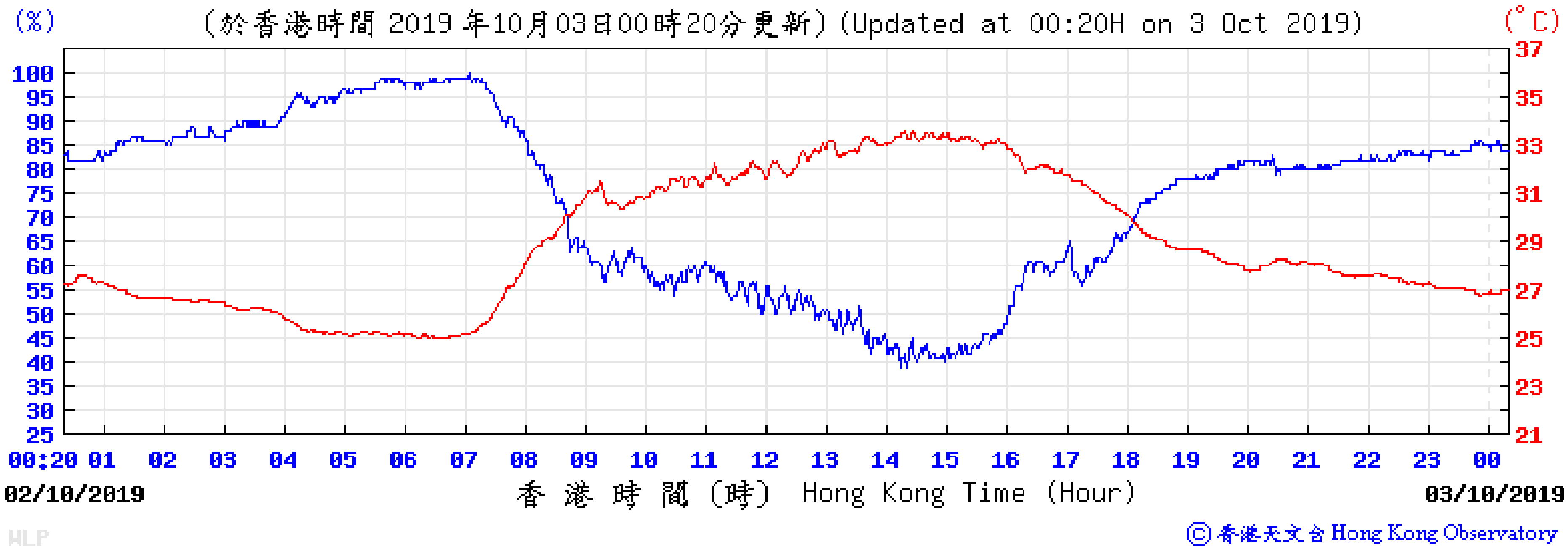
Wind Direction:



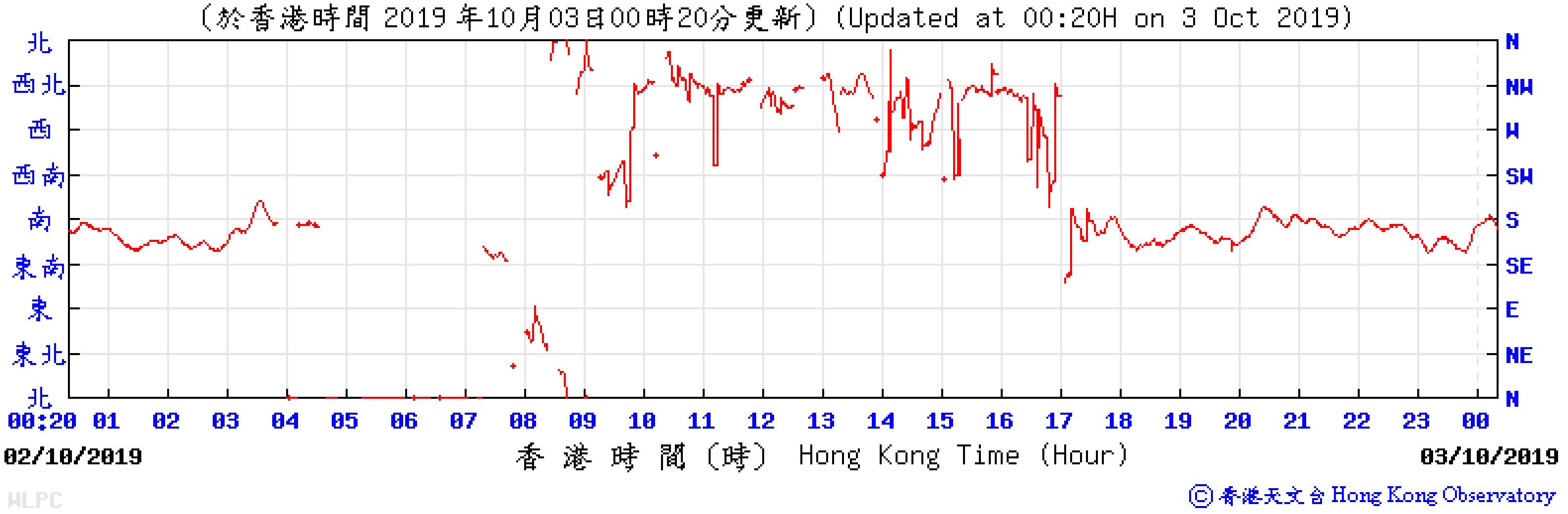
Wind Speed:



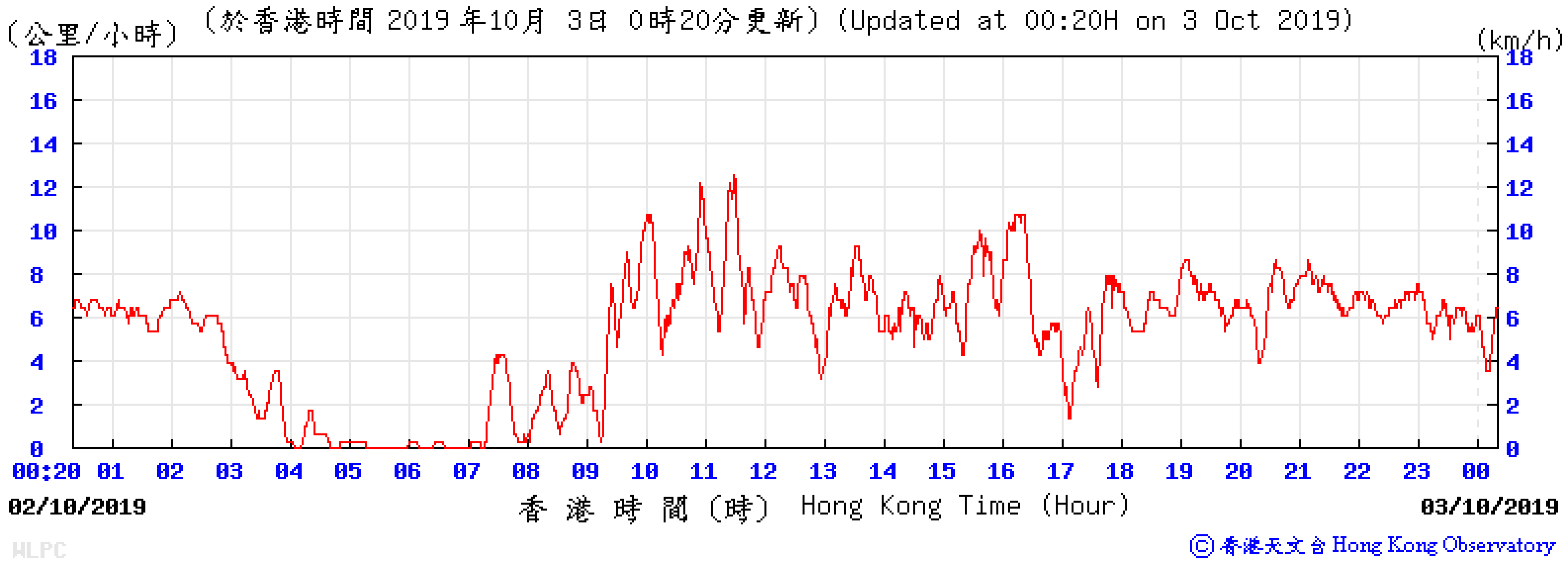
Tempeartture/Humidity:



Wind Direction:



Wind Speed:



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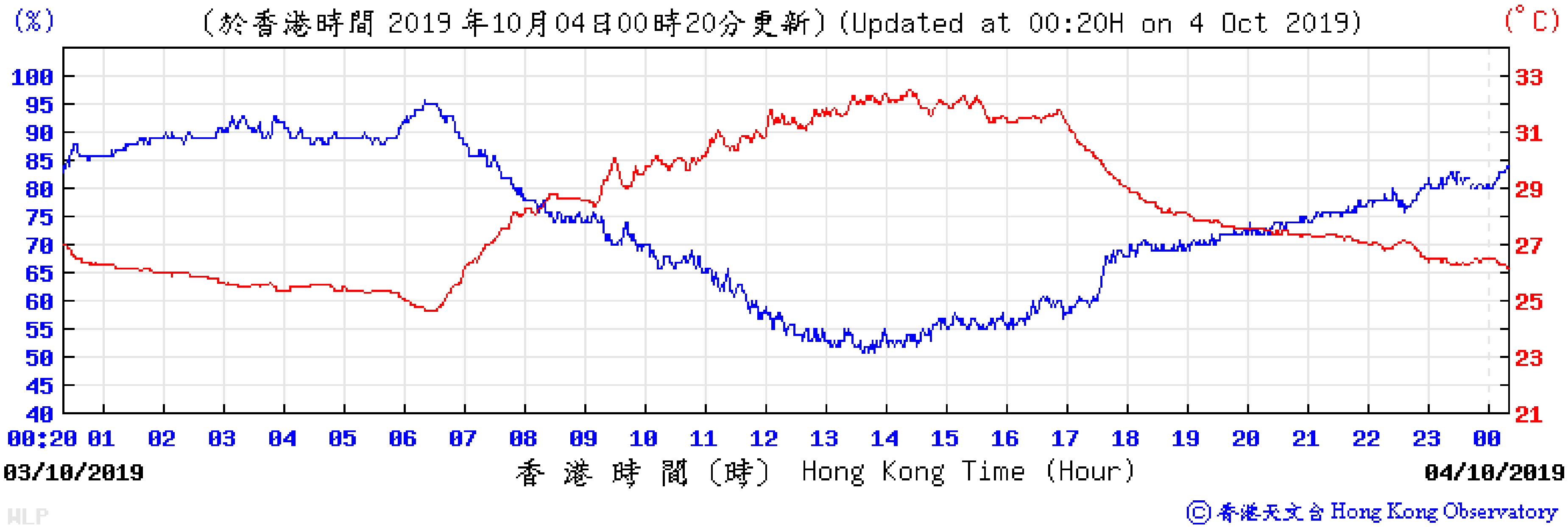
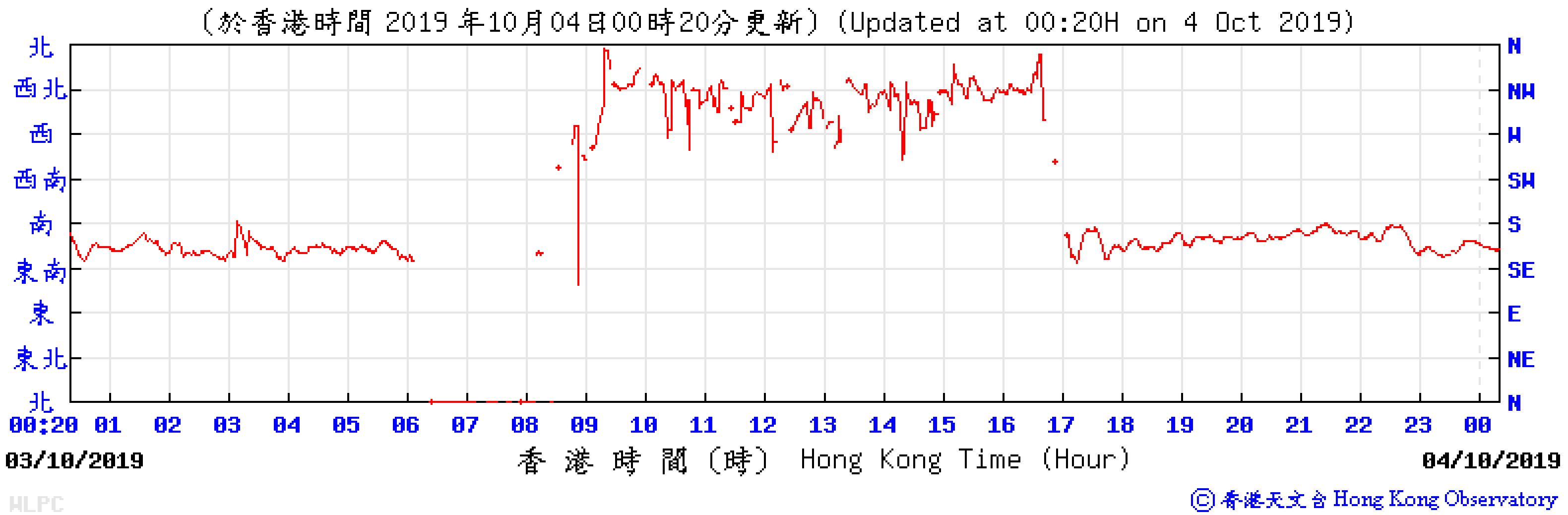
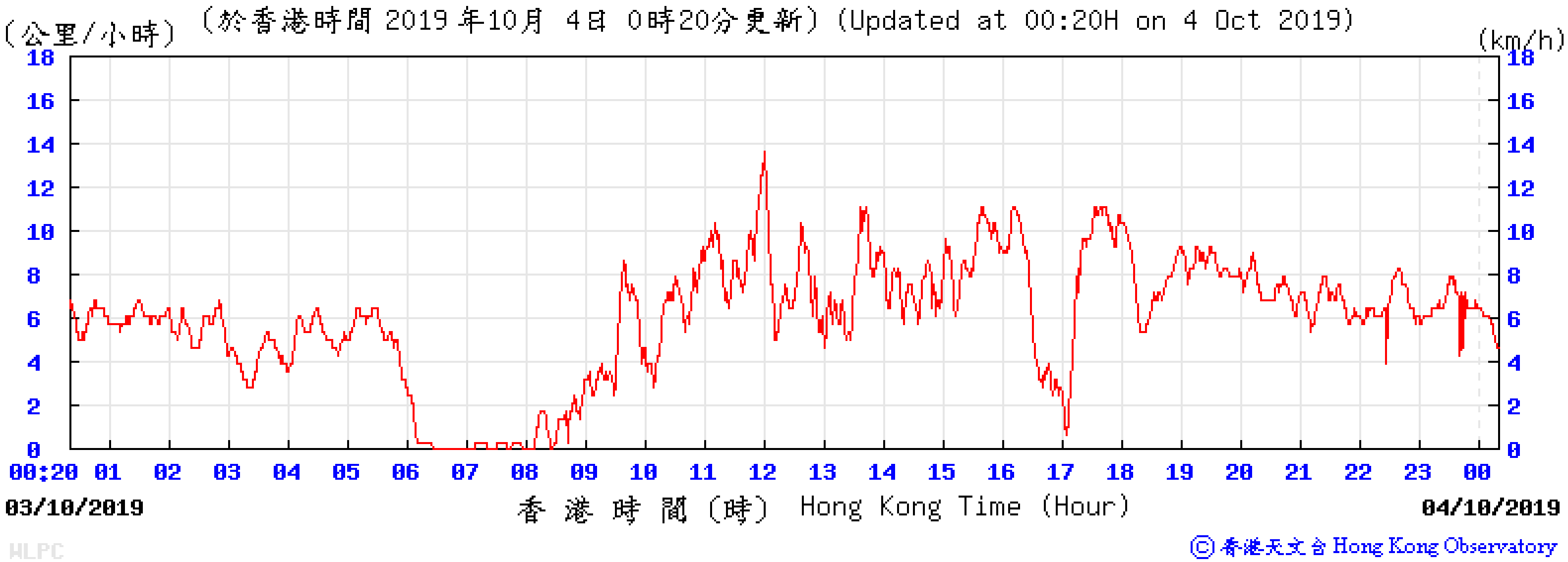


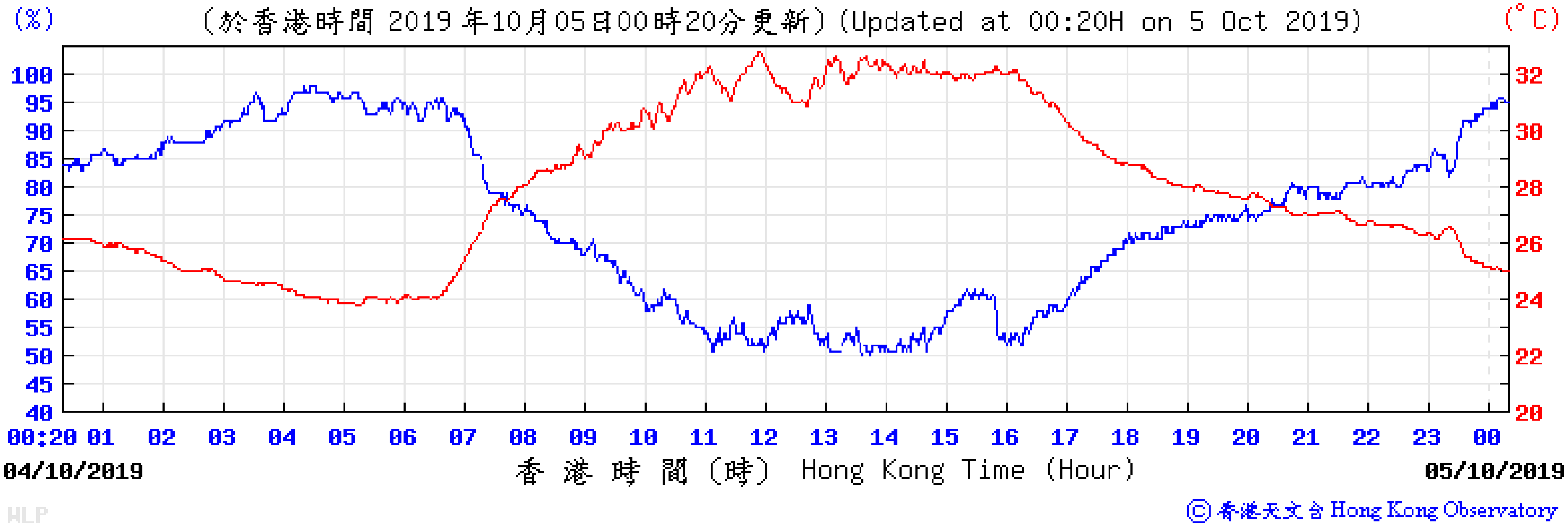
Wind Direction:



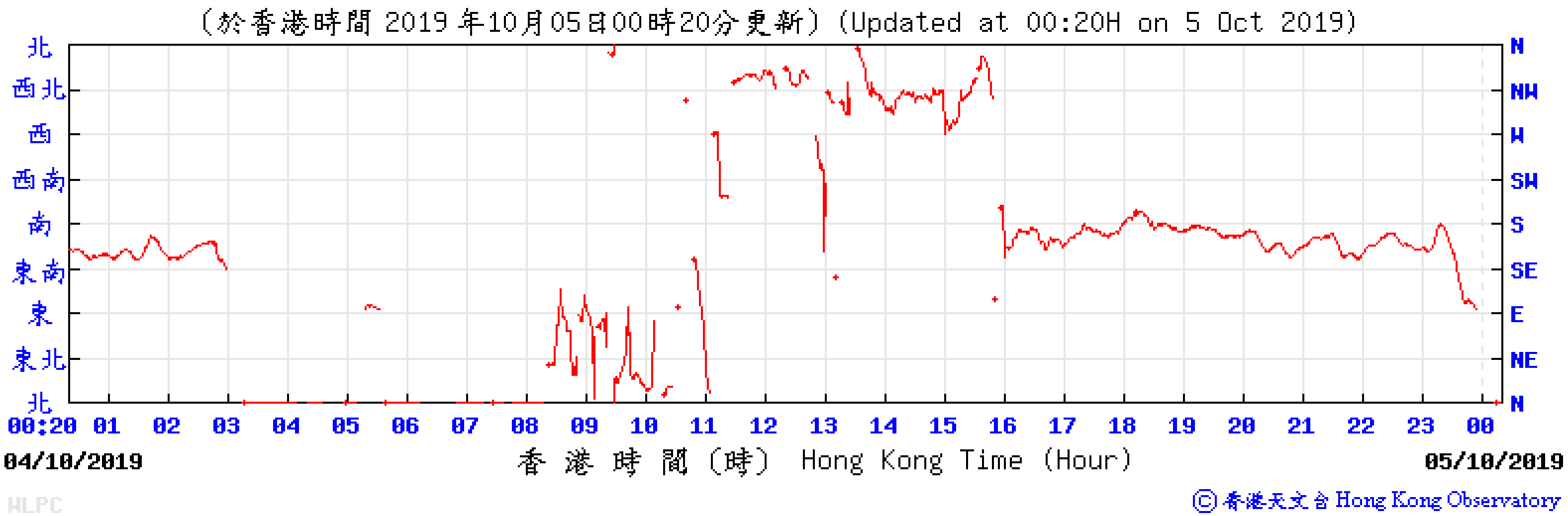
Wind Speed:



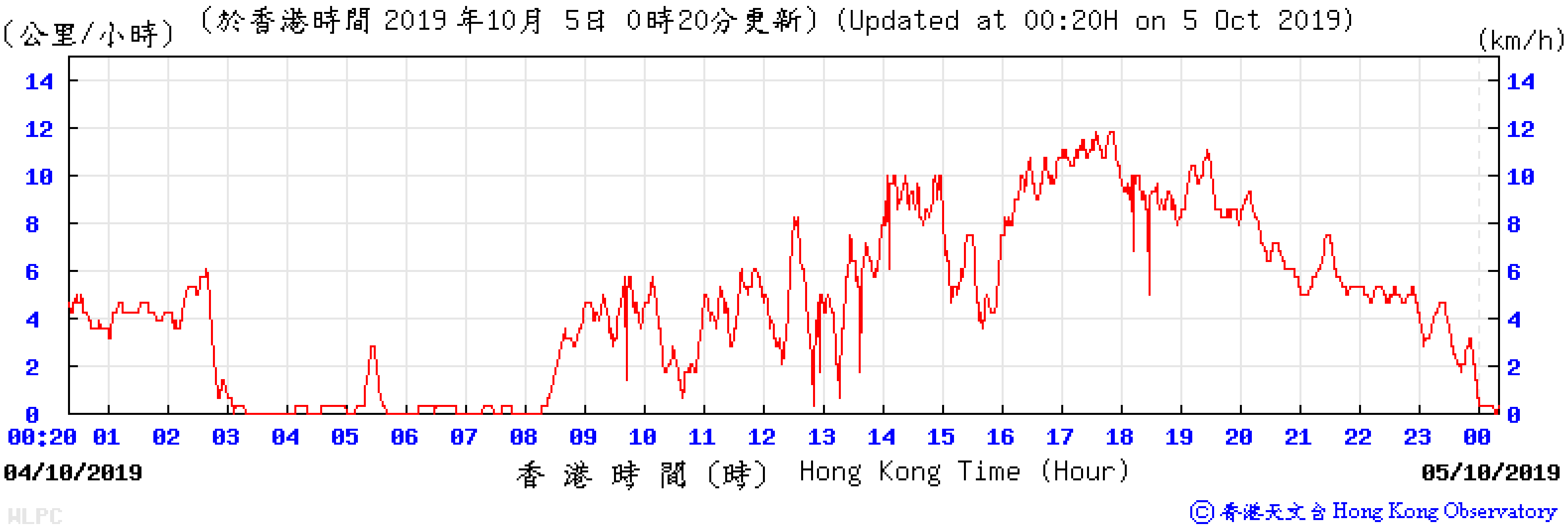
Tempearture/Humidity:



Wind Direction:



Wind Speed:

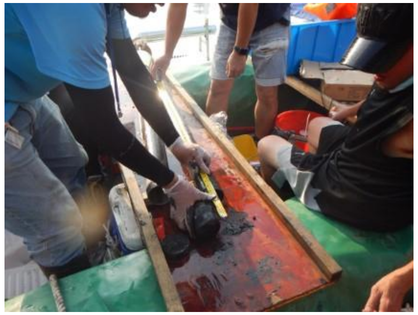


APPENDIX 5

ALS Olfactometer Laboratory

APPENDIX 6

Photos Using the K-B Core for Collecting Sediment Samples

Photos for the Sediment Collected

APPENDIX 7

Hydrogen Sulphide Analyzer Calibration Certificate

BROOKFIELD AMETEK

3375 N. Delaware Street, Chandler, AZ 85225
800.528.7411 | (f) 602.281.1745 | azic.com

Certification of Instrument Calibration

Guyline (Asia) Ltd
Rm 1611, Eastern Harbour Centre
Quarry Bay,

RMA # 2650660

This is to certify that the Jerome **J605-0002** Gold Film Hydrogen Sulfide Analyzer, Serial Number **60500180**, with Sensor Number **17-11-7-W2CS**, was calibrated with standard units traceable to NIST.

Calibration Status as Received: **Out of Calibration**

		Actual	Calibration Gas	Allowable Range
Incoming:	Range 1	999.000 ppm H_2S	0.500 ppm H_2S	0.470 - 0.530 ppm H_2S
Outgoing:	Range 1	0.484 ppm H_2S	0.500 ppm H_2S	0.475 - 0.525 ppm H_2S
	RSD %	0.56		<3%

Calibration Status as Left: **In Calibration**

Estimated Uncertainty of Calibration System: 2.4%

Calibration Date: 03-Apr-2019 Recalibration Date: 02-Apr-2020

Temperature °F: 72.20 % Relative Humidity: 20.70

Approved By: Cheryl Hradek

Date Approved: 04-Apr-2019

Title: Cheryl Hradek - Quality Control

Equipment Used:

H2S Calibration Standard: CC-230020 **NIST#:** 1417575
Calibration Date: 30-May-2017 **Calibration Date Due:** 31-May-2020

Mass Flow Controller B: 124604 **NIST#:** 215457
Calibration Date: 13-Dec-2018 **Calibration Date Due:** 13-Dec-2019

Mass Flow Controller D: 124602 **NIST#:** 215454
Calibration Date: 13-Dec-2018 **Calibration Date Due:** 13-Dec-2019

Digital Multimeter: 66961028 **NIST#:** 7003135
Calibration Date: 16-Feb-2019 **Calibration Date Due:** 16-Feb-2020

Flowmeter: US15G63224 **NIST#:** 1813; 1817; 1796
Calibration Date: 26-Sep-2018 **Calibration Date Due:** 27-Sep-2019

Calibration Procedure Used: 730-0099

AMETEK Brookfield certifies that the above listed instrument meets or exceeds all published specifications and has been calibrated using standards whose accuracy are traceable to the NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY within the limitations of the Institute's calibration services, or have been derived from accepted values of natural physical constants, or have been derived by the ratio type of self-calibration techniques.

Disclaimer: Any unauthorized adjustments, removal or breaking of QC seals, or other customer modifications on your Jerome Analyzer WILL VOID this factory calibration. Because any of the above acts could affect the calibration and readings of the instrument, their certification will no longer be valid and, further, AMETEK Brookfield WILL NOT be responsible for any liabilities created as a result of using the instrument after such adjustments, seal removal, or modifications. As long as a functional test is within range, according to the procedure outlined in the Operator's Manual, the instrument is performing correctly.

RMA.E20

Guyline (Asia) Ltd.

Company name: ALS
Attn : Mr Allen Poon
Tel : 852-26101044
Fax : 852-26102021
Address : 11/F Chung Shun Knitting Centre
1-3 Wing Yip Street, Kwai Chung, NT, Hong Kong
Date : 9 of Oct, 2019
e-mail : allen.poon@ALSGlobal.com

Service Report

Service information:
Instrument: Model J605-002
Serial number: 60500180

Verification test with JEROME H_2S Functional Test model s/n: FTM-1519. Repeat this until a total of 10 samples have been taken and recorded. Disregard the first 5 samples test result and average the last 5 sample test result. The results are following:

Sample 1: 0.242 (discard)
Sample 2: 0.263 (discard)
Sample 3: 0.267 (discard)
Sample 4: 0.265 (discard)
Sample 5: 0.255 (discard)
Sample 6: 0.267
Sample 7: 0.270
Sample 8: 0.270
Sample 9: 0.271
Sample 10:0.272

Average of sample 6-10 is 0.27. The result is pass and within the acceptable range.
For the acceptable range is 0.2-0.3ppm H_2S

Performed By: CHAN KA LEUNG
Title: Service Engineer
Company: GUYLINE (ASIA) Ltd.

Page **1** of **1**

Appendix 3.2

Survey Report of Shenzhen River Odour Survey 2020

Concentric Construction Limited

Contract No. YL/2018/03

Development of Lok Ma Chau Loop: Main Works Package 1 – Special Site Investigation Works (In-situ Trial of Sediment Treatment Works in Shenzhen River) and Laboratory Testing

Additional Odour Survey Report at Shenzhen River

(Version 2.0)

Certified By	(Environmental Team Leader)

REMARKS:

The information supplied and contained within this report is, to the best of our knowledge, correct at the time of printing.

WELLAB accepts no responsibility for changes made to this report by third parties

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EXECUTIVE SUMMARY

Introduction

1. This is the Additional Odour Survey Report prepared by Wellab Limited (WELLAB) for "Contract No. YL/2018/03 Development of Lok Ma Chau Loop: Main Works Package 1– Special Site Investigation Works" (hereinafter called the "Contract") under Site Instruction (SI) No. 009. This report documents the results and findings of the additional odour survey at Shenzhen River conducted from 14th to 28th August 2020.

Additional Odour Survey Works

2. In accordance with Annex B of Particular Specification (PS) for Odour Survey at Shenzhen River, the sampling works at water surface must be completed by end of August 2020. The remaining sampling works must be completed by the first week of September 2020. The details of odour survey activities are listed below:

   (i) Carry out odour sampling from water surface at 38 designated locations at Shenzhen River during low/ebb tide period (i.e. after mid-ebb tide or during low tide, which refers to the tide level of +1.0 mCD (metre above chart datum) or below at Tsim Bei Tsui by Hong Kong Observatory).

   (ii) Carry out odour sampling from exposed sediment surface at 19 designated locations at Shenzhen River during low-ebb tide period. If exposed sediment surface is not found near the designated locations, the sampling work shall be omitted.

   (iii) Carry out ambient air sampling from reedbed area at 19 designated locations at Shenzhen River during low/ebb tide period.

   (iv) Carry out ambient air sampling from the area near the reedbed at 19 designated locations at Shenzhen River during low-ebb tide period.

   (v) Carry out olfactometry analysis for all collected odour samples from water surface and exposed sediment surface, and ambient air samples from reedbed area and the area near the reedbed according to EN13725.

   (vi) Carry out hedonic tone test for collected ambient air samples from the reedbed area and area near the reedbed.

3. The odour survey activities shall only be undertaken in hot days, i.e. ambient temperature greater than 30 °C, and ebb tide/low tide period. No odour sampling shall be conducted in rainy day (If there is 0.5mm or more rainfall as recorded in Hong Kong Observatory in the area along Shenzhen River during the period between 12a.m. of the sampling day and before the sampling works, it is considered as rainy day) or the sampling day in previous 24 hours with black rainstorm warning unless approval is given by the Engineer.

4. The collected odour samples from water surface and exposed sediment surface, as well as the ambient air samples shall be delivered to the designed laboratory for olfactometry analysis within 8 hours. The Contractor shall allow for delivery of samples at least twice per day, should the sampling time be longer than 8 hours.

5. In order to capture more representative results, all measurements and sampling shall be conducted during low/ebb tide with reference to the predicted tides at Tsim Bei Tsui by Hong Kong Observatory.

6. Based on the above, the odour survey works at Shenzhen River were conducted on 14th, 15th, 17th, 18th, 20th, 21st, 25th, 26th, 27th and 28th August 2020.

1. INTRODUCTION

Background

1.1 In accordance with Annex B of PS for Odour Survey at Shenzhen River, odour survey at Shenzhen River comprising odour sampling from water surface and exposed sediment surface; ambient air sampling from reedbed area and the area near the reedbed; olfactometry analysis for all odour samples and hedonic tone tests for ambient air samples from the reedbed area and area near the reedbed.

1.2 Wellab Limited (WELLAB) was commissioned by Concentric Construction Limited (the Contractor) to undertake the odour survey at Shenzhen River under SI No. 009 according to Annex B of PS for the Contract.

1.3 According to the PS, Section 1.11, a Draft Report shall be submitted to Client's Representative within 2 weeks after the completion of odour survey. This is the Additional Odour Survey Report summarizing the odour survey works for the Contract conducted in August 2020.

2. ODOUR SAMPLING METHODOLOGY

2.1 The CVs of Odour Team Leader and On-site Odour Sampling Supervisor are provided in List of Curriculum Vitae (**Appendix A**).

2.2 The On-site Odour Sampling Supervisor lead the team members to conduct the odour sampling exercise including odour sampling from water surface / exposed sediment surface and ambient air sampling in August 2020 as follows:

<u>Odour Sampling from Water Surface and Exposed Sediment Surface</u>

- A wind tunnel system as a "hood" was employed in the sampling work (**Photo 1**). The wind tunnel covered the odour emitting surface.
- The wind tunnel was placed onto odour emitting surface on the designated locations.
- An odour-free gas from a nitrogen gas cylinder was supplied to generate an air inflow at a fixed velocity inside the hood. The inflow rate with speed of 0.01m/s was adopted during sampling. A flow meter has been installed at the nitrogen gas cylinder to ensure the wind tunnel was operated at 0.01 m/s (**Photo 2**). The certificate of the flow meter is shown in **Appendix B.**
- Purging of the wind tunnel and the connected tubing was conducted with odour-free nitrogen gas. At least 3 times the wind tunnel volume of gas was allowed to purge the equipment before connecting to the sampling bag.
- The exhaust of the wind tunnel was connected via tubing to sampling bag, which is placed inside a sampler (**Photo 3**). With the sampler gradually drawn to vacuum, gas (odour) sample was collected by the sampling bag.
- Sufficient volume of gas sample was collected at the selected sampling locations for the olfactometry analysis at laboratory.
- Before sampling at each location, the wind tunnel was cleaned to avoid potential contamination of the sampling instruments during sampling in previous location.


Photo 1 – Wind Tunnel System


Photo 2 – Flow Meter

 Photo 3 – Vacuum Sampler	

Ambient Air Sampling from Reedbed and the Area near Reedbed

- Ambient air sampling from reedbed and the area near reedbed for the same sampling location (e.g. AA-101 and RAA-101) was conducted within the same day.
- The engine of motor vehicle/ship involved in sampling works was turned off for 10 minutes prior to below sampling works.
- A tubing was used for ambient air sampling.
- One end of the tubing was placed within reedbed area or the area near reedbed.
- The tubing was purged with ambient air for at least 3-minute at the sampling location before connecting the sampling bag.
- The other end of the tubing was connected to a sampling bag, which was placed inside a sampler (Photo 3). With the sampler gradually drawn to vacuum, gas (odour) sample was collected by the sampling bag.
- Sufficient volume of gas sample (not less than 60L per sample) was collected at the selected sampling locations for the Hedonic Tone test and olfactometry analysis at laboratory. The gas sample at each selected sampling location was collected into a maximum of 2 nos. separate sample bags.
- The vehicle/ship engine was then turned on for transportation to the next sampling location.

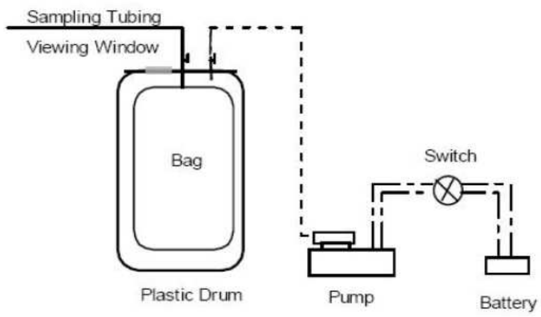


Photo 3 – Vacuum Sampler

2.3 All "wetted" parts exposed to the odorous gas sample is composed of stainless steel and Teflon tubing. Sampling bag was pre-conditioned, that is to part fill the bag with the odorous sample and then empty it prior to filling for odour testing. The sample bags are manufactured from PTFE, Tedlar if the bags to be reused or from nalophane NATM if the sample bags are to be discarded after use.

2.4 The odour samples would not be contaminated, lost, or altered during storage. In this regard, the odour bags are:

- Odour-free, i.e. they will not add odours to the sample;
- Made of materials which does not absorb or react with odorous samples;
- Sufficiently impervious to prevent any significant loss of odour components;
- Reasonably robust;
- Leak-free;
- Equipped with leak-free fittings, compatible with olfactometer and other sampling equipment; and
- Of sufficient capacity to enable the completion of the tests.

2.5 Exposure of samples to direct sunlight was avoided to minimize photochemical reactions.

Sampling Locations

2.6 Odour survey shall be conducted at the locations summarized in **Table 2.1** and shown on **Drawing no. 1**. The exact locations have been determined on site and agreed by the Engineer.

Table 2.1 Summary of Odour Survey Locations

Location of Sampling	No. of Sampling Location	Sampling Method
Water surface at Shenzhen River	38	Wind Tunnel System
Exposed sediment surface at Shenzhen River	19	
Reedbed area at Shenzhen River	19	Ambient Air Sampling
Area near reedbed at Shenzhen River	19	

2.7 During the odour sampling period, no exposed sediment surface was observed at SED101 to 105, 107, 109, 110, 115 and 116. Therefore, no odour sampling at exposed sediment surface was conducted at these locations.

Monitoring Parameters and Laboratory Testing

2.8 **Table 2.2** summarizes the monitoring parameters and laboratory testing of the odour survey at each of the measurement locations.

Table 2.2 Odour Survey In-Situ Parameters and Laboratory Testing

<table>
<tr><th>Location of Sampling</th><th>In-Situ Parameters, unit</th><th>On-site Records</th><th>Laboratory Testing</th></tr>
<tr><td>Water surface at Shenzhen River</td><td>• Ambient Air Temperature (°C)
• H_2S measured by a portable H_2S analyzer (Jerome J605)
• Water Temperature (°C) at depth 1m above river bed
• Water depth (m)
• Salinity (parts per thousand) at depth 1m above river bed
• Redox Potential (mV) at depth 1m above river bed
• pH at depth 1m above river bed</td><td rowspan="4">• Photo on each of the sampling location
• Meteorological conditions (including ambient temperature, wind speed, wind direction, relative humidity) from the nearest Hong Kong Observatory’s Weather Station including during the monitoring period; and
• Any odour detected during sampling and the flavors of odour with detail description of characteristics (e.g. sewage or rotten-egg smell, decayed vegetables, ammonical, dischargeable odour, putrefaction, sharp, pungent, fish, irritating, fruit, vinegar, etc);
• Duration of odour (intermittent or continuous) during sampling;
• Wind direction and tidal conditions during sampling; and
• Whether any abnormal observation, namely any odour generating activities observed at adjacent areas during the monitoring.</td><td rowspan="2">Olfactometry Analysis only</td></tr>
<tr><td>Exposed sediment surface at Shenzhen River</td><td>• Ambient Air Temperature (°C)
• H_2S measured by a portable H_2S analyzer (Jerome J605)
• Redox Potential (mV) at the exposed sediment
• pH of the exposed sediment</td></tr>
<tr><td>Reedbed area at Shenzhen River</td><td>• Ambient Air Temperature (°C)
• H_2S measured by a portable H_2S analyzer (Jerome J605)</td><td rowspan="2">Olfactometry Analysis and Hedonic Tone Test</td></tr>
<tr><td>Area near reedbed at Shenzhen River</td><td>• Ambient Air Temperature (°C)
• H_2S measured by a portable H_2S analyzer (Jerome J605)</td></tr>
</table>

Monitoring Equipment

Multi-parameter Measuring Equipment

2.9 The instrument for measuring temperature, pH value and salinity is portable and weatherproof complete with cable, sensor, comprehensive operation manuals and use DC power source. It is capable of measuring:

- a temperature of 0-45 degree Celsius;
- 0 to 14 pH value; and
- 0-40 ppt

2.10 It has a membrane electrode with automatic temperature compensation complete with a cable.

2.11 Sufficient stocks of spare electrodes and cables are available for replacement where necessary.

2.12 Standard buffer solutions of at least pH 7 and pH 10 were used for calibration of the instrument before and after use.

Water Depth Detector

2.13 A portable, battery-operated echo sounder was used for the determination of water depth at each designated monitoring station.

Oxidation-reduction potential (ORP) or Redox Measuring Equipment

2.14 The instrument for measuring ORP is portable and weatherproof complete with cable, sensor, comprehensive operation manuals and use DC power source. It is capable of measuring:

- ± 2000mV

Thermo-Anemometer

2.15 The meter capable of measuring air temperature with a combination of a variety of functions such as series of instrumentation.

Position System

2.16 A hand-held digital Global Positioning System (GPS) was used during water quality monitoring to ensure the monitoring vessel is at the correct location before taking measurements.

H_2S Analysis

2.17 The concentration of H_2S is detected on site using Jerome J605 Hydrogen Sulfide Analyzer. The concentration unit is ppb. The detection limit is 3 ppb.

Calibration of In Situ Instruments

2.18 All *in situ* monitoring instruments were checked, calibrated and certified by a laboratory accredited under HOKLAS or other international accreditation scheme before use.

2.19 For the on site calibration of field equipment, the BS 1427:2009, "Guide to Field and on-site test methods for the analysis of waters" was observed.

2.20 Sufficient stocks of spare parts were maintained for replacements when necessary. Backup monitoring equipment was also made available so that monitoring can proceed uninterrupted even when some equipment is under maintenance, calibration, etc.

2.21 **Table 2.3** summarizes the equipment used in the odour survey. Copies of the calibration certificates of the major monitoring equipment (i.e. multi-parameter water quality system, ORP meter, H_2S analyzer) are shown in **Appendix B** and the specifications of odour sampling equipment including wind tunnel, vacuum sampler, vacuum pump, PTFE tubing and PTFE / nalophane NATM sampling bags are shown in **Appendix C**.

Table 2.3 Odour Survey Equipment

Equipment	**Model and Make**	**Qty.**
Multi-parameter Water Quality System	YSI EXO 1	2
Sonar Water Depth Detector	Garmin Striker plus 4	2
ORP Meter	Aquaread AP-2000	2
Thermo-Anemometer	Smart Sensor AR836	2
Monitoring Position Equipment	Garmin Striker plus 4	2
Hydrogen Sulfide Analyzer	Jerome J605	1

QA/QC Requirements

Decontamination Procedures

2.22 Water and sediment sampling equipment were thoroughly washed in clean water prior to each sampling attempt. All disposal equipment was discarded after sampling.

Laboratory Testing

Olfactometry Analysis

2.23 The collected odour samples from water surface / exposed sediment surface and ambient air samples were delivered to the Wellab for olfactometry analysis within 24 hours after collection.

2.24 The odour laboratory is ventilated to maintain an odour-free environment and to provide fresh air to the panel members (**Table 2.4**). Monitoring of environmental condition was performed during the odour testing. Monitoring data was recorded in the Odour Lab daily log.

Table 2.4 Overview Photos of Odour Laboratory

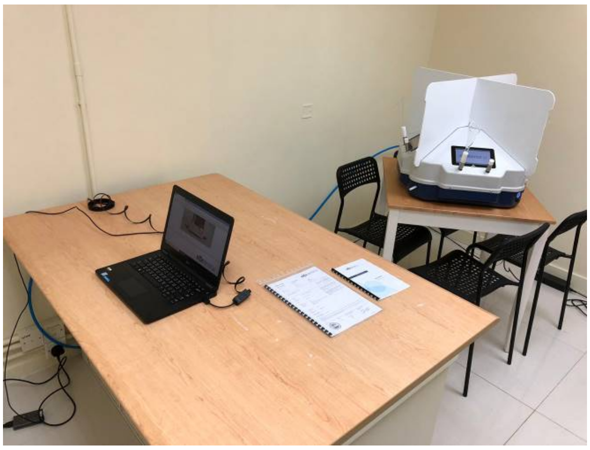
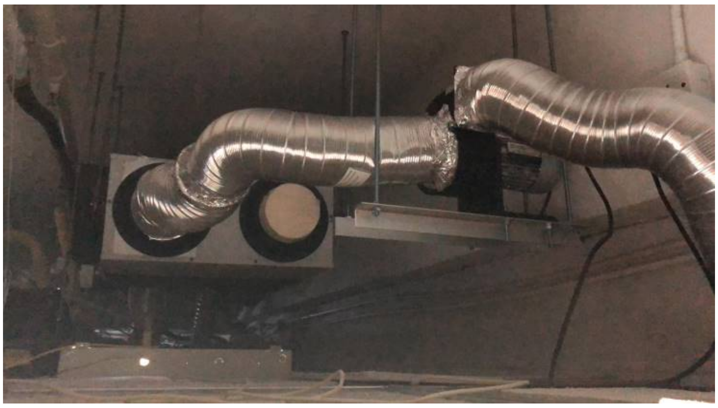
	

Photo 1 - Dedicated Odour Laboratory equipped with a forced-choice dynamic olfactometer	Photo 2 – Ventilation system equipped with activated carbon filter to ventilate and maintain a controlled and odour-free environment

2.25 Each odour testing session comprises at least five qualified panelists. All of the panelists participated in a set of screening tests using a certified n-butanol gas with their individual thresholds (n-butanol) complied with the requirement of EN13725 in the range of 20 to 80 ppb with a R value of <2.3 within 2 weeks before commencement of the odour sampling. The odour panelists calibrated their noses bi-weekly during the measurement period.

2.26 The odour panelists have possess adequate experience in olfactometry analysis for at least three odour sampling projects or completed the Olfactometry Analysis Training for Panelist provided by professional specialist on olfactometry analysis and meet the following minimum requirements:

- Be at least 18 years of age and have experience in olfactometry analysis for at least three odour sampling projects;
- Be free from any respiratory illnesses and do not normally work at the shoreline of Shenzhen River;
- Not be allowed to smoke, eat, drink (except water) or use chewing gum or sweets 30 minutes before and during olfactometry analysis;
- Take great care not to cause any interference with their own perception or that of others by lack of personal hygiene or the use of perfumes, deodorants, body lotions or cosmetics;
- Not communicate with each other about the results of their choices; and
- Need to calibrate their noses bi-weekly during the measurement period.

2.27 The CVs and / or training certificates of panelists are provided in **Appendix A**.

2.28 The odour concentration of the collected air samples were determined by a forced-choice dynamic olfactometer (TO9) with a panel of human assessors being the sensor in accordance with the European Standard Method: *Air Quality – Determination of Odour Concentration by Dynamic Olfactometry* (EN13725) within 24 hours after collection. 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: OUE/m^3. The odour concentration is measured by determining the dilution factor required to reach the detection threshold.

Olfactometer TO9evo

2.29 Copies of the calibration certificates of the olfactometer TO9evo is shown in **Appendix B**.

Specific Odour Emission Rate

2.30 A wind tunnel system as a "hood" was 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:

$$\text{SOER (ou/m2 /s)} = \frac{\text{Odour concentration (ou/m}^3\text{) x Air flow rate inside hood (m}^3\text{ /s)}}{\text{Covered water surface area (m}^2\text{)}}$$

Where air flow rate inside hood = 0.01m/s (Flow velocity) x 0.228 m (H) x 0.33 m (W) = 0.00075m^3/s, and covered surface area = 0.862 m (L) x 0.277 (W) = 0.24m^2

Hedonic Tone Test

2.31 Hedonic tone test was conducted for the collected air samples from reedbed area and the area near reedbed according to modified standard of VDI 3882-2 : 1994 (Olfactometry – Determination of Hedonic Odour Tone) and Annex B of PS.

2.32 Hedonic tone is a category for judging the relative likeness or dislikeness of the odour to screen the "annoyance" odour. The test was conducted by a team of 5 odour panel assessors, who are asked to indicate perceived hedonic tone at each presentation, as a value from the three-point hedonic tone scale listed below. A mean value of such scale was obtained from all 5 members for each gas sample. In this scale, only mean values lower than 0 is considered as "annoying/objectionable". **Table 2.5** summarizes the Hedonic Tone Test scale and its observations.

Table 2.5 The Hedonic Tone Test Scale and its Observations

Scale	Observation
0	Neutral/inoffensive odour or no odour
-2	Moderately unpleasant or unpleasant
-4	Offensive

QA/QC Requirements

2.33 During each odour sampling day, one blank sample was collected for quality control. The sample will be taken by purging pure nitrogen gas into odour bag directly on site as a blank sample.

2.34 The olfactometry analysis was conducted by laboratory (Wellab) complying with the European Standard EN13725:2003.

3. RESULTS AND OBSERVATIONS

3.1 The odour survey was conducted on 14th, 15th, 17th, 18th, 20th, 21st, 25th, 26th, 27th and 28th August 2020 and the odour survey schedule is provided in **Appendix D**. The odour survey works was conducted during the period of ebb tide / low tide and in hot days, i.e. ambient temperature greater than 30°C. In addition, no odour sampling was conducted in rainy day or the sampling day in previous 24 hours with black rainstorm warning.

3.2 Some of the sampling location could not be reached. As agreed by the Engineer on site, odour sampling was conducted at the alternative locations which are the most representative to the original location at that region accordingly. The coordinates of the alternative locations were recorded as shown in **Appendix E** for reference.

3.3 During the odour sampling period, no exposed sediment surface was observed at SED101 to 105, 107, 109, 110, 115 and 116. Therefore, no odour sampling at exposed sediment surface was conducted at the aforesaid locations.

3.4 The *in-situ* measurement results including water and ambient temperature, water depth, salinity, pH, redox potential and the results of H_2S measurement are presented in **Appendix E.**

3.5 The odour nature, duration of odour and possible sources, wind direction and tidal condition which recorded at each of measurement locations are also provided in **Appendix E.**

3.6 All olfactometry measurement results and Hedonic tone test results are presented in **Appendix F** and summarized in **Table 3.1 to 3.5**.

Table 3.1 Summary of Olfactometry Measurement Results from Water Surface (Hong Kong)

Sample ID	Odour Concentration (ou/m^3)	SOER (ou/m2/s)	Hedonic Tone Scale (Average)
WHK-101	17.22	0.054	N/A
WHK-102	<5	<0.016	N/A
WHK-103	<5	<0.016	N/A
WHK-104	<5	<0.016	N/A
WHK-105	<5	<0.016	N/A
WHK-106	5.85	0.018	N/A
WHK-107	12.18	0.038	N/A
WHK-108	<5	<0.016	N/A
WHK-109	17.22	0.054	N/A

Sample ID	Odour Concentration (ou/m^3)	SOER (ou/m2/s)	Hedonic Tone Scale (Average)
WHK-110	36.41	0.115	N/A
WHK-111	<5	<0.016	N/A
WHK-112	8.46	0.027	N/A
WHK-113	15.79	0.050	N/A
WHK-114	17.22	0.054	N/A
WHK-115	17.22	0.054	N/A
WHK-116	5.85	0.018	N/A
WHK-117	7.72	0.024	N/A
WHK-118	5.85	0.018	N/A
WHK-119	7.72	0.024	N/A

Table 3.2 Summary of Olfactometry Measurement Results from Water Surface (Shenzhen)

Sample ID	Odour Concentration (ou/m^3)	SOER (ou/m2/s)	Hedonic Tone Scale (Average)
WSZ-101	13.23	0.042	N/A
WSZ-102	17.22	0.054	N/A
WSZ-103	25.02	0.079	N/A
WSZ-104	25.02	0.079	N/A
WSZ-105	36.41	0.115	N/A
WSZ-106	12.18	0.038	N/A
WSZ-107	25.02	0.079	N/A
WSZ-108	22.79	0.072	N/A
WSZ-109	17.22	0.054	N/A
WSZ-110	25.02	0.079	N/A
WSZ-111	5.85	0.018	N/A
WSZ-112	8.47	0.027	N/A
WSZ-113	5.85	0.018	N/A
WSZ-114	15.79	0.050	N/A
WSZ-115	<5	<0.016	N/A

Sample ID	Odour Concentration (ou/m^3)	SOER (ou/m2/s)	Hedonic Tone Scale (Average)
WSZ-116	<5	<0.016	N/A
WSZ-117	<5	<0.016	N/A
WSZ-118	<5	<0.016	N/A
WSZ-119	12.18	0.038	N/A

Table 3.3 Summary of Olfactometry Measurement Results from Exposed Sediment Surface

Sample ID	Odour Concentration (ou/m^3)	SOER (ou/m2/s)	Hedonic Tone Scale (Average)
SED-106	76.59	0.241	N/A
SED-108	36.41	0.115	N/A
SED-111	15.79	0.050	N/A
SED-112	17.22	0.054	N/A
SED-113	12.18	0.038	N/A
SED-114	17.22	0.054	N/A
SED-117	12.18	0.038	N/A
SED-118	12.18	0.038	N/A
SED-119	7.72	0.024	N/A

Table 3.4 Summary of Olfactometry Measurement Results and Hedonic Tone Test Results from Area near Reedbed

Sample ID	Odour Concentration (ou/m^3)	SOER (ou/m2/s)	Hedonic Tone Scale (Average)
AA-101	17.22	N/A	0
AA-102	17.22	N/A	0
AA-103	17.22	N/A	0
AA-104	15.79	N/A	0
AA-105	17.22	N/A	0

Sample ID	Odour Concentration (ou/m^3)	SOER (ou/m2/s)	Hedonic Tone Scale (Average)
AA-106	12.18	N/A	0
AA-107	9.28	N/A	0
AA-108	17.22	N/A	0
AA-109	17.22	N/A	0
AA-110	17.22	N/A	0
AA-111	9.28	N/A	0
AA-112	7.72	N/A	0
AA-113	36.41	N/A	0
AA-114	17.22	N/A	0
AA-115	8.47	N/A	0
AA-116	11.12	N/A	0
AA-117	33.15	N/A	-2
AA-118	36.41	N/A	0
AA-119	12.18	N/A	-2

Table 3.5 Summary of Olfactometry Measurement Results and Hedonic Tone Test Results from Reedbed Area

Sample ID	Odour Concentration (ou/m^3)	SOER (ou/m2/s)	Hedonic Tone Scale (Average)
RAA-101	<5	N/A	0
RAA-102	<5	N/A	0
RAA-103	<5	N/A	0
RAA-104	15.79	N/A	0
RAA-105	11.12	N/A	0
RAA-106	13.28	N/A	0
RAA-107	25.02	N/A	0
RAA-108	17.22	N/A	0
RAA-109	17.22	N/A	0
RAA-110	17.22	N/A	0

Sample ID	**Odour Concentration (ou/m^3)**	**SOER (ou/m2/s)**	**Hedonic Tone Scale (Average)**
RAA-111	9.28	N/A	0
RAA-112	12.18	N/A	0
RAA-113	17.22	N/A	0
RAA-114	17.22	N/A	0
RAA-115	12.18	N/A	0
RAA-116	11.12	N/A	0
RAA-117	221.65	N/A	0
RAA-118	17.22	N/A	0
RAA-119	17.22	N/A	-2

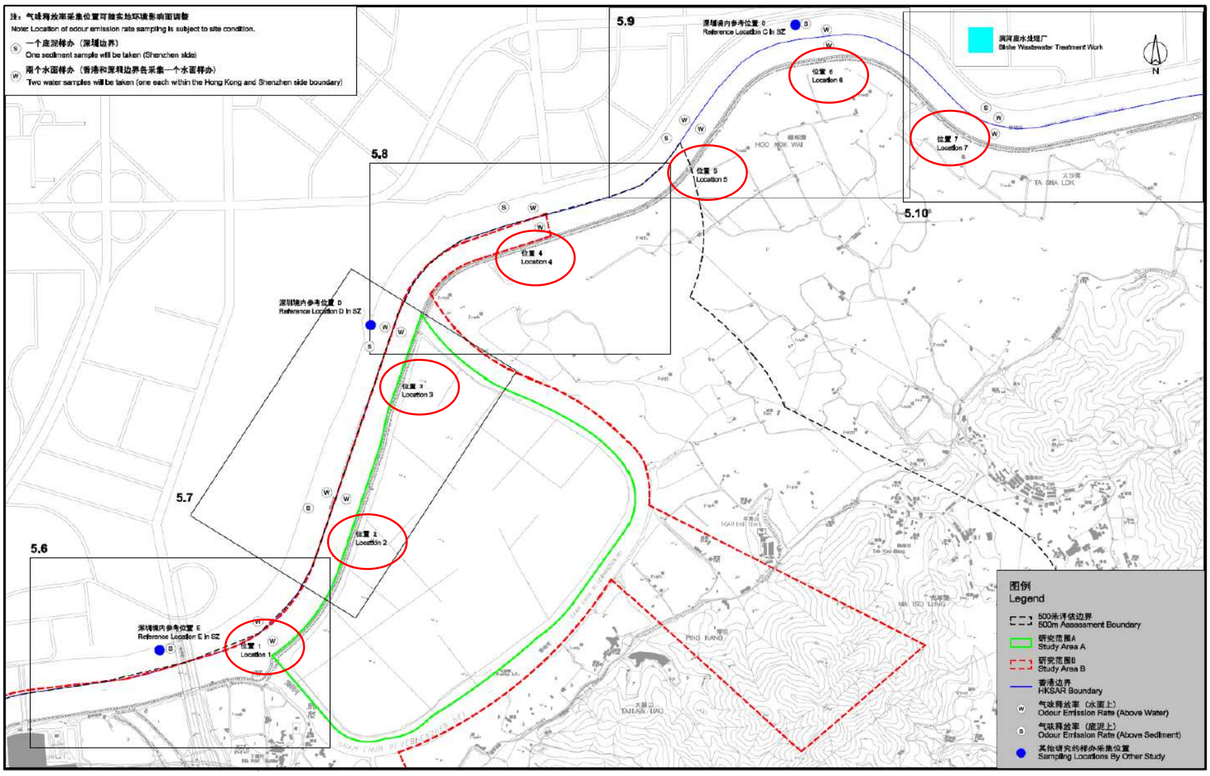
3.7 The relevant meteorological data including ambient temperature, wind speed and wind direction from the Hong Kong Observatory Station during the measurement/sampling period are provided in **Appendix G**.

3.8 The photographs for field works at each of the sampling location are shown in **Appendix H.**

4. INTERPRETATION OF ODOUR MONITORING RESULTS

4.1 According to the Measurement Reports for Odour Sampling at Shenzhen River (PolyU) in Appendix 3-9 of Environmental Impact Assessment (EIA) Report for Development of Lok Ma Chua Loop, an odour assessment service comprising the odour sampling from the 7 sampling locations on water surface of Shenzhen River at Lok Ma Chau Loop using a wind tunnel method was conducted on 6th August 2010.

4.2 A total of 7 odour samples were collected for olfactometry analysis. The sampling location plan was extracted from the above measurement report as shown below:-



4.3 The summary of specific odour emission rates from water surface at the 7 sampling locations are presented in **Table 4.1**

Table 4.1 Summary of Odour Survey Results in 2010

Sample ID	Location coordinate		Date	Time	AT (°C)	RH (%)	WS (m/s)	WD	WT (°C)	WD (m)	OC (ou/m³)	SOER (ou/m²/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

4.4 The comparison of odour concentration and odour emission rates (SOER) derived from the odour concentration between the collected samples at each measurement location in 2010 (EIA stage) and approximate locations conducted in 2020 (Contract No. YL/2018/03) are presented in **Table 4.2**.

Table 4.2 Comparison of OC and SOER for Odour Samples between 2010 (EIA) and 2020 (YL/2018/03)

Location		OC (ou/m^3)		Difference (+/-)	SOER (ou/m2/s)		Difference (+/-)
2010	2020	2010	2020		2010	2020	
HK-W-1	WSZ-110	200	25.02	174.98	0.58	0.079	0.501
	WHK-110		36.41	163.59		0.115	0.465
HK-W-2	WSZ-109	88	17.22	70.78	0.25	0.054	0.196
	WHK-109		17.22	70.78		0.054	0.196
HK-W-3	WSZ-108	84	22.79	61.21	0.24	0.072	0.178
	WHK-108		<5	79		<0.016	0.234
HK-W-4	WSZ-107	72	25.02	46.98	0.21	0.079	0.131
	WHK-107		12.18	59.82		0.038	0.172
HK-W-5	WSZ-106	98	12.18	85.82	0.28	0.038	0.242
	WHK-106		5.85	92.15		0.018	0.262
HK-W-6	WSZ-105	104	36.41	67.59	0.30	0.115	0.185
	WHK-105		<5	99		<0.016	0.284
HK-W-7	WSZ-104	257	25.02	231.98	0.74	0.079	0.661
	WHK-104		<5	252		<0.016	0.724

Remarks: 1) For the results below the reporting limit, the results will be taken as the reporting limit of the corresponding parameters for calculation.
2) + mean the olfactometry analysis results in 2010 is higher than that in 2020
- mean the olfactometry analysis results in 2010 is lower than that in 2020

4.5 Based on the results in **Table 4.2**, the odour emission rates (SOER) derived from the odour concentration of collected samples from Shenzhen River in 2020 (Contract No. YL/2018/03) are lower than that the odour samples collected in 2010 (i.e. the quantity (mass) of odour emitted per unit time from a unit surface area reduced). The odour concentration was also significantly decreased at the survey area in 2020.

5. CONCLUSION

5.1 Odour survey at Shenzhen River under SI No. 009 were performed on 14th, 15th, 17th, 18th, 20th, 21st, 25th, 26th, 27th, and 28th August 2020 and all monitoring results were checked and reviewed.

5.2 All odour survey was completed in August 2020 in accordance with Annex B of PS under Contract No. YL/2018/03.

5.3 In compare with the odour assessment results conducted in August 2010 during EIA Stage for Development of Lok Ma Chau Loop, the odour survey results in 2020 show improvement to the monitoring results conducted in 2010 in general.

DRAWING

SETTING OUT POINTS		
POINTS	EASTING	NORTHING
WSZ-101	829284.742	843494.949
WSZ-102	828965.121	843848.876
WSZ-103	828479.879	843883.840
WSZ-104	828005.714	843821.613
WSZ-105	827444.269	844120.346
WSZ-106	827030.124	843847.635
WSZ-107	826508.045	843508.591
WSZ-108	826048.133	843154.931
WSZ-109	825855.792	842573.040
WSZ-110	825602.320	842112.294
WSZ-111	825136.222	841947.376
WSZ-112	824665.341	841843.567
WSZ-113	824261.889	841545.313
WSZ-114	823995.968	841140.391
WSZ-115	823938.698	840641.513
WSZ-116	823560.223	840343.163
WSZ-117	823061.819	840345.103
WSZ-118	822592.801	840510.498
WSZ-119	822111.304	840624.944

SETTING OUT POINTS		
POINTS	EASTING	NORTHING
WHK-101	829297.544	843467.395
WHK-102	828985.259	843827.791
WHK-103	828508.300	843880.826
WHK-104	828016.686	843794.176
WHK-105	827464.636	844100.466
WHK-106	827045.866	843816.735
WHK-107	826507.956	843486.305
WHK-108	826061.285	843131.064
WHK-109	825879.805	842569.904
WHK-110	825626.983	842121.813
WHK-111	825167.231	841939.252
WHK-112	824694.419	841831.960
WHK-113	824207.207	841544.416
WHK-114	824002.794	841099.761
WHK-115	823958.813	840612.851
WHK-116	823577.765	840307.832
WHK-117	823077.924	840320.447
WHK-118	822617.150	840492.995
WHK-119	822132.456	840615.761

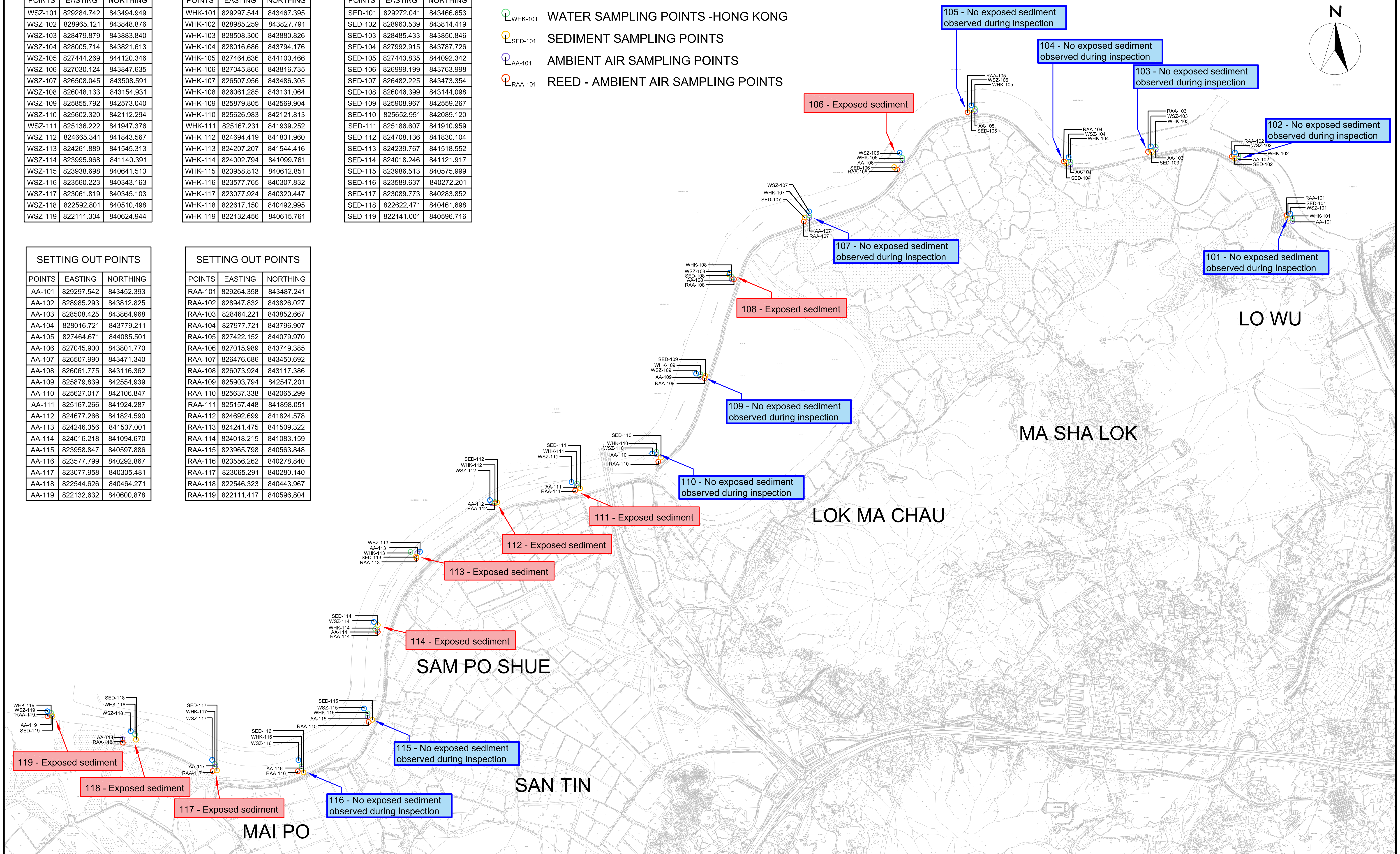
SETTING OUT POINTS		
POINTS	EASTING	NORTHING
SED-101	829272.041	843466.653
SED-102	828963.539	843814.419
SED-103	828485.433	843850.846
SED-104	827992.915	843787.726
SED-105	827443.835	844092.342
SED-106	826999.199	843763.998
SED-107	826482.225	843473.354
SED-108	826046.399	843144.098
SED-109	825908.967	842559.267
SED-110	825652.951	842089.120
SED-111	825186.607	841910.959
SED-112	824708.136	841830.104
SED-113	824239.767	841518.552
SED-114	824018.246	841121.917
SED-115	823986.513	840575.999
SED-116	823589.637	840272.201
SED-117	823089.773	840283.852
SED-118	822622.471	840461.698
SED-119	822141.001	840596.716

LEGEND:

- WSZ-101 WATER SAMPLING POINTS -SHENZHEN
- WHK-101 WATER SAMPLING POINTS -HONG KONG
- SED-101 SEDIMENT SAMPLING POINTS
- AA-101 AMBIENT AIR SAMPLING POINTS
- RAA-101 REED - AMBIENT AIR SAMPLING POINTS

SETTING OUT POINTS		
POINTS	EASTING	NORTHING
AA-101	829297.542	843452.393
AA-102	828985.293	843812.825
AA-103	828508.425	843864.968
AA-104	828016.721	843779.211
AA-105	827464.671	844085.501
AA-106	827045.900	843801.770
AA-107	826507.990	843471.340
AA-108	826061.775	843116.362
AA-109	825879.839	842554.939
AA-110	825627.017	842106.847
AA-111	825167.266	841924.287
AA-112	824677.266	841824.590
AA-113	824246.356	841537.001
AA-114	824016.218	841094.670
AA-115	823958.847	840597.886
AA-116	823577.799	840292.867
AA-117	823077.958	840305.481
AA-118	822544.626	840464.271
AA-119	822132.632	840600.878

SETTING OUT POINTS		
POINTS	EASTING	NORTHING
RAA-101	829264.358	843487.241
RAA-102	828947.832	843826.027
RAA-103	828464.221	843852.667
RAA-104	827977.721	843796.907
RAA-105	827422.152	844079.970
RAA-106	827015.989	843749.385
RAA-107	826476.686	843450.692
RAA-108	826073.924	843117.386
RAA-109	825903.794	842547.201
RAA-110	825637.338	842065.299
RAA-111	825157.448	841898.051
RAA-112	824692.699	841824.578
RAA-113	824241.475	841509.322
RAA-114	824018.215	841083.159
RAA-115	823965.798	840563.848
RAA-116	823556.262	840278.840
RAA-117	823065.291	840280.140
RAA-118	822546.323	840443.967
RAA-119	822111.417	840596.804



WELLAB 匯力
consulting . testing . research

Contract No. YL/2018/03
Development of Lok Ma Chau Loop: Main Works Package 1 -
Special Site Investigation Works (In-situ Trial of Sediment Treatment Works in Shenzhen River) and Laboratory Testing

Additional Odour Survey Report at Shenzhen River

SCALE	1:50000@A3	DATE	AUG 2020
CHECK	HC	DRAWN	NL
Project No.	WMS19015	DRAWING No. 1	REV -

APPENDIX A
LIST OF CURRICULUM VITAE AND TRAINING CERTIFICATE

NAME: TAM YUEN CHI (IVY)
PROPOSED POSITION: ODOUR MONITORING TEAM LEADER

COMPANY	WELLAB LIMITED
POSITION	ASSOCIATE
PROFESSION	ENVIRONMENTAL MANAGEMENT
NATIONALITY	CHINESE

PROFESSIONAL QUALIFICATIONS & AFFILIATIONS

- Bachelor of Science in Environmental Studies, The Open University of Hong Kong, 2012.
- Higher Diploma in Environmental Protection and Management, Hong Kong Institute Vocational Education, 2007.
- Member, Hong Kong Institute of Environmental Impact Assessment, 2014
- Member, Hong Kong Waste Management Association, 2014
- Member, Hong Kong Institute of Acoustics, 2019
- Associate Member, BEAM Society Limited, 2019
- BEAM Professional, 2019

KEY EXPERIENCE

Ivy has over 12 years of extensive experience in Environmental Monitoring and Audit (EM&A), odour monitoring, sediment quality assessment, land contamination assessment, environmental testing and water quality analysis. In the past 12 years, she has undertaken and joined in numerous odour survey and odour monitoring-related consultancy projects, sediment quality and water quality assessment projects. She is the Environmental Team Leader for projects including SPW09/2018 Baseline Surveys for Shatin Cavern Sewage Treatment Works and Contract No. DE/2017/01 Upgrading of Kwun Tong Preliminary Treatment Works Supply Contract No. EM003. Furthermore, she is currently the Project Supervisor of all environmental audit and monitoring projects in the company. Apart from the coordinating role, she undertakes site audit, meeting with site personnel, providing mitigation measures and preparation of audit reports. On many occasions, she represents clients in attending meetings with District Councilors and Green Group representatives.

PROFESSIONAL HISTORY

2019 – Present	Associate, WELLAB Limited
2013 – 2018	Principal Environmental Consultant, Cinotech Consultants Limited
2011 – 2013	Senior Environmental Consultant, Cinotech Consultants Limited
2009 – 2011	Environmental Consultant, Cinotech Consultants Limited
2007 – 2009	Assistant Environmental Consultant, Cinotech Consultants Limited

PROFESSIONAL EXPERIENCE

Odour Survey and Odour Monitoring-related Consultancy Projects

Responsible for managing and coordinating the odour monitoring team and monitoring the progress of the odour monitoring (including H_2S measurement and odour patrol works).

Analyzing and auditing of odour monitoring data. Preparation of odour monitoring report and liaison with Authorities to obtain approval of the report for the following projects (partial list):

Project Title	**Clients**	**Period of Involvement**	
		From	**To**
Contract No. KLN/2009/10 Odour, Sediment and Water Quality Monitoring Works for Improvement Works at Kai Tak Approach Channel (KTAC) and Kwun Tong Typhoon Shelter (KTTS)	Civil Engineering and Development Department	2009	2012
Contract No. KL/2010/02 Kai Tak Development – Kai Tak Approach Channel and Kwun Tong Typhoon Shelter Improvement Works (Phase 1)	Civil Engineering and Development Department via Penta-Ocean – Concentric – Alchmex Joint Venture	2011	2015
Contract No. KL/2014/09 Odour Survey at Kai Tak Nullah (KTN), Kai Tak Approach Channel (KTAC) and Kwun Tong Typhoon Shelter (KTTS)	Civil Engineering and Development Department	2014	2014
Contract No. KLN/2016/01 Water Quality Monitoring Works at Kai Tak Approach Channel (KTAC) and Kwun Tong Typhoon Shelter (KTTS)	Civil Engineering and Development Department	2016	2017
Contract No. DC/2007/23 HATS Stage 2A Construction of Sewage Conveyance System From North Point to Stonecutters Island	Drainage Service Department via Gammon Construction Limited	2015	2016
Contract No. DC/2009/23 HATS Stage 2A Upgrading of Preliminary Treatment Works at North Point, Wan Chai East and Central	Drainage Service Department via Leader and JEC Joint Venture	2011	2017
Contract No. DC/2009/24 HATS Stage 2A – Upgrading of Preliminary Treatment Works at Sandy Bay, Cyberport, Wah Fu, Aberdeen and Ap Lei Chau	Drainage Service Department via Leader and JEC Joint Venture	2011	Present

Sediment Quality Assessment

Responsible for the preparation of sediment sampling and testing plan and sediment quality report, and site supervision of the field works including sediment sampling. Liaison with Authorities to obtain approval of the report for the following projects (partial list):

1. Maintenance Dredging at Berth 8 of Terminal 6 and Berth 9 of Terminal 7
1. Maintenance Dredging at Terminals 1, 2 & 5
2. Sediment Quality Assessment at Kai Chung Container Terminal No.3
3. Maintenance Dredging at Kwai Chung Container Port Terminal 5
4. Environmental Consultant and Laboratory Testing for Sediment Management at HKBCF
5. Maintenance Contract for Seawalls and Navigation Channels (2017-2021)
6. Maintenance Dredging at Kwai Chung Container Port Terminal 6 Berth 7

7. Environmental Consultant and Laboratory Test for Sediment Management at Tung Chung Town
8. Maintenance Dredging at Kwai Chung Container Port Terminal 8 Berths 11, 12, 13 & 14 (Including Berth 10 Extension, X'wharf and Basin)
9. Maintenance Dredging Works at Terminal 6 & 7
10. Maintenance Dredging at Terminal 4 Berth 4 &6, T4 Crosswharf & Basin and Terminal 9 Berth 15 & 16
11. Maintenance Dredging at Terminal 6 Berth 7 (West) and Terminal 7 Berth 10
12. Maintenance Dredging along the Quayside of Kwai Chung Container Terminal No. 3

Environmental Monitoring and Audit

Responsible for coordinating the EM&A works, which includes weekly environmental site inspection, auditing of environmental monitoring data, providing mitigation measures and preparing monitoring reports for submission. In addition, she is also responsible for supervising the environmental team to carry out environmental monitoring for the following projects (partial list):

1. Contract No. YL/2017/03 – Development of Lok Ma Chau Loop: Land Decontamination and Advance Engineering Works – Design and Construction
2. Kai Tak Development - Stage 4 Infrastructure at Former North Apron Area
3. Kai Tak Development –Stage 3A Infrastructure at Former North Apron Area
4. Kai Tak Development - Stage 2 Infrastructure Works at North Apron Area
5. Kai Tak Development - Kai Tak Approach Channel and Kwun Tong Typhoon Shelter Improvement Works (Phase 1)
6. Kai Tak Development -Environmental Monitoring Works (Schedule 3 EIA)
7. Odour, Sediment and Water Quality Monitoring Works for Improvement Works at Kai Tak Approach Channel (KTAC) and Kwun Tong Typhoon Shelter (KTTS)
8. Kai Tak Development- Decommissioning of the Remaining Parts (Ex-GFS Building and Radar Station) of the Former Kai Tak Airport
9. Kai Tak Development- Decommissioning and Decontamination Works at The South Apron of the Former Kai Tak Airport
10. CEDD Maintenance Contract for Seawalls and Navigation Channels (2010 – 2013)
11. CEDD Maintenance of Seawalls and Navigation Channels (2007-2010)
12. CEDD Maintenance Dredging (2005-2008)
13. Hong Kong-Zhuhai-Macao Bridge Hong Kong - Baseline Environmental Monitoring
14. Hong Kong-Zhuhai-Macao Bridge Hong Kong Link Road – Section between HKSAR Boundary and Scenic Hill
15. Contract No. DE/2014/01 Provision of Electrical and Mechanical Facilities for Shek Wu Hui Sewage Treatment Works – Further Expansion Phase 1A – Advance Works and Ng Chow South Road Sewage Pumping Station
16. Contract No. DE/2017/01 Upgrading of Kwun Tong Preliminary Treatment Works Supply Contract No. EM003
17. Contract No. DC/2008/09 Harbour Area Treatment Scheme Stage 2A – Construction of Sewage Conveyance System from Ap Lei Chau to Aberdeen
18. Contract No. DC/2009/17 HATS Stage 2A – Upgrading Works at Stonecutters Island Sewage Treatment Works - Sludge Dewatering Facilities
19. Contract No. DC/2009/10 HATS Stage 2A – Upgrading Works at Stonecutters Island Treatment Works – Main Pumping Station, Sedimentation Tanks and Ancillary Facilities

20. Contract No. DC/2009/18 Upgrading Works at Stonecutters Island Sewage Treatment Works – Effluent Tunnel and Disinfection Facilities
21. Contract No. DC/2009/23 HATS Stage 2A – Upgrading of Preliminary Treatment Works at North Point, Wan Chai East and Central
22. Contract No. DC/2009/24 HATS Stage 2A – Upgrading of Preliminary Treatment Works at Sandy Bay, Cyberport, Wah Fu, Aberdeen and Ap Lei Chau
23. Construction of Tai Po Sewage Treatment Works Stage 5 Phase 2B
24. Supply and Installation of Electrical and Mechanical Equipment for Tai Po Sewage Treatment Works Stage 5 Phase 2B
25. Construction of Tai Po Sewage Treatment Works – Stage V Phase I
26. Supply and Installation of Electrical and Mechanical Equipment for Tai Po Sewage Treatment Works Stage V Phase I
27. Drainage Improvement in Northern Hong Kong Island - Western Lower Catchment Works
28. Deep Cement Mixing Trial Works (By Sing Rig and Multiple Rigs)
29. Design and Construction of Hong Kong West Drainage Tunnel
30. MTR Works Contract 1126 - Reprovisioning of Harbour Road Sports Centre and Wan Chai Swimming Pool
31. MTR Works Contract 1117 – Pat Heung Depot Modification Works
32. MTR Shatin to Central Link - Contract 1102 Hin Keng Station and Approach Structures
33. MTR Shatin to Central Link - Contract 1107 Diamond Hill to Kai Tak Tunnels
34. MTR Shatin to Central Link - Contract 1106 Diamond Hill Station
35. MTR Shatin to Central Link - Contract 1108A Kai Tak Barging Point Facilities
36. Sediment Removal at Yim Tin Tsai (East) Fish Culture Zone
37. Tin Wan Concrete Batching Plant
38. Tung Tau Estate Ph. 9
39. Foundation Works for HD's Project in Tuen Mun Area 18
40. Sheung Wan Stormwater Pumping Station Main Structure, E&M and Landscaping Works

NAME: TANG WING KWAI
PROPOSED POSITION: ON-SITE ODOUR SAMPLING SUPERVISOR

COMPANY	WELLAB LIMITED
POSITION	TECHNICAL MANAGER
PROFESSION	ENVIRONMENTAL TECHNICIAN
NATIONALITY	CHINESE

PROFESSIONAL QUALIFICATIONS & AFFILIATIONS

- Higher Certificate in Environmental Technology, Hong Kong Institute Vocational Education, 2006

PROFESSIONAL HISTORY

2019 – Present	Technical Manager, Wellab Limited
2016 – 2018	Technical Manager, Cinotech Consultants Ltd, Hong Kong
2010 – 2016	Principal Technical Officer, Cinotech Consultants Ltd, Hong Kong
2005 – 2010	Senior Technical Officer, Cinotech Consultants Ltd, Hong Kong
2003 – 2005	Technical Officer, Cinotech Consultants Ltd, Hong Kong
2002 – 2003	Assistant Technical Officer, Cinotech Consultants Ltd, Hong Kong

PROFESSIONAL EXPERIENCE AND RECORD

Odour Survey and Odour Monitoring-related Consultancy Projects

Responsible for carrying out the odour sampling from water surface using wind tunnel system for the following projects (partial list):

1. Contract No. KLN/2009/10 Odour, Sediment and Water Quality Monitoring Works for Improvement Works at Kai Tak Approach Channel (KTAC) and Kwun Tong Typhoon Shelter (KTTS)
2. Contract No. KL/2010/02 Kai Tak Development – Kai Tak Approach Channel and Kwun Tong Typhoon Shelter Improvement Works (Phase 1)
3. Contract No. KL/2014/09 Odour Survey at Kai Tak Nullah (KTN), Kai Tak Approach Channel (KTAC) and Kwun Tong Typhoon Shelter (KTTS)
4. Contract No. KLN/2016/01 Water Quality Monitoring Works at Kai Tak Approach Channel (KTAC) and Kwun Tong Typhoon Shelter (KTTS)

CERTIFICATE
OF COMPLETION

This certifies that

[MR. TANG WING KWAI]

has successfully completed the training course of

[Olfactometry Analysis for Panelists]

24 February 2020

Date

Signature

Professor H. Chua, Specialist in Olfactometry Analysis

CERTIFICATE OF COMPLETION

This certifies that

[MS. TANG MEI LING]

has successfully completed the training course of

[Olfactometry Analysis for Panelists]

24 February 2020
Date

Signature
Professor H. Chua, Specialist in Olfactometry Analysis

CERTIFICATE OF COMPLETION

This certifies that

[MR. LEE MAN HEI]

has successfully completed the training course of

[Olfactometry Analysis for Panelists]

24 February 2020
Date

Signature
Professor H. Chua, Specialist in Olfactometry Analysis

CERTIFICATE OF COMPLETION

This certifies that

[MR. HO KA CHUN]

has successfully completed the training course of

[Olfactometry Analysis for Panelists]

24 February 2020
Date

Signature
Professor H. Chua, Specialist in Olfactometry Analysis

CERTIFICATE OF COMPLETION

This certifies that

[MR. LEUNG KWOK WAH]

has successfully completed the training course of

[Olfactometry Analysis for Panelists]

24 February 2020

Date

Signature

Professor H. Chua, Specialist in Olfactometry Analysis

CERTIFICATE OF COMPLETION

This certifies that

[MS. LEE WING SEE]

has successfully completed the training course of

[Olfactometry Analysis for Panelists]

24 February 2020

Date

Signature

Professor H. Chua, Specialist in Olfactometry Analysis

CERTIFICATE
OF COMPLETION

This certifies that

[MR. IVAN WONG]

has successfully completed the training course of

[Olfactometry Analysis for Panelists]

24 February 2020

Date

Signature

Professor H. Chua, Specialist in
Olfactometry Analysis

CERTIFICATE
OF COMPLETION

This certifies that

[MS. ANGEL CHAN]

has successfully completed the training course of

[Olfactometry Analysis for Panelists]

24 February 2020

Date

Signature

Professor H. Chua, Specialist in
Olfactometry Analysis

CERTIFICATE OF COMPLETION

This certifies that

[MS. EVA WONG]

has successfully completed the training course of

[Olfactometry Analysis for Panelists]

24 February 2020

Date

Signature

Professor H. Chua, Specialist in Olfactometry Analysis

APPENDIX B
COPIES OF CALIBRATION CERTIFCATES

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+49 (0)431-220-12-17

E-Mail
de@olfasense.com
Web
www.olfasense.com

Proprietary calibration certificate
Werkskalibrierschein

Calibration mark Kalibrierzeichen	000555 **Olfasense** 14.11.2019

Object: *Gegenstand:*	Olfactometer / Olfaktometer
Manufacturer: *Hersteller:*	Olfasense GmbH
Type: *Typ:*	TO9evo
Serial no.: *Fabrikat/Serien-Nr.:*	9001
Customer: *Auftraggeber:*	Wellab Ltd. Room 1701, Technology Park, 18 On Lai Street 852 Fo Tan, Shatin, N.T. HONG KONG
Customer No.: *Kundennummer:*	14026
Order No.: *Auftragsnummer:*	AB1900532
Number of pages: *Anzahl der Seiten:*	5
Date of calibration: *Datum der Kalibrierung:*	14.11.2019

This proprietary calibration certificate documents the tracebility to national standards, which realize the units of measurement according to the International System of Units (SI).
The user is obliged to have the object recalibrated at appropriate intervals.

Dieser Werkskalibrierschein dokumentiert die Rückführung auf nationale Normale zur Darstellung der Einheiten in Übereinstimmung mit dem Internationalen Einheitensystem (SI).
Für die Einhaltung einer angemessenen Frist zur Wiederholung der Kalibrierung ist der Benutzer verantwortlich.

Seal *Stempel*	Date *Datum*	Head of the laboratory *Leiter des Laboratoriums*	Person in charge *Bearbeiter*
CALIBRATION SERVICE · CALIBRATION SERVICE · Olfasense GmbH olfasense Germany	14.11.2019	Stellv. Heinz Vieg Vieg	Jan Hauschildt

Protocol of calibration

Kalibrierprotokoll

Object: *Gegenstand:*	Olfactometer / Olfaktometer
Method: *Angewandtes Kalibrierverfahren:*	Calibration according to KL-AA01 Kalibrierung entsprechend KL-AA01 Comparison of the measured values with metrologically traceable calibration gases, dilution factor Z measured as amount content of propane (C_3H_8) with air as a matrix according to EN13725:2003 with correction 2006 Vergleich der Messwerte mit metrologisch rückgeführten Kalibriergasen, Verdünnungszahl Z gemessen als Stoffmengenanteil von Propan (C_3H_8) mit Luft als Matrix gemäß DIN EN 13725:2003 mit Berichtigung 2006
Location of calibration: *Ort der Kalibrierung:*	Kalibrierlabor Schauenburgerstr. 116, 24118 Kiel

Laboratory condition

Raumbedingungen

Humidity - %: *Relative Luftfeuchte in %*	44,8 ± 2,5	Used measurement equipment: *Verwendetes Messmittel:*	KL-T-002
Temperature - °C : *Temperatur in °C*	21,7 ± 0,5	Used measurement equipment: *Verwendetes Messmittel:*	KL-T-002
Barometric pressure - mbar : *Luftdruck in mbar*	1000 ± 2,0	Used measurement equipment: *Verwendetes Messmittel:*	KL-P-001

Calibrator *Kalibrator*	Ident.-No. *Ident-Nr.*		
Monitor Ratfisch RS 55-T *Monitor Ratfisch RS 55-T*	KL-FID-001	Valid until: *gültig bis:*	07/2020

Calibration gases

Kalibriergase

Referencegas 1: *Prüfgas 1:*	49800	ppm C_3H_8 in N, container no.: *ppm C_3H_8 in N, Behälternummer:*	1739193
Referencegas 2: *Prüfgas 2:*	1985	ppm C_3H_8 in N, container no.: *ppm C_3H_8 in N, Behälternummer:*	27600502859687

Uncertainty of measurement:

Messunsicherheit:

The reported relative extended uncertainty linked to the result is 3.8%.
The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k = 2, which provides a level of confidence of approximately 95% for a normal distribution. It is calculated according to DAkkS-DKD-3 (EA-4/02). It includes the uncertainties of the calibration procedure and the object during the calibration, with no account being taken of the objects long-term stability.

Die angegebene relative erweiterte Messunsicherheit, die dem Ergebniswert beigeordnet ist, beträgt 3,8%.
Angegeben ist die erweiterte Messunsicherheit, die sich aus der Standardmessunsicherheit durch Multiplikation mit dem Erweiterungsfaktor k=2 ergibt. Sie wurde gemäß DAkkS-DKD-3 ermittelt. Der Wert der Messgröße liegt mit einer Wahrscheinlichkeit von 95% im zugeordneten Werteintervall.

Operating conditions

Betriebsbedingungen

Operating state by measurement method: *Betriebszustände nach Messverfahren:*	Yes/No *Ja/Nein*	Forced-choice *Forced-Choice*
Inlet pressure before device – bar: *Geräteeingangsdruck in bar:*	4,2 ± 0,1	4,0 ± 0,1
Operating pressure – bar: *Betriebsdruck in bar:*	2,4 ± 0,1	2,3 ± 0,1

Volume flow measurement on the panel ports:
Volumenstrommessung an den Prüferplätzen

Port no.	Sample Air - m^3/h:			Reference Air - m^3/h:		
Portnr.	*Probenluft in m^3/h:*			*Referenzluft in m^3/h:*		
Method *Methode*	Y/N *(J/N)*	FC		Y/N *(J/N)*	FC	
1	1,25	1,25		1,25	1,25	
2	1,25	1,25		1,25	1,25	
3	1,25	1,25		1,25	1,25	
4	1,25	1,25		1,25	1,25	
5	-	-		-	-	
6	-	-		-	-	

Required volume flow emanating from a single port according to EN13725: ≥ 1,2 m^3/h (20 l/min)
Mindestvolumenstrom je Port nach DIN EN 13725:2003 (D)

Used measurement equipment for sample and reference air: KL-V-005
Verwendetes Messmittel für Proben- und Referenzluft:

Results

Ergebnisse

Setting	Dilution					Accuracy	Instability
Y/N	expected	observed		standard	difference	A_d	I_d
	Z_{exp}	$Z_{w,d}$		deviation	exp. - obs.		
i				n = 10		according EN13725	
1	65000	65526	±	675	-526	0,02	1,7%
2	45166	44504	±	450	662	0,03	1,3%
3	31384	31191	±	125	192	0,01	0,7%
4	21807	21549	±	38	258	0,01	0,7%
5	15153	15180	±	39,9	-27	0,01	0,3%
6	10529	10516	±	28,8	13	0,00	0,3%
7	7316	7353	±	10,8	-36	0,01	0,3%
8	5084	4934	±	3,7	149	0,03	0,2%
9	3532	3613	±	2,6	-81	0,02	0,4%
10	2455	2450	±	3,2	5	0,00	0,3%
11	1706	1638	±	0,98	68	0,04	0,3%
12	1185	1183	±	0,59	2	0,00	0,2%
13	823	828	±	0,39	-4	0,01	0,3%
14	572	550	±	5,82	22	0,05	1,0%
15	398	388	±	2,35	9	0,03	0,4%
16	276	276	±	1,45	0	0,01	0,3%
17	192	178	±	0,79	14	0,09	0,6%
18	133	131	±	0,48	2	0,02	0,4%
19	92,7	93,4	±	0,26	-1	0,01	0,3%
20	64,4	62,8	±	0,21	2	0,03	0,5%
21	44,8	43,6	±	0,17	1	0,03	0,3%
22	31,1	30,4	±	0,14	1	0,03	0,2%
23	21,6	20,6	±	0,09	1	0,05	0,2%
24	15,0	14,4	±	0,10	1	0,05	2,5%
25	10,4	10,3	±	0,06	0	0,02	1,8%
26	7,25	6,97	±	0,03	0	0,05	1,0%
27	5,04	4,91	±	0,02	0	0,03	0,7%
28	3,50	3,57	±	0,01	0	0,03	0,6%

Setting	Dilution					Accuracy	Instability
FC	expected	observed		standard	difference	A_d	I_d
	Z_{exp}	$Z_{w,d}$		deviation	exp. - obs.		
i				n = 10		according EN13725	
1	134625	140599	±	8376	-5974	0,12	3,0%
2	93545	89601	±	3546	3944	0,10	2,1%
3	65000	62799	±	1293	2201	0,06	1,6%
4	45166	43455	±	482	1710	0,05	0,9%
5	31384	31591	±	310,5	-207	0,02	1,0%
6	21807	21436	±	101,2	371	0,02	0,6%
7	15153	14713	±	43,2	440	0,03	0,4%
8	10529	10083	±	17,4	446	0,05	0,3%
9	7316	6762	±	21,3	555	0,09	0,2%
10	5084	4897	±	24,0	186	0,04	0,2%
11	3532	3362	±	22,05	170	0,06	0,3%
12	2455	2347	±	12,71	108	0,05	0,2%
13	1706	1702	±	9,61	3	0,01	0,2%
14	1185	1142	±	6,2	43	0,04	0,2%
15	823	809	±	4,14	15	0,02	0,2%
16	572	546	±	3,65	26	0,06	1,0%
17	398	388	±	3,22	9	0,03	0,3%
18	276	265	±	1,64	11	0,05	0,2%
19	192	188	±	0,99	3	0,03	0,4%
20	133	126	±	0,65	7	0,07	0,4%
21	92,7	89,6	±	0,37	3	0,04	0,4%
22	64,4	62,5	±	0,23	2	0,04	0,3%
23	44,8	43,4	±	0,13	1	0,04	0,2%
24	31,1	30,2	±	0,11	1	0,04	0,4%
25	21,6	21,0	±	0,06	1	0,04	0,3%
26	15,0	14,3	±	0,09	1	0,07	2,2%
27	10,4	10,0	±	0,05	0	0,05	1,5%
28	7,25	7,09	±	0,03	0	0,03	1,2%

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Website: www.wellab.com.hk

TEST REPORT

APPLICANT: **Wellab Limited (EM&A)**
RM 1808, Technology Park,
18 On Lai Street,
Shatin, N.T., Hong Kong

ATTN: **Miss Mei Ling Tang**

Test Report No.:	33772
Date of Issue:	2020-07-15
Date Received:	2020-07-13
Date Tested:	2020-07-13 to 2020-07-15
Date Completed:	2020-07-15

CERTIFICATE OF CALIBRATION

Item for calibration:

YSI EXO1 Multiparameter Sondes	Equipment No.:	SW-08-86
Manufacturer:	YSI Incorporated, a Xylem brand	
Description:	Model No.	Serial No.
- EXO1 Sonde, 100 meter Depth, 4 Sensor ports	599502-24	17B100181
- EXO Optical DO Sensor, Ti	599100-01	17A105010
- EXO conductivity/Temperature Sensor, Ti	599870	17H104109
- EXO Turbuduty Sensor, Ti	599101-01	17A104093
- EXO pH Sensor Assembly, Guarded, Ti	599701	17A105264

Test conditions:

Room Temperatre : 17-22 degree Celsius
Relative Humidity : 40-70%

Test Specifications:

Performance checking for Conductivity, Temperature, pH, Dissolved oxygen (D.O.) and Turbidity

Methodology:

According to manufacturer instruction manual, APHA 20e 4500-O C

****

PREPARED AND CHECKED BY:
For and On Behalf of **WELLAB Ltd.**

Patrick Tse

PATRICK TSE
General Manager

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TEST REPORT

Test Report No.:	33772
Date of Issue:	2020-07-15
Date Received:	2020-07-13
Date Tested:	2020-07-13 to 2020-07-15
Date Completed:	2020-07-15
Page:	2 of 2

CERTIFICATE OF CALIBRATION

Results:

Conductivity performance checking

	Instrument Readings (µS/cm)	Accetance Criteria	Comment
KCl stock solution (12890 µS/cm)	12900	12246-13534	Pass

Temperature performance checking

Reference thermometer-E431 Readings (°C)	Instrument Readings (°C)	Correction (°C)	Comment
20.0	20.002	-0.002	N/A

pH performance checking

	Instrument Readings (pH unit)	Accetance Criteria	Comment
pH QC buffer 4.00	4.01	4.00 ± 0.10	Pass
pH QC buffer 6.86	6.86	6.86 ± 0.10	Pass
pH QC buffer 9.18	9.16	9.18 ± 0.10	Pass

D.O. performance checking

	Instrument Readings (mg/L)	Accetance Criteria	Comment
Zero DO soultion	0.08	<0.1mg/L	Pass

Winkler Titration value (mg/L)	Instrument Readings (mg/L)	Accetance Criteria	Comment
8.00	8.11	Difference between Titration value and instrument reading <0.2mg/L	Pass

Turbidity performance checking

Turbidity stock solution	Instrument Readings (NTU)	Accetance Criteria	Comment
10 NTU	9.96	9.0-11.0	Pass
50 NTU	50.02	45.0-55.0	Pass
100 NTU	100.0	90.0-110.0	Pass

Depth performance checking

Water Depth	Instrument Readings (m)	Accetance Criteria	Comment
0.5 meter	0.50	0.45-0.55	Pass

***********************************END OF REPORT*******************************

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TEST REPORT

APPLICANT: **Wellab Limited (EM&A)**
RM 1808, Technology Park,
18 On Lai Street,
Shatin, N.T., Hong Kong

ATTN: **Miss Mei Ling Tang**

Test Report No.:	33658
Date of Issue:	2020-06-19
Date Received:	2020-06-17
Date Tested:	2020-06-17 to 2020-06-19
Date Completed:	2020-06-19

Certificate of Calibration

Item for calibration:

YSI EXO1 Multiparameter Sondes	Equipment No.:	SW-08-87
Manufacturer:	YSI Incorporated, a Xylem brand	
Description:	Model No.	Serial No.
- EXO1 Sonde, 100 meter Depth, 4 Sensor ports	599502-24	17B100182
- EXO Optical DO Sensor, Ti	599100-01	17A105011
- EXO conductivity/Temperature Sensor, Ti	599870	17A105105
- EXO Turbuduty Sensor, Ti	599101-01	17K100326
- EXO pH Sensor Assembly, Guarded, Ti	599701	17B100246

Test conditions:

Room Temperatre : 17-22 degree Celsius
Relative Humidity : 40-70%

Test Specifications:

Performance checking for Conductivity, Temperature, pH, Dissolved oxygen (D.O.) and Turbidity

Methodology:

According to manufacturer instruction manual, APHA 20e 4500-O C

****

PREPARED AND CHECKED BY:
For and On Behalf of **WELLAB Ltd.**

Patrick Tse

PATRICK TSE
General Manager

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TEST REPORT

Test Report No.:	33658
Date of Issue:	2020-06-19
Date Received:	2020-06-17
Date Tested:	2020-06-17 to 2020-06-19
Date Completed:	2020-06-19

Certificate of Calibration

Results:

Conductivity performance checking

	Instrument Readings (μS/cm)	Accetance Criteria	Comment
KCl stock solution (12890 μS/cm)	12900	12246-13534	Pass

Temperature performance checking

Reference thermometer-E431 Readings (°C)	Instrument Readings (°C)	Correction (°C)	Comment
20.0	20.001	-0.001	N/A

pH performance checking

	Instrument Readings (pH unit)	Accetance Criteria	Comment
pH QC buffer 4.00	4.01	4.00 ± 0.10	Pass
pH QC buffer 6.86	6.86	6.86 ± 0.10	Pass
pH QC buffer 9.18	9.20	9.18 ± 0.10	Pass

D.O. performance checking

	Instrument Readings (mg/L)	Accetance Criteria	Comment
Zero DO soultion	0.07	<0.1mg/L	Pass

Winkler Titration value (mg/L)	Instrument Readings (mg/L)	Accetance Criteria	Comment
8.00	7.99	Difference between Titration value and instrument reading <0.2mg/L	Pass

Turbidity performance checking

Turbidity stock solution	Instrument Readings (NTU)	Accetance Criteria	Comment
10 NTU	10.00	9.0-11.0	Pass
50 NTU	50.02	45.0-55.0	Pass
100 NTU	100.9	90.0-110.0	Pass

Depth performance checking

Water Depth	Instrument Readings (m)	Accetance Criteria	Comment
0.5 meter	0.50	0.45-0.55	Pass

************************************END OF REPORT********************************

ARIZONA INSTRUMENT LLC

3375 N, Delaware St., Chandler, AZ 85225
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www.azic.com • customerservice@azic.com

Certification of Instrument Calibration

Guyline **(Asia) Ltd**
Rm 1611. Eastern Harbour Centre
Quarry Bay,

RMA # **2431614**

This is to certify that the Jerome **J605-0002** Gold Film Hydrogen Sulfide Analyzer, Serial Number **60500200**, with Sensor Number **16-5-18-Z2AS,** was calibrated with standard units traceable to NIST.

Calibration Status as Received: **Out of Calibration**

		Actual		Calibration Gas		Allowable Range		
Incoming:	Range 1	0.318	ppm H2S	0.500	ppm H2S	0.470	- 0.530	ppm H2S
Outgoing:	Range 1	0.506	ppm H2S	0.500	ppm H2S	0.475	- 0.525	ppm H2S
	RSD %	0.41				<3%		

Calibration Status as Left: **In Calibration**

Estimated Uncertainty of Calibration system: 2.4%

Calibration Date: 07-Oct-2019 Recalibration Date: 06-Oct-2020

Temperature °F: 70.50 % Relative Humidity: 21.40

Approved By:________________________ Date Approved: 07-Oct-2019

Title: Johnny Padilla - Quality Control

Equipment Used:

H2S Calibration Standard: CC-57152 **NIST#1:** 1385481
Calibration Date: 17-Aug-2019 **Calibration Date Due:** 18-Aug-2020

Mass Flow Controller B: 124604 **NIST#:** 152971
Calibration Date: 28-Sep-2019 **Calibration Date Due:** 28-Sep-2020

Mass Flow Controller D: 124602 **NIST#:** 151792
Calibration Date: 08-Sep-2019 **Calibration Date Due:** 08-Sep-2020

Digital Multimeter: 84370196 **NIST#:** 7000660
Calibration Date: 28-Sep-2019 **Calibration Date Due:** 28-Sep-2020

Flow meter: US04I26034 **NIST#:** 1813; 1817; 1796
Calibration Date: 29-Aug-2019 **Calibration Date Due:** 30-Aug-2020

Calibration Procedure Used: 730-0099

Arizona Instrument certifies that the above listed instrument meets or exceeds all published specifications and has been calibrated using standards whose accuracy are traceable to the NATIONAL INSTITUTE OF STANDARDS AMD TECHNOLOGY within the limitations of the Institute's calibration services, or have been derived from accepted values or natural physical constants, or have been derived by the ratio type of self-calibration techniques.

Disclaimer: Any unauthorized adjustments, removal or breaking of QC seals, or other customer modifications on your Jerome Analyzer WILL VOID this factory calibration. Because any of the above acts could affect the calibration and readings of the instrument , their certification will no longer be valid and, further, Arizona Instrument LLC WILL NOT be responsible for any liabilities created as a result of using the instrument after such adjustments , seal removal, or modifications. As long as a functional test is within range, according to the procedure outlined in the Operator's Manual, the instrument is performing correctly.

合格证

许可证号：浙制 02810338

本产品已通过ISO9001认证

名称：面板式流量计

型号：LZM—6T

余姚远大仪表厂

测量范围 5-50LPM

精　　度　4 级

额定工作压力 ≤ 0.6MPa

介　　质　气 水

使用介质温度 60℃

检验部门

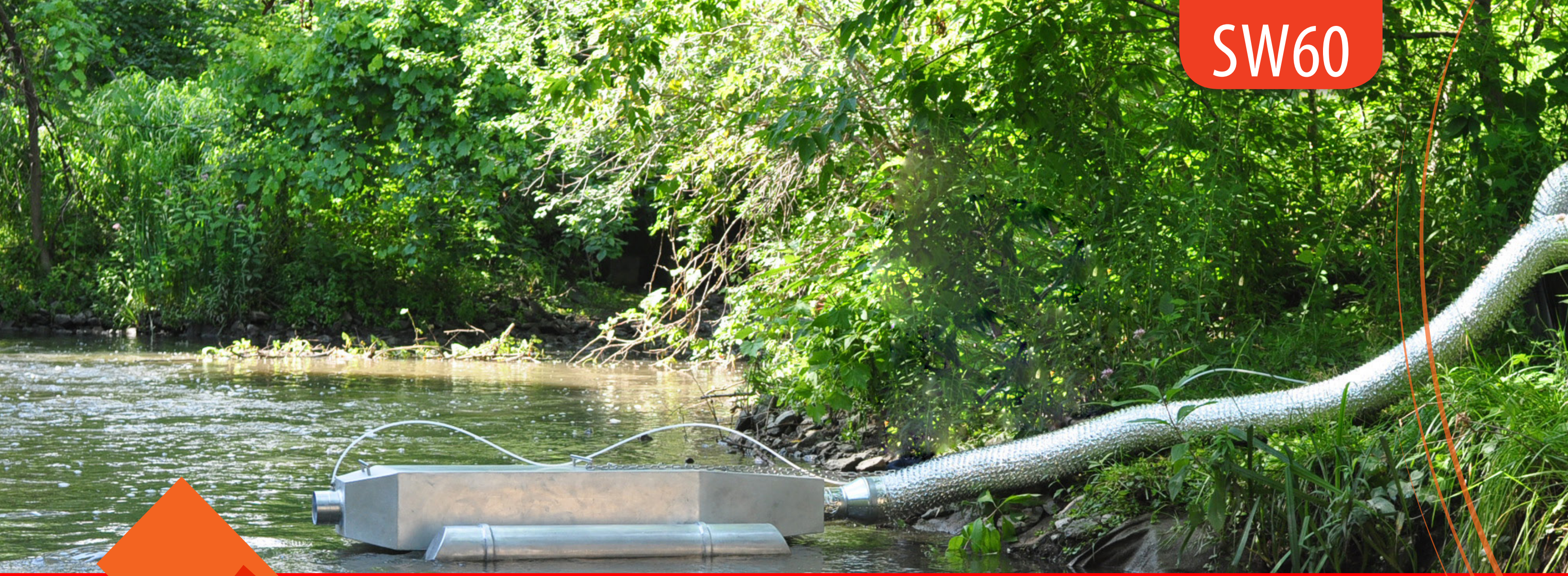
余姚市远大仪表厂
检定专用章

检 定 员 021

检定日期 20年/月/日

本产品执行JB/T9255-1999标准

APPENDIX C
SPECIFICATION OF ODOUR SAMPLING EQUIPMENT



SW60

SCENTROID SW60

Wind Tunnel Sampler (AKA Ventilated Sampling Hood)

Scentroid SW60 is the next generation Wind Tunnel Sampler (AKA Ventilated Sampling Hood), used for sampling on solid or liquid surfaces with passive odour emissions in accordance with the EN13725 and VDI3880. The SW60 offers a number of unique features that make it the most accurate and user-friendly area source sampler in the world.

CONTINUOUS AIR SPEED MONITORING

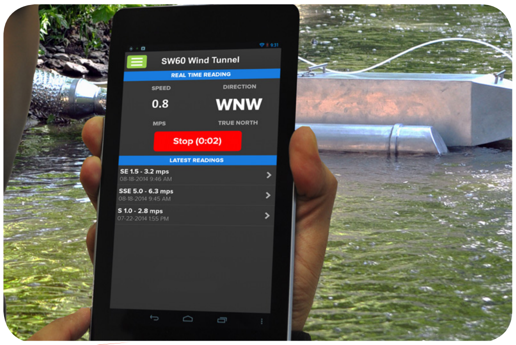
Scentroid SW60 has a built-in anemometer that remotely monitors the exact wind speed inside the tunnel. The data is logged and shown on any mobile tablet or phone. This not only significantly increases the accuracy of odour sampling, but also provides a means of setting the air speed to the exact desired value.

ULTRA-LIGHT AEROSPACE MATERIALS

Scentroid SW60 is made of state-of-the-art PTFE coated aluminium composite material that is both, extremely rigid and ultra-light. The wind tunnel only weight 10 kg making it very easy to handle by a single technician. Despite being extremely light, the composite material makes the SW60 tough enough to withstand the toughest working conditions.

A COMPLETE SELF-CONTAINED SOLUTION

The Scentroid SW60 comes as a complete sampling solution. The kit includes the wind tunnel, the floaters, and the air supply. The air supply enclosed in a waterproof carrying case contains an activated carbon filter, a variable speed blower, and a battery pack. Simply connect the air supply to the tunnel and set the desired air speed.



SCENTROID
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SPECIFICATIONS

SW60

Manufacturer	SCENTROID
Model	Scentroid SW60
Sources for Sampling	Liquid or solid passive (non-ventilated) sources
Electronic Interface	Air speed measurements
Wind speed range	0.15 m/s to 1 m/s
Battery capacity	1.5 hours
Charging options	12V DC car outlet, 100-240 V AC power
Power supply	12V-8Ah deep cycle rechargeable battery. Can also be operated directly from 12V auto power outlet
Air supply	Carbon filter, variable speed blower and flexible aluminium duct enclosed in a waterproof carrying case.
Standards	VDI 3880, EN13725, AS4323
Sample port	1/4" / 12 mm stainless steel compression fitting
Removable Floaters	PTFE coated aluminium
Wind Tunnel Material	PTFE coated Aluminium Composite
Dimension	167x23x33 cm without floaters installed / 167x23x74 cm with floaters installed
Weight	10 kg

FEATURES...

1. Continuous use for more than 1 hours

The SW60 battery pack can sustain the blower for 1.5 hours of continuous use. Plugging the SW60 to a standard 12V auto power outlet, will allow for infinite use while also charging the battery pack.

2. Lindvall Concept

The SW60 is designed based on the Lindvall concept, which is considered the industry's most widely accepted and most accurate wind tunnel design.

3. Uniform air flow

The SW60 uses a series of 15 fins to direct the air speed within the chamber ensuring complete uniform flow for highest level of odour sampling accuracy.

4. ZERO CONTAMINATION

As with all Scentroid products, contamination control is a high priority for the SW60. The instrument is entirely PTFE coated aluminium composite with no plastic parts.

5. PORTABILITY

Scentroid SW60 has been designed to be easily handled and deployed by a single technician. The floaters can be dismantled and carried separately while the entire air supply module is built into a single waterproof carrying case.

6. VARIABLE AIR SPEED

The Scentroid SW60 has a variable air supply allowing the technician to set any air speed between 0.15 to 1 m/s. The air speed is continuously monitored via the built-in anemometer to ensure readings are accurate and reliable.

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SB10

VACUUM CHAMBERS

The Scentroid Vacuum Chambers are easy to use, portable, and cost-effective air sample collection devices. Vacuum chambers are used to pull samples directly without dilution from stack, ambient air, or other sampling devices such as flux chamber or wind tunnel. The Scentroid vacuum chambers come in multiple sizes to fit bags of up to 10L, 25L, and even 50L.

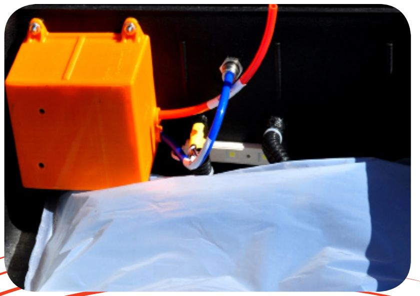
CAPABILITIES

Scentroid Vacuum Chamber uses a built in miniature pump to create a vacuum of more than 18" HG inside the sample box.

The 12V rechargeable battery is capable of sustaining more than 75 samples with a single charge and can be charged

EASE OF USE

The auto purge function creates a positive pressure inside the chamber forcing all the air inside the sample bag to exhaust through the sample line. This auto function makes purging, priming, and conditioning a one-step simple process.



OPERATION

1. Open the Vacuum chamber.
2. Connect the Sample bag to the PTFE tube inside the vacuum chamber.
3. Close the vacuum chamber.
4. Connect the external sample line to the sample collection device (i.e probe or Flux chamber) for source sampling or leave off if sampling ambient air.
5. Switch to Sample function to draw in the sample air.
6. Stop when sample is half full and switch to purge routine to exhaust all the lines and the sample bag with source air.
7. Switch to Sample function again and fill the bag with sample air.
8. Turn unit off and open the case.
9. Close sample bag valve and remove it from the vacuum chamber.

VACUUM CHAMBER APPLICATIONS

- Acquire sample from ambient air
- Acquire sample from flux chamber
- Acquire sample from static hood
- Acquire sample from wind tunnel
- Acquire sample from other source that will

BUILT-IN SAMPLE PUMP

The Scentroid SB10 vacuum chamber is equipped with a powerful built-in variable flow rate sampling pump capable of taking up to 12 lpm of sample even in negative pressure conditions. The larger models (SB20, and SB50) come with dual pumps for increased flow rate.

SCENTROID
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Markham, ON, L3R 3L4

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www.scentroid.com

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RECYCLED PAPER

SB10

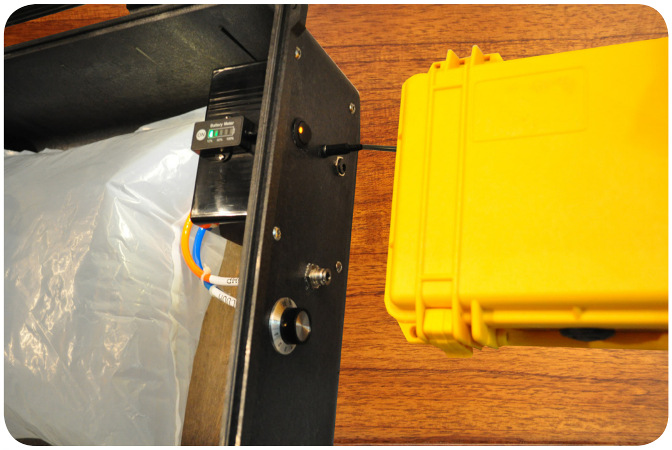
VACUUM CHAMBERS

EXTERNAL TRIGGER

Scentroid vacuum chambers come equipped with an external trigger that can easily connect to odotracker, Scentinal, GSM modem, or weather station to acquire a sample when the odour exceedance is detected, the wind directions changes, or when there is a compliant.

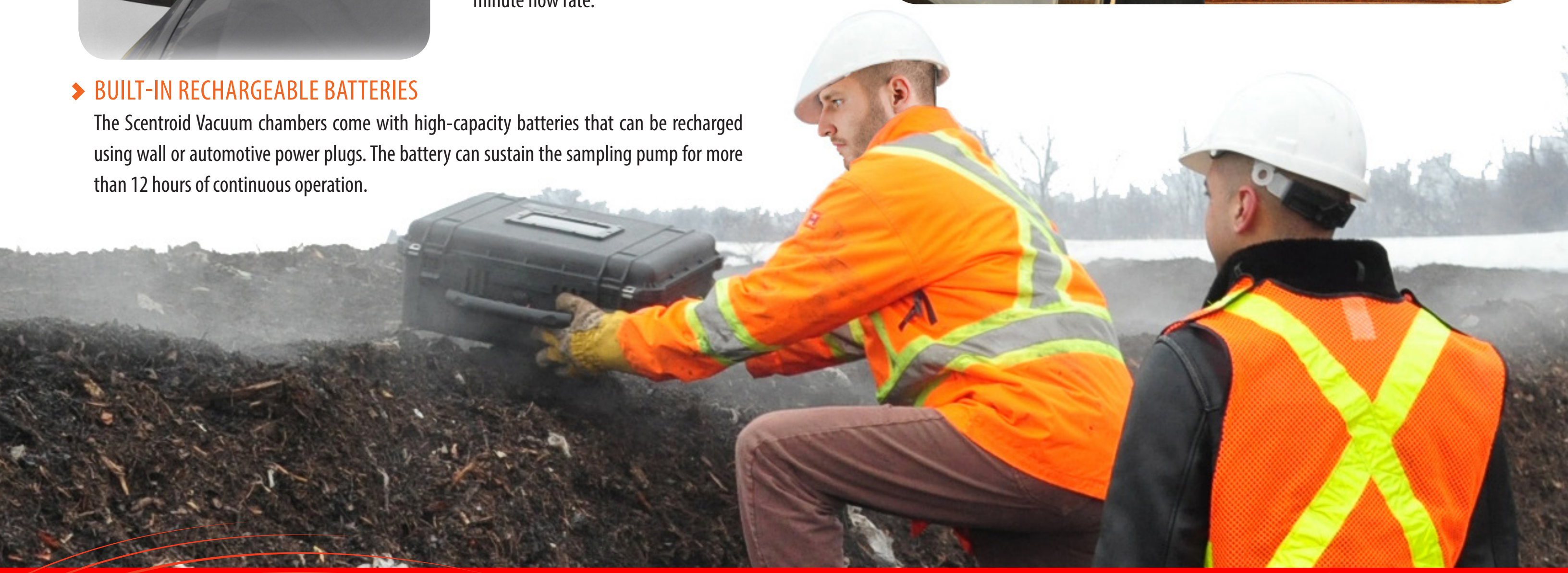
ADJUSTABLE SAMPLING FLOW RATE

To achieve "time sampling" the user can vary the sampling rate via small external knub. The motor speed is adjusted to reach from 0.1 to 12 Liters per minute flow rate.



BUILT-IN RECHARGEABLE BATTERIES

The Scentroid Vacuum chambers come with high-capacity batteries that can be recharged using wall or automotive power plugs. The battery can sustain the sampling pump for more than 12 hours of continuous operation.



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RECYCLED PAPER

Scentroid Sampling Bags

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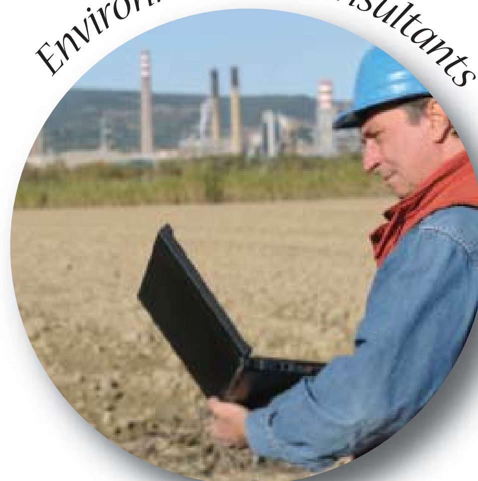


Laboratories

Health and Medical Industries

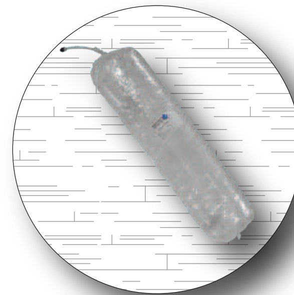
Universities and Researchers

Oil and Gas Refineries

Target The Right Bag Material For Your Application

Scentroid is the world leader in air sampling and odour measurement equipment and services, providing solutions to over 40 countries around the world. Our unique instruments are used by universities, government agencies, laboratories, environmental consultants, waste water treatment plants, landfills, petrochemical plants, and many other industries that deal with odour nuisances.

SCENTROID BAG MATERIAL AND CONSTRUCTION



NALOPHAN: Nalophan is an inexpensive material used for making disposable sample bags. Nalophan can be purchased pre-made or as a large roll to reduce cost. Nalophan has the shortest holding time for most compounds such as H2S, Ammonia and VOCs.

TEDLAR: Tedlar bags provide a reusable storage medium. Scentroid Tedlar bags are made of 2 mill thick film and purged at 100 °C using scentroid's patented heat/vacuum Purger for ultimate purity.

PTFE: Scentroid is the only manufacturer offering PTFE air sampling bags. These bags offer a much higher resistance to contamination and have a longer holding time than Tedlar bags. They are also accepted bag material for all standards. PTFE Sample bags are extremely resistant to contamination and therefore can be easily cleaned and reused. PTFE sample bags are already approved by the Ministry of Environment in Ontario and almost every other jurisdiction around the world.

STAINLESS STEEL: Scentroid is the only manufacturer in the world to offer stainless steel sampling bags. Each stainless steel bag is made of electro polished marine grade (400 series) stainless steel film. Stainless steel sampling bags are ideal for sampling corrosive materials such as high H2S or benzene. The stainless steel is rolled into a thin film that provides it with flexibility while maintaining the 100% sample preservation. scentroid stainless Steel bags are used commonly instead of Sumo canisters.

A Word About Fittings

SCENTROID sample bag fittings are designed specifically for air sampling. SCENTROID fittings are offered in a choice of materials and styles to fit your application. Stainless steel, polypropylene, and PTFE fittings combine the connector and valve with septum into one easy to use fitting. Compression style fittings made of PTFE coated nylon are used on larger bags where low flow restriction is required.

SCENTROID Bag Pricing and Delivery

SCENTROID bags are stocked in a variety of sizes and materials and can be shipped immediately. All scentroid bags are produced in-house at our Canadian location. This means that we can manufacture custom bags to your specification at no extra charge. In most cases even custom made bags are shipped the same day.

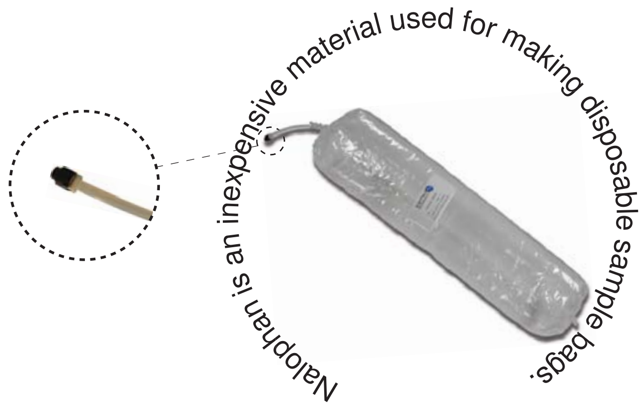
SCENTROID — The Highest Technology in Sample Bags

SCENTROID provides advanced air sample bags to provide the highest holding time and zero contamination. Our dedication to sample preservation and odour measurement accuracy is evident in our newly introduced pure PTFE and 100% stainless steel sample bags. Browse our products for complete description of our line of sampling equipment, sample bags and purging equipment.

Sampling Bags

Nalophan Air Sample Bags

- Quality Nalophan film for durable and reliable sampling.
- Low background odour.
- Good stability for carbon monoxide.
- Can be pre-made or as a DIY (do-it-yourself) Kit.
- Straight tube connection for zero back pressure flow.
- Scentroid one-touch caps provide secure and reliable solutions.
- Stocked in 153 mm wide tubes that can be made to any capacity; custom size bags available.
- Bags available for EPA TCLP method.



SCENTROID Nalophan bags made of classic Nalophan film are an affordable solution for air sampling.
Nalophan bags are commonly used in Europe and parts of North America due to their relatively good holding time and affordable pricing. The bags are easy to use and are thrown out after one use, eliminating the need for purging and reuse.

Recommended for samples:
- Processed without long delays (less than six hours for most samples).
- With moderate VOC and H2S.

Not recommended for samples:
- Being processed six or more hours after sampling.
- With high humidity.
- With high H2S.
- With Benzene or other petrochemical.

Stability of air samples in Nalophan Bag

	Recovery %	
Odour Source	12 hours	24 hours
WWTP	70	45
Compost	61	40
Landfill	65	48
Gas Refinery	20	17
Swine Production	55	39
Processing Plants	68	51
Pet Food Factories	62	43
Coffee Production	80	75

Ideal For: Short Term Storage and On-Site Analysis.

Tedlar Air Sample Bags

- Dupont Tedlar film for good sample preservation.
- Good stability for VOCs and some sulfur compounds, including hydrogen sulfide.
- Good stability for carbon monoxide, carbon dioxide, methane, and sulfur hexafluoride.
- High bursting pressure to ensure samples are transported safely.
- Pre-purged using Scentoid's patented Heated Air Purger for minimal background contamination.
- Choice of fittings to match bag size and application include both compression and 2-in-1 valve/septum fittings in a variety of materials including PTFE, stainless steel, PTFE coated Nylon, and Polypropylene.
- Stocked in a variety of sizes; custom bags available.
- Bags available for EPA TCLP method.

Recommended for samples:

- Processed with moderate delay. (6 to 12 hours)
- With moderate to high VOC and H2S.

Not recommended for samples:

- Being processed twelve or more hours after sampling.
- With low contamination (due to high background chemical levels).
- With Benzene and other petrochemicals.

SCENTROID Tedlar bags are made with Dupont Tedlar film. The Scentroid lightweight Nylon and PTFE fittings are easy to use and prevent damage to the bag from repeated operation.

Stability of air samples in Tedlar Bag

	Recovery %	
Odour Source	12 hours	24 hours
WWTP	80	60
Compost	72	69
Landfill	68	58
Gas Refinery	18	15
Swine Production	65	47
Processing Plants	78	56
Pet Food Factories	72	63
Coffee Production	75	65

Sampling Bags

PTFE Air Sample Bags

- Ultra-pure PTFE film with exceptional sample preservation.
- PTFE density of 2.2 g per cubic centimeter is twice as high as Tedlar allowing for much longer sample preservation.
- Excellent stability for most compounds including VOCs, sulfur compounds, including hydrogen sulfide.
- Excellent stability for carbon monoxide, carbon dioxide, methane, and sulfur hexafluoride.
- Excellent stability for petrochemical products such as benzene.
- Low sample absorption.
- Zero background odour allows for ambient sampling.
- UV protection helps preserve samples during transportation.
- Easy to clean and reuse (typical lifespan is 30 samples).
- Choice of fittings to match bag size and application include both compression and 2-in-1 valve/septum fittings in a variety of materials including PTFE, stainless steel, PTFE coated Nylon, and Polypropylene.
- Stocked in a variety of sizes; custom bags available.
- Bags available for EPA TCLP method.

Recommended for samples:

- Where samples are processed with long delay. (+12 hours)
- With high VOC and H2S.
- With any petrochemical products such as benzene.
- With low odour threshold (will not contaminate sample).
- With high humidity.

Not Recommended for Samples:

- Being processed with delay exceeding 30 hours.

SCENTROID PTFE bags are made of pure PTFE film. The Scentroid lightweight Nylon and PTFE fittings are easy to use and prevent damage to the bag from repeated operation.

Stability of air samples in PTFE Bag

	Recovery %	
Odour Source	12 hours	24 hours
WWTP	84	80
Compost	86	82
Landfill	90	82
Gas Refinery	86	75
Swine Production	78	78
Processing Plants	91	88
Pet Food Factories	87	83
Coffee Production	82	78

Sampling Bags

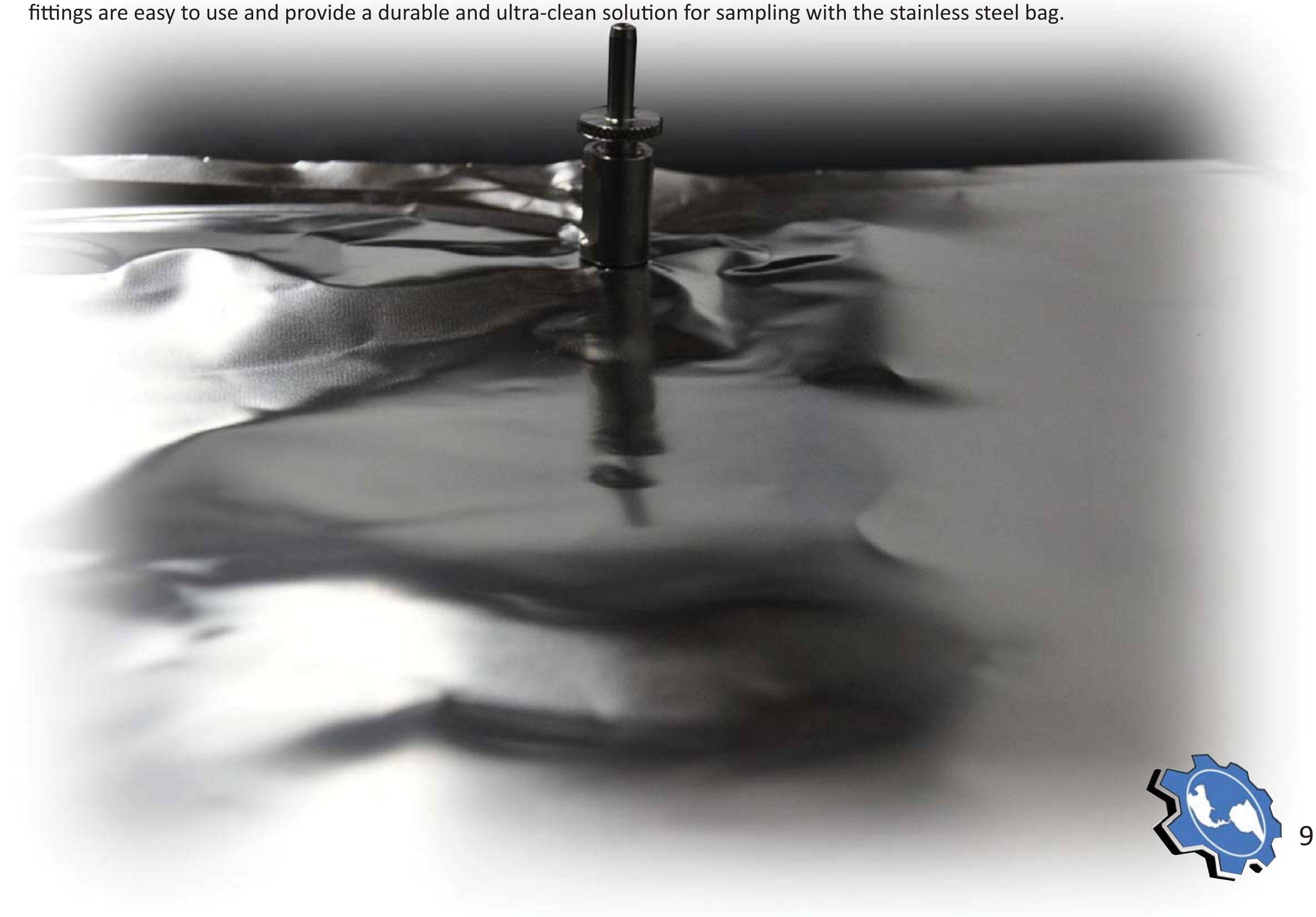
Stainless Steel Air Sample Bags

- Flexible electro-polished stainless steel film for complete sample preservation.
- Excellent stability for all chemicals and compounds.
- Excellent substitute for Sumo canisters.
- Can be used with regular sampling equipment elimination the need for vacuum generation.
- Does not require expensive cleaning procedures.
- Extremely durable for ease of transportation.
- Perfect for GCMS analysis as container has zero chemical contamination.
- Available in 10 L bag.

Recommended for Samples:

- Where GCMS analysis were purity is a must.
- With ultra-high H2S content where sample preservation is critical.
- With high concentration of petrochemical compounds.

SCENTROID Stainless Steel bags made of pure 400 series stainless steel film and welded at the seams. The Scentroid stainless steel fittings are easy to use and provide a durable and ultra-clean solution for sampling with the stainless steel bag.



Fittings

Select a Fitting

SCENTROID sample bags are stocked with a choice of fittings to meet your applications.
SCENTROID bag fittings are not "off-the-shelf" industrial fittings but are designed specifically for air sampling. Choose from quality fittings including dual stainless steel, all-in-one single polypropylene, or Nylon compression fittings.

All Scentroid sample bags are manufactured in a dedicated, closed room with continuous air filtration via 3 HEPA and carbon filtration systems.

All bags are tested to pressure of 10 inches of water to ensure strong and reliable seals.

Stainless Steel Fitting: These all stainless steel fittings are used only on Scentroid stainless bags. This type of fitting is highly resistant to corrosive materials and can be used in high temperature sampling.

PTFE Coated Nylon: These fitting offer zero resistance on the sample flow and therefore are the ideal choice for large sample bags. They also allow attachment of tubing or syringe sample extraction by changing caps.

2 IN 1 Polypropylene : On/Off valve function with replaceable septum in a single unit. Quick, easy opening and closing of valve. Less than one half turn opens/closes the valve. These fittings fit all 1/4" and 6 mm tubing.

2 In 1 PTFE Fitting: The combination fitting and septum is made of pure PTFE and offers high corrosion resistance. The fittings are light weight and therefore provide an excellent choice for PTFE sample bags. The 2in1 PTFE fittings have some flow resistance and therefore are recommended for bags of 1 to 5 L.

1/8" Barb Stainless Steel Fitting: The stainless steel barbed fittings are used in autosamplers and where the sample bag must remain in the process.

Sample Bags Order

For PTFE and Tedlar

Select Your Bag, Size, Fitting

☐ PTFE

☐ Tedlar

☐ 1L (7"x7")

☐ 3L (7"x14")

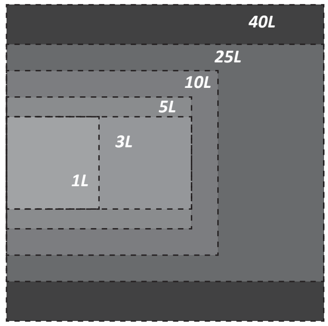
☐ 5L (10"x14")

☐ 10L (14"x16")

☐ 25L (18"x24")

☐ 40L (18"x24")

☐ Other: Length ________ " Width ________ "



Quantity of bags ________

☐ PTFE Coated Nylon

☐ 2 In 1 PTFE Fitting

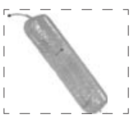
☐ 2 IN 1 Polypropylene

☐ 1/8" Barb Stainless Steel Fitting

Quantity of fittings ________

For Nalophan

Nalophan Bag



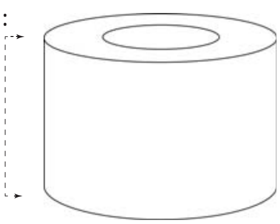
Select your bag size: ☐ 5L ☐ 10L ☐ 20L ☐ Other: Length ________ " Width 153 mm

Quantity of bags ________ Quantity of caps ________

Nalophan Roll

Select your roll size:

153mm



☐ 100m

☐ 300m

☐ 500m

☐ 1000m

Nalophan DIY (do-it-yourself) Kit:

Roll for 100 bags
20 Caps
1 Cable tie gun
50 Cable ties
(10' x 1/4") PTFE tubing

Quantity of kits ________

For Stainless Steel

Stainless steel Bag

Stainless Steel bag size is 12"x24" and it comes with a stainless steel fitting.

Quantity of bags ________

APPENDIX D
ODOUR SURVEY SCHEDULE

Contract No. YL/2018/03
Development of Lok Ma Chau Loop: Main Works Package 1 – Special Site Investigation Works
(In-situ Trial of Sediment Treatment Works in Shenzhen River) and Laboratory Testing
Additional Odour Survey and Ambient Air Sampling Schedule (August 2020)

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
						1-Aug
2-Aug	3-Aug	4-Aug	5-Aug	6-Aug	7-Aug	8-Aug
9-Aug	10-Aug	11-Aug	12-Aug	13-Aug	14-Aug	15-Aug
					Additional Odour Survey **(Water Surface / Exposed Sediment Surface)** (~11:00 - 16:30) **Additional Ambient Air Sampling** **(Reedbed / The Area near Reedbed)** (~11:00- 16:30)	**Additional Odour Survey** **(Water Surface / Exposed Sediment Surface)** (~11:00 - 18:00) **Additional Ambient Air Sampling** **(Reedbed / The Area near Reedbed)** (~13:30 - 18:00)
16-Aug	17-Aug	18-Aug	19-Aug	20-Aug	21-Aug	22-Aug
	Additional Odour Survey **(Water Surface / Exposed Sediment Surface)** (~12:32 - 19:30) **Additional Ambient Air Sampling** **(Reedbed / The Area near Reedbed)** (~13:30 - 19:30)	**Additional Odour Survey** **(Water Surface / Exposed Sediment Surface)** (~13:20 - 20:00) **Additional Ambient Air Sampling** **(Reedbed / The Area near Reedbed)** (~13:30 - 20:00)		**Additional Odour Survey** **(Water Surface / Exposed Sediment Surface)** (~14:47 - 21:00) **Additional Ambient Air Sampling** **(Reedbed / The Area near Reedbed)** (~14:47 - 21:00)	**Additional Odour Survey** **(Water Surface / Exposed Sediment Surface)** (~15:27 - 21:30) **Additional Ambient Air Sampling** **(Reedbed / The Area near Reedbed)** (~15:27 - 21:30)	
23-Aug	24-Aug	25-Aug	26-Aug	27-Aug	28-Aug	29-Aug
		Additional Odour Survey **(Water Surface / Exposed Sediment Surface)** (~05:49 - 11:00) **Additional Ambient Air Sampling** **(Reedbed / The Area near Reedbed)** (~05:49 - 11:00)	**Additional Odour Survey** **(Water Surface / Exposed Sediment Surface)** (~06:48 - 12:30) **Additional Ambient Air Sampling** **(Reedbed / The Area near Reedbed)** (~06:48 - 12:30)	**Additional Odour Survey** **(Water Surface / Exposed Sediment Surface)** (~08:05 - 14:30) **Additional Ambient Air Sampling** **(Reedbed / The Area near Reedbed)** (~08:05 - 14:30)	**Additional Odour Survey** **(Water Surface / Exposed Sediment Surface)** (~09:31 - 16:45) **Additional Ambient Air Sampling** **(Reedbed / The Area near Reedbed)** (~09:31 - 16:45)	
30-Aug	31-Aug					

Remark: Additional odour survey is arranged during low/ebb tide period (i.e. after mid-ebb tide or during low tide, which refers to the tide level of +1.0 mCD (metre above chart datum) or below at Tsim Bei Tsui by Hong Kong Observatory).

APPENDIX E
IN-SITU MEASUREMENT RESULTS OF ODOUR SURVEY

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Contract No. YL/2018/03
Development of Lok Ma Chau Loop: Main Works Package 1 – Special Site Investigation Works (In-situ Trial of Sediment Treatment Works in Shenzhen River) and Laboratory Testing

Additional Odour Monitoring Field Record Sheet

Sampling Date: 14-Aug-20

Sampling Location		WSZ-111	WSZ-112	WSZ-113	WSZ-115	WSZ-116	WHK-111	WHK-112	WHK-115	WHK-116
Weather Condition		Cloudy	Cloudy	Cloudy	Sunny	Sunny	Cloudy	Cloudy	Sunny	Sunny
Start Time		10:05	13:24	14:18	14:55	15:48	10:40	13:50	15:12	15:30
Water Depth (m)		3.8	2.0	0.2	3.5	3.1	2.2	2.2	2.9	3.3
Ambient Air Temperature (℃)		32.6	34.6	34.6	35.4	35.4	33.4	34.4	34.8	34.4
Wind Direction		N	S	SW	S	S	N	S	S	S
H_2S (ppbv)	1st	<3	<3	<3	<3	<3	<3	<3	<3	<3
	2nd	<3	<3	<3	<3	<3	<3	<3	<3	<3
Water Temperature (℃)	1st	29.2	29.7	31.3	31.3	30.0	29.4	31.4	30.7	30.3
	2nd	29.2	29.8	31.3	31.3	30.1	29.4	31.4	30.7	30.3
Salinity (ppt)	1st	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.2	0.3
	2nd	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.2	0.3
pH	1st	7.2	7.3	7.1	7.0	7.0	7.1	7.2	6.8	7.0
	2nd	7.2	7.3	7.1	7.0	7.0	7.1	7.2	6.8	7.0
Redox (mV)	1st	-101.2	38.7	4.0	76.1	-50.7	36.3	-54.3	5.0	-3.3
	2nd	-101.0	38.4	3.8	75.6	-51.2	36.1	-53.4	4.8	-3.5
Duration of Odour		Intermittent	Intermittent	Intermittent	~~Intermittent / Continuous~~	~~Intermittent / Continuous~~	~~Intermittent / Continuous~~	Intermittent	~~Intermittent / Continuous~~	~~Intermittent / Continuous~~
*Odour Characteristics & **Potential Odour Sources		Dead Fish	Nature grass / Fishy	Nature grass / Sewage	N/A	N/A	N/A	Fishy	N/A	N/A
Remark(s)		N/A	N/A	N/A	N/A	N/A	N/A	N 841831.960 E 824694.419	N/A	N/A

*Description of Odour Characteristics: Sewage or rotten-egg smell, decayed vegetables, ammonical, dischargeable odour, putrefaction, sharp, pungent, fish, irritating, fruit, vinegar, etc
**Potential Odour Source: Exposed sediment, water or sewage; floating debris or material etc

	Name	Signature	Date
Recorded by:	Ho Ka Chun		14-Aug-20
Checked by:	Ivy Tam		14-Aug-20

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Contract No. YL/2018/03
Development of Lok Ma Chau Loop: Main Works Package 1 – Special Site Investigation Works
(In-situ Trial of Sediment Treatment Works in Shenzhen River) and Laboratory Testing

Additional Odour Monitoring Field Record Sheet

Sampling Date: 14-Aug-20

Sampling Location		RAA-111	RAA-112	RAA-115	RAA-116	AA-111	AA-112	AA-115	AA-116
Weather Condition		Cloudy	Sunny	Sunny	Sunny	Cloudy	Sunny	Sunny	Sunny
Start Time		10:30	13:41	15:14	15:52	10:10	13:22	14:51	15:40
Ambient Air Temperature (℃)		33	33.4	34.5	33.8	33	33.2	34.2	34.5
Wind Direction		N/A	SW	SW	N/A	N/A	SW	SW	N/A
H_2S (ppbv)	1st	<3	<3	<3	<3	<3	<3	<3	<3
	2nd	<3	<3	<3	<3	<3	<3	<3	<3
Duration of Odour		Intermittent ~~/ Continuous~~	Intermittent ~~/ Continuous~~	Intermittent ~~/ Continuous~~	Intermittent ~~/ Continuous~~	Intermittent ~~/ Continuous~~	Intermittent ~~/ Continuous~~	~~Intermittent / Continuous~~	~~Intermittent / Continuous~~
*Odour Characteristics & **Potential Odour Sources		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Remark(s)		N 841898.061 E 825157.448	N 841824.578 E 824692.699	N/A	N 840278.840 E 823556.262	N/A	N 841824.590 E 824677.266	N/A	N/A

*Description of Odour Characteristics: Sewage or rotten-egg smell, decayed vegetables, ammonical, dischargeable odour, putrefaction, sharp, pungent, fish, Irritating, fruit, vinegar, etc
**Potential Odour Source: Exposed sediment, water or sewage; floating debris or material etc

	Name	Signature	Date
Recorded by:	Ho Ka Chun		14-Aug-20
Checked by:	Ivy Tam		14-Aug-20

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Contract No. YL/2018/03
Development of Lok Ma Chau Loop: Main Works Package 1 – Special Site Investigation Works
(In-situ Trial of Sediment Treatment Works in Shenzhen River) and Laboratory Testing

Additional Odour Monitoring Field Record Sheet

Sampling Date: 15-Aug-20

Sampling Location		WSZ-117	WSZ-118	WSZ-119	WHK-117	WHK-118	WHK-119	SED-117	SED-118	SED-119
Weather Condition		Sunny	Sunny	Sunny	Sunny	Sunny	Sunny	Sunny	Sunny	Sunny
Start Time		16:16	14:29	13:46	15:57	15:00	13:54	15:39	15:18	14:10
Water Depth (m)		2.8	2.9	2.3	2.8	2.9	2.4			
Ambient Air Temperature (℃)		32.2	31.4	31.8	31.6	30.6	32.3	31.8	30.8	34.6
Wind Direction		N/A	W	W	W	W	W	N/A	W	W
H_2S (ppbv)	1st	<3	<3	<3	<3	<3	<3	<3	<3	<3
	2nd	<3	<3	<3	<3	<3	<3	<3	<3	<3
Water Temperature (℃)	1st	30.8	30.6	30.9	30.8	30.7	30.9			
	2nd	30.8	30.6	30.9	30.8	30.7	30.9			
Salinity (ppt)	1st	0.6	0.9	0.4	0.6	0.8	0.3			
	2nd	0.6	0.9	0.4	0.6	0.8	0.3			
pH	1st	7.0	6.9	7.1	7.1	6.7	6.9	6.6	6.6	6.9
	2nd	7.0	6.9	7.1	7.1	6.7	6.9	6.6	6.6	6.9
Redox (mV)	1st	35.0	-38.6	48.6	-10.5	44.0	89.5	-189.2	-274.9	-251.5
	2nd	32.7	-37.9	47.7	-10.0	43.1	88.0	-190.0	-275.0	-252.4
Duration of Odour		~~Intermittent / Continuous~~	~~Intermittent / Continuous~~	~~Intermittent / Continuous~~	~~Intermittent / Continuous~~	~~Intermittent / Continuous~~	~~Intermittent / Continuous~~	~~Intermittent / Continuous~~	~~Intermittent / Continuous~~	~~Intermittent / Continuous~~
*Odour Characteristics & **Potential Odour Sources		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Remark(s)		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

*Description of Odour Characteristics: Sewage or rotten-egg smell, decayed vegetables, ammonical, dischargeable odour, putrefaction, sharp, pungent, fish, irritating, fruit, vinegar, etc
**Potential Odour Source: Exposed sediment, water or sewage; floating debris or material etc

	Name	Signature	Date
Recorded by:	Ho Ka Chun		15-Aug-20
Checked by:	Ivy Tam		15-Aug-20

Contract No. YL/2018/03
Development of Lok Ma Chau Loop: Main Works Package 1 – Special Site Investigation Works (In-situ Trial of Sediment Treatment Works in Shenzhen River) and Laboratory Testing

Additional Odour Monitoring Field Record Sheet

Sampling Date: 15-Aug-20

Sampling Location		RAA-119	AA-119
Weather Condition		Sunny	Sunny
Start Time		11:55	11:25
Ambient Air Temperature (℃)		35.2	34.8
Wind Direction		N/A	N/A
H_2S (ppbv)	1st	<3	<3
	2nd	<3	<3
Duration of Odour		~~Intermittent / Continuous~~	~~Intermittent / Continuous~~
*Odour Characteristics & **Potential Odour Sources		Nature grass with stinky soil	Nature grass with stinky soil
Remark(s)		N 840592.010 E 822112.590	N/A

*Description of Odour Characteristics: Sewage or rotten-egg smell, decayed vegetables, ammonical, dischargeable odour, putrefaction, sharp, pungent, fish, Irritating, fruit, vinegar, etc
**Potential Odour Source: Exposed sediment, water or sewage; floating debris or material etc

	Name	Signature	Date
Recorded by:	Ho Ka Chun	Chun	15-Aug-20
Checked by:	Ivy Tam	Ivy	15-Aug-20

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Development of Lok Ma Chau Loop: Main Works Package 1 – Special Site Investigation Works
(In-situ Trial of Sediment Treatment Works in Shenzhen River) and Laboratory Testing

Additional Odour Monitoring Field Record Sheet

Sampling Date: 17-Aug-20

Sampling Location		SED-113	SED-114
Weather Condition		Cloudy	Cloudy
Start Time		13:20	13:47
Water Depth (m)			
Ambient Air Temperature (℃)		32.4	33.6
Wind Direction		N	N
H_2S (ppbv)	1st	<3	<3
	2nd	<3	<3
Water Temperature (℃)	1st		
	2nd		
Salinity (ppt)	1st		
	2nd		
pH	1st	6.9	6.6
	2nd	6.9	6.6
Redox (mV)	1st	-151.2	-167.6
	2nd	-149.3	-167.5
Duration of Odour		~~Intermittent / Continuous~~	~~Intermittent / Continuous~~
*Odour Characteristics & **Potential Odour Sources		N/A	N/A
Remark(s)		N 841518.552 E 824239.767	N 841121.917 E 824018.246

*Description of Odour Characteristics: Sewage or rotten-egg smell, decayed vegetables, ammonical, dischargeable odour, putrefaction, sharp, pungent, fish, Irritating, fruit, vinegar, etc
**Potential Odour Source: Exposed sediment, water or sewage; floating debris or material etc

	Name	Signature	Date
Recorded by:	Ho Ka Chun		17-Aug-20
Checked by:	Ivy Tam		17-Aug-20

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Development of Lok Ma Chau Loop: Main Works Package 1 – Special Site Investigation Works (In-situ Trial of Sediment Treatment Works in Shenzhen River) and Laboratory Testing

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Additional Odour Monitoring Field Record Sheet

Sampling Date: 18-Aug-20

Sampling Location		RAA-108	AA-108
Weather Condition		Cloudy	Cloudy
Start Time		13:23	13:53
Ambient Air Temperature (℃)		30.4	33.6
Wind Direction		N/A	N
H_2S (ppbv)	1st	<3	<3
	2nd	<3	<3
Duration of Odour		Intermittent	~~Intermittent / Continuous~~
*Odour Characteristics & **Potential Odour Sources		Nature grass	N/A
Remark(s)		N 843117.386 E 826073.924	N/A

***Description of Odour Characteristics:** Sewage or rotten-egg smell, decayed vegetables, ammonical, dischargeable odour, putrefaction, sharp, pungent, fish, Irritating, fruit, vinegar, etc

****Potential Odour Source:** Exposed sediment, water or sewage; floating debris or material etc

	Name	Signature	Date
Recorded by:	Ho Ka Chun		18-Aug-20
Checked by:	Ivy Tam		18-Aug-20

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Development of Lok Ma Chau Loop: Main Works Package 1 – Special Site Investigation Works (In-situ Trial of Sediment Treatment Works in Shenzhen River) and Laboratory Testing

Additional Odour Monitoring Field Record Sheet

Sampling Date: 20-Aug-20

Sampling Location		WSZ-106	WHK-106	WHK-107	SED-106
Weather Condition		Sunny	Sunny	Sunny	Sunny
Start Time		16:10	16:32	17:22	16:56
Water Depth (m)		1.9	0.6	1.9	
Ambient Air Temperature (℃)		33.8	34.4	33.8	33.6
Wind Direction		E	E	E	E
H_2S (ppbv)	1st	<3	<3	<3	<3
	2nd	<3	<3	<3	<3
Water Temperature (℃)	1st	28.1	29.0	28.4	
	2nd	28.1	29.0	28.4	
Salinity (ppt)	1st	0.1	0.5	0.2	
	2nd	0.1	0.5	0.2	
pH	1st	7.1	6.8	7.1	6.6
	2nd	7.0	6.8	7.1	6.6
Redox (mV)	1st	39.2	40.9	81.4	-226.2
	2nd	40.0	41.1	82.3	-228.9
Duration of Odour		~~Intermittent / Continuous~~	~~Intermittent / Continuous~~	~~Intermittent / Continuous~~	~~Intermittent / Continuous~~
*Odour Characteristics & **Potential Odour Sources		N/A	N/A	N/A	N/A
Remark(s)		N/A	N/A	N/A	N/A

*Description of Odour Characteristics: Sewage or rotten-egg smell, decayed vegetables, ammonical, dischargeable odour, putrefaction, sharp, pungent, fish, Irritating, fruit, vinegar, etc
**Potential Odour Source: Exposed sediment, water or sewage; floating debris or material etc

	Name	Signature	Date
Recorded by:	Ho Ka Chun		20-Aug-20
Checked by:	Ivy Tam		20-Aug-20

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Development of Lok Ma Chau Loop: Main Works Package 1 – Special Site Investigation Works (In-situ Trial of Sediment Treatment Works in Shenzhen River) and Laboratory Testing

Additional Odour Monitoring Field Record Sheet

Sampling Date: 20-Aug-20

Sampling Location		RAA-106	RAA-107	AA-106	AA-107
Weather Condition		Cloudy	Cloudy	Sunny	Sunny
Start Time		15:31	14:49	15:55	15:14
Ambient Air Temperature (℃)		33.8	33.8	33.6	32.2
Wind Direction		S	S	E	E
H_2S (ppbv)	1st	<3	<3	<3	<3
	2nd	<3	<3	<3	<3
Duration of Odour		~~Intermittent / Continuous~~	~~Intermittent / Continuous~~	Intermittent	~~Intermittent / Continuous~~
*Odour Characteristics & **Potential Odour Sources		N/A	N/A	Sewage	N/A
Remark(s)		N/A	N/A	N/A	N/A

*Description of Odour Characteristics: Sewage or rotten-egg smell, decayed vegetables, ammonical, dischargeable odour, putrefaction, sharp, pungent, fish, Irritating, fruit, vinegar, etc
**Potential Odour Source: Exposed sediment, water or sewage; floating debris or material etc

	Name	Signature	Date
Recorded by:	Ho Ka Chun		20-Aug-20
Checked by:	Ivy Tam	Ivy	20-Aug-20

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Development of Lok Ma Chau Loop: Main Works Package 1 – Special Site Investigation Works (In-situ Trial of Sediment Treatment Works in Shenzhen River) and Laboratory Testing

Additional Odour Monitoring Field Record Sheet

Sampling Date: 21-Aug-20

Sampling Location		WSZ-109
Weather Condition		Cloudy
Start Time		15:54
Water Depth (m)		3.8
Ambient Air Temperature (℃)		33.8
Wind Direction		NW
H_2S (ppbv)	1st	<3
	2nd	<3
Water Temperature (℃)	1st	29.4
	2nd	29.4
Salinity (ppt)	1st	0.2
	2nd	0.2
pH	1st	6.7
	2nd	6.7
Redox (mV)	1st	42.4
	2nd	42.3
Duration of Odour		~~Intermittent / Continuous~~
*Odour Characteristics & **Potential Odour Sources		N/A
Remark(s)		N/A

*Description of Odour Characteristics: Sewage or rotten-egg smell, decayed vegetables, ammonical, dischargeable odour, putrefaction, sharp, pungent, fish, Irritating, fruit, vinegar, etc
**Potential Odour Source: Exposed sediment, water or sewage; floating debris or material etc

	Name	Signature	Date
Recorded by:	Ho Ka Chun		21-Aug-20
Checked by:	Ivy Tam		21-Aug-20

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Development of Lok Ma Chau Loop: Main Works Package 1 – Special Site Investigation Works
(In-situ Trial of Sediment Treatment Works in Shenzhen River) and Laboratory Testing

Additional Odour Monitoring Field Record Sheet

Sampling Date: 25-Aug-20

Sampling Location		WSZ-107	WSZ-108	WSZ-110	WHK-109	WHK-110	SED-108
Weather Condition		Sunny	Sunny	Sunny	Sunny	Sunny	Sunny
Start Time		10:50	10:35	09:28	08:58	09:50	10:15
Water Depth (m)		1.9	0.7	2.6	2.3	2.7	
Ambient Air Temperature (℃)		34	34.2	32.8	32.8	32.2	32.8
Wind Direction		SW	SW	SW	SW	SW	SW
H_2S (ppbv)	1st	<3	<3	<3	<3	<3	<3
	2nd	<3	<3	<3	<3	<3	<3
Water Temperature (℃)	1st	30.2	30.2	29.8	30.0	29.9	
	2nd	30.2	30.2	29.8	29.9	29.9	
Salinity (ppt)	1st	0.3	0.3	0.2	0.2	0.3	
	2nd	0.3	0.2	0.2	0.2	0.3	
pH	1st	6.6	6.6	6.5	6.6	6.6	6.3
	2nd	6.6	6.6	0.6	6.5	6.6	6.3
Redox (mV)	1st	66.3	55.8	35.6	49.8	41.2	-141.2
	2nd	68.6	55.7	36.3	49.7	42.6	-142.5
Duration of Odour		~~Intermittent / Continuous~~	~~Intermittent / Continuous~~	~~Intermittent / Continuous~~	~~Intermittent / Continuous~~	~~Intermittent / Continuous~~	~~Intermittent / Continuous~~
*Odour Characteristics & **Potential Odour Sources		N/A	N/A	N/A	N/A	N/A	N/A
Remark(s)		N/A	N/A	N/A	N/A	N/A	N/A

***Description of Odour Characteristics:** Sewage or rotten-egg smell, decayed vegetables, ammonical, dischargeable odour, putrefaction, sharp, pungent, fish, Irritating, fruit, vinegar, etc
****Potential Odour Source:** Exposed sediment, water or sewage; floating debris or material etc

	Name	Signature	Date
Recorded by:	Ho Ka Chun		25-Aug-20
Checked by:	Ivy Tam		25-Aug-20

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Development of Lok Ma Chau Loop: Main Works Package 1 – Special Site Investigation Works (In-situ Trial of Sediment Treatment Works in Shenzhen River) and Laboratory Testing

Additional Odour Monitoring Field Record Sheet

Sampling Date: 26-Aug-20

Sampling Location		WSZ-102	WSZ-103	WSZ-104	WSZ-105	WHK-102	WHK-103	WHK-104	WHK-105	WHK-108
Weather Condition		Sunny	Sunny	Sunny	Sunny	Sunny	Sunny	Sunny	Sunny	Sunny
Start Time		12:05	11:25	09:50	10:45	11:45	11:05	09:36	10:30	09:00
Water Depth (m)		1.2	1.9	3.4	0.6	0.8	1.8	1.5	0.3	0.3
Ambient Air Temperature (℃)		34.8	34.8	33.2	33.6	34.2	34.6	33	34.4	33.4
Wind Direction		NW	NW	N	NW	NW	NW	N	NW	NW
H_2S (ppbv)	1st	<3	<3	<3	<3	<3	<3	<3	<3	<3
	2nd	<3	<3	<3	<3	<3	<3	<3	<3	<3
Water Temperature (℃)	1st	30.9	30.6	30.0	30.3	30.8	30.6	30.0	30.0	29.9
	2nd	30.9	30.6	30.0	30.2	30.9	30.6	30.0	30.0	29.9
Salinity (ppt)	1st	0.3	0.3	0.3	0.3	0.3	0.2	0.2	0.2	0.2
	2nd	0.3	0.3	0.3	0.3	0.3	0.2	0.2	0.2	0.2
pH	1st	6.7	6.8	6.7	6.7	6.8	6.9	6.8	6.9	6.6
	2nd	6.7	6.7	6.7	6.7	6.8	6.9	6.7	6.8	6.6
Redox (mV)	1st	84.3	74.1	58.6	73.2	65.4	66.5	35.6	42.7	30.5
	2nd	82.2	74.2	58.4	73.8	63.8	66.1	35.4	42.9	30.1
Duration of Odour		~~Intermittent / Continuous~~	~~Intermittent / Continuous~~	~~Intermittent / Continuous~~	~~Intermittent / Continuous~~	~~Intermittent / Continuous~~	~~Intermittent / Continuous~~	~~Intermittent / Continuous~~	~~Intermittent / Continuous~~	~~Intermittent / Continuous~~
*Odour Characteristics & **Potential Odour Sources		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Remark(s)		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

*Description of Odour Characteristics: Sewage or rotten-egg smell, decayed vegetables, ammonical, dischargeable odour, putrefaction, sharp, pungent, fish, irritating, fruit, vinegar, etc
**Potential Odour Source: Exposed sediment, water or sewage; floating debris or material etc

	Name	Signature	Date
Recorded by:	Ho Ka Chun		26-Aug-20
Checked by:	Ivy Tam		26-Aug-20

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Contract No. YL/2018/03
Development of Lok Ma Chau Loop: Main Works Package 1 – Special Site Investigation Works
(In-situ Trial of Sediment Treatment Works in Shenzhen River) and Laboratory Testing

Additional Odour Monitoring Field Record Sheet

Sampling Date: 26-Aug-20

Sampling Location		RAA-101	RAA-102	RAA-103	RAA-104	AA-101	AA-102	AA-103	AA-104
Weather Condition		Sunny	Sunny	Sunny	Sunny	Sunny	Sunny	Sunny	Sunny
Start Time		11:35	10:55	10:10	09:20	12:00	11:15	10:30	09:45
Ambient Air Temperature (℃)		35.2	35.2	34.8	34.2	35.4	35.8	35.2	34.8
Wind Direction		W	W	W	NW	NW	W	W	NW
H_2S (ppbv)	1st	<3	<3	<3	<3	<3	<3	<3	<3
	2nd	<3	<3	<3	<3	<3	<3	<3	<3
Duration of Odour		~~Intermittent / Continuous~~	~~Intermittent / Continuous~~	~~Intermittent / Continuous~~	~~Intermittent / Continuous~~	~~Intermittent / Continuous~~	~~Intermittent / Continuous~~	~~Intermittent / Continuous~~	~~Intermittent / Continuous~~
*Odour Characteristics & **Potential Odour Sources		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Remark(s)		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

*Description of Odour Characteristics: Sewage or rotten-egg smell, decayed vegetables, ammonical, dischargeable odour, putrefaction, sharp, pungent, fish, Irritating, fruit, vinegar, etc
**Potential Odour Source: Exposed sediment, water or sewage; floating debris or material etc

	Name	Signature	Date
Recorded by:	Ho Ka Chun		26-Aug-20
Checked by:	Ivy Tam	Ivy	26-Aug-20

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Development of Lok Ma Chau Loop: Main Works Package 1 – Special Site Investigation Works (In-situ Trial of Sediment Treatment Works in Shenzhen River) and Laboratory Testing

Additional Odour Monitoring Field Record Sheet

Sampling Date: 27-Aug-20

Sampling Location		WSZ-101	WSZ-114	WHK-101	WHK-113	WHK-114	SED-111	SED-112
Weather Condition		Cloudy	Cloudy	Sunny	Cloudy	Cloudy	Cloudy	Cloudy
Start Time		09:37	14:00	09:57	14:25	13:38	11:50	11:14
Water Depth (m)		3.5	1.8	4.0	1.0	0.4		
Ambient Air Temperature (℃)		31	33.2	30.4	32.2	32.6	31.2	33.2
Wind Direction		N/A	S	N/A	N/A	N/A	SW	S
H_2S (ppbv)	1st	<3	3.12	<3	<3	<3	<3	<3
	2nd	<3	3.04	<3	<3	<3	<3	<3
Water Temperature (℃)	1st	29.9	30.8	29.9	31.4	31.7		
	2nd	29.9	30.9	29.9	31.4	31.7		
Salinity (ppt)	1st	0.2	0.4	0.2	0.4	0.4		
	2nd	0.2	0.4	0.2	0.4	0.4		
pH	1st	6.5	6.9	6.6	6.9	7.1	6.1	6.2
	2nd	6.5	6.9	6.6	6.8	7.1	6.1	6.2
Redox (mV)	1st	38.1	94.4	66.0	112.8	103.5	-159.8	-126.4
	2nd	38.2	93.2	65.8	112.0	101.8	-160.7	-131.9
Duration of Odour		~~Intermittent / Continuous~~	~~Intermittent / Continuous~~	~~Intermittent / Continuous~~	~~Intermittent / Continuous~~	~~Intermittent / Continuous~~	~~Intermittent / Continuous~~	~~Intermittent / Continuous~~
*Odour Characteristics & **Potential Odour Sources		N/A	N/A	N/A	N/A	N/A	N/A	N/A
Remark(s)		N/A	N 841140.391 E 823995.968	N/A	N 841544.416 E 824207.207	N 841099.781 E 824002.794	N 841910.959 E 825186.607	N 841830.104 E 824708.136

***Description of Odour Characteristics:** Sewage or rotten-egg smell, decayed vegetables, ammonical, dischargeable odour, putrefaction, sharp, pungent, fish, Irritating, fruit, vinegar, etc
****Potential Odour Source:** Exposed sediment, water or sewage; floating debris or material etc

	Name	Signature	Date
Recorded by:	Ho Ka Chun		27-Aug-20
Checked by:	Ivy Tam		27-Aug-20

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Development of Lok Ma Chau Loop: Main Works Package 1 – Special Site Investigation Works (In-situ Trial of Sediment Treatment Works in Shenzhen River) and Laboratory Testing

Additional Odour Monitoring Field Record Sheet

Sampling Date: 27-Aug-20

Sampling Location		RAA-105	RAA-109	RAA-110	AA-105	AA-109	AA-110
Weather Condition		Cloudy	Cloudy	Cloudy	Cloudy	Cloudy	Cloudy
Start Time		09:22	10:10	10:42	09:43	10:25	10:58
Ambient Air Temperature (℃)		30.2	32.8	32.2	30.2	32.6	33.6
Wind Direction		NW	NW	NW	N/W	NW	NW
H_2S (ppbv)	1st	<3	<3	<3	<3	<3	<3
	2nd	<3	<3	<3	<3	<3	<3
Duration of Odour		~~Intermittent / Continuous~~	~~Intermittent / Continuous~~	~~Intermittent / Continuous~~	~~Intermittent / Continuous~~	~~Intermittent / Continuous~~	~~Intermittent / Continuous~~
*Odour Characteristics & **Potential Odour Sources		N/A	N/A	N/A	N/A	N/A	N/A
Remark(s)		N 844079.970 E 827422.152	N 842547.201 E 825903.794	N/A	N/A	N/A	N/A

***Description of Odour Characteristics:** Sewage or rotten-egg smell, decayed vegetables, ammonical, dischargeable odour, putrefaction, sharp, pungent, fish, Irritating, fruit, vinegar, etc
****Potential Odour Source:** Exposed sediment, water or sewage; floating debris or material etc

	Name	Signature	Date
Recorded by:	Ho Ka Chun		27-Aug-20
Checked by:	Ivy Tam	Ivy	27-Aug-20

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Contract No. YL/2018/03
Development of Lok Ma Chau Loop: Main Works Package 1 – Special Site Investigation Works
(In-situ Trial of Sediment Treatment Works in Shenzhen River) and Laboratory Testing

Additional Odour Monitoring Field Record Sheet

Sampling Date: 28-Aug-20

Sampling Location		RAA-113	RAA-114	RAA-117	RAA-118	AA-113	AA-114	AA-117	AA-118
Weather Condition		Cloudy	Cloudy	Cloudy	Cloudy	Cloudy	Cloudy	Cloudy	Cloudy
Start Time		9:31	10:05	10:45	11:20	9:45	10:25	11:00	11:38
Ambient Air Temperature (℃)		33.8	34.4	34	33.8	34.4	34	34.6	34
Wind Direction		N	N	N	N	N	N	N	N
H_2S (ppbv)	1st	<3	<3	<3	<3	<3	<3	<3	<3
	2nd	<3	<3	<3	<3	<3	<3	<3	<3
Duration of Odour		~~Intermittent / Continuous~~	~~Intermittent / Continuous~~	~~Intermittent / Continuous~~	~~Intermittent / Continuous~~	~~Intermittent / Continuous~~	~~Intermittent / Continuous~~	~~Intermittent / Continuous~~	~~Intermittent / Continuous~~
*Odour Characteristics & **Potential Odour Sources		N/A	N/A	N/A	N/A	N/A	N/A	Stinky soil	N/A
Remark(s)		N 841509.322 E 824241.475	N 841083.159 E 824018.215	N/A	N 840443.967 E 822546.323	N 841524.079 E 824251.775	N/A	N/A	N 840464.271 E 822544.626

*Description of Odour Characteristics: Sewage or rotten-egg smell, decayed vegetables, ammonical, dischargeable odour, putrefaction, sharp, pungent, fish, Irritating, fruit, vinegar, etc
**Potential Odour Source: Exposed sediment, water or sewage; floating debris or material etc

	Name	Signature	Date
Recorded by:	Ho Ka Chun		28-Aug-20
Checked by:	Ivy Tam		28-Aug-20

APPENDIX F
RESULTS OF OLFACTOMETRY ANALYSIS AND HEDONIC TONE TEST

Contract No. YL/2018/03
Development of Lok Ma Chau Loop: Main Works Package 1 – Special Site Investigation Works (In-situ Trial of Sediment Treatment Works in Shenzhen River) and Laboratory Testing

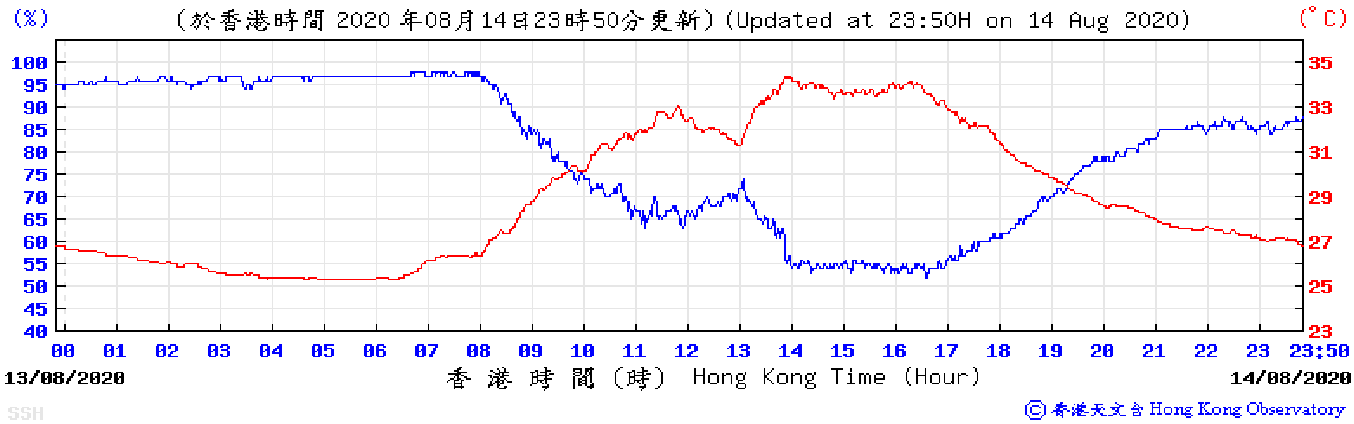
Additional Odour Monitoring Preliminary Results (SI No. 009)

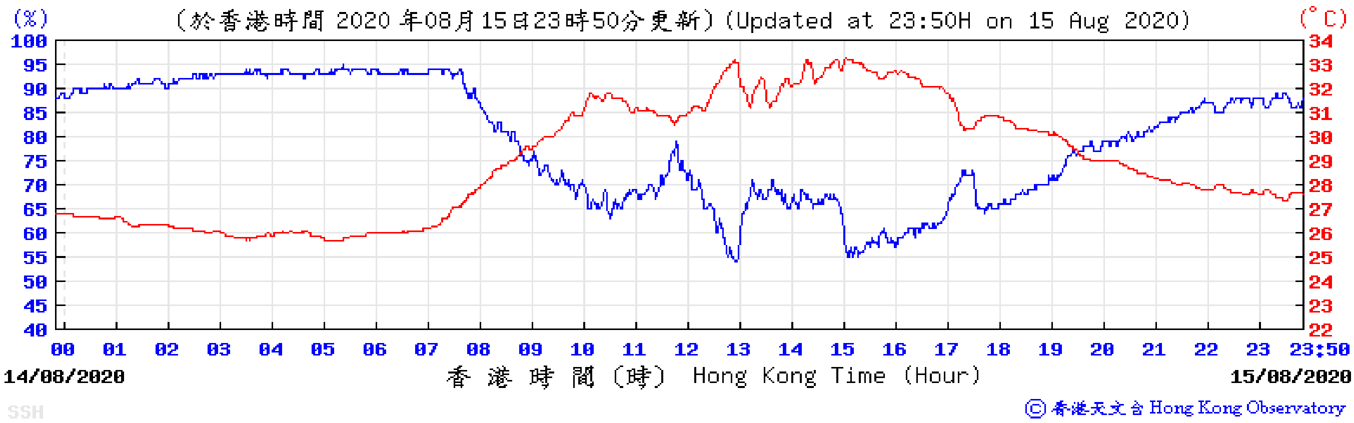
Sampling Date	Sampling Type	Sample ID	Sample No.	Odour Concentration (ou/m^3)	SOER (ou/m2/s)	Hedonic Tone Scale (Average)
14-Aug-2020	Water Surface	Blank	33905-28	<5	<0.016	0
	Water Surface	WHK-111	33905-6	<5	<0.016	N/A
	Water Surface	WSZ-111	33905-1	5.85	0.018	N/A
	Water Surface	WHK-112	33905-7	8.46	0.027	N/A
	Water Surface	WSZ-112	33905-2	8.47	0.027	N/A
	Water Surface	WSZ-113	33905-3	5.85	0.018	N/A
	Water Surface	WHK-115	33905-8	17.22	0.054	N/A
	Water Surface	WSZ-115	33905-4	<5	<0.016	N/A
	Water Surface	WHK-116	33905-9	5.85	0.018	N/A
	Water Surface	WSZ-116	33905-5	<5	<0.016	N/A
	Ambient Air	AA-111	33905-18&19	9.28	N/A	0
	Ambient Air	RAA-111	33905-10&11	9.28	N/A	0
	Ambient Air	AA-112	33905-20&21	7.72	N/A	0
	Ambient Air	RAA-112	33905-12&13	12.18	N/A	0
	Ambient Air	AA-115	33905-24&25	8.47	N/A	0
	Ambient Air	RAA-115	33905-14&15	12.18	N/A	0
	Ambient Air	AA-116	33905-26&27	11.12	N/A	0
	Ambient Air	RAA-116	33905-16&17	11.12	N/A	0
15-Aug-2020	Water Surface	Blank	33902-14	<5	<0.016	0
	Water Surface	WHK-117	33902-6	7.72	0.024	N/A
	Water Surface	WSZ-117	33902-3	<5	<0.016	N/A
	Sediment Surface	SED-117	33902-9	12.18	0.038	N/A
	Water Surface	WHK-118	33902-5	5.85	0.018	N/A
	Water Surface	WSZ-118	33902-2	<5	<0.016	N/A
	Sediment Surface	SED-118	33902-8	12.18	0.038	N/A
	Water Surface	WHK-119	33902-4	7.72	0.024	N/A
	Water Surface	WSZ-119	33902-1	12.18	0.038	N/A
	Sediment Surface	SED-119	33902-7	7.72	0.024	N/A
	Ambient Air	RAA-119	33902-10 & 11	17.22	N/A	-2
	Ambient Air	AA-119	33902-12 &13	12.18	N/A	-2
17-Aug-2020	Water Surface	Blank	33918-1	<5	<0.016	N/A
	Sediment Surface	SED-113	33918-2	12.18	0.038	N/A
	Sediment Surface	SED-114	33918-3	17.22	0.054	N/A
18-Aug-2020	Water Surface	Blank	33924-1	<5	<0.016	0
	Ambient Air	RAA-108	33924-2&3	17.22	N/A	0
	Ambient Air	AA-108	33924-4&5	17.22	N/A	0
20-Aug-2020	Water Surface	Blank	33929-1	<5	<0.016	0
	Water Surface	WSZ-106	33929-2	12.18	0.038	N/A
	Water Surface	WHK-106	33929-3	5.85	0.018	N/A
	Water Surface	WHK-107	33929-4	12.18	0.038	N/A
	Sediment Surface	SED-106	33929-5	76.59	0.241	N/A
	Ambient Air	RAA-106	33929-7&8	13.28	N/A	0
	Ambient Air	RAA-107	33929-9&10	25.02	N/A	0
	Ambient Air	AA-106	33929-11&12	12.18	N/A	0
	Ambient Air	AA-107	33929-13&14	9.28	N/A	0
21-Aug-2020	Water Surface	Blank	33938-1	<5	<0.016	N/A
	Water Surface	WSZ-109	33938-2	17.22	0.054	N/A
25-Aug-20	Water Surface	Blank	33955-1	<5	<0.016	N/A
	Water Surface	WSZ-107	33955-4	25.02	0.079	N/A
	Water Surface	WSZ-108	33955-5	22.79	0.072	N/A
	Water Surface	WSZ-110	33955-6	25.02	0.079	N/A
	Water Surface	WHK-109	33955-2	17.22	0.054	N/A
	Water Surface	WHK-110	33955-3	36.41	0.115	N/A
	Sediment Surface	SED-108	33955-7	36.41	0.115	N/A

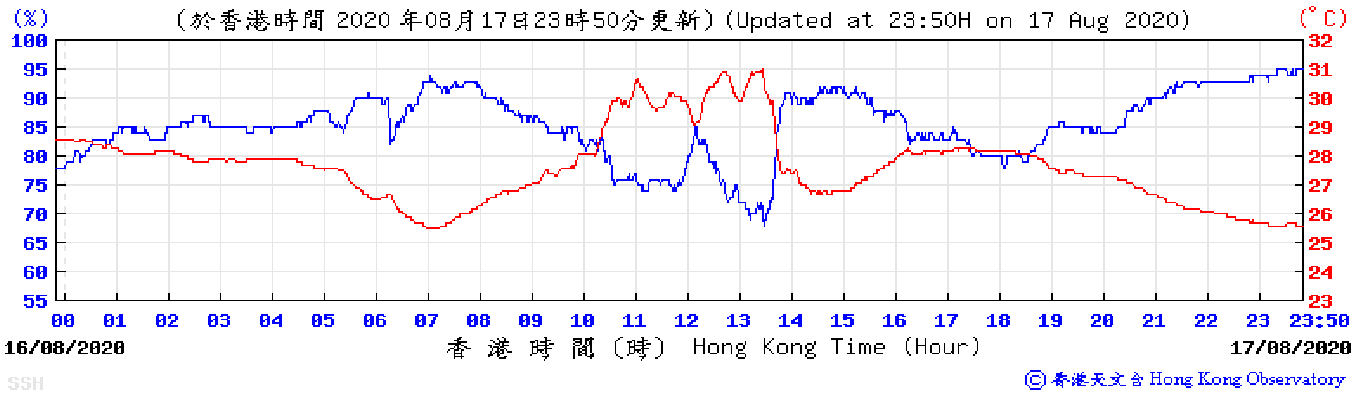
Sampling Date	Sampling Type	Sample ID	Sample No.	Odour Concentration (ou/m^3)	SOER (ou/m2/s)	Hedonic Tone Scale (Average)
26-Aug-20	Water Surface	Blank	33961-1	<5	<0.016	0
	Water Surface	WSZ-102	33961-2	17.22	0.054	N/A
	Water Surface	WSZ-103	33961-3	25.02	0.079	N/A
	Water Surface	WSZ-104	33961-4	25.02	0.079	N/A
	Water Surface	WSZ-105	33961-5	36.41	0.115	N/A
	Water Surface	WHK-102	33961-6	<5	<0.016	N/A
	Water Surface	WHK-103	33961-7	<5	<0.016	N/A
	Water Surface	WHK-104	33961-8	<5	<0.016	N/A
	Water Surface	WHK-105	33961-9	<5	<0.016	N/A
	Water Surface	WHK-108	33961-10	<5	<0.016	N/A
	Ambient Air	RAA-101	33961-11&12	<5	N/A	0
	Ambient Air	RAA-102	33961-13&14	<5	N/A	0
	Ambient Air	RAA-103	33961-15&16	<5	N/A	0
	Ambient Air	RAA-104	33961-17&18	15.79	N/A	0
	Ambient Air	AA-101	33961-19&20	17.22	N/A	0
	Ambient Air	AA-102	33961-21&22	17.22	N/A	0
	Ambient Air	AA-103	33961-23&24	17.22	N/A	0
	Ambient Air	AA-104	33961-25&26	15.79	N/A	0
27-Aug-20	Water Surface	Blank	33983-1	<5	<0.016	0
	Water Surface	WSZ-101	33983-2	13.23	0.042	N/A
	Water Surface	WSZ-114	33983-3	15.79	0.050	N/A
	Water Surface	WHK-101	33983-4	17.22	0.054	N/A
	Water Surface	WHK-113	33983-5	15.79	0.050	N/A
	Water Surface	WHK-114	33983-6	17.22	0.054	N/A
	Sediment Surface	SED-111	33983-7	15.79	0.050	N/A
	Sediment Surface	SED-112	33983-8	17.22	0.054	N/A
	Ambient Air	RAA-105	33983-9&10	11.12	N/A	0
	Ambient Air	RAA-109	33983-11&12	17.22	N/A	0
	Ambient Air	RAA-110	33983-13&14	17.22	N/A	0
	Ambient Air	AA-105	33983-15&16	17.22	N/A	0
	Ambient Air	AA-109	33983-17&18	17.22	N/A	0
	Ambient Air	AA-110	33983-19&20	17.22	N/A	0
28-Aug-2020	Water Surface	Blank	33993-1	<5	<0.016	0
	Ambient Air	RAA-113	33993-3&4	17.22	N/A	0
	Ambient Air	RAA-114	33993-5&6	17.22	N/A	0
	Ambient Air	RAA-117	33993-7&8	221.65	N/A	0
	Ambient Air	RAA-118	33993-9&10	17.22	N/A	0
	Ambient Air	AA-113	33993-11&12	36.41	N/A	0
	Ambient Air	AA-114	33993-13&14	17.22	N/A	0
	Ambient Air	AA-117	33993-15&16	33.15	N/A	-2
	Ambient Air	AA-118	33993-17&18	36.41	N/A	0

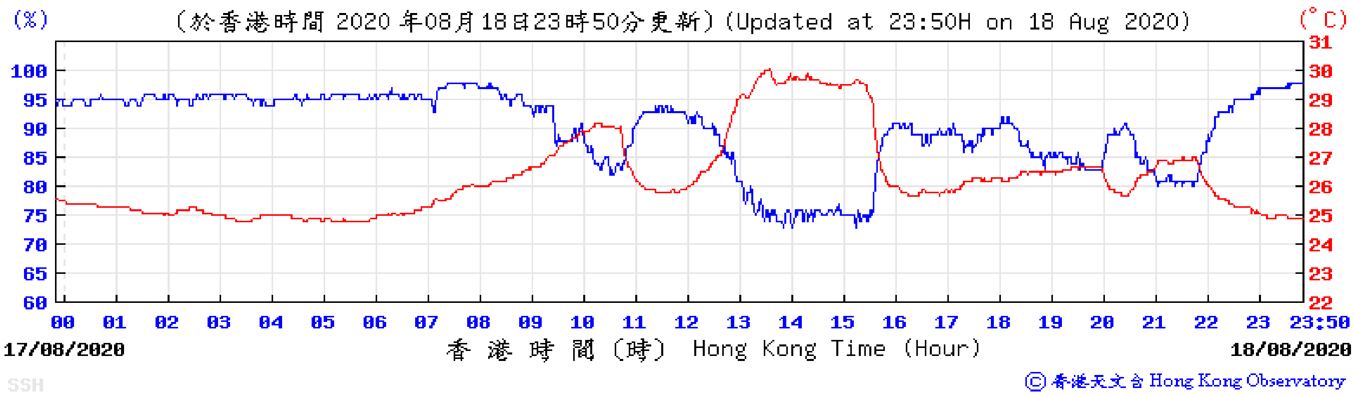
APPENDIX G
METEOROLOGICAL DATA FROM HONG KONG OBSERVATORY STATION DURING ODOUR SAMPLING

Tempearture/Humidity: (Sheung Shui)



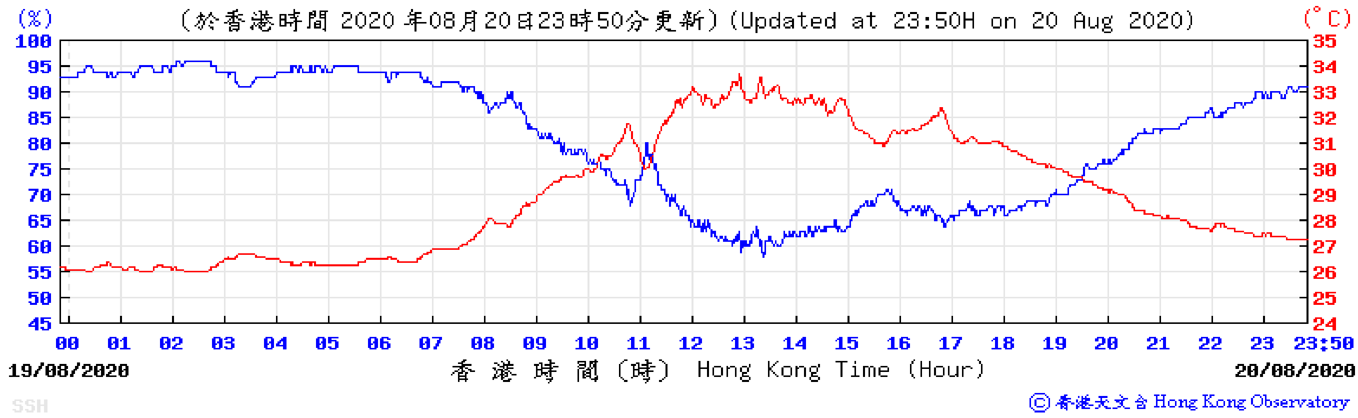


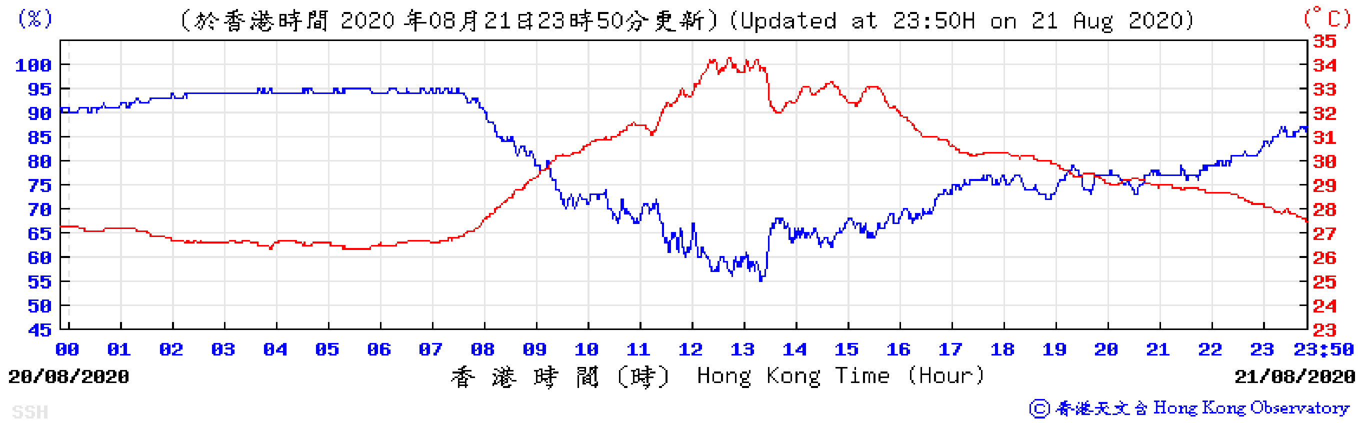


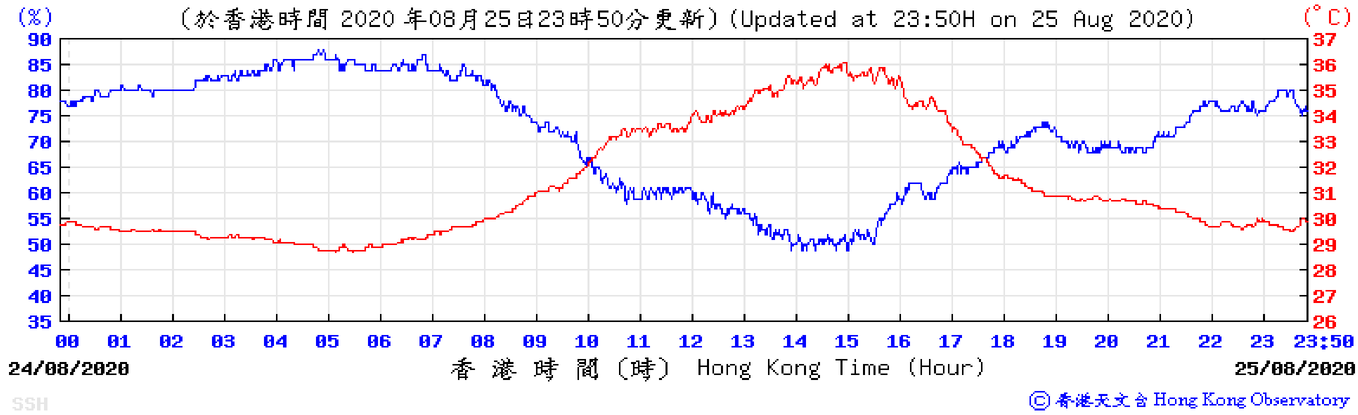


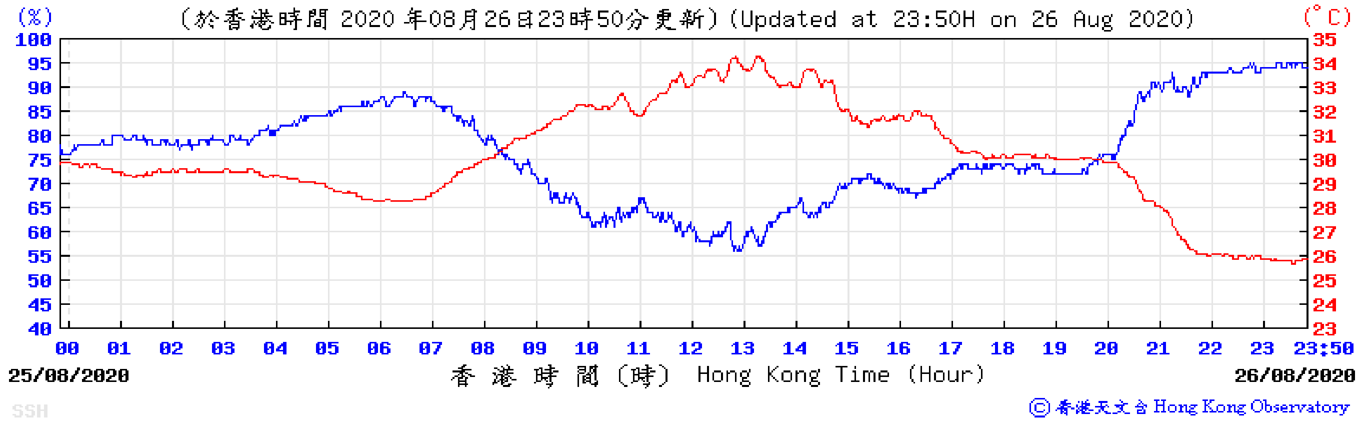
Title	Scale	Project No.	
Contract No. YL/2018/03 Development of Lok Ma Chau Loop: Main Works Package 1 – Special Site Investigation Works (In-situ Trial of Sediment Treatment Works in Shenzhen River) and Laboratory Testing Meteorological Data Recorded from Hong Kong Observatory	N.T.S	WMS19015	WELLAB 匯力 consulting . testing . research
	Date Aug 20	Appendix G	

Tempearture/Humidity: (Sheung Shui)









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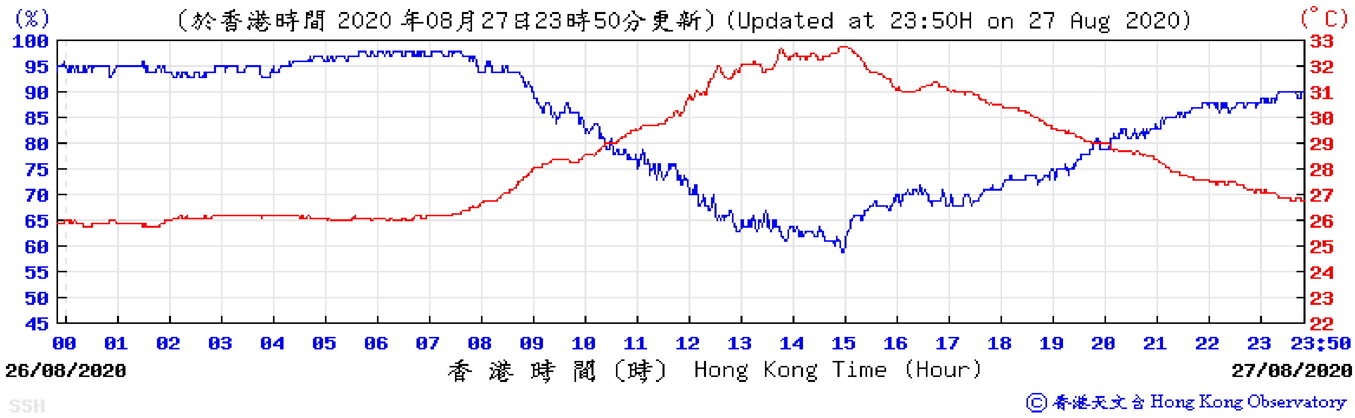
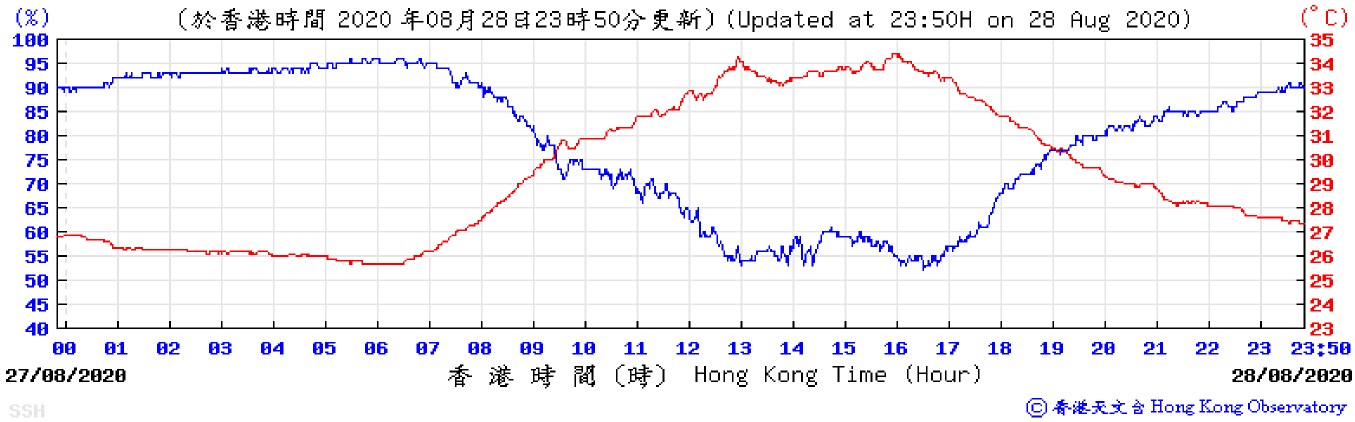
Tempearture/Humidity: (Sheung Shui)





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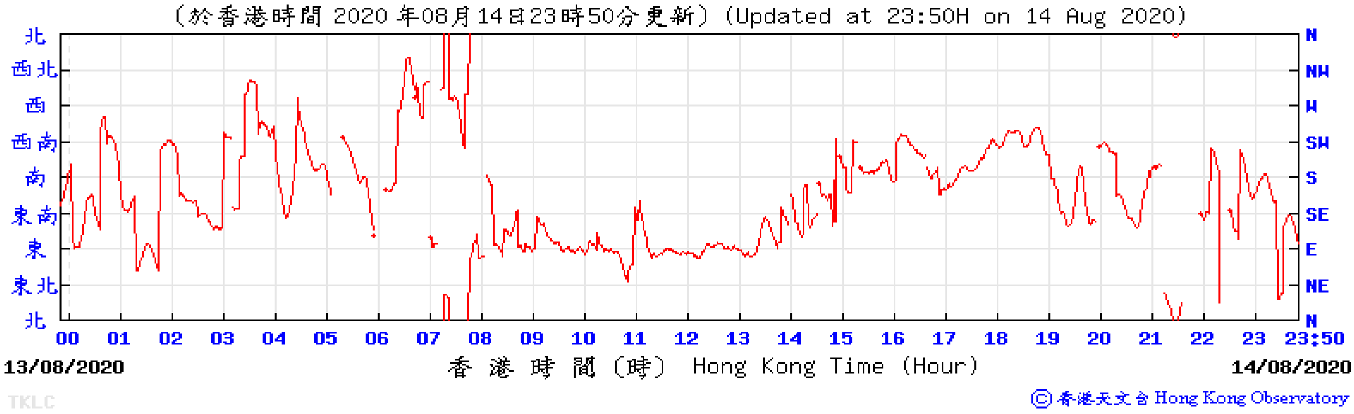
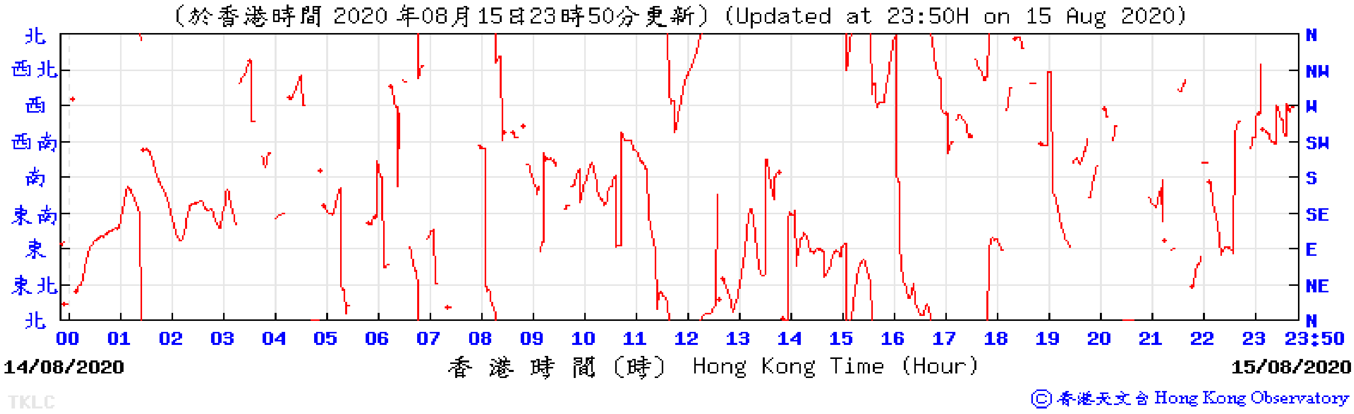
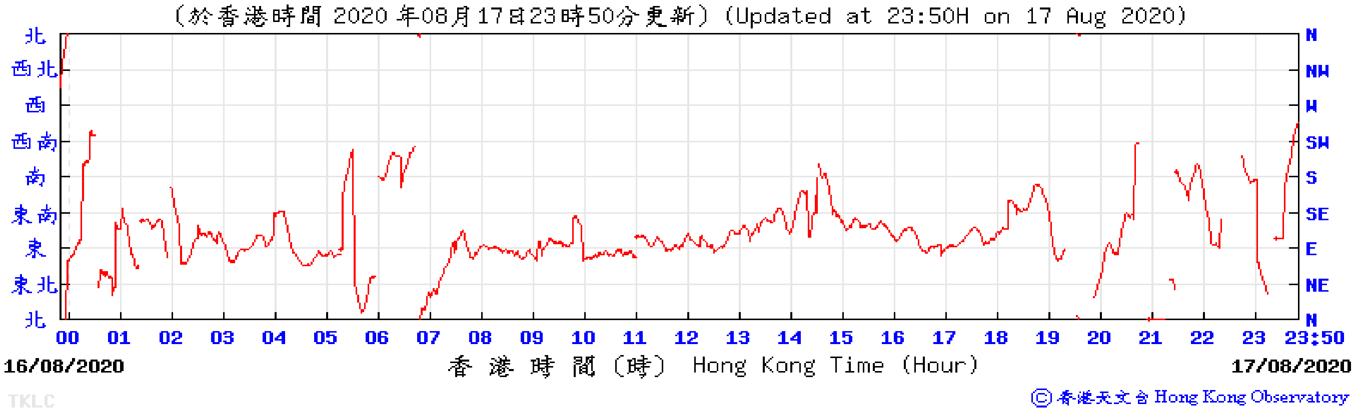
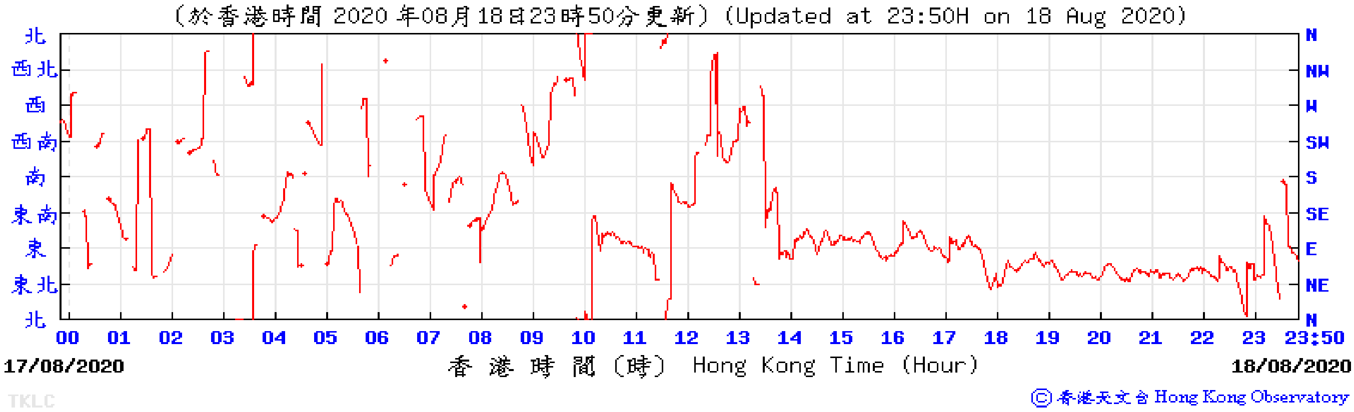
Wind Direction: (Ta Kwu Ling)









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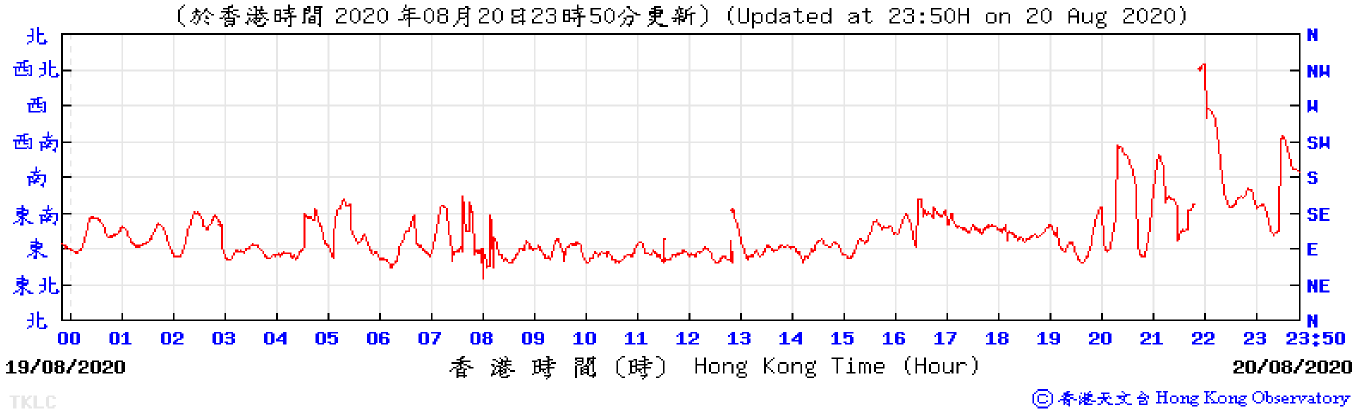

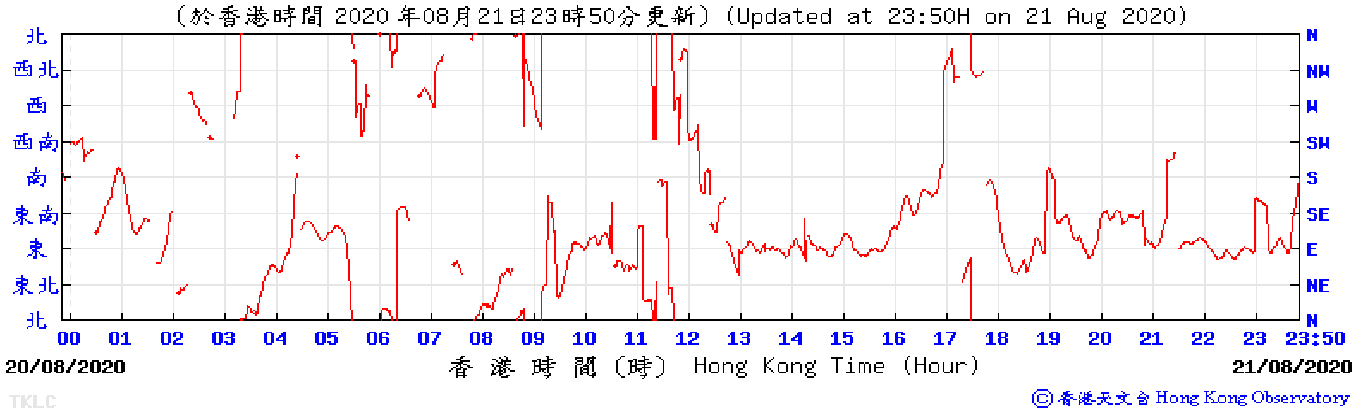

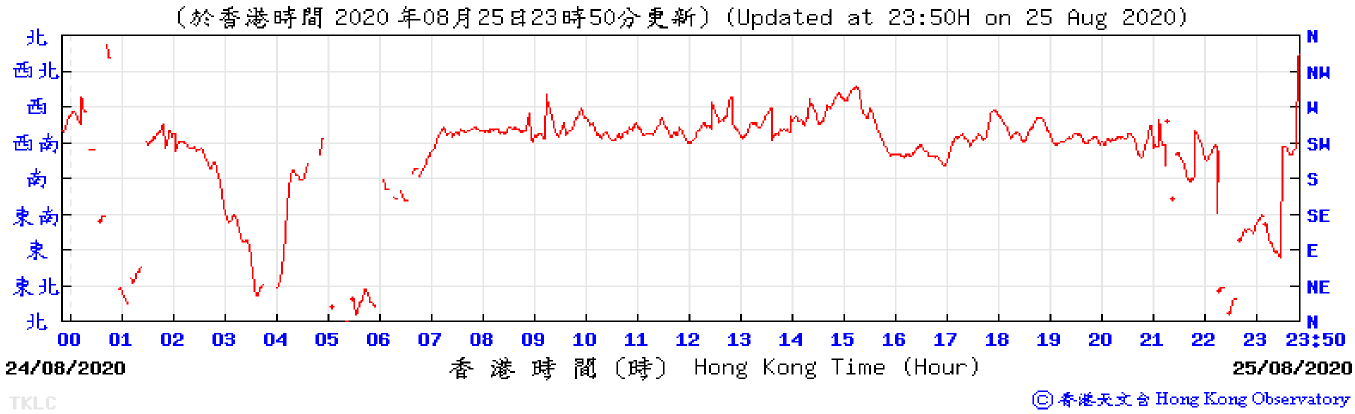

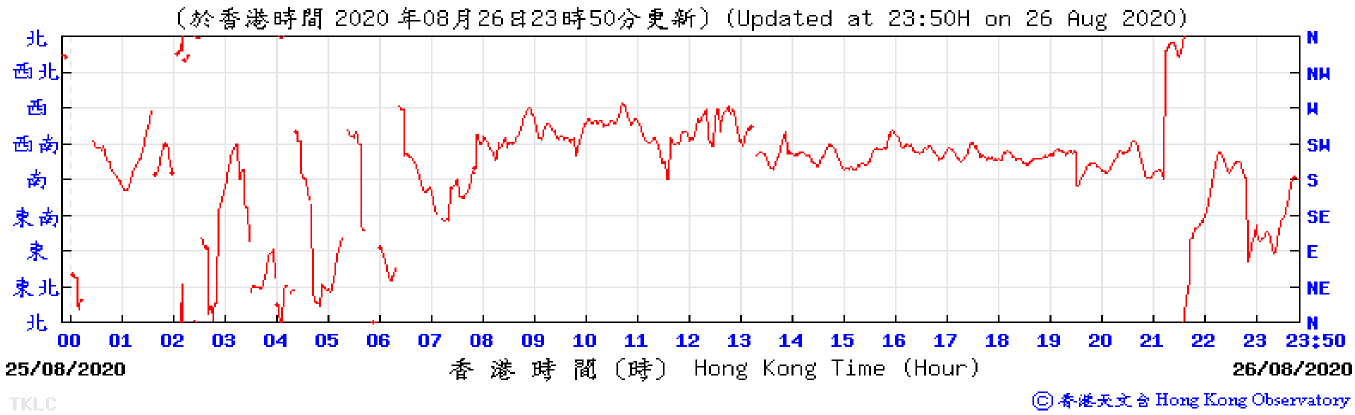

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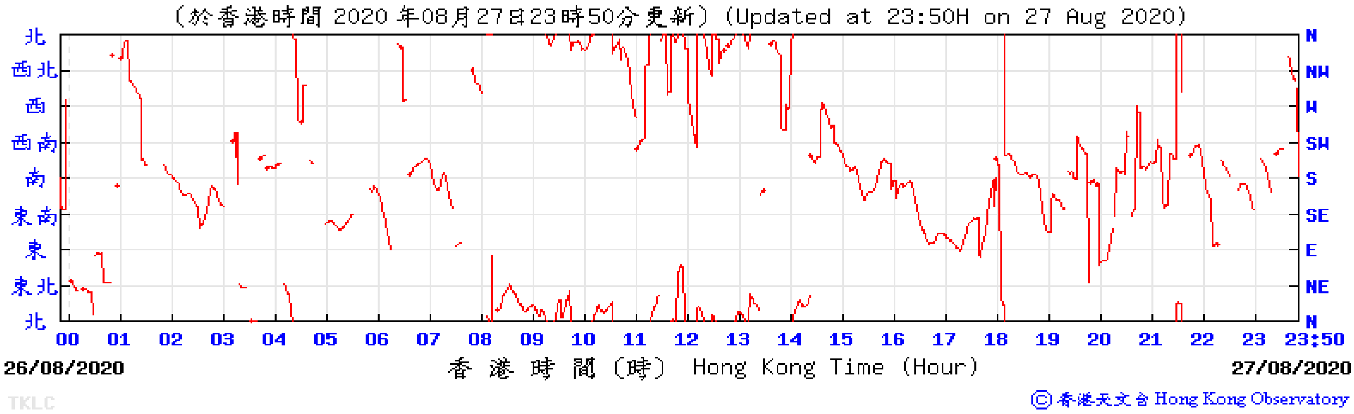

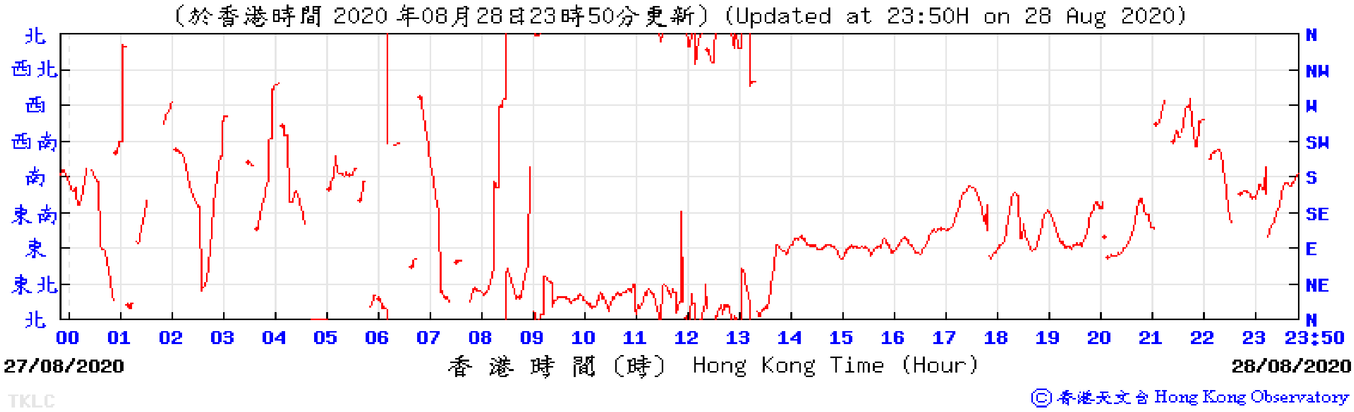

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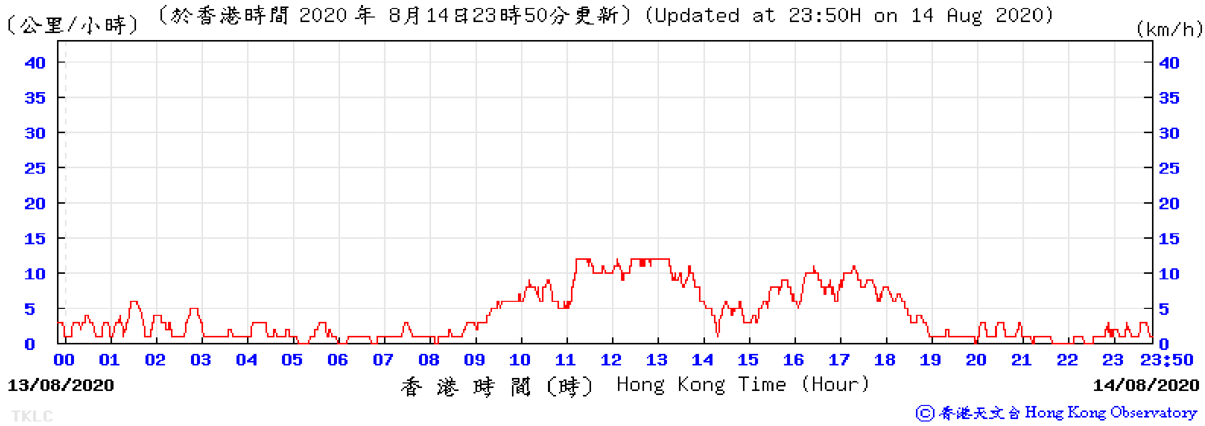
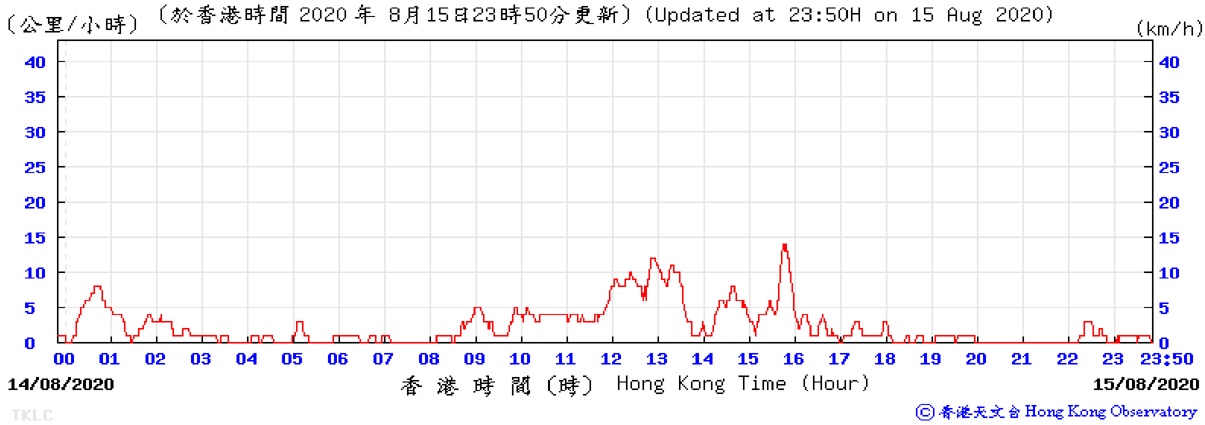
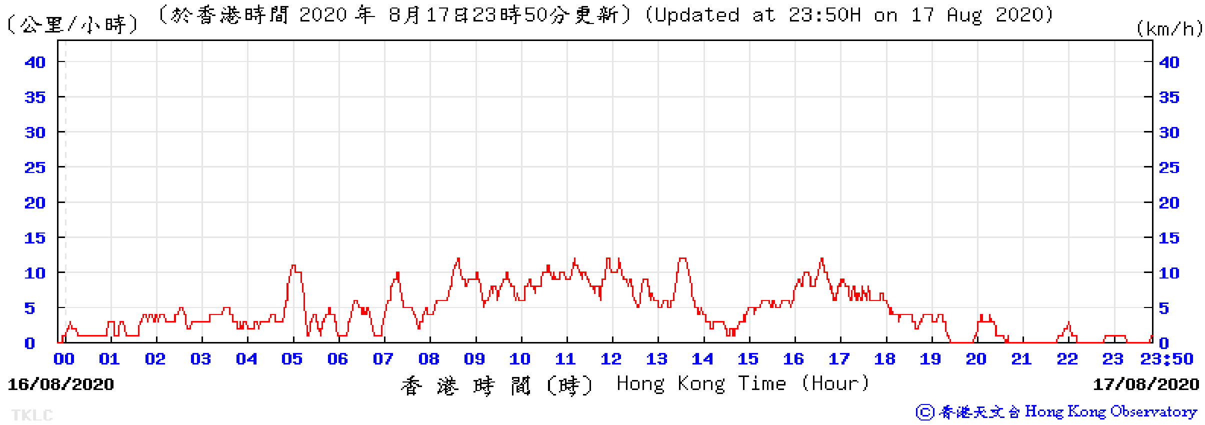
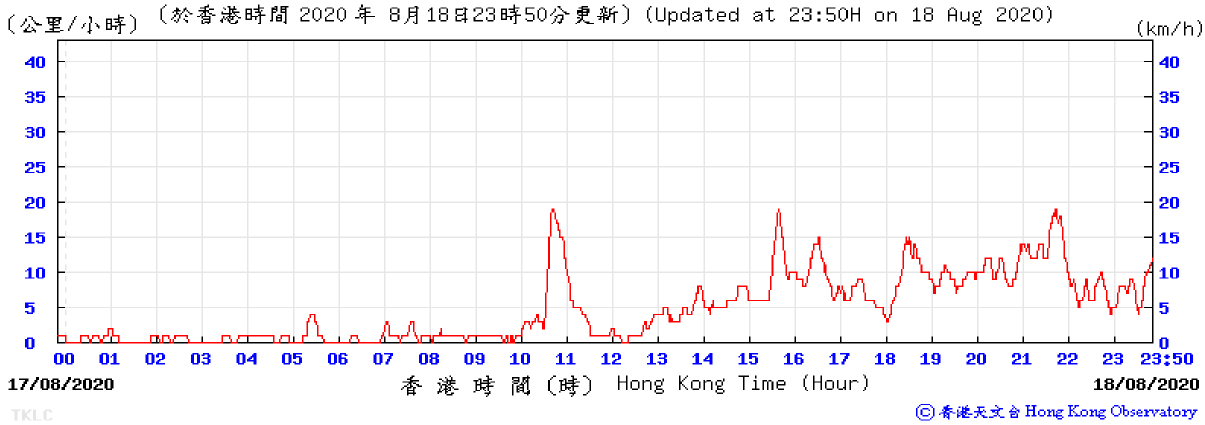
Wind Speed: (Ta Kwu Ling)









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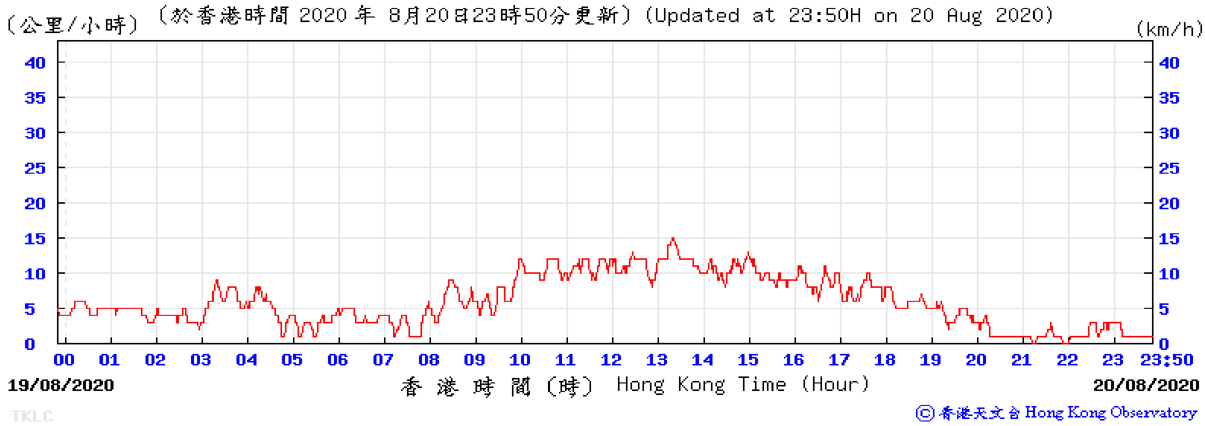
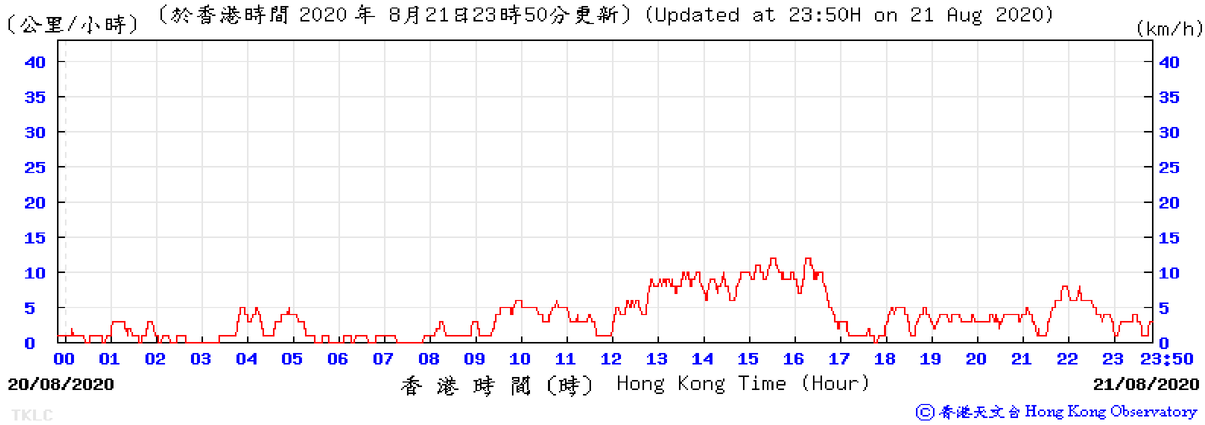
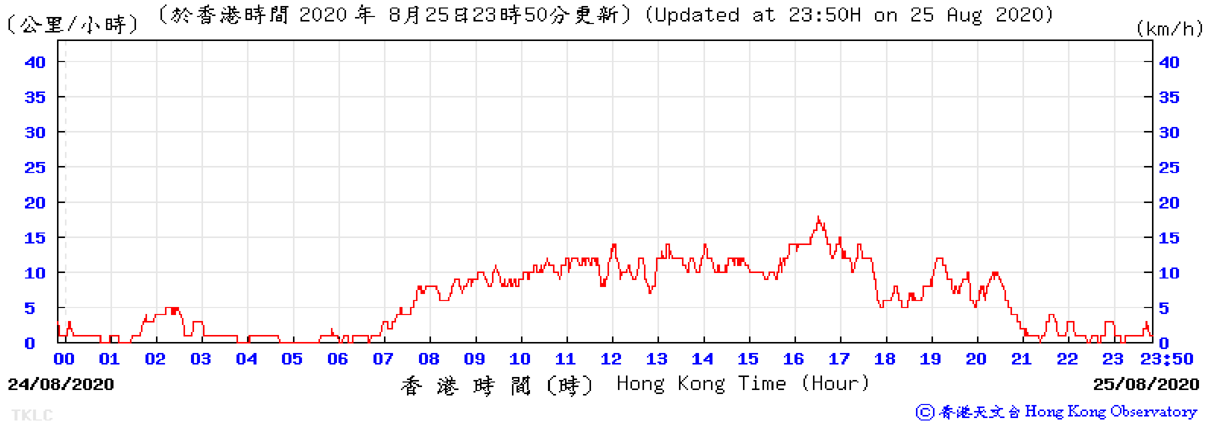
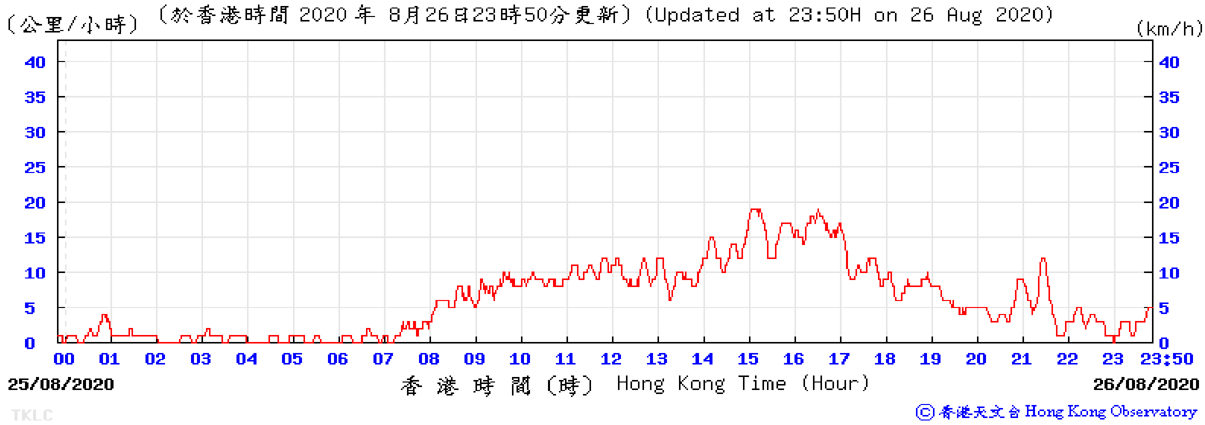
Wind Speed: (Ta Kwu Ling)









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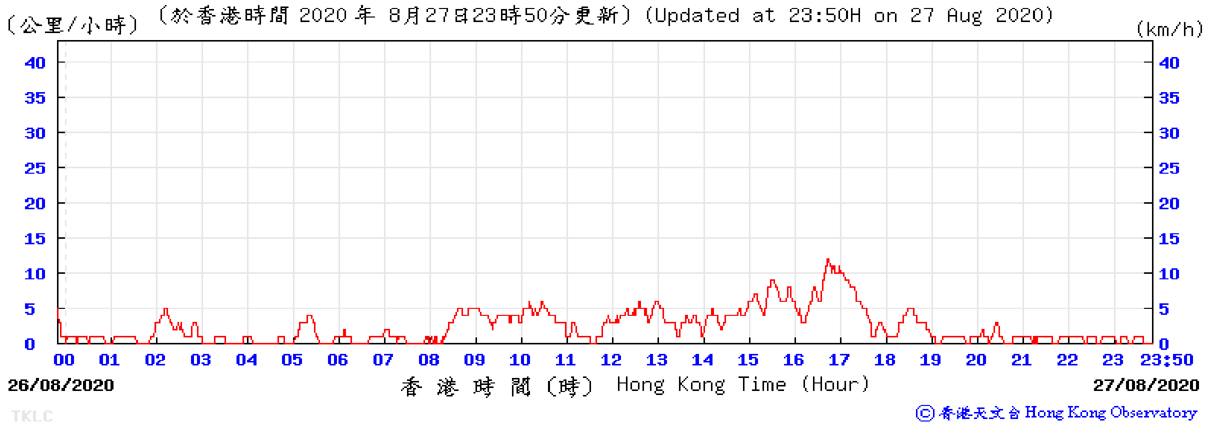
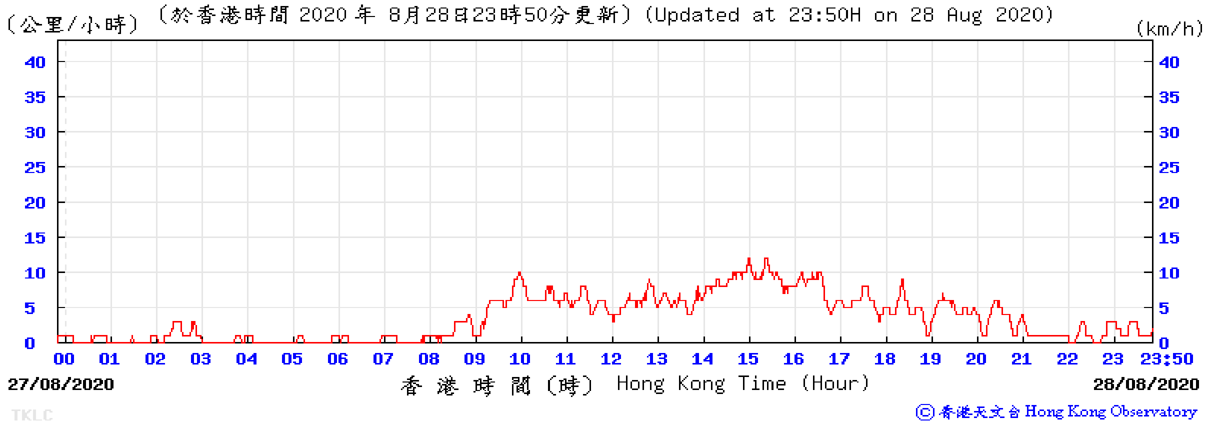
Wind Speed: (Ta Kwu Ling)





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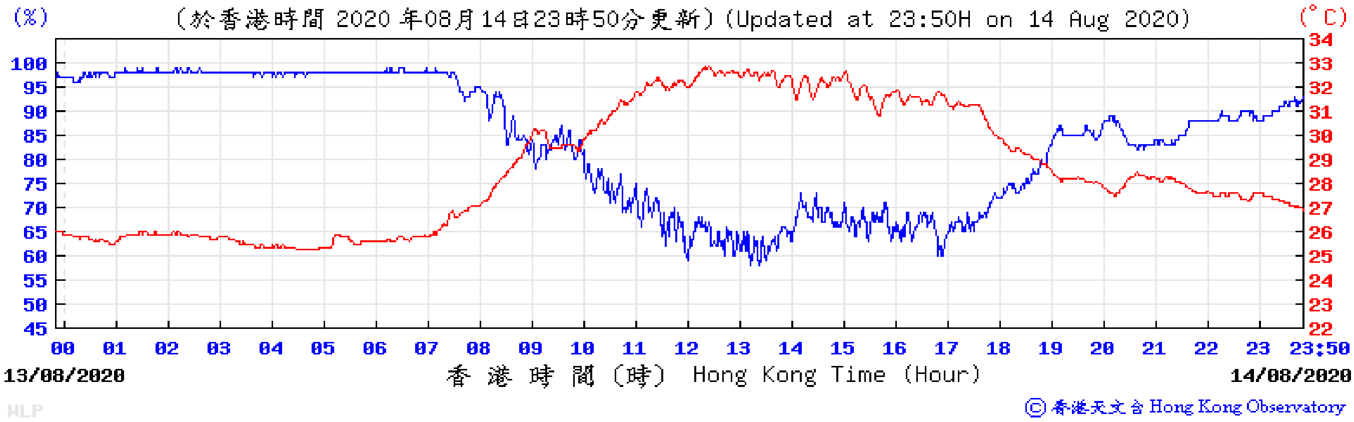
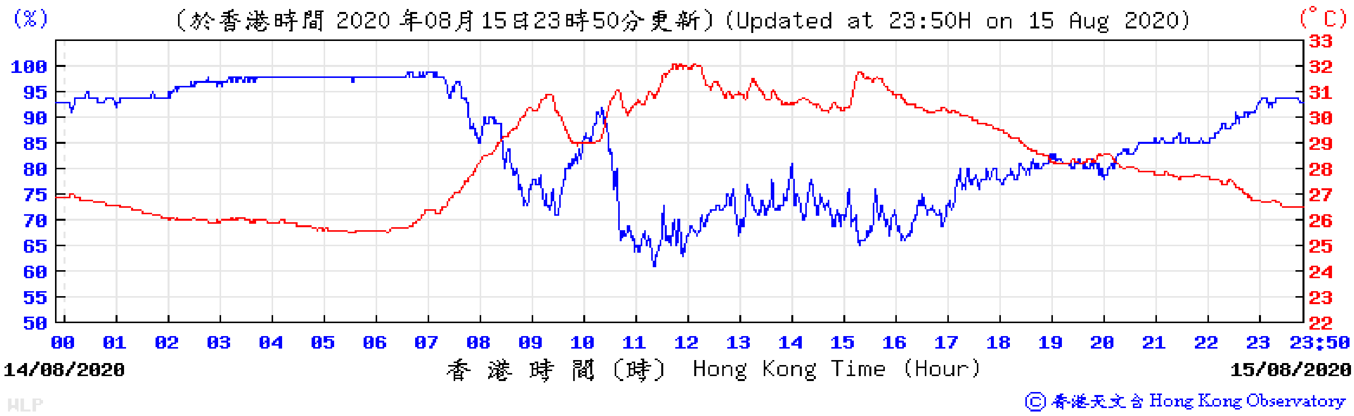
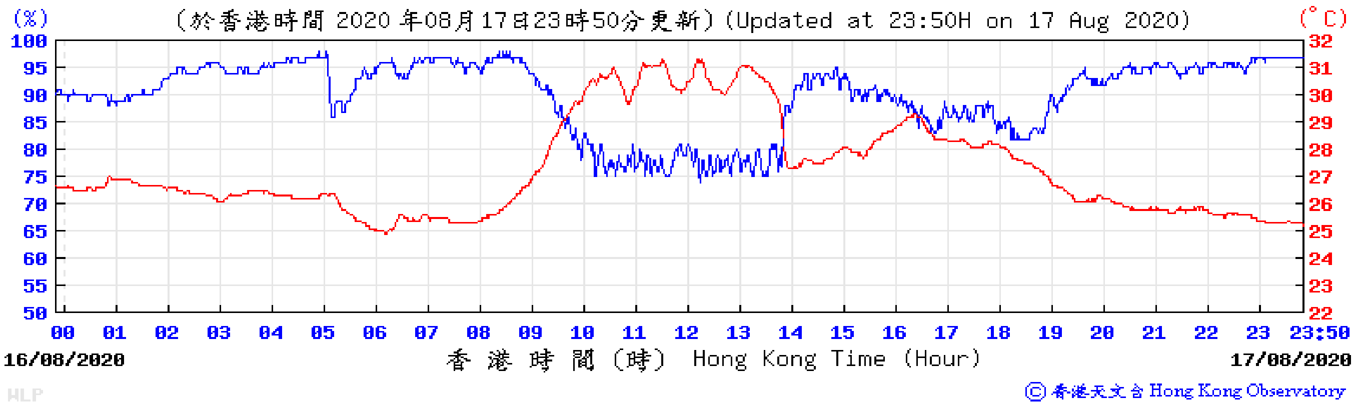
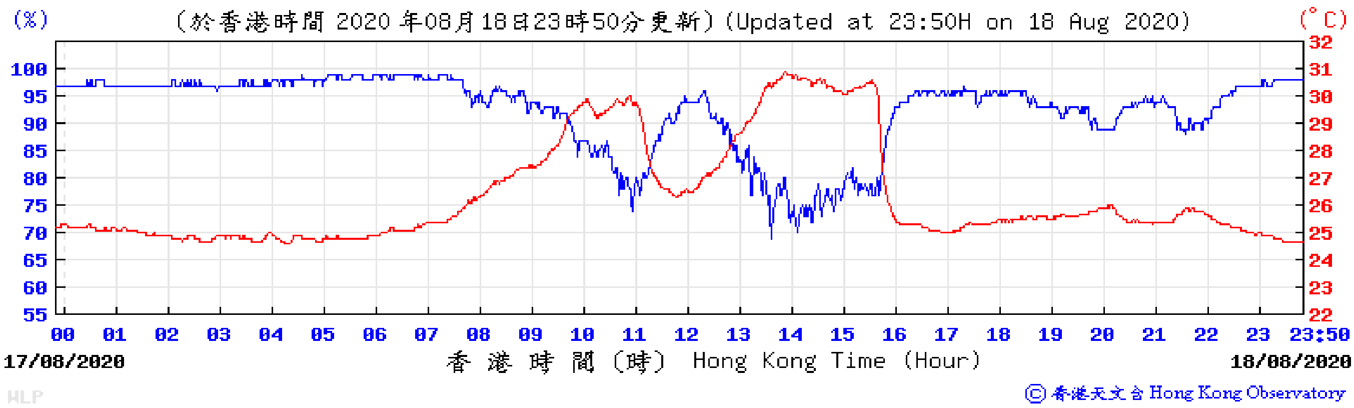
Tempearture/Humidity: (Wetland Park)









Title	Scale	Project No.	
Contract No. YL/2018/03 Development of Lok Ma Chau Loop: Main Works Package 1 – Special Site Investigation Works (In-situ Trial of Sediment Treatment Works in Shenzhen River) and Laboratory Testing Meteorological Data Recorded from Hong Kong Observatory	N.T.S	WMS19015	WELLAB 匯力 consulting . testing . research
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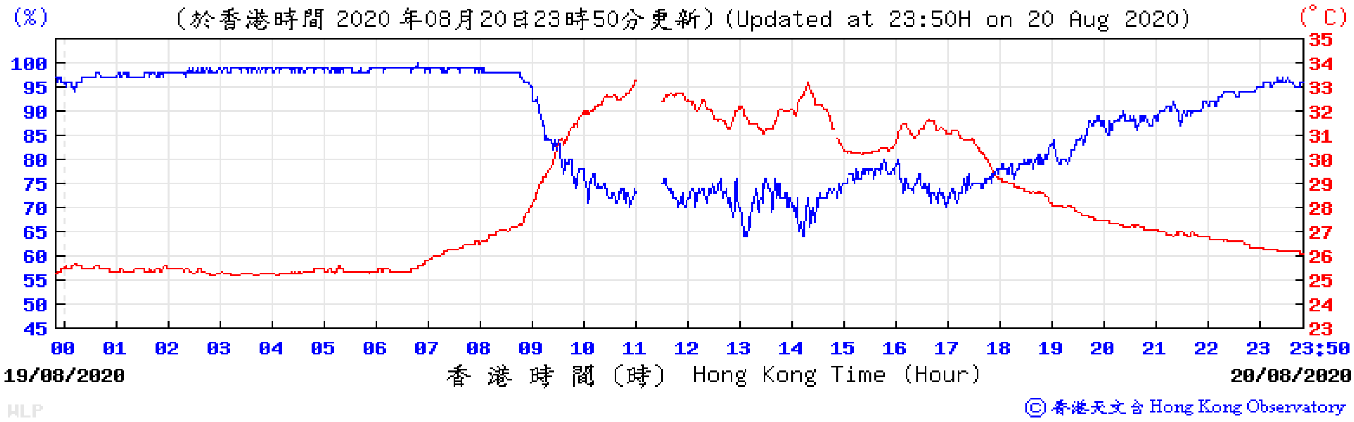
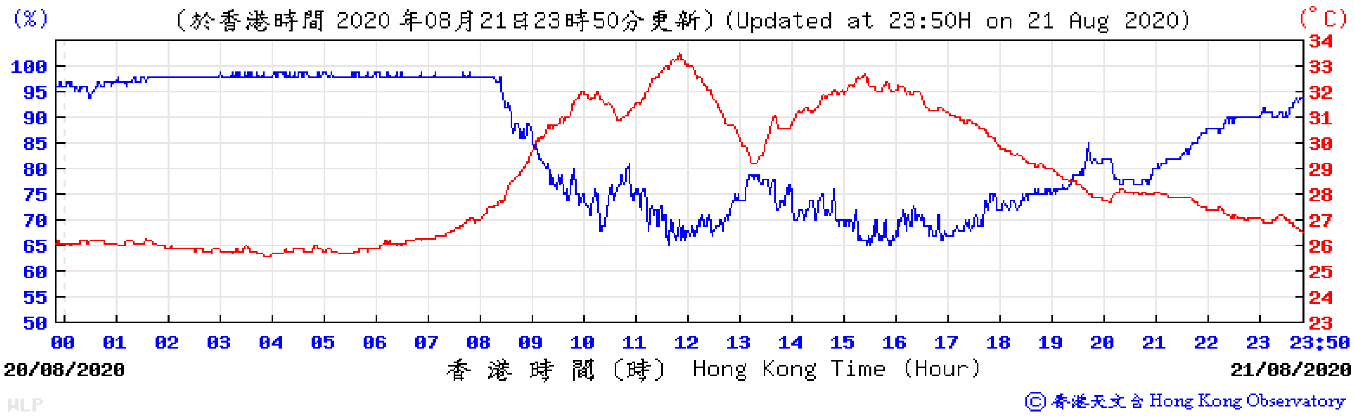
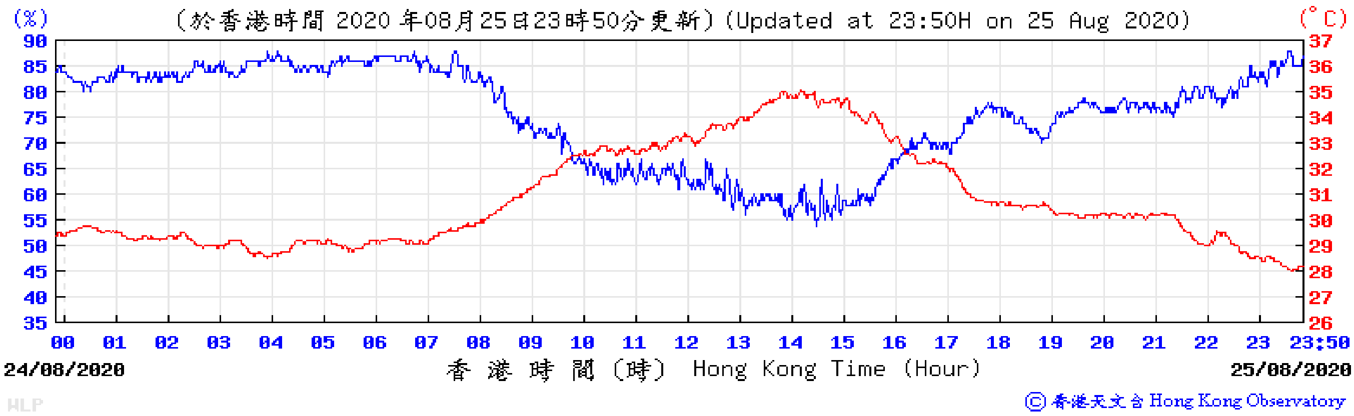
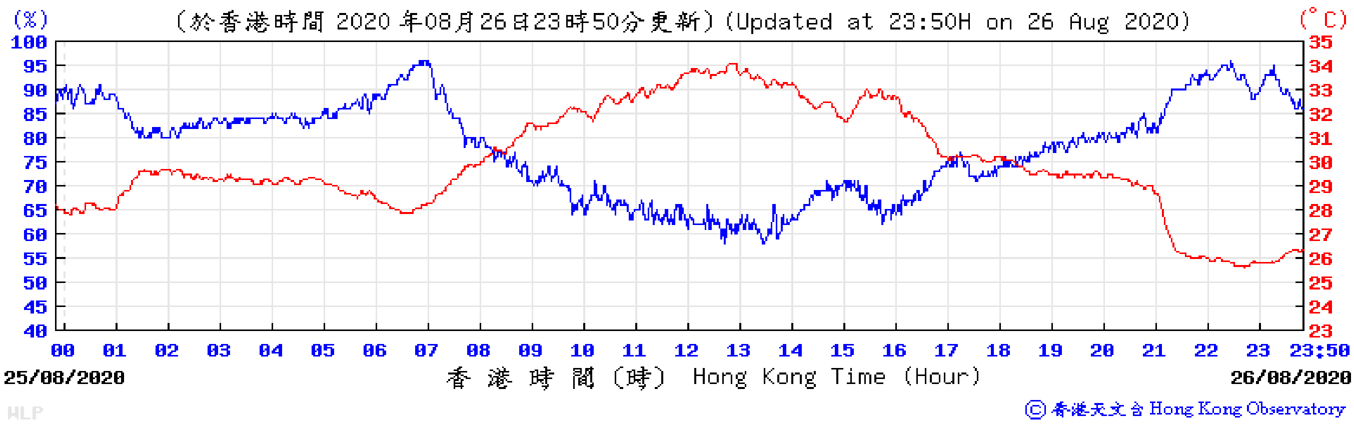
Tempearture/Humidity: (Wetland Park)









Title	Scale	Project No.	
Contract No. YL/2018/03 Development of Lok Ma Chau Loop: Main Works Package 1 – Special Site Investigation Works (In-situ Trial of Sediment Treatment Works in Shenzhen River) and Laboratory Testing Meteorological Data Recorded from Hong Kong Observatory	N.T.S	WMS19015	WELLAB 匯力 consulting . testing . research
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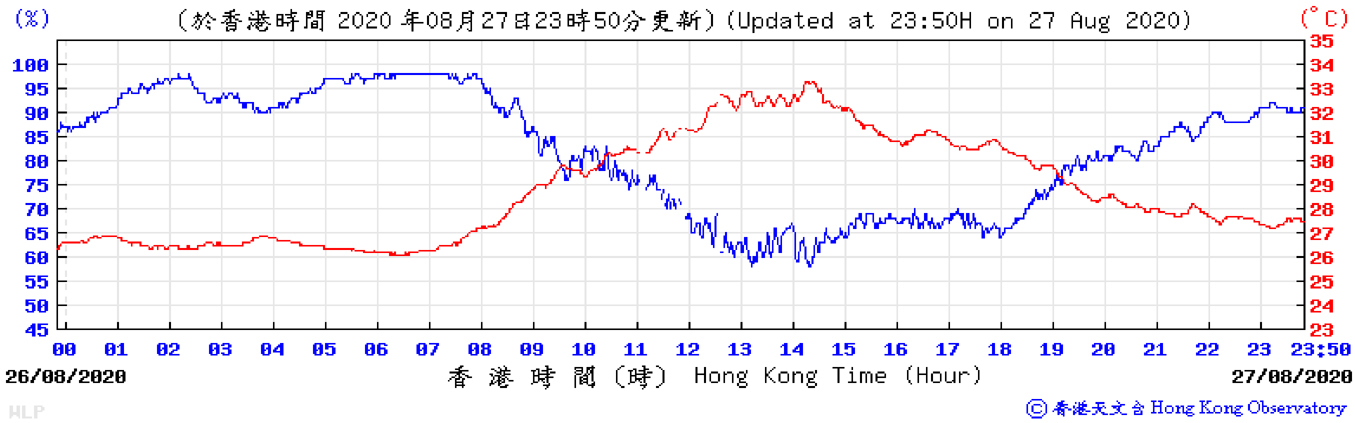
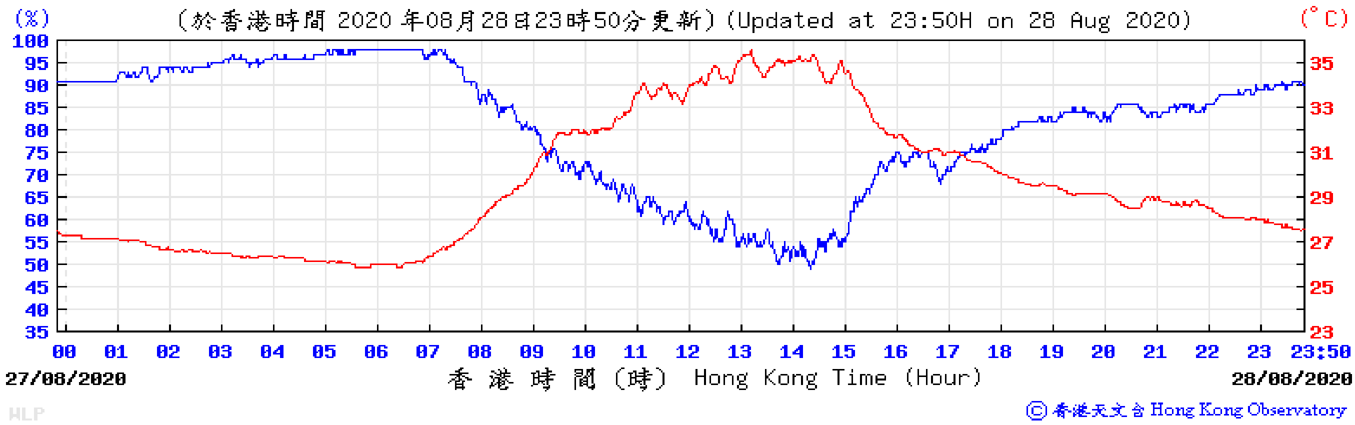
	Aug 20	G	

Tempearture/Humidity: (Wetland Park)





Title	Scale	Project No.	
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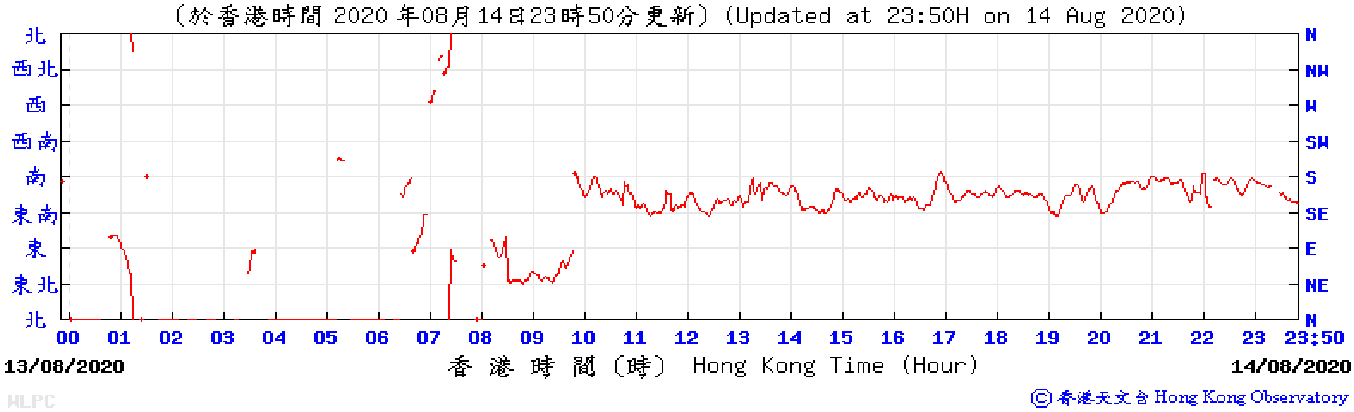
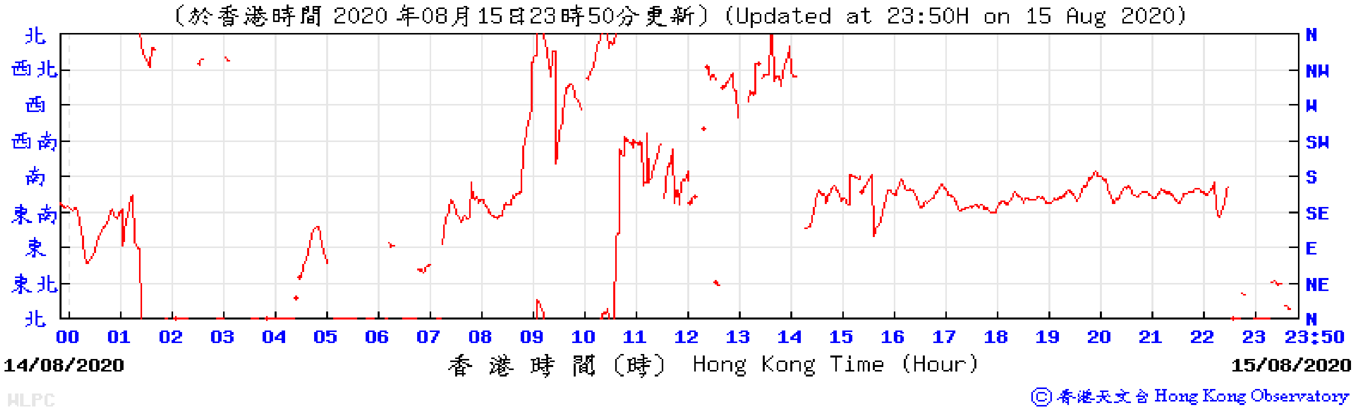
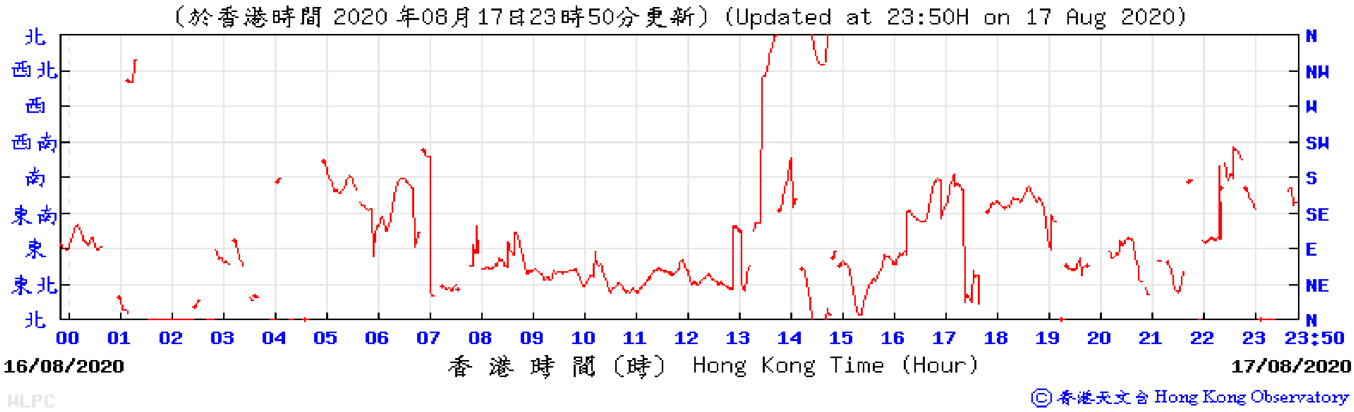
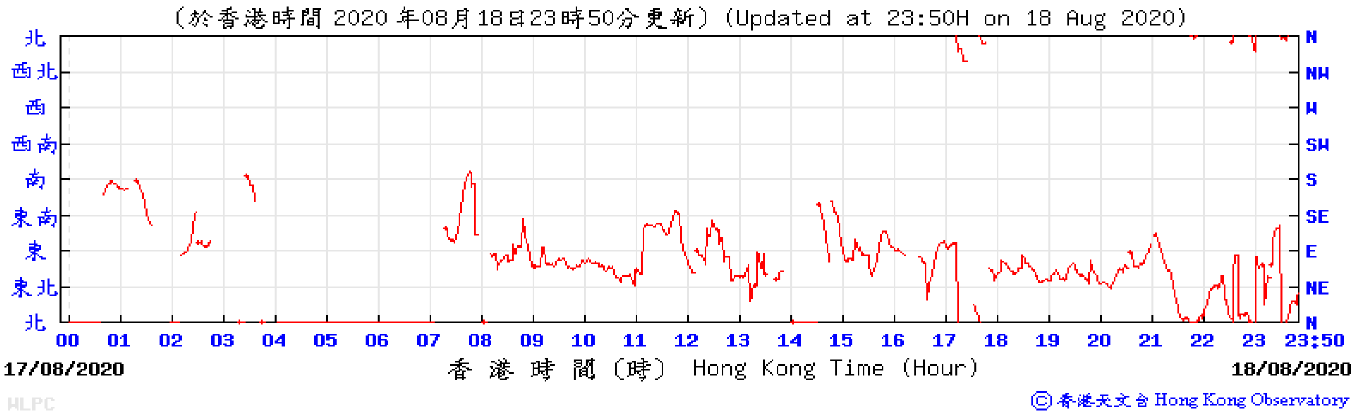
Wind Direction: (Wetland Park)



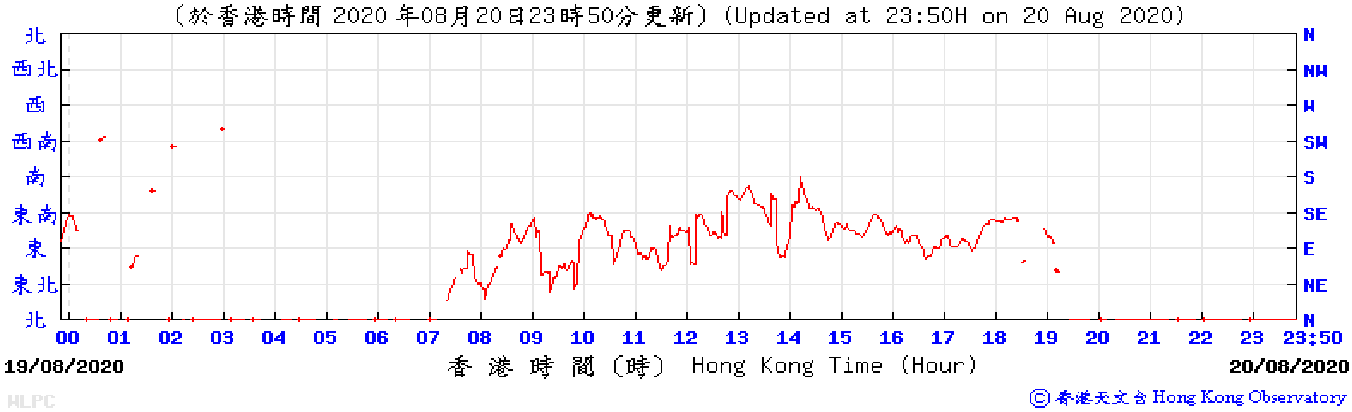


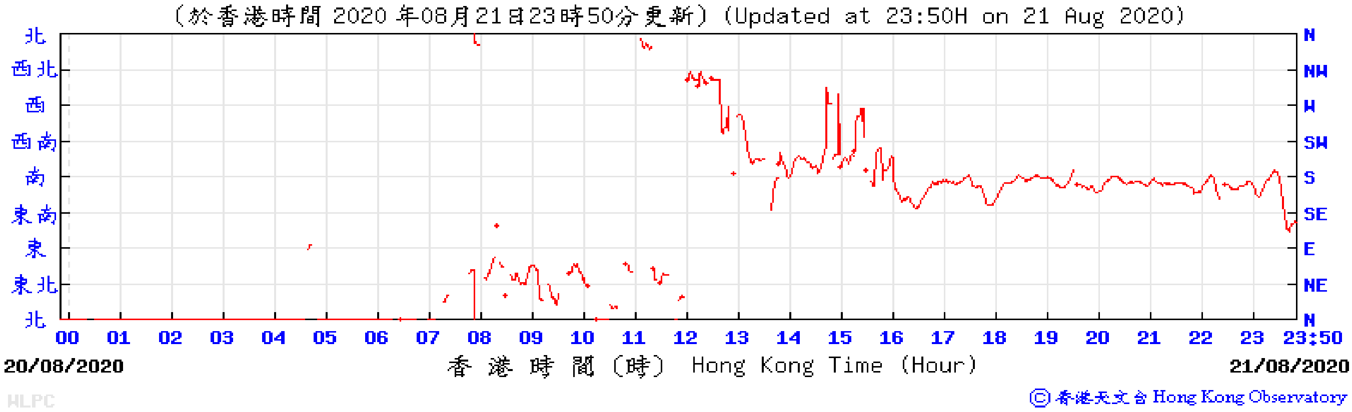


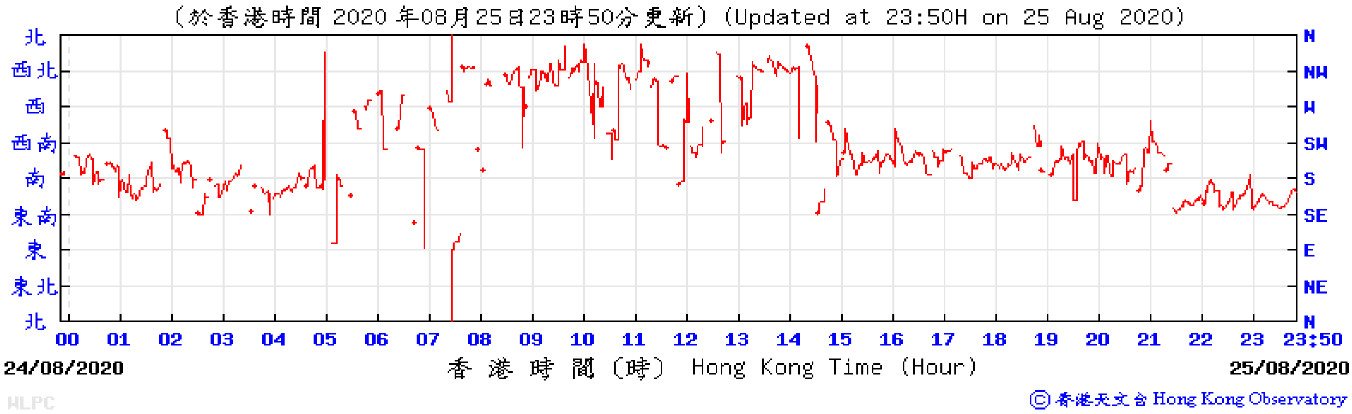


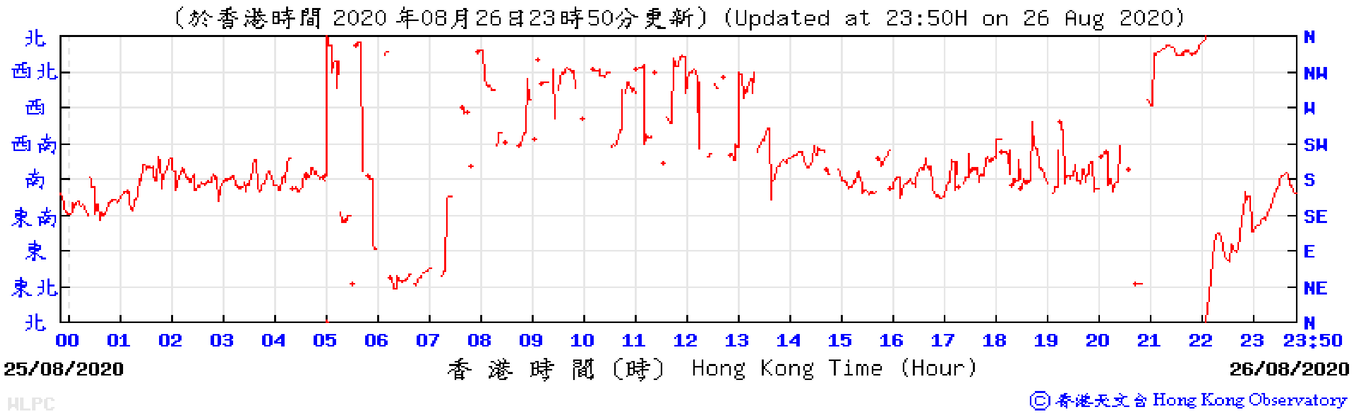
Title	Contract No. YL/2018/03 Development of Lok Ma Chau Loop: Main Works Package 1 – Special Site Investigation Works (In-situ Trial of Sediment Treatment Works in Shenzhen River) and Laboratory Testing Meteorological Data Recorded from Hong Kong Observatory	Scale N.T.S	Project No. WMS19015	WELLAB 匯力 consulting . testing . research
		Date Aug 20	Appendix G	

Wind Direction: (Wetland Park)



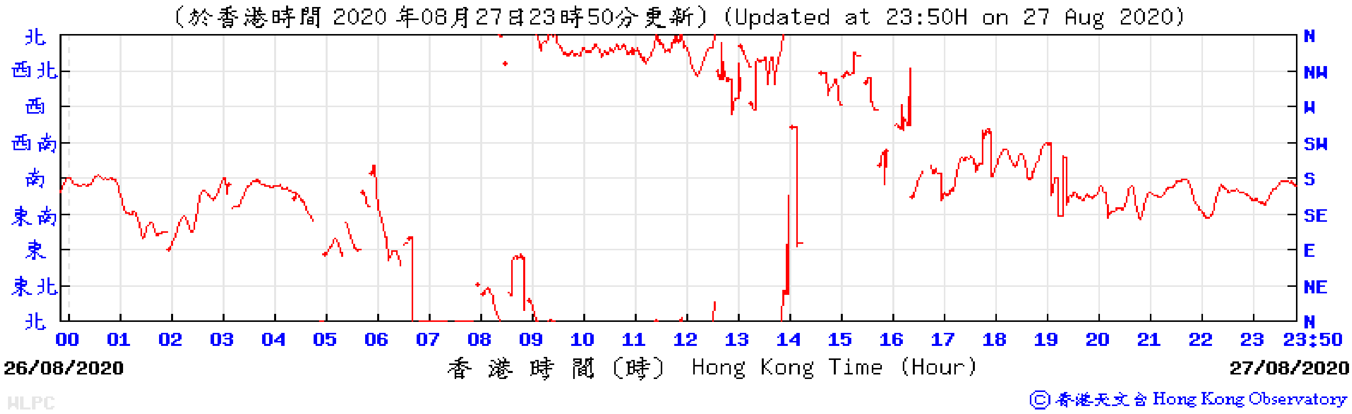


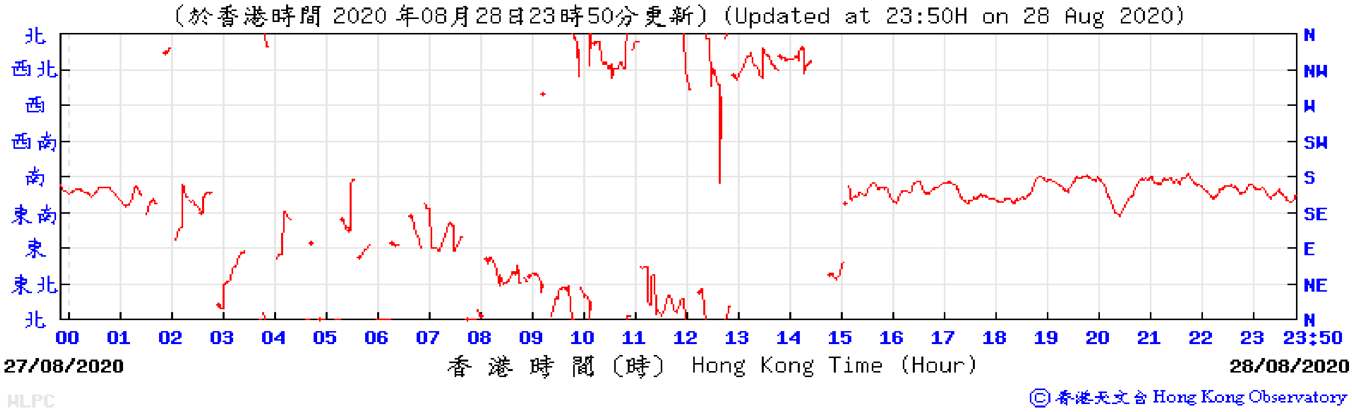




Title	Scale	Project No.	
Contract No. YL/2018/03 Development of Lok Ma Chau Loop: Main Works Package 1 – Special Site Investigation Works (In-situ Trial of Sediment Treatment Works in Shenzhen River) and Laboratory Testing Meteorological Data Recorded from Hong Kong Observatory	N.T.S	WMS19015	WELLAB 匯力 consulting . testing . research
	Date Aug 20	Appendix G	

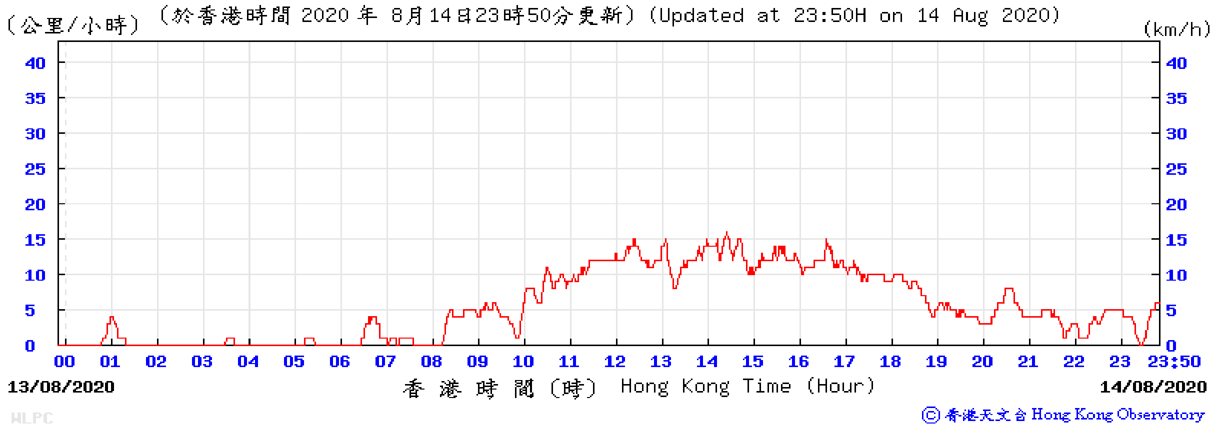
Wind Direction: (Wetland Park)

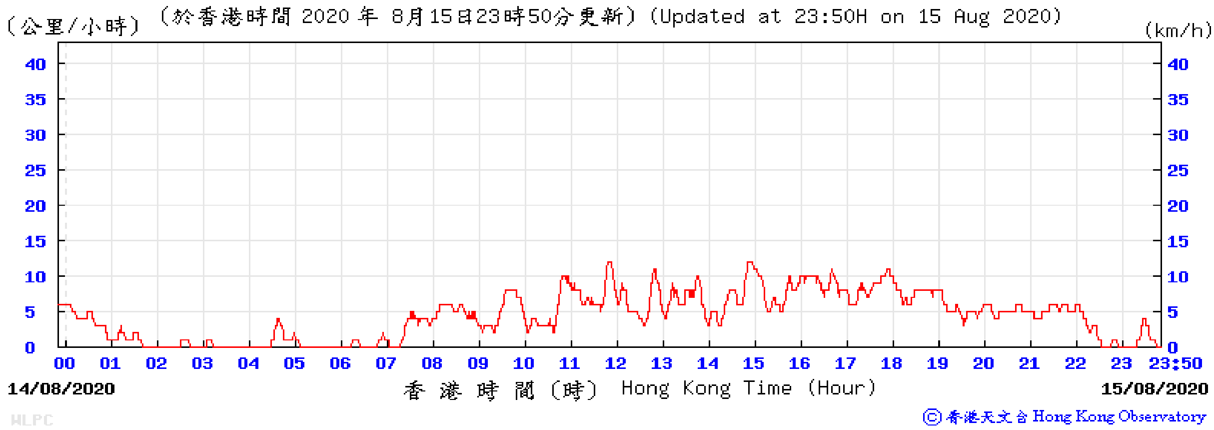


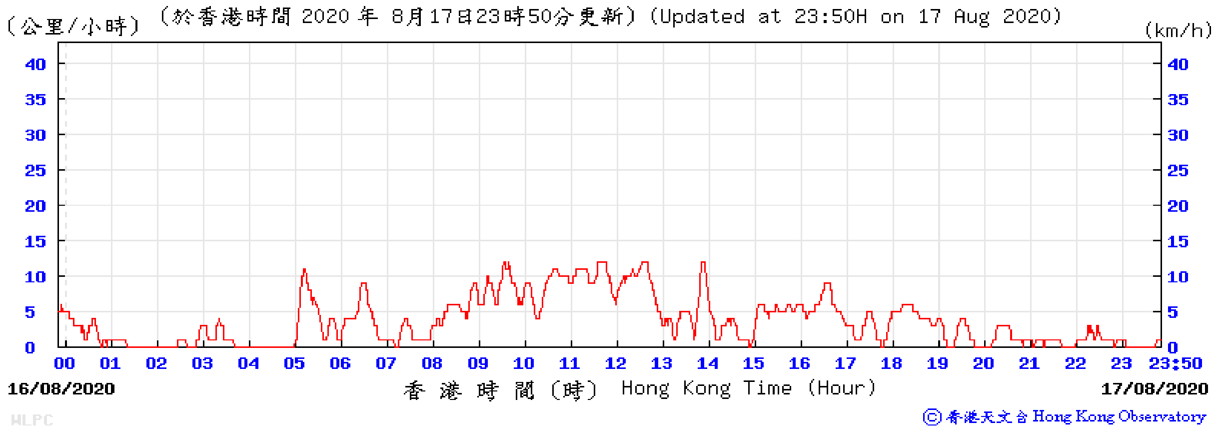


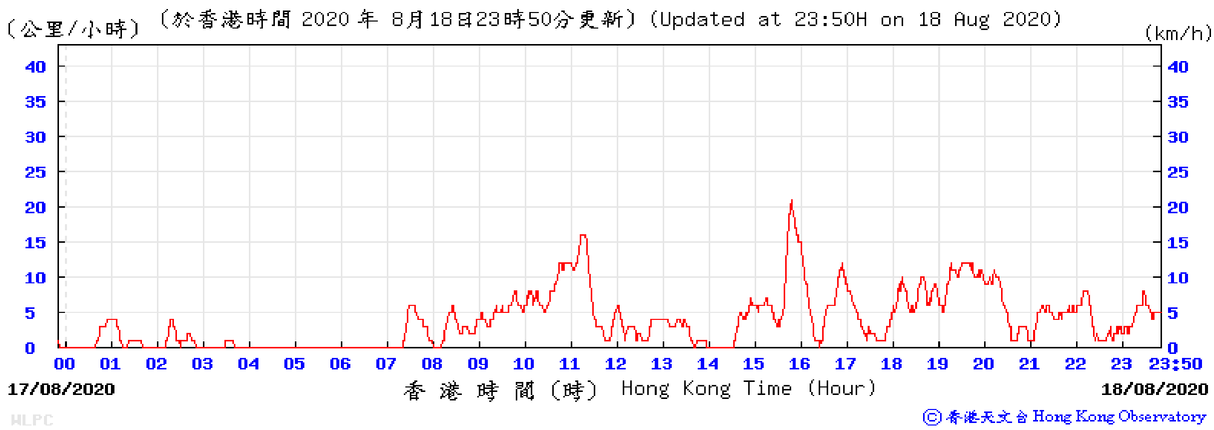
Title	Scale	Project No.	
Contract No. YL/2018/03 Development of Lok Ma Chau Loop: Main Works Package 1 – Special Site Investigation Works (In-situ Trial of Sediment Treatment Works in Shenzhen River) and Laboratory Testing Meteorological Data Recorded from Hong Kong Observatory	N.T.S	WMS19015	WELLAB 匯力 consulting . testing . research
	Date Aug 20	Appendix G	

Wind Speed: (Wetland Park)



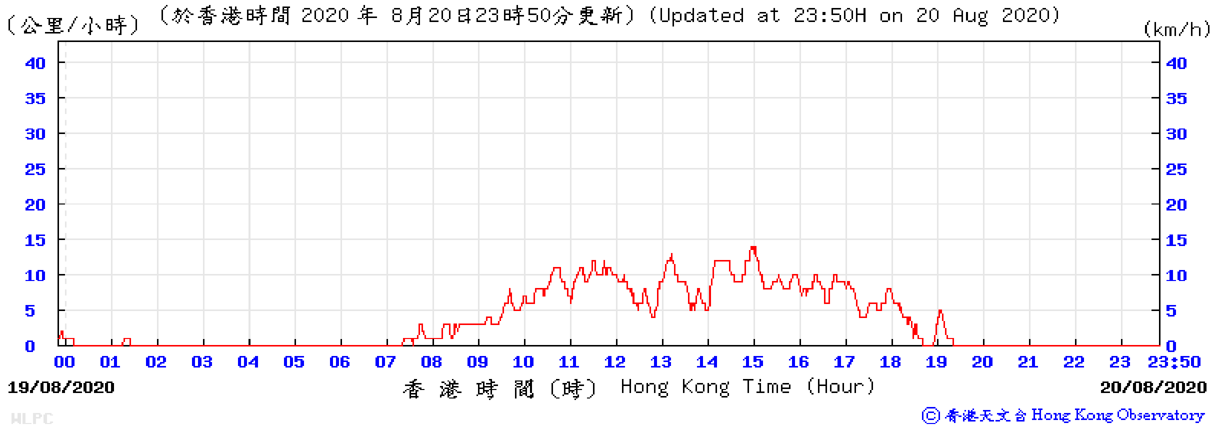


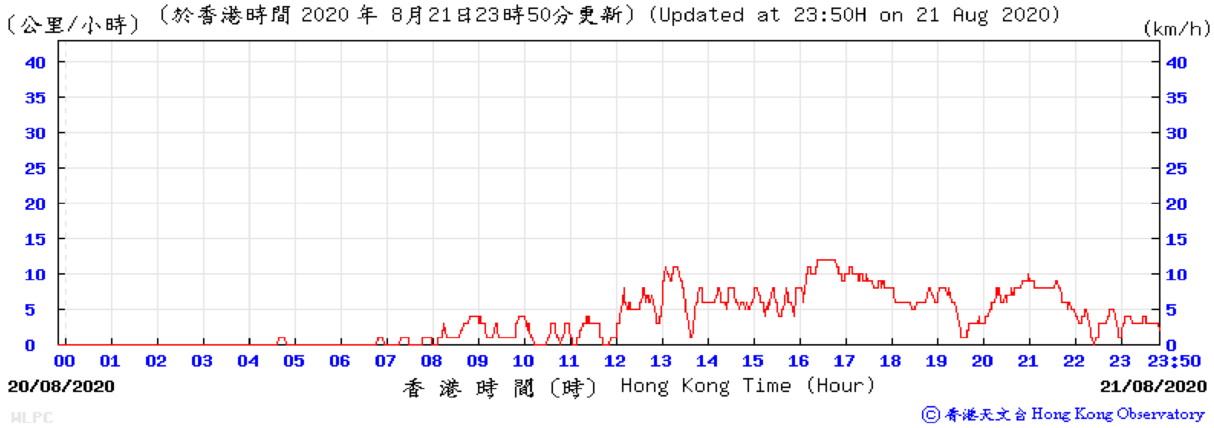


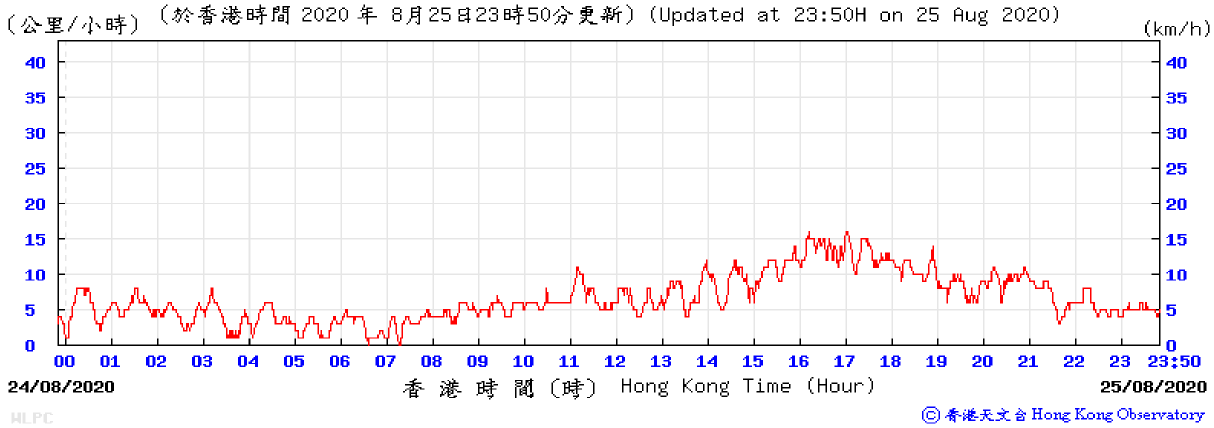


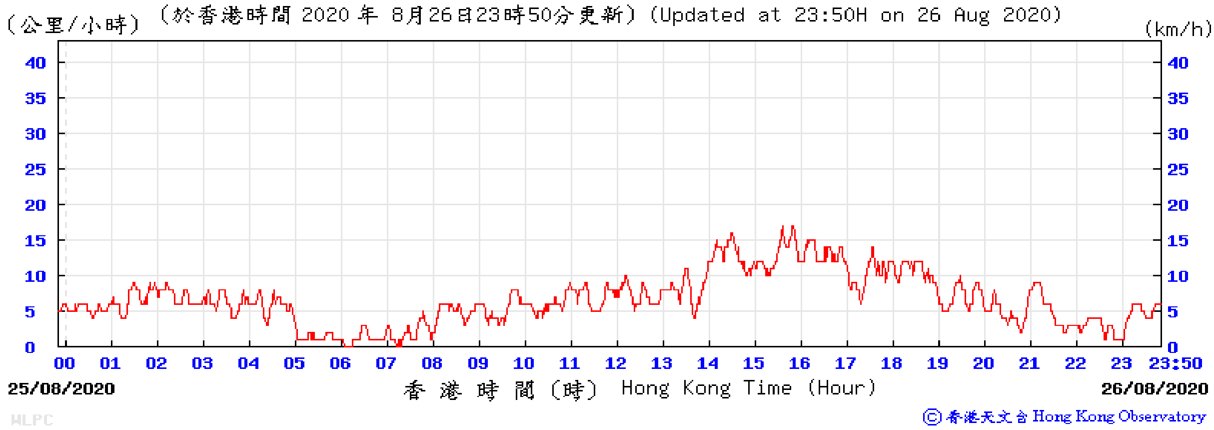
Title	Scale	Project No.	
Contract No. YL/2018/03 Development of Lok Ma Chau Loop: Main Works Package 1 – Special Site Investigation Works (In-situ Trial of Sediment Treatment Works in Shenzhen River) and Laboratory Testing Meteorological Data Recorded from Hong Kong Observatory	N.T.S	WMS19015	WELLAB 匯力 consulting . testing . research
	Date: Aug 20	Appendix: G	

Wind Speed: (Wetland Park)









Title	Scale	Project No.	
Contract No. YL/2018/03 Development of Lok Ma Chau Loop: Main Works Package 1 – Special Site Investigation Works (In-situ Trial of Sediment Treatment Works in Shenzhen River) and Laboratory Testing Meteorological Data Recorded from Hong Kong Observatory	N.T.S	WMS19015	WELLAB 匯力 consulting . testing . research
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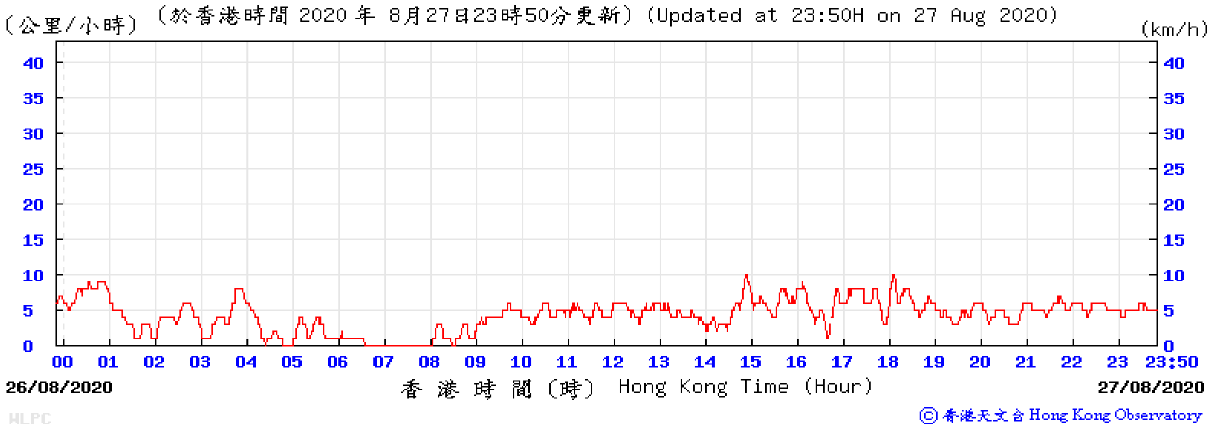
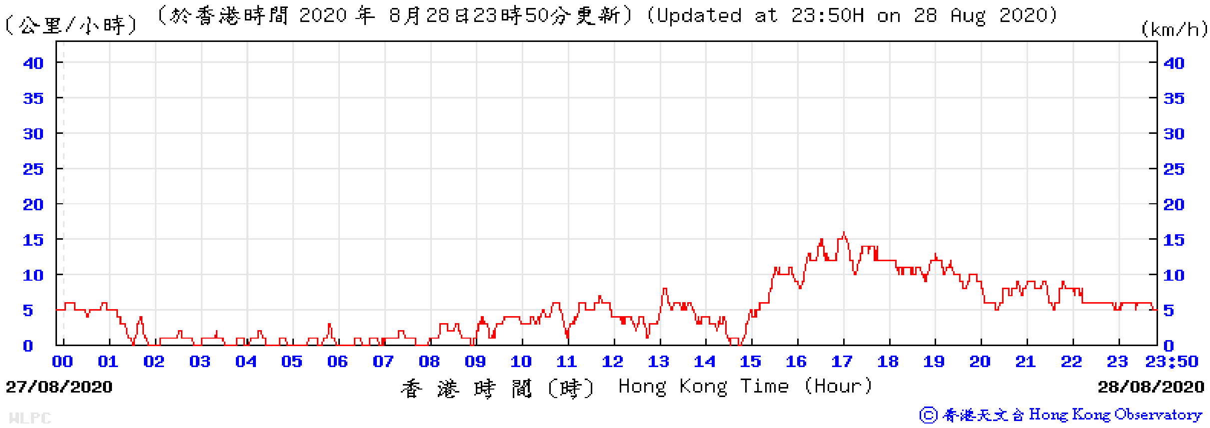
Wind Speed: (Wetland Park)





Title	Contract No. YL/2018/03 Development of Lok Ma Chau Loop: Main Works Package 1 – Special Site Investigation Works (In-situ Trial of Sediment Treatment Works in Shenzhen River) and Laboratory Testing Meteorological Data Recorded from Hong Kong Observatory	Scale N.T.S	Project No. WMS19015	WELLAB 匯力 consulting . testing . research
		Date Aug 20	Appendix G	

APPENDIX H
PHOTOGRAPHIC RECORDS FOR FIELD WORKS AT EACH OF THE SAMPLING LOCATION

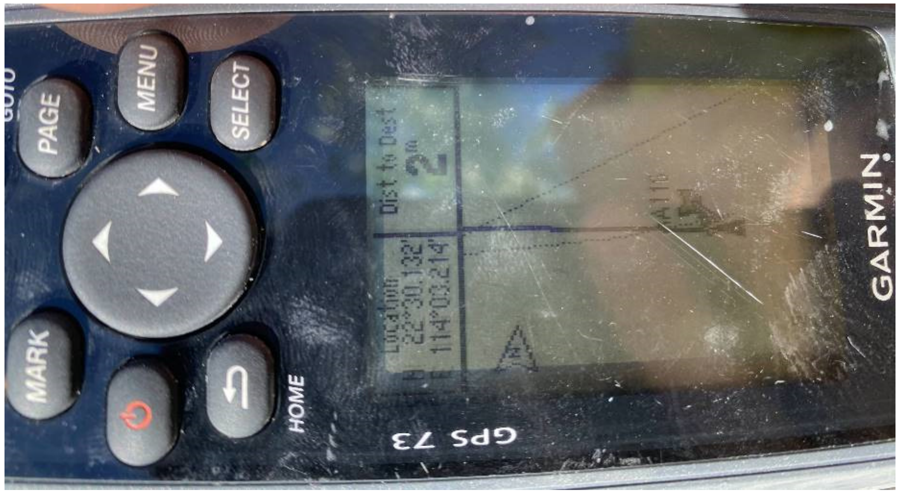
Odour Survey Photographic Record (14th August 2020)

Sampling Location: AA-111

Sampling Location: AA-115

Sampling Location: AA-112

Sampling Location: AA-116



Sampling Location: RAA-111

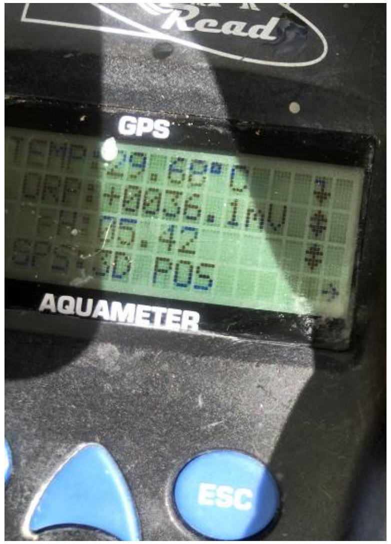
	
	

Sampling Location: RAA-112

Sampling Location: RAA-115

Sampling Location: RAA-116

Sampling Location: WHK111



Sampling Location: WHK112

Sampling Location: WHK115

Sampling Location: WHK116

Sampling Location: WSZ-111

Sampling Location: WSZ-112

Sampling Location: WSZ-113

Sampling Location: WSZ-115

Sampling Location: WSZ-116

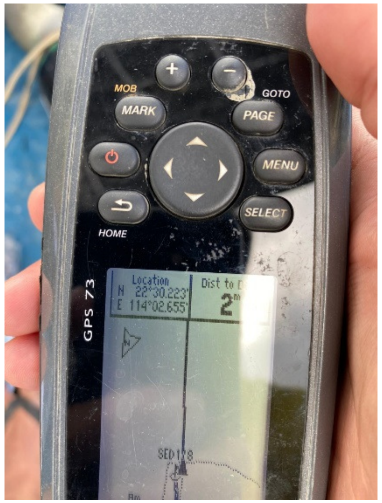
Odour Survey Photographic Record (15th August 2020)

Sampling Location: AA-119

Sampling Location: RAA-119

Sampling Location: SED-117

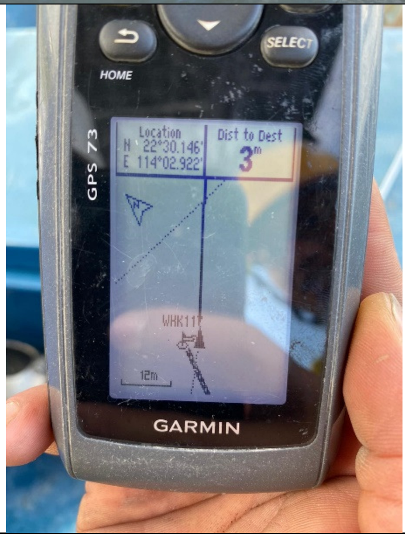
Sampling Location: SED-118

Sampling Location: SED-119

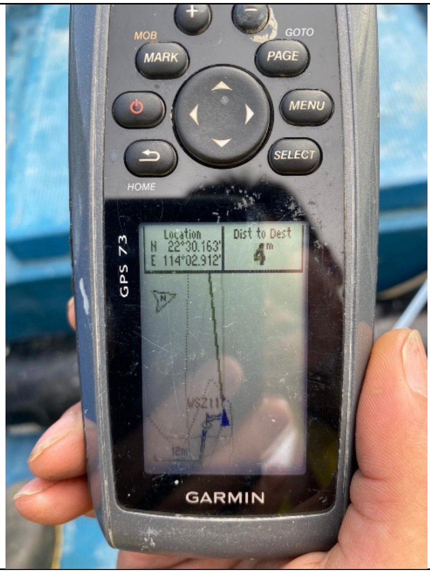
Sampling Location: WHK-117



Sampling Location: WHK-118

Sampling Location: WHK-119

Sampling Location: WSZ-117



Sampling Location: WSZ-118

Sampling Location: WSZ-119

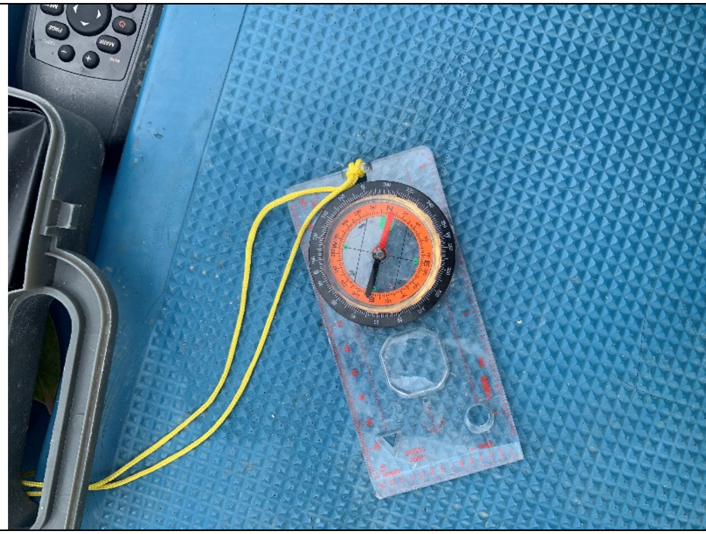
Odour Survey Photographic Record (17th August 2020)

Sampling Location: SED-113

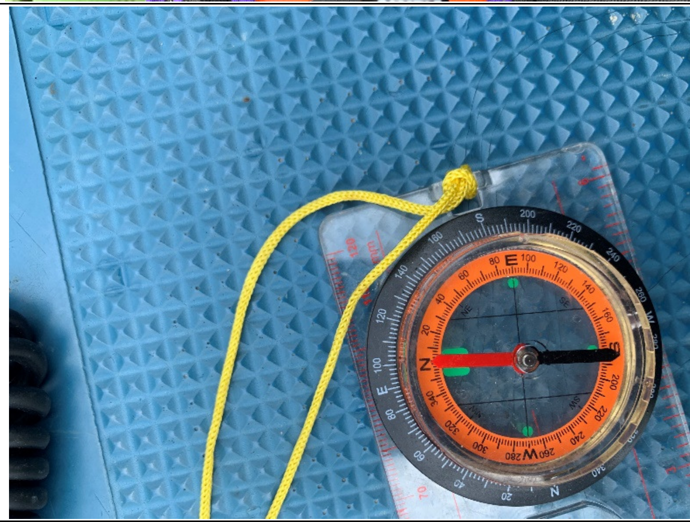
Sampling Location: SED-114

Odour Survey Photographic Record (18th August 2020)

Sampling Location: AA-108



Sampling Location: RAA-108



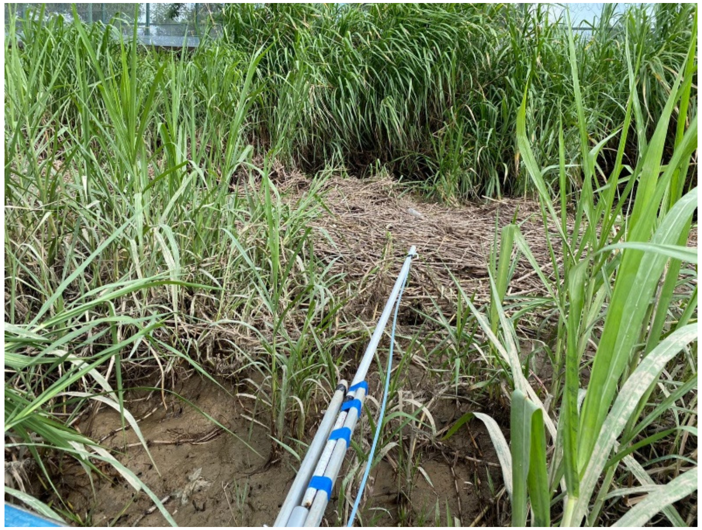
Odour Survey Photographic Record (20th August 2020)

Sampling Location: AA-106

Sampling Location: AA-107

Sampling Location: RAA-106

Sampling Location: RAA-107



Sampling Location: SED-106

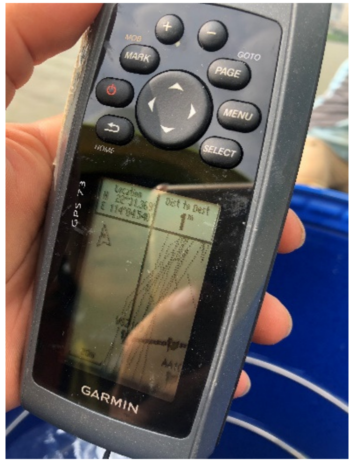
Sampling Location: WHK-106

Sampling Location: WHK-107

Sampling Location: WSZ-106

Odour Survey Photographic Record (21st August 2020)

Sampling Location: WSZ-109



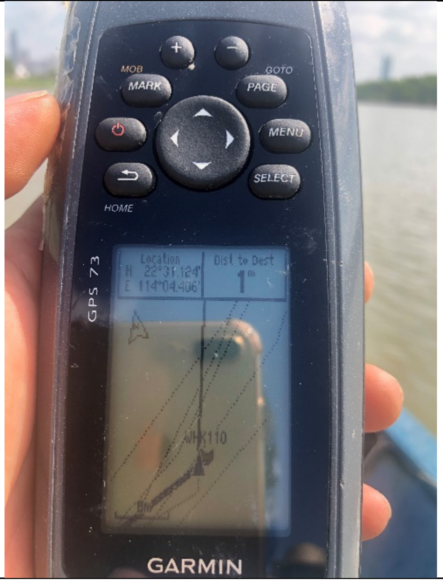
Odour Survey Photographic Record (25th August 2020)

Sampling Location: SED-108

Sampling Location: WHK-109

Sampling Location: WHK-110



Sampling Location: WSZ-107

Sampling Location: WSZ-108

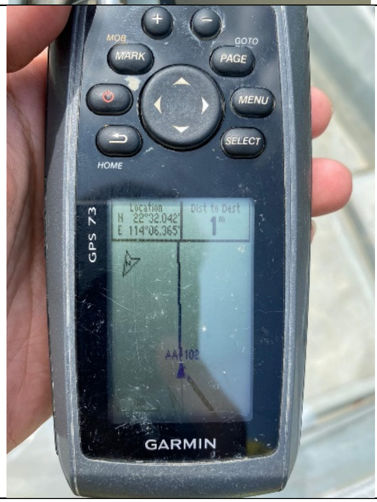
Sampling Location: WSZ-110

Odour Survey Photographic Record (26th August 2020)

Sampling Location: AA-101

Sampling Location: AA-102



Sampling Location: AA-103

Sampling Location: AA-104

Sampling Location: RAA-101

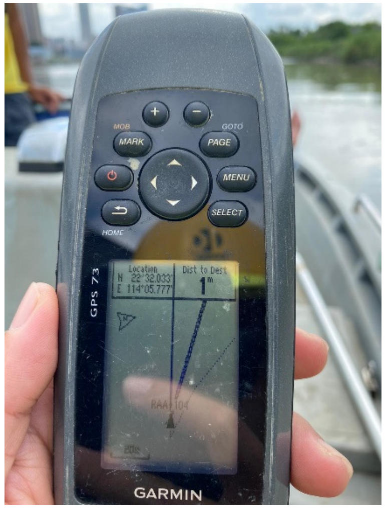
Sampling Location: RAA-102

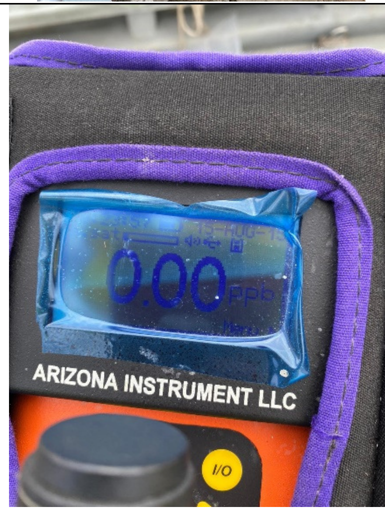
	
	

Sampling Location: RAA-103

Sampling Location: RAA-104





Sampling Location: WHK-102

Sampling Location: WHK-103

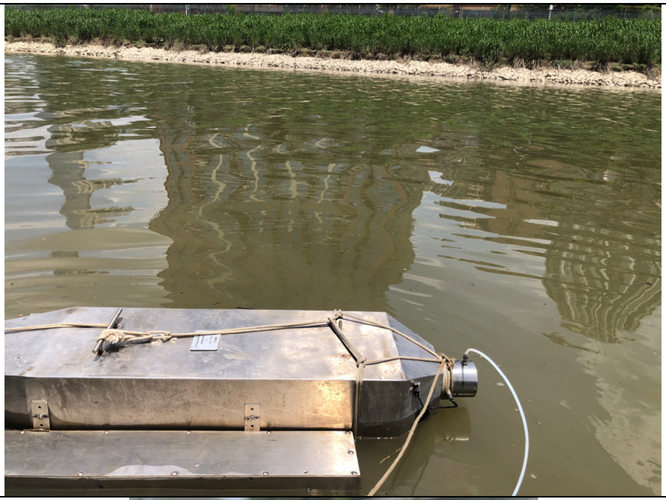
Sampling Location: WHK-104

Sampling Location: WHK-105

Sampling Location: WHK-108

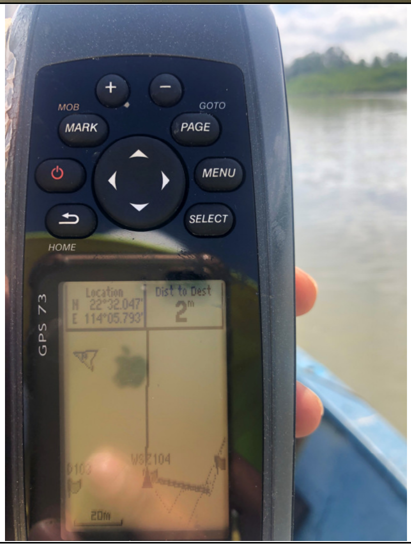
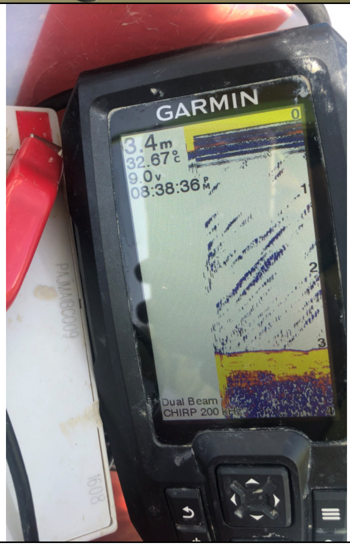
Sampling Location: WSZ-102



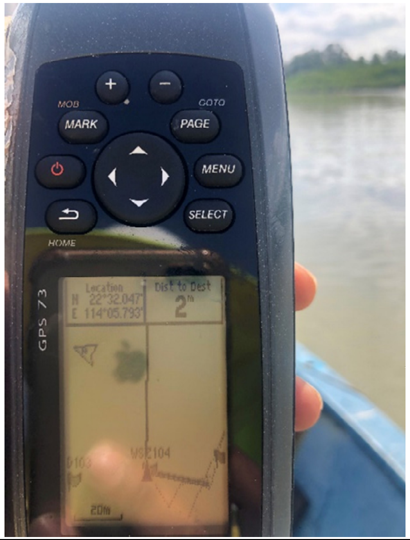
Sampling Location: WSZ-103

Sampling Location: WSZ-104

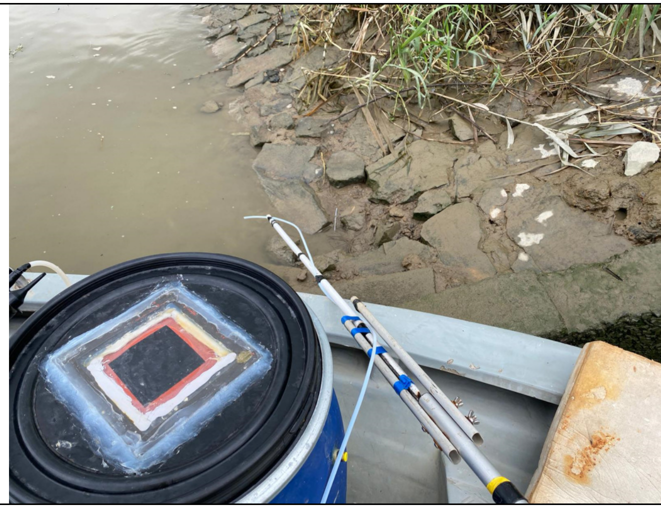
	
	

Sampling Location: WSZ-105

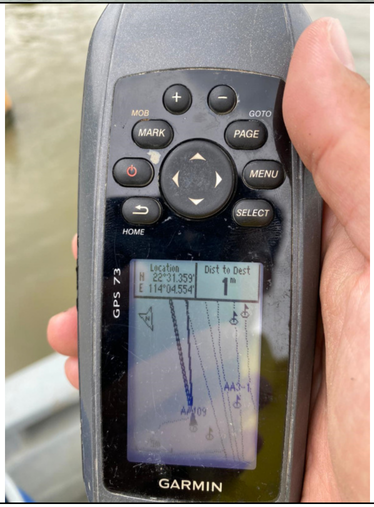


Odour Survey Photographic Record (27th August 2020)

Sampling Location: AA-105



Sampling Location: AA-109



Sampling Location: AA-110

Sampling Location: RAA-105

Sampling Location: RAA-109

Sampling Location: RAA-110

Sampling Location: SED-111

Sampling Location: SED-112

Sampling Location: WHK-101

Sampling Location: WHK-113

Sampling Location: WHK-114

Sampling Location: WSZ-101

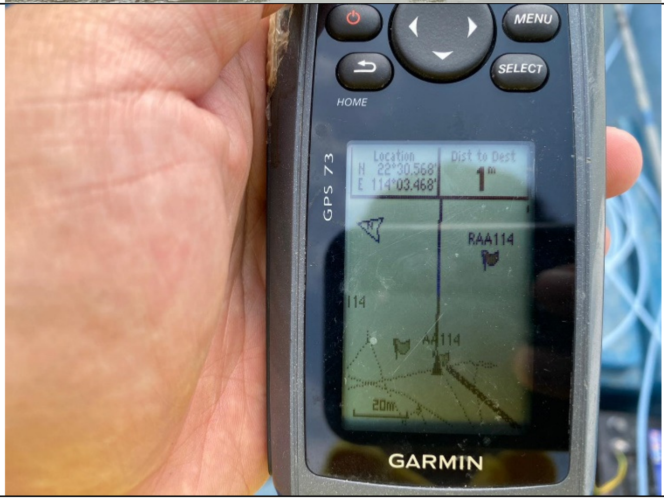
Sampling Location: WSZ-114

Odour Survey Photographic Record (28th August 2020)

Sampling Location: AA-113

Sampling Location: AA-114

Sampling Location: AA-117

Sampling Location: AA-118

Sampling Location: RAA-113

Sampling Location: RAA-114

Sampling Location: RAA-117

Sampling Location: RAA-118

Contract No. YL/2018/03

Development of Lok Ma Chau Loop: Main Works Package 1 – Special Site Investigation Works
(In-situ Trial of Sediment Treatment Works in Shenzhen River) and Laboratory Testing

Additional Odour Monitoring (SI No. 009)

Observation of No Exposed Sediment Surface

Sampling Location	Sampling Date	Sampling Time	Tide Height (m)
SED-101	27-Aug-2020	10:11	1.0
SED-102	26-Aug-2020	11:43	0.85
SED-103	26-Aug-2020	11:04	0.8
SED-104	26-Aug-2020	9:32	0.9
SED-105	28-Aug-2020	16:35	0.9
SED-107	20-Aug-2020	17:15	0.65
SED-109	25-Aug-2020	9:21	0.73
SED-110	25-Aug-2020	10:05	0.75
SED-115	27-Aug-2020	13:26	0.8
SED-116	27-Aug-2020	13:31	0.8

Photographic Records for Observation of No Exposed Sediment Surface

Sampling Location: SED-101

Sampling Location: SED-102

Sampling Location: SED-103

Sampling Location: SED-104

Sampling Location: SED-105

Sampling Location: SED-107

Sampling Location: SED-109

Sampling Location: SED-110

Sampling Location: SED-115

Sampling Location: SED-116

Appendix 3.3

Correlation of Odour Emissions, AVS Levels and Redox Potential

1. SUMMARY OF IN-SITU TRIAL TEST OF BIOREMEDIATION

1.1 General

1.1.1 As recommended in the Environmental Impact Assessment (EIA) Report, to establish the relationship between acid volatile sulphide (AVS) reduction percentage and odour removal efficiency, in-situ trial test of bioremediation was carried out from 31 December 2019 and substantially completed on 23 January 2021.

1.1.2 The in-situ trial test of bioremediation works involved the injection of calcium nitrate solution into the sediment. The in-situ trial test, for the purpose of investigating the AVS / odour relationship, were carried out at 4 trial areas (viz. Trial Area A1, A3, A4 and B3) during summer and other seasons. The trial areas were carried out near the LMCL (Trial Area A1, A3 and A4) and at area further upstream (Trial Area B3) where desilting works have previously been carried out by Shenzhen River Regulation Office of the Shenzhen Government (SZRRO). The trial areas were divided into test grids and different calcium nitrate dosages, taken into consideration the Environmental Monitoring and Audit (EM&A) Manual requirements, were applied to each of the grids.

1.1.3 At each of the test grids, sediment monitoring, including measurement of AVS and redox potential, were conducted prior to the bioremediation and one month after the bioremediation.

1.1.4 Details of the trial areas are summarised in **Table 1** and locations are shown in **Annex A**.

Table 1 Details of In-situ Trial Test Areas

Trial Area	Season	Location	Test Grids
A1	Non-summer Season	Near LMCL; area without desilting	4 test grids (A1-4 to A1-7)*
A3	Summer		9 test grids (A3-1 to A3-9)
A4	Summer		9 test grids (A4-1 to A4-9)
B3	Non-summer season	Upstream of 4.2 km section of Shenzhen (SZ) River recommended for bioremediation; area with desilting works by SZRRO	9 test grids (B3-1 to B3-9)

Notes:
* In view of the proximity to SZ marine traffic while upkeeping the operation safety of in-situ trial at SZ River, Trial Area A1 were only able to be carried out in 4 of the proposed 9 grids (namely A1-4 to A1-7).

1.2 Correlation Between Odour Emissions (Water Surface) and AVS Levels / Redox Potential

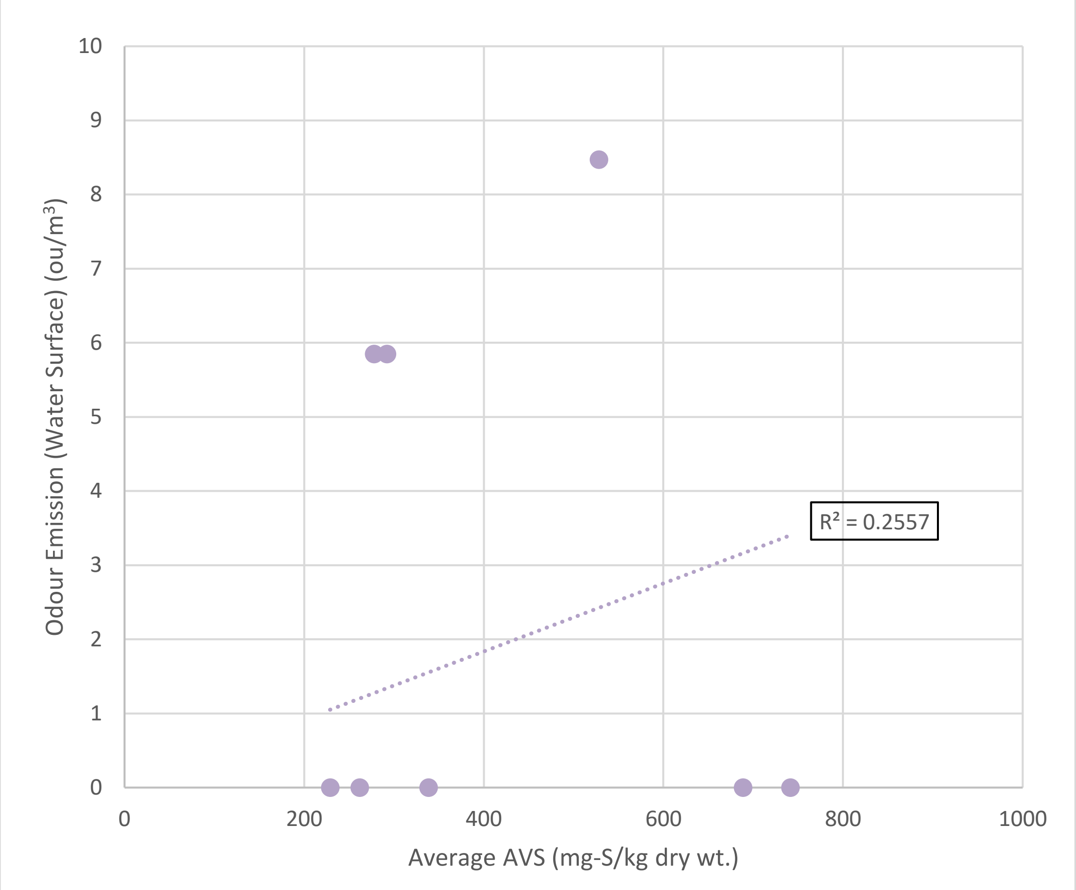
1.2.1 Plots of odour emissions (water surface) and AVS levels / redox potential, based on the in-situ trial test, are discussed below.

Odour Emissions (Water Surface) and AVS Levels

Trial Area A1 (Non-Summer Season)

1.2.2 A plot of odour emissions (water surface) versus AVS levels prior to and after bioremediation is shown in **Figure 1**. Based on the plot, there is no strong correlation between odour emissions (water surface) and AVS levels.

Figure 1 Odour Emissions (Water Surface) vs. AVS Levels in Trial Area A1



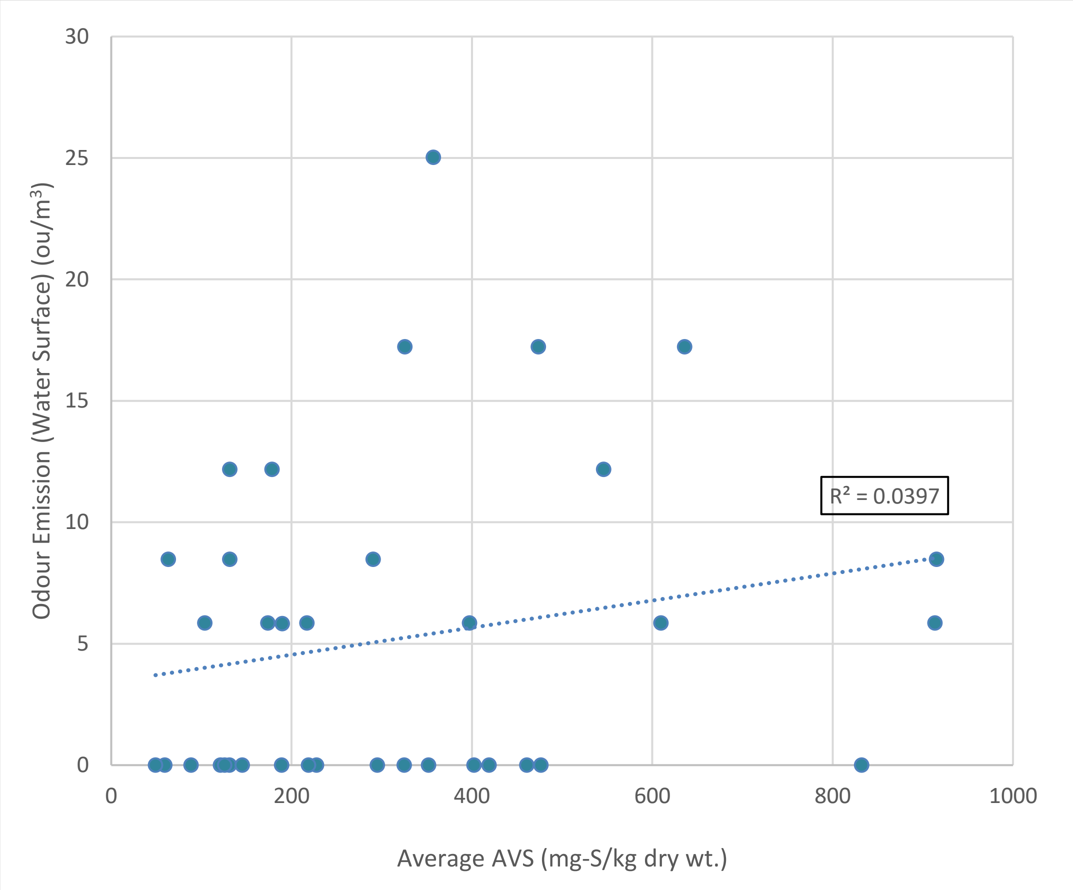
Note:
1. Odour emissions are assumed zero if results below reporting limit.

1.2.3 For the relationship between odour emission (water surface) removal and AVS removal, of the 4 tested grids at Trial Area A1, three showed either an increase in AVS levels or did not detect any odour prior to and after bioremediation. As a result, no plots between odour emission (water surface) removal and AVS removal could be deduced.

Trial Area A3 and A4 (Summer Season)

1.2.4 A plot of odour emissions (water surface) versus AVS levels prior to and after bioremediation is shown in **Figure 2**. Based on the plot, there is no strong correlation between odour emissions (water surface) and AVS levels.

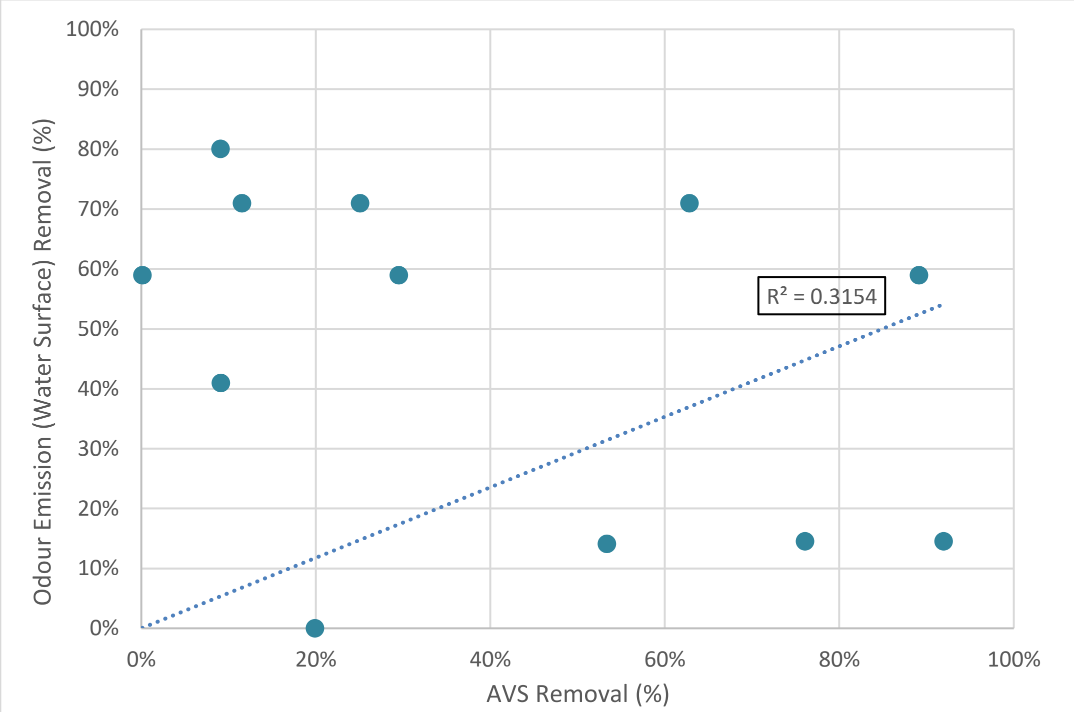
Figure 2 Odour Emissions (Water Surface) vs. AVS Levels in Trial Area A3 and A4



Note:
1. Odour emissions are assumed zero if results below reporting limit.

1.2.5 Plots of odour emission (water surface) removal and AVS removal are shown in **Figure 3.** Based on the plots, there appears to be no strong correlation between odour emission (water surface) removal and AVS removal.

Figure 3 Odour Emission (Water Surface) Removal vs. AVS Removal in Trial Area A3 and A4

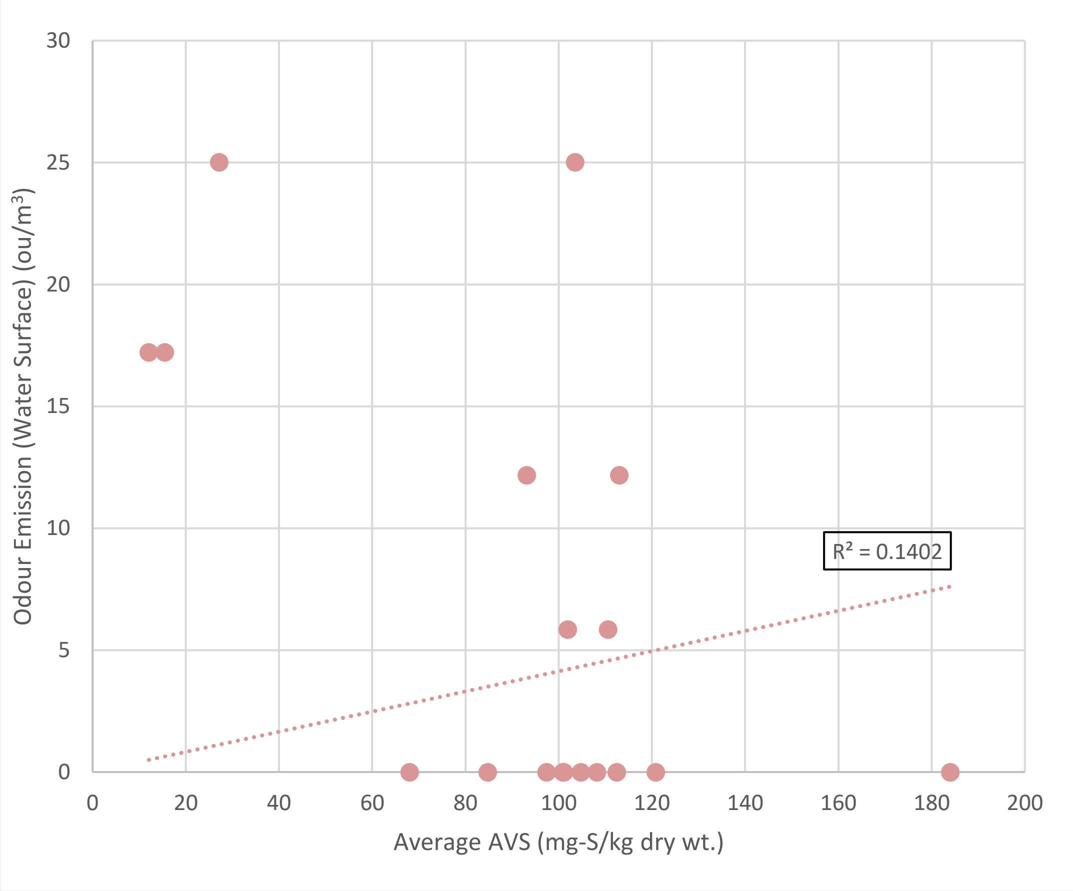


Note:
1. Grids with increased odour emissions / AVS levels after bioremediation or with no odour emissions reported prior to and after bioremediation are omitted in the figure above.
2. For cases where odour concentration are below the reporting limit prior to bioremediation, odour emission removal is calculated assuming the odour concentration is at the reporting limit.

Trial Area B3 (Non-Summer; Desilted Area)

1.2.6 A plot of odour emissions (water surface) versus AVS levels prior to and after bioremediation is shown in **Figure 4**. Based on the plot, there is no strong correlation between odour emissions (water surface) and AVS levels.

Figure 4 Odour Emissions (Water Surface) vs. AVS Levels in Trial Area B3



Note:
1. Odour emissions are assumed zero if results below reporting limit.

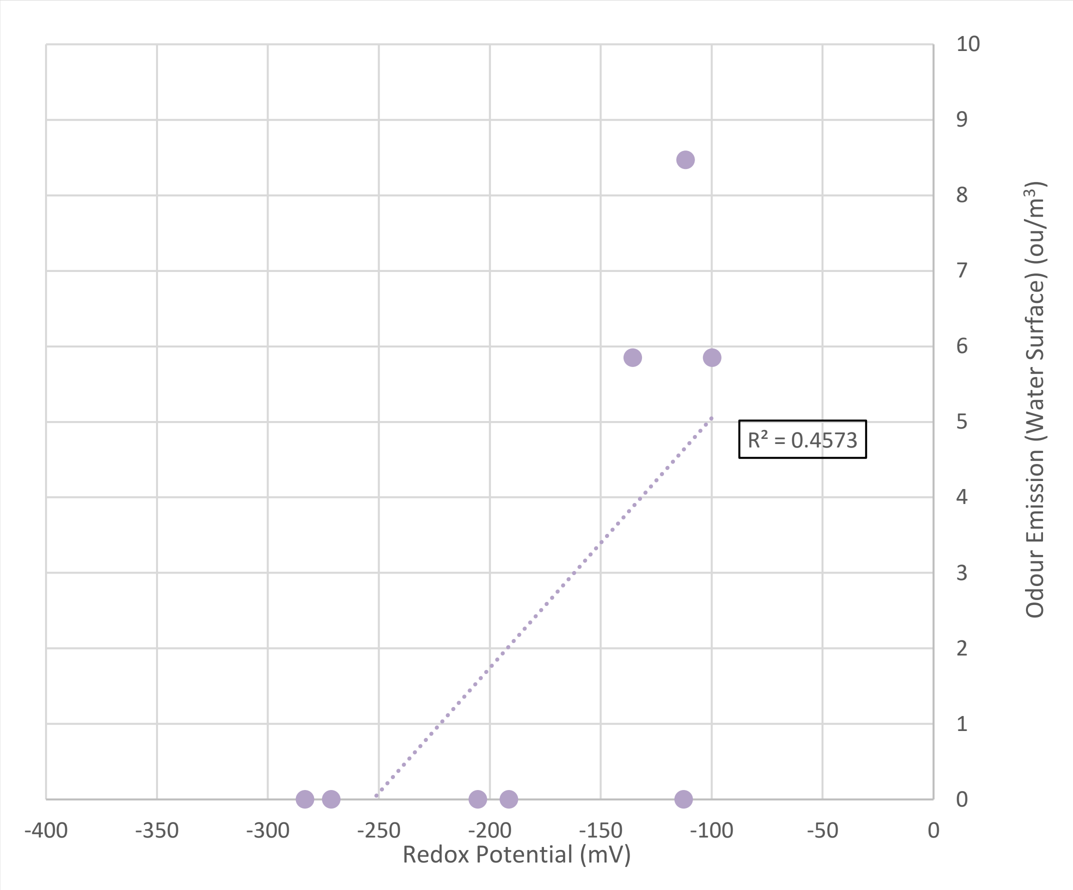
1.2.7 For the relationship between odour emission (water surface) removal and AVS removal, of the 9 test grids at Trial Area B3, eight showed either an increase in odour concentration or did not detect any odour prior to and after bioremediation. As a result, no plots between odour emission (water surface) removal and AVS removal applied could be deduced.

<u>Odour Emissions (Water Surface) and Redox Potential</u>

Trial Area A1 (Non-Summer Season)

1.2.8 A plot of odour emissions (water surface) versus redox potential prior to and after bioremediation is shown in **Figure 5**. Based on the plot, there is no strong correlation between odour emissions (water surface) and redox potential.

Figure 5 Odour Emissions (Water Surface) vs. Redox Potential in Trial Area A1



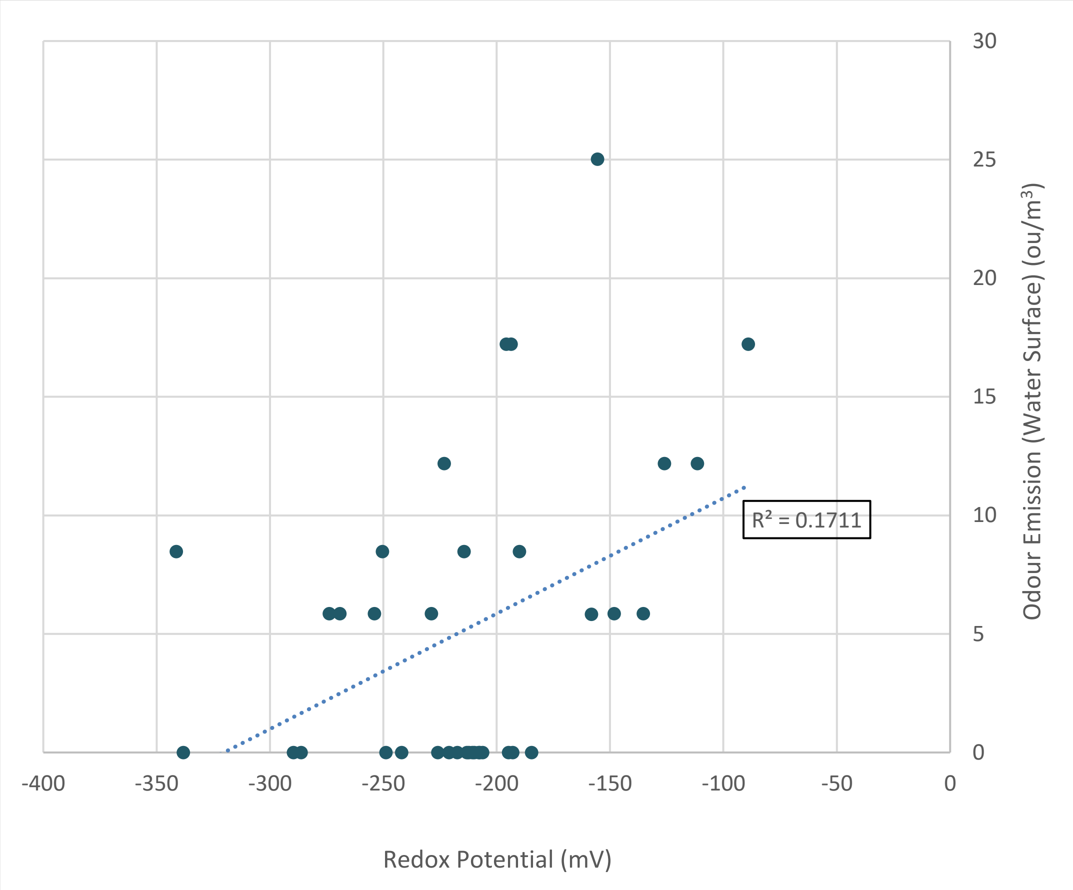
Note:
1. Odour emissions are assumed zero if results below reporting limit.

1.2.9 For the relationship between odour emission (water surface) removal and redox potential increase, all 4 test grids at Trial Area A1 showed an unexpected decrease in redox potential in sediment. As a result, no plots between odour emission (water surface) removal and redox potential increase could be deduced.

Trial Area A3 and A4 (Summer Season)

1.2.10 A plot of odour emissions (water surface) versus redox potential is shown in **Figure 6**. Based on the plot, there is no strong correlation between odour emissions (water surface) and redox potential.

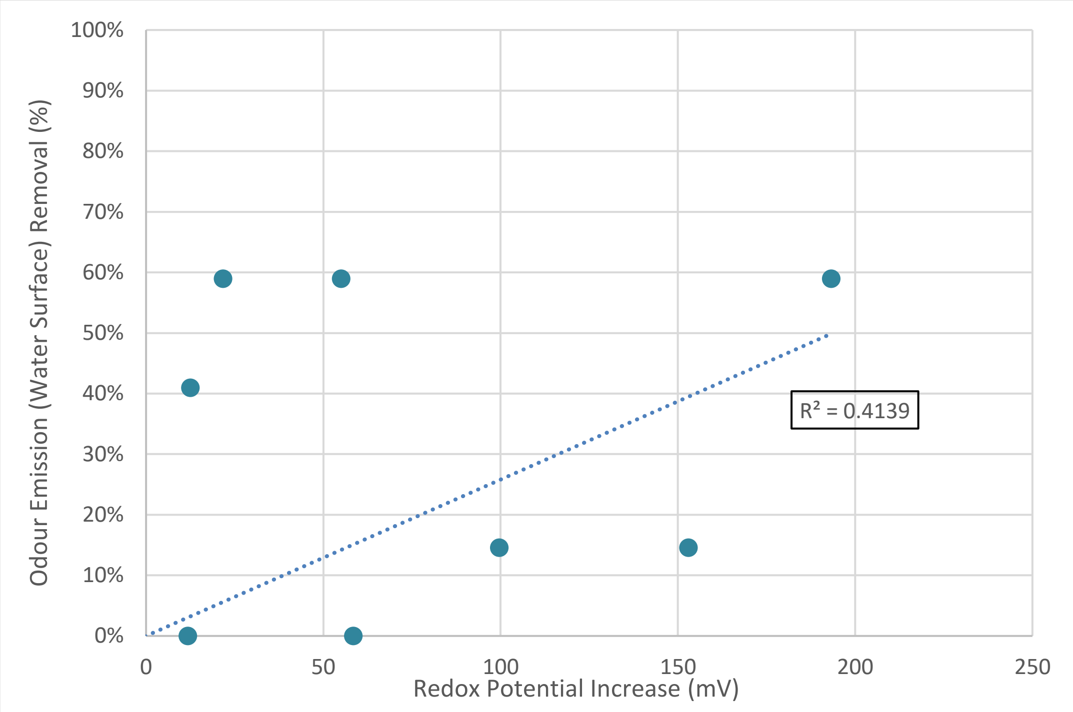
Figure 6 Odour Emissions (Water Surface) vs. Redox Potential in Trial Area A3 and A4



Note:
1. Odour emissions are assumed zero if results below reporting limit.

1.2.11 Plot of odour emission (from water surface) removal and redox potential increase is shown in **Figure 7**. Based on the plot, there appears to be no strong correlation between odour emission (from water surface) removal and redox potential increase.

Figure 7 Odour Emission (Water Surface) Removal vs. Redox Potential Increase in Trial Area A3 and A4

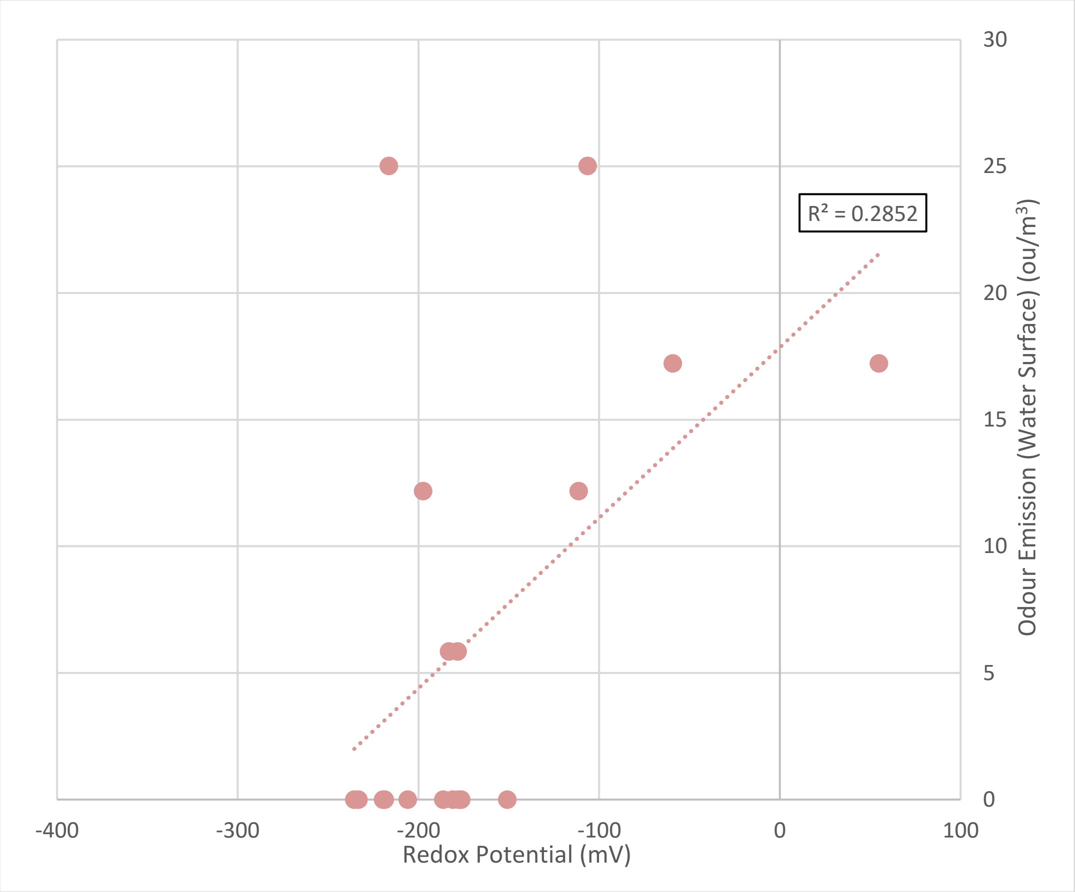


Note:
1. Grids with increased odour emissions / decreased redox potential after bioremediation or with no odour emissions reported prior to and after bioremediation are omitted in the figure above.
2. For cases where odour concentration are below the reporting limit prior to bioremediation, odour emission removal is calculated assuming the odour concentration is at the reporting limit.

Trial Area B3 (Non-Summer; Desilted Area)

1.2.12 A plot of odour emissions (water surface) versus redox potential is shown in **Figure 8**. Based on the plot, there is no strong correlation between odour emissions (water surface) and redox potential.

Figure 8 Odour Emissions (Water Surface) vs. Redox Potential in Trial Area B3



Note:
1. Odour emissions are assumed zero if results below reporting limit.

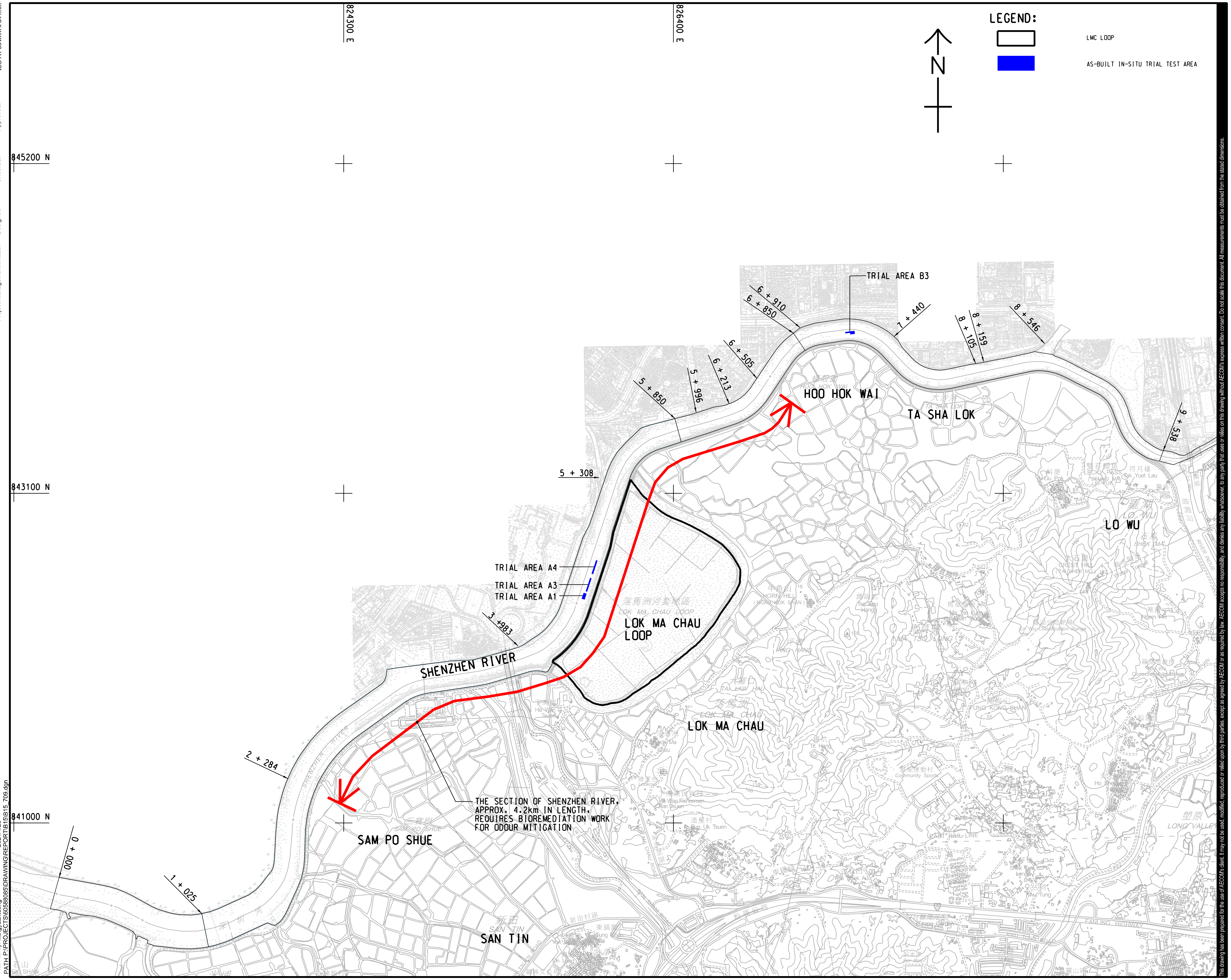
1.2.13 For the relationship between odour emission (water surface) removal and redox potential increase, of the 9 test grids at Trial Area B3, eight showed either an increase in odour concentration or did not detect any odour prior to and after bioremediation. As a result, no plots between odour emission (water surface) removal and redox potential increase could be deduced.

1.3 Conclusion

1.3.1 Based on the plots above, no strong correlation can be derived between odour emissions and AVS levels / redox potential.

1.3.2 It is worth noting that the sediment AVS levels at the trial areas were low with average pre-bioremediation levels near the LMCL (i.e. Trial Area A1, A3 and A4) and the desilted area (i.e. Trial Area B3) as 418.6 mg-S/kg and 100.2 mg-S/kg respectively. In comparison, for the similar bioremediation works at Kai Tak Approach Channel, the average pre-treatment AVS level in sediment was 3145.6 mg-S/kg and sediment with AVS levels below 400 mg-S/kg would not need to be treated under the bioremediation works[1].

[1] Contract No. KL/2010/02 Kai Tak Approach and Kwun Tong Typhoon Shelter Improvement Works (Phase 1)



AECOM

PROJECT

DEVELOPMENT OF LOK MA CHAU LOOP MAIN WORKS PACKAGE 1 DESIGN AND CONSTRUCTION

CLIENT

土木工程拓展署 Civil Engineering and Development Department

CONSULTANT

AECOM Asia Company Ltd.
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SUB-CONSULTANTS

ISSUE/REVISION

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PROJECT NO.: 60588085

CONTRACT NO.: CE 5/2018(CE)

SHEET TITLE

AS-BUILT LOCATIONS OF IN-SITU TRIAL TESTS

SHEET NUMBER

ANNEX A

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Approved:
Checked:
Designer:
Project Management Initials:
2021/4/23
Plot File by: mingyuan.song
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Appendix 4.1

Odour Emission Parameters for Lok Ma Chau Loop Sewage Treatment Works

Appendix 4.1 Odour Emission Parameters for Lok Ma Chau Loop Sewage Treatment Works

Details of Deodourisation Units for LMCL STW

Details of Deodourisation Units for LMCL STW after Design Changes

Facilities	X	Y	Ground level (mPD)	Stack Height (mAG)	Stack Diameter (m)	Exhaust Temperature (K)	Exhaust Velocity (m/s)	Effective Surface Area (m^2)	Air change Rate (ACH)	Freeboard (m)	Exhaust Volume (m3/hr)	SOER ($OU/m^2/s$) [1]	Emission Rate (ou/s)	Emission Rate with 1.5 Safety Factor (ou/s)	Additional 30% Safety Factor for Enhanced Influent Load (ou/s)	Emission Rate with 95% Odour Removal Efficiency (ou/s)
DOU1	826620	842737	6	10	1.10	298	10						**5190**	**7784**	**10120**	**506**
Inlet pumps and screens								195	3	1-6	2446	3.26	636			
Equalisation Tank								800	3	4	11520	3.51	2808			
Grit Trap								109	3	1	391	1.84	201			
Primary Settling Tank								360	3-12	1-6	6886	4.03	1451			
Screening and Grit Skip								86	12	6	7452	1.10	95			
DOU2	826725	842672	6	10	1.30	298	10						**2113**	**3169**	**4120**	**206**
MBR Fine Screens								106	3	1	357	4.03	427			
Screening Skip								101	12	6	8748	1.10	111			
MBR Bioreactors								948	3	1	19714	1.65	1564			
MBR Membrane Tanks								510	3	1	17172	0.02	10			
DOU3	826694	842722	6	10	1.30	298	10						**774**	**1161**	**1509**	**75**
Sludge Holding Tanks								163	3	3	1755	3.98	649			
Centrifigues								22	3	1	79	3.98	88			
Sludge Skip								266	12	6	20269	0.06	16			
Sludge Dewatering Facilities								364	12	6	23409	0.06	22			
															Total Odour Emission (ou/s)	***787***

Conversion of 1-hour Average to 5-second Average Concentration

Facilities	Source Type	Stability	1-hour Average Emission Rate, OU/s	Conversion Multiplier	5-second Average Emission Rate, OU/s	Reference
DOU1	Point	A	506	2.3	1163.8	-Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales'
		B	506	2.3	1163.8	
		C	506	2.3	1163.8	
		D	506	2.3	1163.8	- Katestone Scientific 1995, The Evaluation of Peak-to-Mean Ratios for Odour Assessments, volumes I and II, Katestone Scientific Pty Ltd, Brisbane.
		E	506	2.3	1163.8	
		F	506	2.3	1163.8	
DOU2	Point	A	206	2.3	473.8	
		B	206	2.3	473.8	- Katestone Scientific 1998, Peak-to-Mean Concentration Ratios for Odour Assessments, Katestone Scientific Pty Ltd, Brisbane.
		C	206	2.3	473.8	
		D	206	2.3	473.8	
		E	206	2.3	473.8	
		F	206	2.3	473.8	
DOU3	Point	A	75	2.3	173.6	
		B	75	2.3	173.6	
		C	75	2.3	173.6	
		D	75	2.3	173.6	
		E	75	2.3	173.6	
		F	75	2.3	173.6	

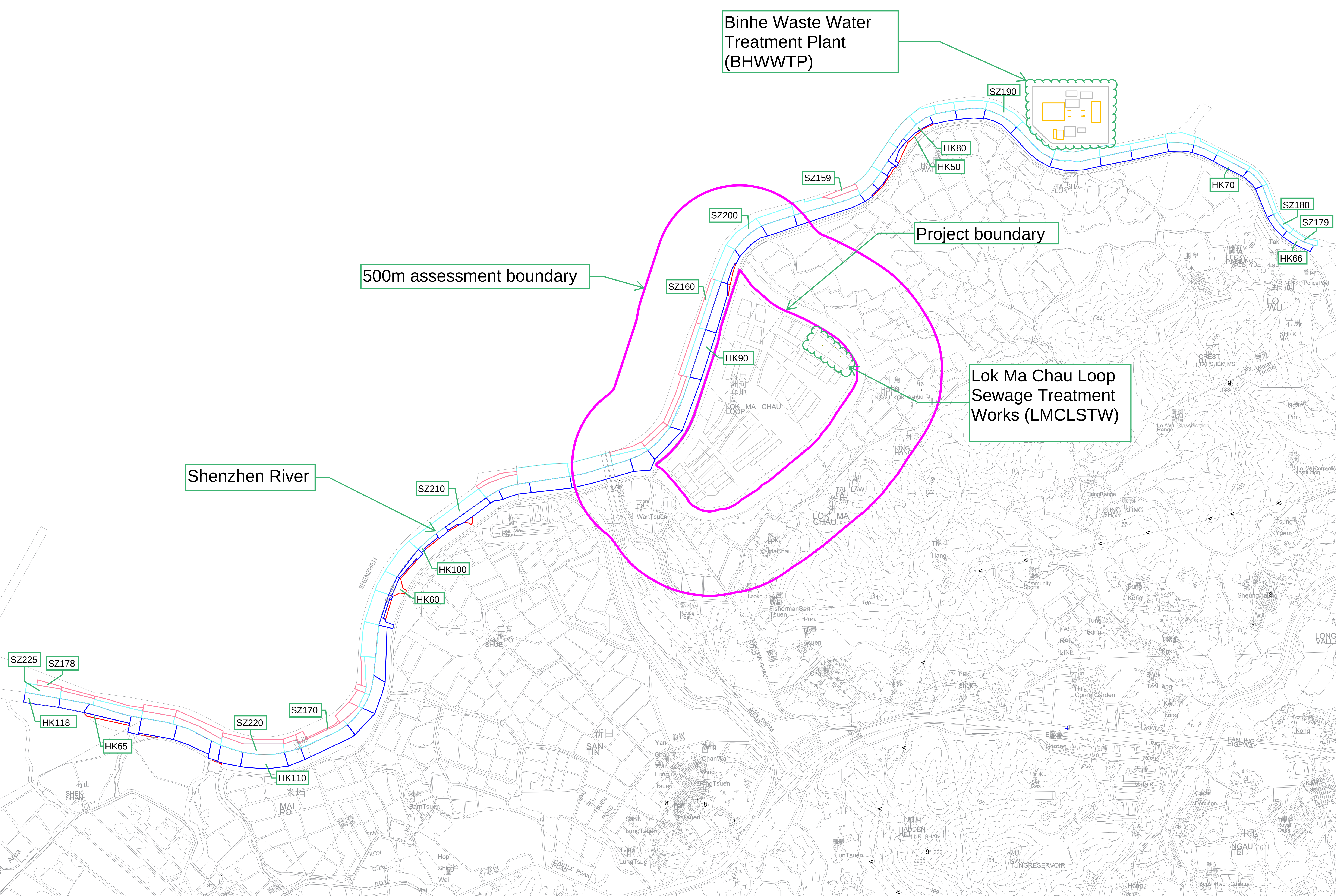
Note:
[1] SOER make reference to the approved EIA report of Shek Wu Hui Effluent Polishing Plant (EIA-213/2013)

Details of Deodourisation Units for LMCL STW under EIA Study

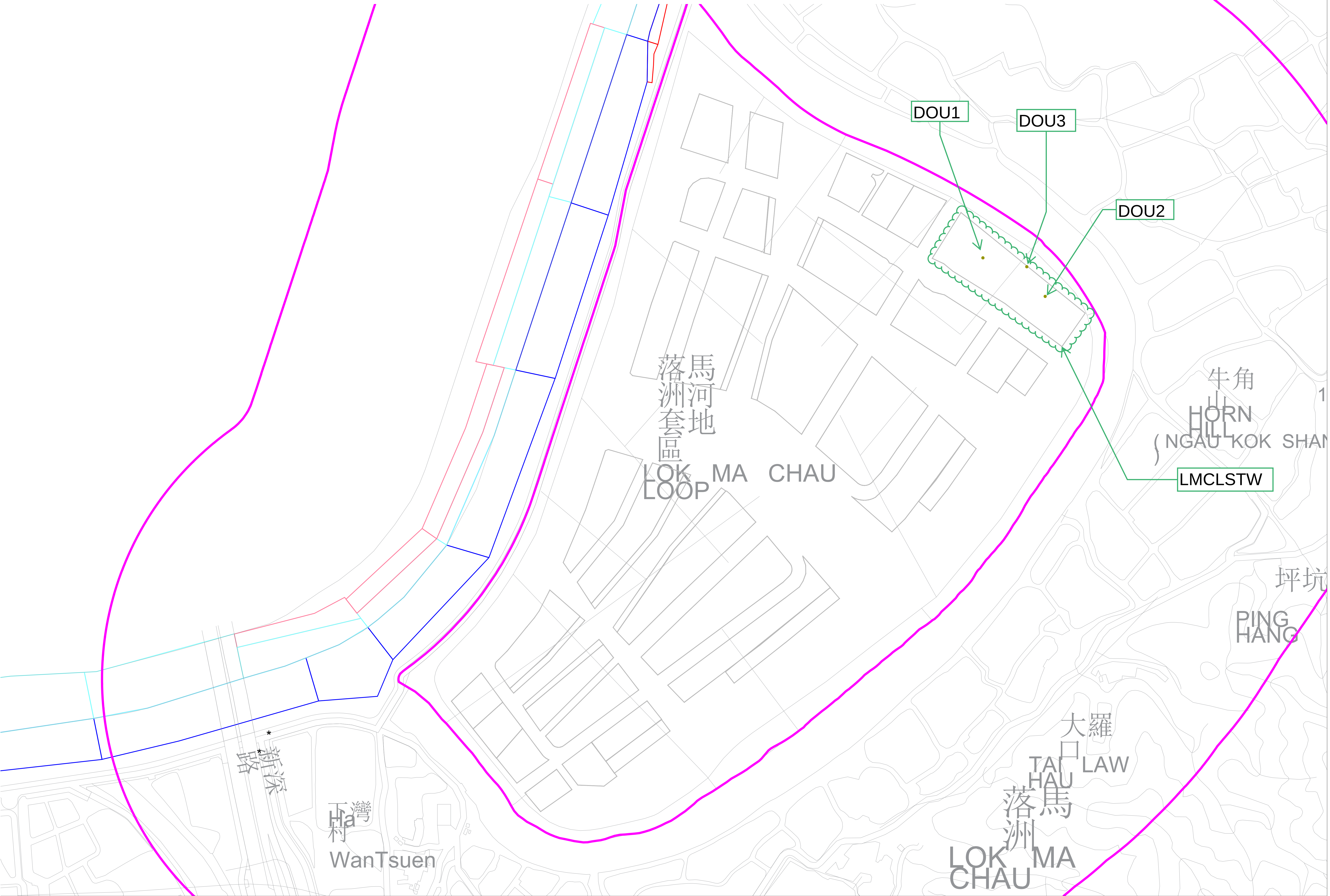
Facilities	X	Y	Ground level (mPD)	Stack Height (mAG)	Stack Diameter (m)	Exhaust Temperature (K)	Exhaust Velocity (m/s)	Effective Surface Area (m^2)	Extract Vol. (cu.m/hr)	SOER ($OU/m^2/s$) [2]	Emission Rate (ou/s)	-	Emission Rate with 95% Odour Removal Efficiency (ou/s)
DOU1	826586	842731	3	10	0.57	298	10				**8840**		**442**
Inlet Pumping Station (Screw Pump) (1)								352	1056	7.80	2746		
Screens and Grit Traps (2)								248	744	5.72	1419		
Primary Sedimentation Tanks (3)								636	1908	5.68	3612		
Membrane Bioreactor (Bioreactor) including fine screen (5a)								1330	3990	0.60	798		
Membrane Bioreactor (Membranes) (5b)								144	432	0.60	86		
Pump Compound (5c)								299	897	0.60	179		
DOU2	826615	842774	3	10	0.49	298	10				**39780**		**1989**
Equilisation Tank (4)								612.5	1837.5	5.68	3479		
Primary Sludge Storage Tank (8a)								23.76	71.27561719	3.90	93		
Primary Sludge Thickeners (8b)								95.03	285.1024688	15.15	1440		
MBR Sludge Storage Tanks (9a)								190.07	570.2049375	3.90	741		
Dissolved Air Flotation Units (9b)								85	255	0.42	36		
Aerobic Sludge Digestion Tanks (11)								950.34	2851.024688	33.97	32283		
Sludge Filter Press House (12)								306.25	918.75	5.58	1709		
												Total Odour Emission (ou/s)	***2431***

Note:
[2] SOER has been adopted from the "PolyU Technology & Consultancy Co. Ltd. 2006 Report for Phase I Odour Sampling (Flux Hood) and Analysis.

Indicative Location Plan of the Odour Sources



Location Plan of the Odour Emission Sources of Lok Ma Chau Loop Sewage Treatment Works (LMCLSTW)



Appendix 4.2

Odour Emission Parameters for Binhe Waste Water Treatment Plant

Appendix 4.2 Odour Emission Parameters for Binhe Waste Water Treatment Plant

Emission Parameters of Sources from Binhe Waste Water Treatment Plant Referenced from LMCL EIA Report (AEIAR-176/2013)

Facilities	Source ID	Source Type	X1	Y1	X2	Y2	Width (m) / Angle (degree)	Szint	Working Hours	Source Odour Emission Rate ($OU/m^2/s$)	Release Height (m)	Temp. (K)^
Aeration Tank	A262	Area	827987.45	844018.08	16.94	56.45	0	-	24	0.6	0	0
Final Sedimentation Tank (Wesatern)	A263	Area	828008.78	844013.72	37.06	55.59	0	-	24	0.39	0	0
Aerobic Zone Aeration Tank	A264	Area	827924.09	844174.47	128.62	105.24	0	-	24	0.6	0	0
Final Sedimentation Tank (Eastern)	A265	Area	828215.98	844182.90	53.11	123.92	0	-	24	0.39	0	0

Facilities	Source ID	Source Type	X1	Y1	X2	Y2	Width (m) / Angle (degree)	Szint	Working Hours	Source Odour Emission Rate (OU/s)	Release Height (m)	Temp. (K)^
Deodourising Unit 1	A267	Point	828074.30	844128.93	-	-	-	-	24	148.22	5	0
Deodourising Unit 2	A268	Point	828080.36	844128.93	-	-	-	-	24	148.22	5	0
Deodourising Unit 3	A269	Point	828085.05	844128.93	-	-	-	-	24	148.22	5	0
Deodourising Unit 4	A270	Point	828090.53	844129.32	-	-	-	-	24	148.22	5	0
Deodourising Unit 5	A271	Point	828156.24	844130.11	-	-	-	-	24	148.22	5	0
Deodourising Unit 6	A272	Point	828161.33	844129.91	-	-	-	-	24	148.22	5	0
Deodourising Unit 7	A273	Point	828166.22	844129.91	-	-	-	-	24	148.22	5	0
Deodourising Unit 8	A274	Point	828171.50	844130.11	-	-	-	-	24	148.22	5	0
Deodourising Unit 9	A275	Point	828172.47	844096.66	-	-	-	-	24	148.22	5	0
Deodourising Unit 10	A276	Point	828166.80	844096.86	-	-	-	-	24	148.22	5	0
Deodourising Unit 11	A277	Point	828161.52	844096.66	-	-	-	-	24	148.22	5	0
Deodourising Unit 12	A278	Point	828156.63	844096.66	-	-	-	-	24	148.22	5	0
Deodourising Unit 13	A279	Point	828090.72	844094.90	-	-	-	-	24	148.22	5	0
Deodourising Unit 14	A280	Point	828085.44	844094.90	-	-	-	-	24	148.22	5	0
Deodourising Unit 15	A281	Point	828080.75	844094.71	-	-	-	-	24	148.22	5	0
Deodourising Unit 16	A282	Point	828075.47	844094.71	-	-	-	-	24	148.22	5	0
Deodourising Unit 17	A266	Point	828186.62	844014.40	-	-	-	-	24	84.54	5	0

Remarks:

^ The Emission at ambient temperature is denoted as 0 K in AERMOD.

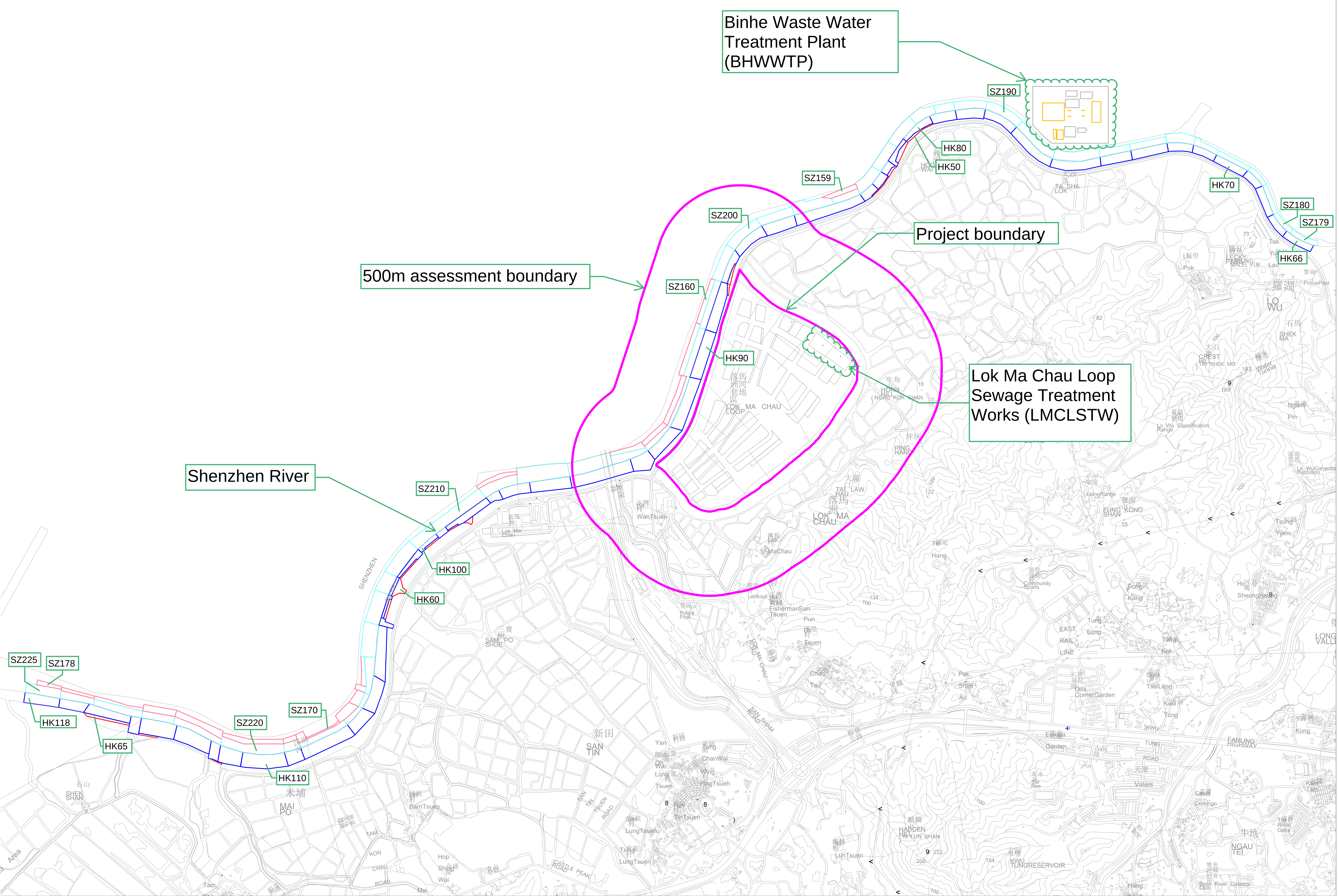
Appendix 4.2 Odour Emission Parameters for Binhe Waste Water Treatment Plant

Odour Emission Rate of Sources under Different Stability Classes

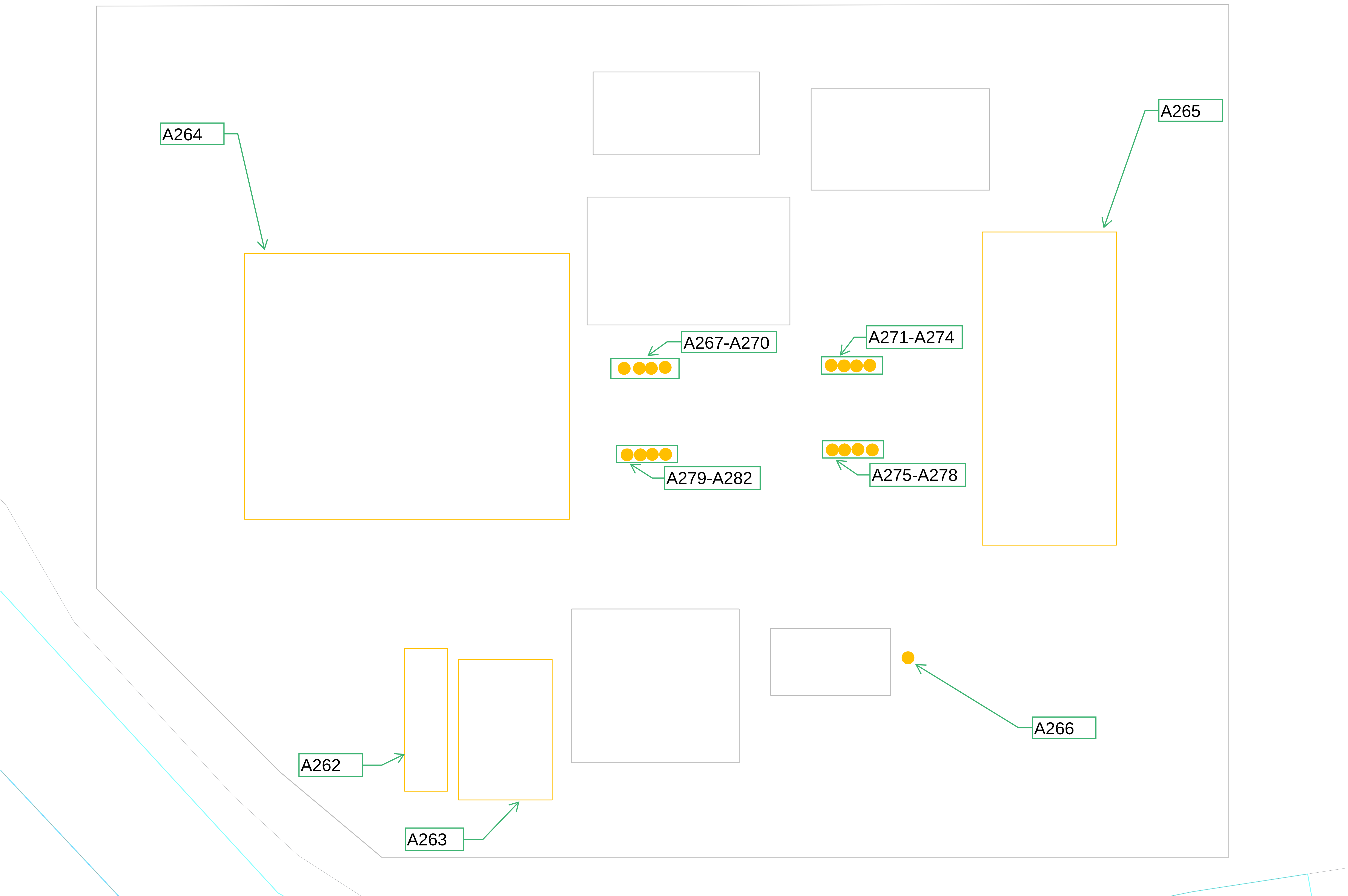
Facilities	Source ID	Source Type	Source Odour Emission Rate under EIA ($OU/m^2/s$)			Source Odour Emission Rate Modified by Backward Calculation ($OU/m^2/s$)			Reference
			Base Emission	Stability Class (A, B, C, and D)	Stability Class (E and F)	Base Emission	Stability Class (A, B, C, and D)	Stability Class (E and F)	
Aeration Tank	A262	AREA	0.6	1.5	1.38	0.102	0.2551	0.2347	-Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales' - Katestone Scientific 1995, The Evaluation of Peak-to-Mean Ratios for Odour Assessments, volumes I and II, Katestone Scientific Pty Ltd, Brisbane. - Katestone Scientific 1998, Peak-to-Mean Concentration Ratios for Odour Assessments, Katestone Scientific Pty Ltd, Brisbane.
Final Sedimentation Tank (Wesatern)	A263	AREA	0.39	0.975	0.897	0.066	0.1658	0.1526	
Aerobic Zone Aeration Tank	A264	AREA	0.6	1.5	1.38	0.102	0.2551	0.2347	
Final Sedimentation Tank (Eastern)	A265	AREA	0.39	0.975	0.897	0.066	0.1658	0.1526	

Facilities	Source ID	Source Type	Source Odour Emission Rate under EIA (OU/s)			Source Odour Emission Rate Modified by Backward Calculation (OU/s)			Reference
			Base Emission	Stability Class (A, B, C, and D)	Stability Class (E and F)	Base Emission	Class (A, B, C, and D)	Stability Class (E and F)	
Deodourising Unit 1	A267	POINT	148.22	340.906	340.906	25.207	57.9772	57.9772	-Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales' - Katestone Scientific 1995, The Evaluation of Peak-to-Mean Ratios for Odour Assessments, volumes I and II, Katestone Scientific Pty Ltd, Brisbane. - Katestone Scientific 1998, Peak-to-Mean Concentration Ratios for Odour Assessments, Katestone Scientific Pty Ltd, Brisbane.
Deodourising Unit 2	A268	POINT	148.22	340.906	340.906	25.207	57.9772	57.9772	
Deodourising Unit 3	A269	POINT	148.22	340.906	340.906	25.207	57.9772	57.9772	
Deodourising Unit 4	A270	POINT	148.22	340.906	340.906	25.207	57.9772	57.9772	
Deodourising Unit 5	A271	POINT	148.22	340.906	340.906	25.207	57.9772	57.9772	
Deodourising Unit 6	A272	POINT	148.22	340.906	340.906	25.207	57.9772	57.9772	
Deodourising Unit 7	A273	POINT	148.22	340.906	340.906	25.207	57.9772	57.9772	
Deodourising Unit 8	A274	POINT	148.22	340.906	340.906	25.207	57.9772	57.9772	
Deodourising Unit 9	A275	POINT	148.22	340.906	340.906	25.207	57.9772	57.9772	
Deodourising Unit 10	A276	POINT	148.22	340.906	340.906	25.207	57.9772	57.9772	
Deodourising Unit 11	A277	POINT	148.22	340.906	340.906	25.207	57.9772	57.9772	
Deodourising Unit 12	A278	POINT	148.22	340.906	340.906	25.207	57.9772	57.9772	
Deodourising Unit 13	A279	POINT	148.22	340.906	340.906	25.207	57.9772	57.9772	
Deodourising Unit 14	A280	POINT	148.22	340.906	340.906	25.207	57.9772	57.9772	
Deodourising Unit 15	A281	POINT	148.22	340.906	340.906	25.207	57.9772	57.9772	
Deodourising Unit 16	A282	POINT	148.22	340.906	340.906	25.207	57.9772	57.9772	
Deodourising Unit 17	A266	POINT	84.54	194.442	194.442	14.378	33.0684	33.0684	

Indicative Location Plan of the Odour Sources



Location Plan of the Odour Emission Sources of Binhe Waste Water Treatment Plant (BHWWTP)



Appendix 4.3

Odour Emission Parameters for Shenzhen River

Appendix 4.3 Odour Emission Parameters for Shenzhen River

Odour Emission Rate from the Sources of Shenzhen River

Source ID	HK/SZ	Source Type	Type	Source Odour Emission Rate (OU/m^2/s)	5 second Source Odour Emission Rate (OU/m^2/s)		Release Height (m)	Temp. (K)^
					Stability Class (A, B, C, and D)	Stability Class (E and F)		
HK50	HK	Sediment	Area	0.241	0.603	0.554	0	0
HK51	HK	Sediment	Area	0.241	0.603	0.554	0	0
HK52	HK	Sediment	Area	0.241	0.603	0.554	0	0
HK53	HK	Sediment	Area	0.231	0.577	0.531	0	0
HK54	HK	Sediment	Area	0.119	0.297	0.273	0	0
HK55	HK	Sediment	Area	0.112	0.279	0.257	0	0
HK56	HK	Sediment	Area	0.047	0.118	0.109	0	0
HK57	HK	Sediment	Area	0.044	0.110	0.101	0	0
HK58	HK	Sediment	Area	0.039	0.098	0.090	0	0
HK59	HK	Sediment	Area	0.043	0.108	0.100	0	0
HK60	HK	Sediment	Area	0.047	0.118	0.108	0	0
HK61	HK	Sediment	Area	0.052	0.129	0.119	0	0
HK62	HK	Sediment	Area	0.038	0.095	0.087	0	0
HK63	HK	Sediment	Area	0.038	0.095	0.087	0	0
HK64	HK	Sediment	Area	0.038	0.095	0.087	0	0
HK65	HK	Sediment	Area	0.031	0.078	0.072	0	0
HK66	HK	Water	Area	0.054	0.135	0.124	0	0
HK67	HK	Water	Area	0.054	0.135	0.124	0	0
HK68	HK	Water	Area	0.043	0.109	0.100	0	0
HK69	HK	Water	Area	0.032	0.081	0.074	0	0
HK70	HK	Water	Area	0.021	0.051	0.047	0	0
HK71	HK	Water	Area	0.016	0.040	0.037	0	0
HK72	HK	Water	Area	0.016	0.040	0.037	0	0
HK73	HK	Water	Area	0.016	0.040	0.037	0	0
HK74	HK	Water	Area	0.016	0.040	0.037	0	0
HK75	HK	Water	Area	0.016	0.040	0.037	0	0
HK76	HK	Water	Area	0.016	0.040	0.037	0	0
HK77	HK	Water	Area	0.016	0.040	0.037	0	0
HK78	HK	Water	Area	0.016	0.040	0.037	0	0
HK79	HK	Water	Area	0.016	0.041	0.038	0	0
HK80	HK	Water	Area	0.017	0.043	0.039	0	0
HK81	HK	Water	Area	0.018	0.044	0.041	0	0
HK82	HK	Water	Area	0.018	0.045	0.041	0	0
HK83	HK	Water	Area	0.022	0.055	0.051	0	0
HK84	HK	Water	Area	0.025	0.063	0.058	0	0
HK85	HK	Water	Area	0.033	0.083	0.076	0	0
HK86	HK	Water	Area	0.032	0.081	0.075	0	0
HK87	HK	Water	Area	0.026	0.064	0.059	0	0
HK88	HK	Water	Area	0.019	0.047	0.043	0	0
HK89	HK	Water	Area	0.028	0.070	0.064	0	0
HK90	HK	Water	Area	0.047	0.117	0.107	0	0
HK91	HK	Water	Area	0.077	0.193	0.177	0	0
HK92	HK	Water	Area	0.107	0.268	0.247	0	0
HK93	HK	Water	Area	0.094	0.236	0.217	0	0
HK94	HK	Water	Area	0.045	0.114	0.104	0	0
HK95	HK	Water	Area	0.020	0.049	0.045	0	0
HK96	HK	Water	Area	0.024	0.061	0.056	0	0
HK97	HK	Water	Area	0.026	0.066	0.061	0	0
HK98	HK	Water	Area	0.036	0.089	0.082	0	0
HK99	HK	Water	Area	0.044	0.110	0.102	0	0
HK100	HK	Water	Area	0.048	0.121	0.111	0	0
HK101	HK	Water	Area	0.051	0.128	0.117	0	0
HK102	HK	Water	Area	0.052	0.131	0.120	0	0
HK103	HK	Water	Area	0.053	0.133	0.123	0	0
HK104	HK	Water	Area	0.054	0.135	0.124	0	0
HK105	HK	Water	Area	0.054	0.135	0.124	0	0
HK106	HK	Water	Area	0.054	0.135	0.124	0	0
HK107	HK	Water	Area	0.044	0.111	0.102	0	0
HK108	HK	Water	Area	0.028	0.069	0.063	0	0
HK109	HK	Water	Area	0.019	0.048	0.044	0	0
HK110	HK	Water	Area	0.021	0.053	0.049	0	0
HK111	HK	Water	Area	0.024	0.059	0.054	0	0
HK112	HK	Water	Area	0.023	0.058	0.053	0	0
HK113	HK	Water	Area	0.021	0.054	0.049	0	0
HK114	HK	Water	Area	0.019	0.047	0.043	0	0
HK115	HK	Water	Area	0.019	0.047	0.044	0	0
HK116	HK	Water	Area	0.021	0.052	0.048	0	0
HK117	HK	Water	Area	0.023	0.059	0.054	0	0
HK118	HK	Water	Area	0.023	0.057	0.053	0	0

Appendix 4.3 Odour Emission Parameters for Shenzhen River

Odour Emission Rate from the Sources of Shenzhen River

Source ID	HK/SZ	Source Type	Type	Source Odour Emission Rate ($OU/m^2/s$)	5 second Source Odour Emission Rate ($OU/m^2/s$) Stability Class (A, B, C, and D)	Stability Class (E and F)	Release Height (m)	Temp. (K)^
SZ159	SZ	Sediment	Area	0.208	0.521	0.479	0	0
SZ160	SZ	Sediment	Area	0.058	0.146	0.134	0	0
SZ161	SZ	Sediment	Area	0.094	0.236	0.217	0	0
SZ162	SZ	Sediment	Area	0.081	0.202	0.186	0	0
SZ163	SZ	Sediment	Area	0.071	0.177	0.163	0	0
SZ164	SZ	Sediment	Area	0.064	0.161	0.148	0	0
SZ165	SZ	Sediment	Area	0.054	0.135	0.124	0	0
SZ166	SZ	Sediment	Area	0.050	0.125	0.115	0	0
SZ167	SZ	Sediment	Area	0.049	0.122	0.112	0	0
SZ168	SZ	Sediment	Area	0.048	0.120	0.110	0	0
SZ169	SZ	Sediment	Area	0.047	0.117	0.107	0	0
SZ170	SZ	Sediment	Area	0.045	0.111	0.103	0	0
SZ171	SZ	Sediment	Area	0.043	0.108	0.099	0	0
SZ172	SZ	Sediment	Area	0.042	0.106	0.098	0	0
SZ173	SZ	Sediment	Area	0.040	0.101	0.093	0	0
SZ174	SZ	Sediment	Area	0.038	0.095	0.087	0	0
SZ175	SZ	Sediment	Area	0.038	0.095	0.087	0	0
SZ176	SZ	Sediment	Area	0.031	0.078	0.072	0	0
SZ177	SZ	Sediment	Area	0.025	0.062	0.057	0	0
SZ178	SZ	Sediment	Area	0.024	0.060	0.055	0	0
SZ179	SZ	Water	Area	0.042	0.105	0.097	0	0
SZ180	SZ	Water	Area	0.042	0.105	0.097	0	0
SZ181	SZ	Water	Area	0.045	0.112	0.103	0	0
SZ182	SZ	Water	Area	0.049	0.121	0.112	0	0
SZ183	SZ	Water	Area	0.052	0.131	0.120	0	0
SZ184	SZ	Water	Area	0.059	0.148	0.136	0	0
SZ185	SZ	Water	Area	0.067	0.167	0.154	0	0
SZ186	SZ	Water	Area	0.076	0.189	0.174	0	0
SZ187	SZ	Water	Area	0.079	0.198	0.182	0	0
SZ188	SZ	Water	Area	0.079	0.198	0.182	0	0
SZ189	SZ	Water	Area	0.089	0.223	0.205	0	0
SZ190	SZ	Water	Area	0.103	0.257	0.237	0	0
SZ191	SZ	Water	Area	0.114	0.284	0.262	0	0
SZ192	SZ	Water	Area	0.099	0.247	0.227	0	0
SZ193	SZ	Water	Area	0.079	0.197	0.181	0	0
SZ194	SZ	Water	Area	0.057	0.143	0.132	0	0
SZ195	SZ	Water	Area	0.041	0.102	0.094	0	0
SZ196	SZ	Water	Area	0.051	0.127	0.117	0	0
SZ197	SZ	Water	Area	0.061	0.154	0.141	0	0
SZ198	SZ	Water	Area	0.074	0.186	0.171	0	0
SZ199	SZ	Water	Area	0.077	0.192	0.177	0	0
SZ200	SZ	Water	Area	0.074	0.186	0.171	0	0
SZ201	SZ	Water	Area	0.072	0.181	0.166	0	0
SZ202	SZ	Water	Area	0.066	0.165	0.152	0	0
SZ203	SZ	Water	Area	0.057	0.143	0.132	0	0
SZ204	SZ	Water	Area	0.063	0.158	0.145	0	0
SZ205	SZ	Water	Area	0.075	0.188	0.173	0	0
SZ206	SZ	Water	Area	0.062	0.154	0.142	0	0
SZ207	SZ	Water	Area	0.033	0.082	0.076	0	0
SZ208	SZ	Water	Area	0.021	0.053	0.049	0	0
SZ209	SZ	Water	Area	0.026	0.066	0.060	0	0
SZ210	SZ	Water	Area	0.022	0.054	0.050	0	0
SZ211	SZ	Water	Area	0.029	0.072	0.066	0	0
SZ212	SZ	Water	Area	0.039	0.098	0.091	0	0
SZ213	SZ	Water	Area	0.049	0.123	0.113	0	0
SZ214	SZ	Water	Area	0.039	0.097	0.089	0	0
SZ215	SZ	Water	Area	0.025	0.064	0.059	0	0
SZ216	SZ	Water	Area	0.016	0.040	0.037	0	0
SZ217	SZ	Water	Area	0.016	0.040	0.037	0	0
SZ218	SZ	Water	Area	0.016	0.040	0.037	0	0
SZ219	SZ	Water	Area	0.016	0.040	0.037	0	0
SZ220	SZ	Water	Area	0.016	0.040	0.037	0	0
SZ221	SZ	Water	Area	0.016	0.040	0.037	0	0
SZ222	SZ	Water	Area	0.016	0.040	0.037	0	0
SZ223	SZ	Water	Area	0.023	0.058	0.054	0	0
SZ224	SZ	Water	Area	0.035	0.086	0.079	0	0
SZ225	SZ	Water	Area	0.038	0.095	0.087	0	0

Remarks:

^ The Emission at ambient temperature is denoted as 0 K in AERMOD.

Appendix 4.3 Odour Emission Parameters for Shenzhen River

Sources from the Shenzhen River

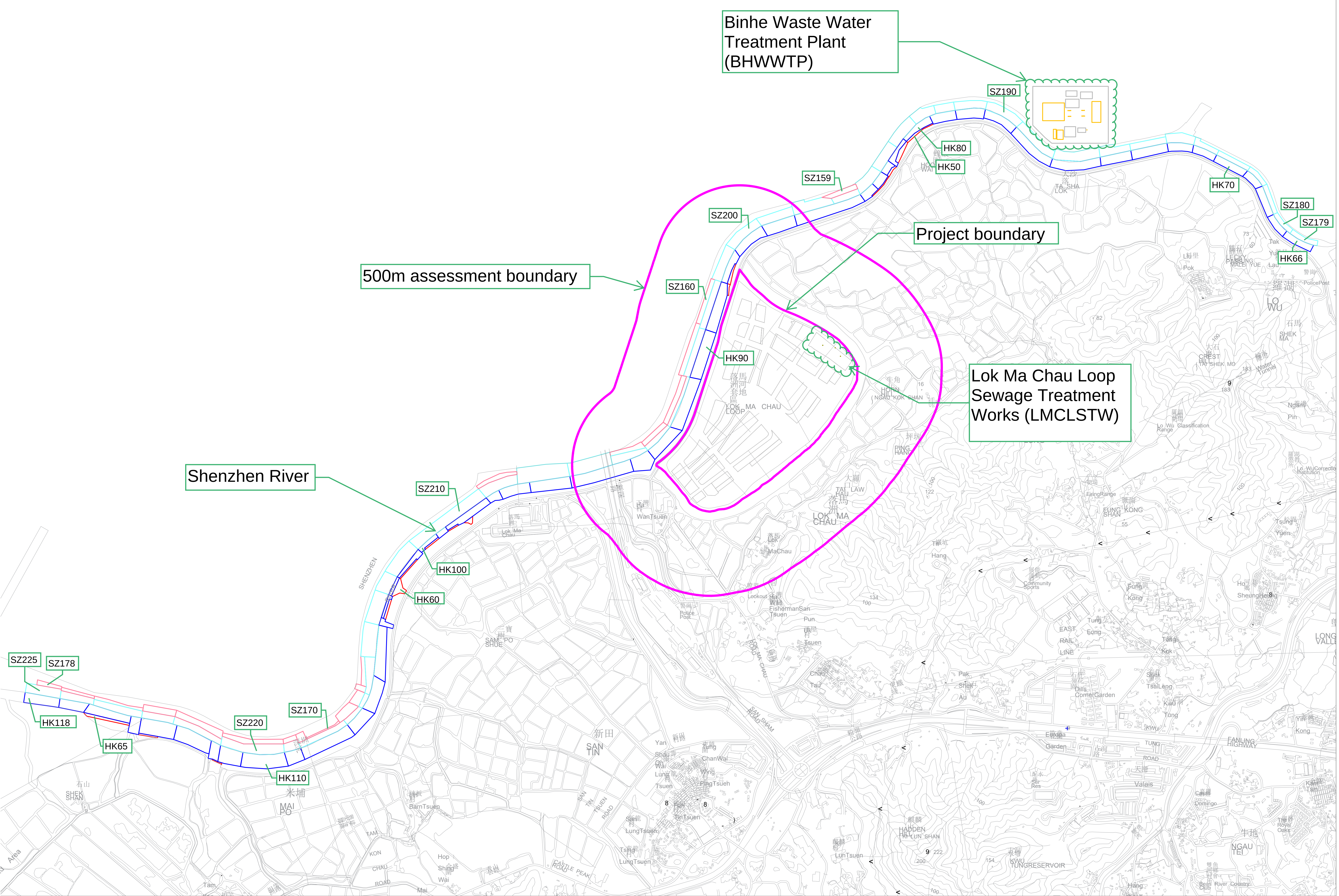
Source ID	HK/SZ	Source Type	Type	Area (m^2)	Vertices (X)	Vertices (Y)	Vertices (X)	Vertices (Y)	Vertices (X)	Vertices (Y)	Vertices (X)	Vertices (Y)	Vertices (X)	Vertices (Y)	Vertices (X)	Vertices (Y)	Vertices (X)	Vertices (Y)	Vertices (X)	Vertices (Y)	Vertices (X)	Vertices (Y)	Vertices (X)	Vertices (Y)	Vertices (X)	Vertices (Y)
HK50	HK	Sediment	Area	1787.09	827273	844055	827276	844049	827216	844020	827192	844000	827175	843984	827125	843940	827116	843946	827164	843994	827221	844029				
HK51	HK	Sediment	Area	3006.26	827116	843946	827073	843894	827051	843829	827068	843817	827090	843864	827125	843940										
HK52	HK	Sediment	Area	983.38	827058	843796	827048	843803	827042	843795	827031	843792	827002	843744	827014	843737	827038	843779								
HK53	HK	Sediment	Area	940.63	826983	843690	826954	843658	826915	843621	826911	843625	826949	843662	826978	843695	827008	843741	827014	843737						
HK54	HK	Sediment	Area	1676.67	826106	843219	826099	843221	826079	843181	826058	843118	826055	843102	826072	843097	826090	843177								
HK55	HK	Sediment	Area	737.65	826062	843033	826054	843034	826055	843102	826072	843097	826065	843081	826064	843062										
HK56	HK	Sediment	Area	1132.81	824544	841723	824543	841683	824535	841675	824517	841684	824492	841685												
HK57	HK	Sediment	Area	527.75	824457	841677	824459	841669	824400	841634	824396	841640														
HK58	HK	Sediment	Area	959.15	824259	841534	824265	841527	824346	841591	824340	841599														
HK59	HK	Sediment	Area	1159.84	824211	841471	824110	841357	824117	841353	824124	841362	824217	841466												
HK60	HK	Sediment	Area	4162.58	824110	841357	824117	841353	824130	841298	824152	841282	824141	841263	824112	841268	824069	841247	824062	841250						
HK61	HK	Sediment	Area	1626.13	824015	841117	824028	841111	824063	841228	824052	841233														
HK62	HK	Sediment	Area	172.46	823054	840250	823057	840259	823033	840268	823032	840263	823053	840253	823054	840250										
HK63	HK	Sediment	Area	200.71	823033	840268	823001	840283	822999	840277	823032	840263														
HK64	HK	Sediment	Area	1000.85	822562	840427	822564	840437	822677	840417	822675	840409														
HK65	HK	Sediment	Area	4056.66	822508	840482	822510	840495	822236	840560	822244	840550	822256	840537												
HK66	HK	Water	Area	7282.73	829426	843376	829391	843400	829372	843415	829346	843381	829406	843341	829511	843292	829531	843331	829522	843332	829486	843345	829471	843352	829438	843368
HK67	HK	Water	Area	5451.16	829293	843513	829257	843496	829267	843479	829301	843426	829346	843381	829372	843415	829357	843427	829332	843453	829301	843495	829293	843513		
HK68	HK	Water	Area	7821.59	829256	843496	829293	843513	829227	843681	829185	843665														
HK69	HK	Water	Area	5236.72	829139	843773	829109	843738	829127	843728	829170	843687	829185	843665	829227	843681	829206	843713	829172	843749	829162	843756				
HK70	HK	Water	Area	8848.62	829139	843773	829043	843823	828996	843846	828956	843866	828936	843828	829109	843738										
HK71	HK	Water	Area	6246.15	828956	843866	828895	843897	828881	843903	828820	843926	828810	843880	828875	843859	828936	843828								
HK72	HK	Water	Area	7267.55	828661	843936	828670	843885	828689	843888	828749	843889	828783	843886	828810	843880	828820	843926	828745	843938	828684	843938				
HK73	HK	Water	Area	11846.69	828447	843892	828457	843837	828670	843885	828661	843936	828643	843933												
HK74	HK	Water	Area	10195.68	828447	843892	828265	843853	828271	843800	828457	843837														
HK75	HK	Water	Area	15831.10	828148	843827	828003	843836	827982	843844	827966	843796	828061	843773	828168	843778	828271	843800	828265	843853						
HK76	HK	Water	Area	15252.42	827769	844032	827735	843993	827844	843875	827902	843830	827966	843796	827982	843844	827920	843877	827880	843914						
HK77	HK	Water	Area	9778.26	827663	844106	827585	844137	827574	844086	827633	844068	827633	844068	827679	844046	827735	843993	827769	844032	827724	844071	827680	844098		
HK78	HK	Water	Area	9746.79	827500	844084	827417	844076	827406	844131	827498	844142	827516	844144	827559	844142	827585	844137	827573	844079	827556	844082	827516	844085		
HK79	HK	Water	Area	8294.65	827406	844131	827291	844111	827254	844095	827276	844049	827349	844065	827417	844076										
HK80	HK	Water	Area	7186.98	827254	844095	827228	844085	827192	844061	827174	844048	827097	843962	827116	843946	827164	843994	827221	844029	827273	844055				
HK81	HK	Water	Area	4758.33	827116	843946	827097	843962	827061	843911	827024	843857	827007	843831	827058	843796	827068	843817	827051	843829	827073	843894				
HK82	HK	Water	Area	3280.08	827007	843831	826965	843766	827002	843744	827031	843792	827042	843795	827048	843803										
HK83	HK	Water	Area	4640.46	826978	843695	826949	843662	826914	843696	826935	843723	826952	843746	826965	843766	827008	843741								
HK84	HK	Water	Area	5121.59	826914	843696	826877	843660	826842	843631	826871	843591	826915	843621	826911	843625	826949	843662								
HK85	HK	Water	Area	23838.46	826689	843575	826451	843509	826468	843445	826710	843526	826794	843553	826871	843591	826842	843631	826769	843601						
HK86	HK	Water	Area	13251.64	826451	843509	826257	843446	826293	843386	826361	843407	826468	843445												
HK87	HK	Water	Area	11708.12	826257	843446	826198	843407	826148	843365	826099	843304	826128	843262	826166	843305	826197	843337	826250	843373	826293	843386				
HK88	HK	Water	Area	7508.10	826099	843304	826065	843239	826046	843194	826019	843114	826055	843102	826058	843118	826079	843181	826099	843221	826106	843219	826128	843262		
HK89	HK	Water	Area	17584.12	826019	843114	825925	842830	825988	842809	826054	843034	826055	843102												
HK90	HK	Water	Area	19583.64	825925	842830	825832	842548	825898	842534	825988	842809														
HK91	HK	Water	Area	21514.99	825832	842548	825795	842437	825715	842252	825787	842231	825898	842534												
HK92	HK	Water	Area	13520.97	825715	842252	825643	842164	825600	842127	825582	842114	825625	842059	825787	842231										
HK93	HK	Water	Area	11927.87	825582	842114	825534	842084	825478	842062	825499	841989	825599	841997	825625	842059										
HK94	HK	Water	Area	26373.93	825478	842062	825443	842048	825373	842028	825274	841997	825211	841977	825120	841960	825134	841891	825264	841922	825499	841989				
HK95	HK	Water	Area	16024.96	825120	841960	824881	841924	824891	841864	825134	841891														
HK96	HK	Water	Area	10816.48	824881	841924	824805	841913	824765	841903	824733	841892	824699	841877	824725	841824	824770	841841	824815	841854	824891	841864				
HK97	HK	Water	Area	3925.95	824699	841877	824664	841859	824624	841832	824651	841801	824677	841817	824701	841818	824725	841824								
HK98	HK	Water	Area	11443.26	824651	841801	824624	841832	824383	841660	824396	841640	824457	841677	824459	841669	824492	841685								
HK99	HK	Water	Area	2266.36	824383	841660	824326	841619	824340	841599	824346	841591	824400	841634	824396	841640										
HK100	HK	Water	Area	3383.63	824276	841578	824248	841553	824221	841527	824241	841509	824265	841527	824259	841534	824340	841599	824326	841619	824313	841609				
HK101	HK	Water	Area	4859.85	824221	841527	824249	841501	824217	841466	824211	841471	824110	841357	824097	841364										
HK102	HK	Water	Area	1939.41	824110	841357	824097	841364	824046	841258	824062	841250														
HK103	HK	Water	Area	2117.77	824063	841228	824069	841247	824046	841258	824003	841123	824015	841117	824052	841233										
HK104	HK	Water	Area	2720.55	824003	841123	824028	841111	824024	841098	824076	841079	824071	841057	823988	841077										
HK105	HK	Water	Area	18672.59	824036	841065	823988	841077	823958	840779	824025	840739														
HK106	HK	Water	Area	14402.16	823958	840779	823944	840704	823931	840663	823919	840633	823890	840585	823963	840553	824008	840675	824025	840739						
HK107	HK	Water	Area	11180.11	823890	840585	823842	840525	823800	840487	823847	840426	823963	840553												
HK108	HK	Water	Area	22665.33	823658	840408	823524	840347	823549	840280	823825	840411	823847	840426	823800	840487	823745	840448								
HK109	HK	Water	Area	7965.29	823524	840348	823469	840331	823427	840323	823452	840241	823549	840280												
HK110	HK	Water	Area	22178.11	823427	840323	823367	840311	823281	840309	823207	840319	823182	840323	823167	840239	823197	840233	823326	840225	823452	840241				
HK111	HK	Water	Area	12802.12	823049	840364	823033	840268	823071	840256	823167	840239	823182	840322												
HK112	HK	Water	Area	5933.56	823049	840364	823033	840268	823001	840283	822975	840286	822995	840393	823016	840382										
HK113	HK	Water	Area	19026.45	822791	840483	822771	840399	822854	840369	822960	840320	822981	840314	822981	840314	822981	840314	822995	840392	822859	840462				
HK114	HK	Water	Area	19468.27	822580	840527	822564	840437	822677	840417	822771	840399	822791	840483	822735	840500										
HK115	HK	Water	Area	6260.80	822519	840538	822499	840442	822562	840427	822580	840527														
HK116	HK	Water	Area	13200.84	822519	840538	822500	840541	822418	840564	822272	840611	822236	840560	822510	840495										
HK117	HK	Water	Area	8988.70	822097	840642	822090	840589	822236	840560	822272	840611														
HK118	HK	Water	Area	11896.50	822097	840642	822063	840648	822000	840659	821891	840679	821882	840619	821992	840603	822049	840595	822090	840589						

Appendix 4.3 Odour Emission Parameters for Shenzhen River

Sources from the Shenzhen River

Source ID	HK/SZ	Source Type	Type	Area (m^2)	Vertices (X)	Vertices (Y)	Vertices (X)	Vertices (Y)	Vertices (X)	Vertices (Y)	Vertices (X)	Vertices (Y)	Vertices (X)	Vertices (Y)	Vertices (X)	Vertices (Y)	Vertices (X)	Vertices (Y)	Vertices (X)	Vertices (Y)	Vertices (X)	Vertices (Y)	Vertices (X)	Vertices (Y)	Vertices (X)	Vertices (Y)
SZ159	SZ	Sediment	Area	5483.27	826828	843665	826815	843694	826727	843660	826615	843614	826670	843608												
SZ160	SZ	Sediment	Area	7246.49	825958	843133	825869	842870	825895	842861	825982	843125														
SZ161	SZ	Sediment	Area	9226.21	825869	842870	825765	842562	825794	842556	825895	842861														
SZ162	SZ	Sediment	Area	9038.22	825674	842280	825747	842450	825783	842558	825813	842552	825776	842442	825699	842263										
SZ163	SZ	Sediment	Area	5318.99	825699	842263	825674	842280	825546	842161	825564	842137														
SZ164	SZ	Sediment	Area	5692.09	825571	842129	825543	842164	825492	842137	825357	842102	825362	842080	825464	842104										
SZ165	SZ	Sediment	Area	6005.40	824566	841901	824579	841886	824638	841920	824749	841961	824807	841971	824806	841988	824749	841984	824704	841976	824611	841932				
SZ166	SZ	Sediment	Area	4285.52	823881	840893	823903	840890	823914	840711	823882	840721	823886	840811												
SZ167	SZ	Sediment	Area	2135.33	823853	840729	823851	840715	823844	840701	823904	840676	823914	840711	823869	840726										
SZ168	SZ	Sediment	Area	4810.32	823902	840669	823868	840594	823811	840619	823862	840693	823904	840676												
SZ169	SZ	Sediment	Area	7256.41	823868	840594	823846	840604	823811	840619	823775	840588	823730	840538	823757	840499	823793	840524								
SZ170	SZ	Sediment	Area	1835.92	823749	840510	823726	840487	823556	840408	823560	840401	823643	840439	823730	840480	823757	840499								
SZ171	SZ	Sediment	Area	2619.89	823538	840448	823494	840427	823512	840378	823560	840401														
SZ172	SZ	Sediment	Area	2349.06	823423	840373	823504	840400	823494	840427	823420	840401														
SZ173	SZ	Sediment	Area	10357.83	823185	840373	823059	840419	823063	840438	823231	840400	823420	840401	823423	840373										
SZ174	SZ	Sediment	Area	11516.10	823056	840400	823064	840449	822789	840572	822778	840535	822921	840478												
SZ175	SZ	Sediment	Area	7645.89	822587	840568	822594	840607	822789	840572	822778	840535														
SZ176	SZ	Sediment	Area	4971.07	822587	840567	822590	840586	822501	840600	822383	840637	822301	840657	822300	840642	822299	840637								
SZ177	SZ	Sediment	Area	3469.13	822107	840709	822104	840689	822300	840642	822301	840657														
SZ178	SZ	Sediment	Area	3401.35	822108	840713	821964	840753	821960	840723	822105	840697	822108	840713												
SZ179	SZ	Water	Area	4925.92	829407	843424	829435	843406	829464	843386	829490	843371	829556	843357	829551	843328	829522	843332	829486	843345	829438	843368	829391	843400		
SZ180	SZ	Water	Area	4117.87	829316	843524	829355	843470	829407	843424	829391	843400	829372	843415	829332	843453	829301	843495	829293	843513						
SZ181	SZ	Water	Area	4923.33	829227	843681	829293	843513	829316	843524	829254	843692														
SZ182	SZ	Water	Area	3889.96	829156	843796	829199	843766	829254	843692	829227	843681	829206	843713	829172	843749	829139	843773								
SZ183	SZ	Water	Area	5899.42	829139	843773	829156	843796	828970	843893	828956	843866	828996	843846	829043	843823										
SZ184	SZ	Water	Area	5259.62	828832	843972	828864	843961	828857	843949	828970	843893	828956	843866	828895	843897	828881	843903	828820	843926						
SZ185	SZ	Water	Area	9490.72	828650	843989	828750	843998	828832	843972	828820	843926	828745	843938	828684	843938	828661	843936								
SZ186	SZ	Water	Area	8419.95	828440	843931	828447	843892	828643	843933	828661	843936	828654	843974												
SZ187	SZ	Water	Area	9201.41	828257	843913	828265	843853	828447	843892	828440	843931	828348	843912	828345	843929	828299	843922								
SZ188	SZ	Water	Area	16057.54	828002	843903	828050	843887	828110	843883	828178	843897	828257	843913	828265	843853	828148	843827	828003	843836	827982	843844				
SZ189	SZ	Water	Area	12893.69	827982	843844	827997	843887	827937	843921	827807	844064	827769	844032	827880	843914	827920	843877								
SZ190	SZ	Water	Area	11879.97	827689	844151	827641	844174	827596	844182	827585	844136	827663	844106	827678	844099	827724	844071	827769	844032	827807	844064	827761	844110		
SZ191	SZ	Water	Area	8939.41	827396	844180	827495	844188	827559	844188	827596	844182	827585	844137	827559	844142	827516	844144	827498	844142	827406	844131				
SZ192	SZ	Water	Area	5889.58	827278	844159	827396	844180	827406	844131	827291	844111														
SZ193	SZ	Water	Area	8880.98	827133	844095	827198	844147	827211	844141	827278	844159	827291	844111	827228	844085	827174	844048								
SZ194	SZ	Water	Area	12208.70	827008	843946	827043	843998	827084	844049	827133	844095	827174	844048	827147	844018	827097	843962	827061	843911						
SZ195	SZ	Water	Area	11119.23	827061	843911	827008	843947	826910	843800	826965	843766	827007	843831	827030	843866										
SZ196	SZ	Water	Area	10851.95	826910	843800	826888	843768	826856	843731	826813	843699	826842	843631	826878	843661	826914	843696	826952	843746	826965	843766				
SZ197	SZ	Water	Area	6411.69	826670	843608	826689	843575	826769	843601	826842	843631	826828	843665												
SZ198	SZ	Water	Area	14574.16	826689	843575	826670	843608	826615	843614	826512	843586	826509	843601	826432	843581	826451	843509								
SZ199	SZ	Water	Area	11151.40	826451	843509	826438	843560	826225	843489	826257	843446														
SZ200	SZ	Water	Area	12553.43	826047	843334	826108	843407	826225	843489	826257	843446	826198	843407	826148	843365	826099	843304								
SZ201	SZ	Water	Area	11900.77	826099	843304	826047	843334	825962	843132	826019	843114	826046	843194	826065	843239										
SZ202	SZ	Water	Area	11639.52	825982	843125	825888	842840	825926	842831	826019	843114														
SZ203	SZ	Water	Area	11604.67	825832	842548	825926	842831	825888	842840	825794	842556														
SZ204	SZ	Water	Area	6229.92	825715	842252	825795	842437	825832	842548	825812	842552	825776	842442	825698	842263										
SZ205	SZ	Water	Area	5514.93	825582	842114	825600	842127	825643	842164	825715	842252	825699	842263	825564	842137										
SZ206	SZ	Water	Area	9101.37	825571	842129	825582	842114	825534	842084	825478	842062	825443	842048	825373	842028	825362	842080								
SZ207	SZ	Water	Area	20694.38	825104	842038	825120	841960	825211	841977	825373	842028	825357	842103	825124	842039										
SZ208	SZ	Water	Area	27574.42	824811	841913	824805	842009	824979	842031	825104	842038	825120	841960												
SZ209	SZ	Water	Area	13948.62	824749	841961	824638	841920	824579	841886	824624	841832	824664	841859	824699	841877	824733	841892	824764	841902	824805	841913	824811	841913	824807	841971
SZ210	SZ	Water	Area	33681.72	824579	841886	824624	841832	824470	841722	824313	841609	824276	841578	824221	841527	824166	841576								
SZ211	SZ	Water	Area	17575.99	824221	841527	824097	841364	824024	841397	824034	841413	824107	841518	824166	841576										
SZ212	SZ	Water	Area	10149.94	824097	841364	824024	841397	823974	841309	823966	841286	824046	841258												
SZ213	SZ	Water	Area	16642.64	823903	841099	823966	841286	824046	841258	823988	841077														
SZ214	SZ	Water	Area	17830.20	823903	841099	823894	841047	823881	840893	823903	840890	823969	840887	823988	841077										
SZ215	SZ	Water	Area	10242.80	823903	840890	823914	840711	823904	840676	823931	840663	823944	840704	823958	840779	823969	840887								
SZ216	SZ	Water	Area	2476.21	823868	840594	823890	840585	823919	840633	823931	840663	823904	840676	823902	840669										
SZ217	SZ	Water	Area	3788.83	823868	840594	823793	840524	823779	840514	823800	840487	823842	840525	823890	840585										
SZ218	SZ	Water	Area	10460.38	823512	840378	823524	840347	823745	840448	823800	840486	823779	840514	823730	840480										
SZ219	SZ	Water	Area	4953.78	823504	840400	823423	840372	823427	840323	823469	840331	823524	840348												
SZ220	SZ	Water	Area	21264.90	823185	840373	823059	840419	823049	840364	823182	840322	823281	840309	823367	840311	823427	840323	823423	840373						
SZ221	SZ	Water	Area	12227.32	823049	840364	823056	840400	822920	840478	822778	840535	822767	840491	822859	840462										
SZ222	SZ	Water	Area	8097.31	822580	840527	822587	840568	822778	840535	822767	840491	822735	840500												
SZ223	SZ	Water	Area	12202.22	822587	840567	822299	840637	822295	840603	822360	840583	822416	840564	822500	840541	822580	840527								
SZ224	SZ	Water	Area	8429.65	822104	840689	822300	840642	822295	840603	822272	840611	822097	840642												
SZ225	SZ	Water	Area	11648.60	822097	840642	822105	840697	821900	840733	821891	840679														

Indicative Location Plan of the Odour Sources

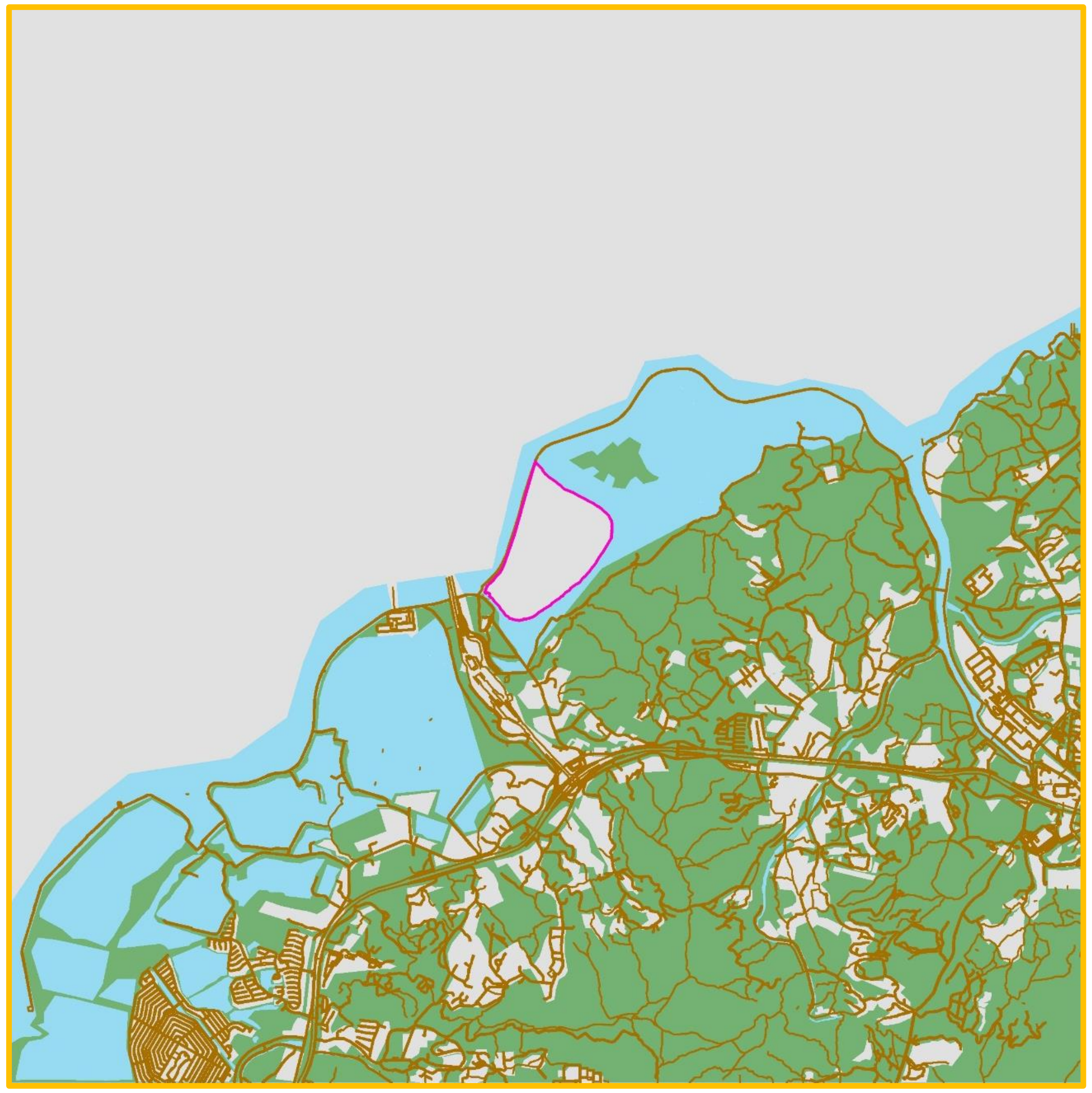


Appendix 4.4a

Determination of Surface Characteristics Parameters for AERMET
(Lok Ma Chau Loop)

Appendix 4.4a Determination of Surface Characteristics Parameters for AERMET (Lok Ma Chau Loop)

10km by 10km Region Centred on the Project Site

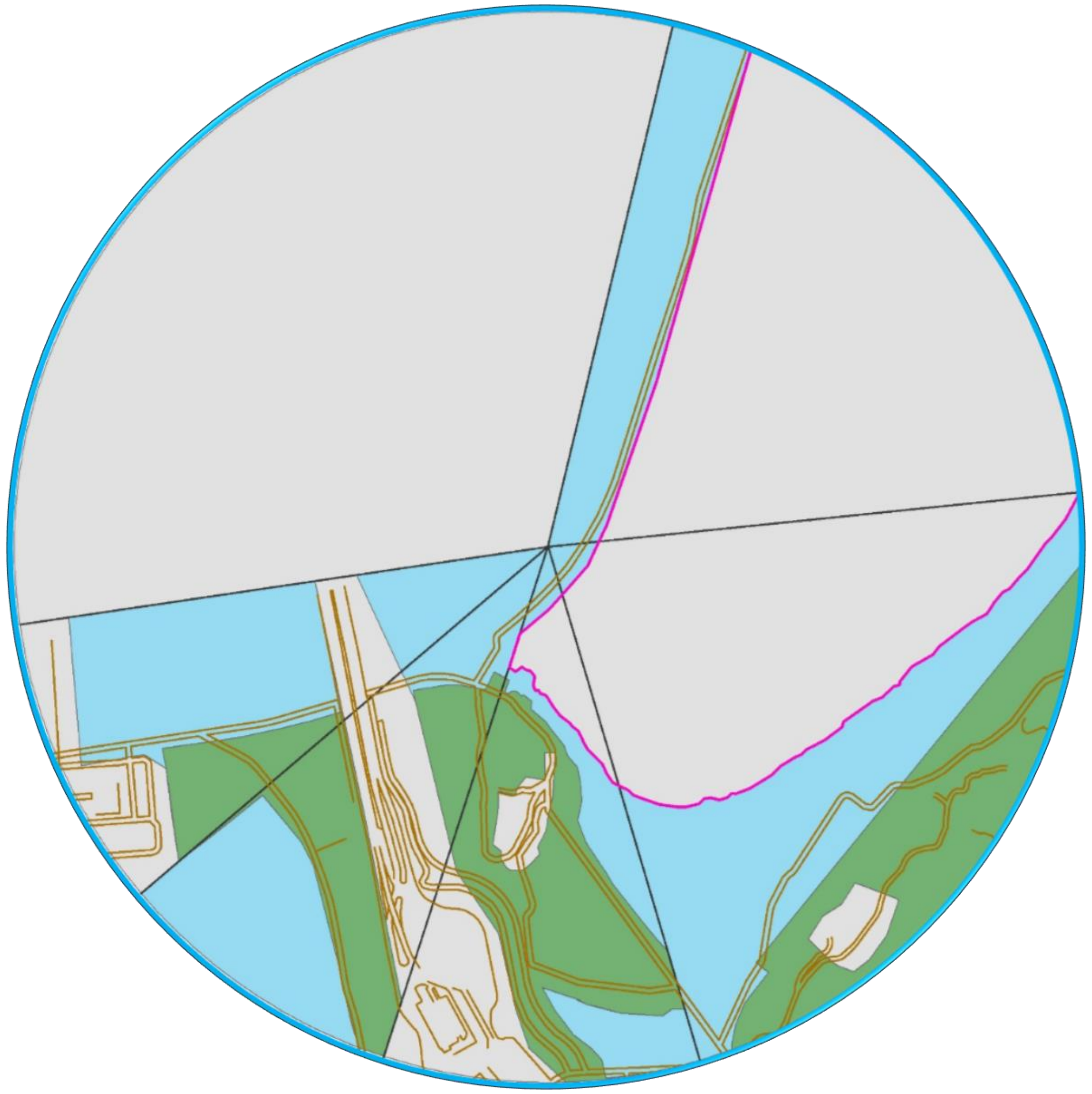


Legend

10km by 10km Region Centered on the Project Site

Project Site

1km Boundary from Grid 3055



Legend

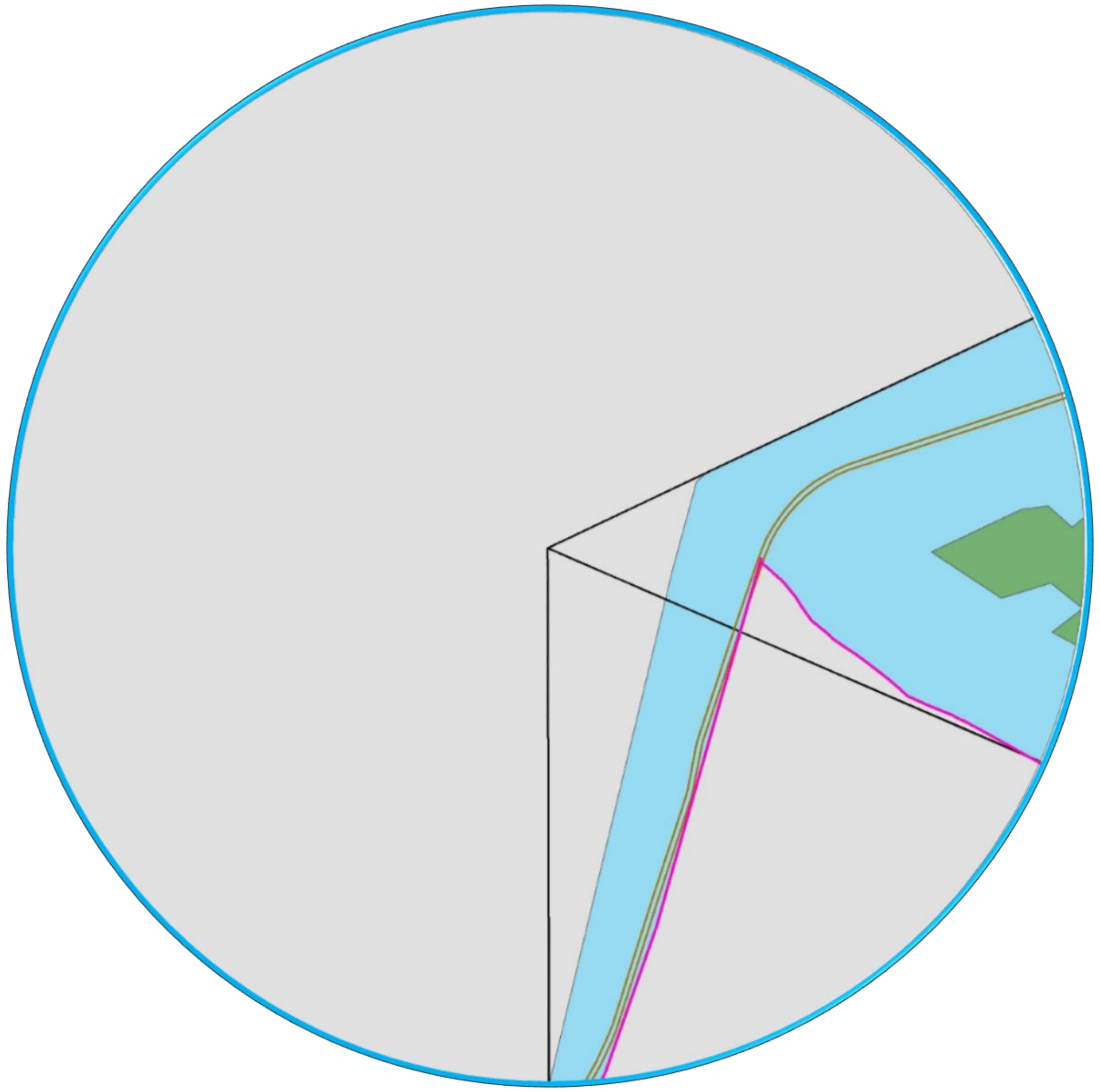
Project Site

1km boundary from Grid 3055

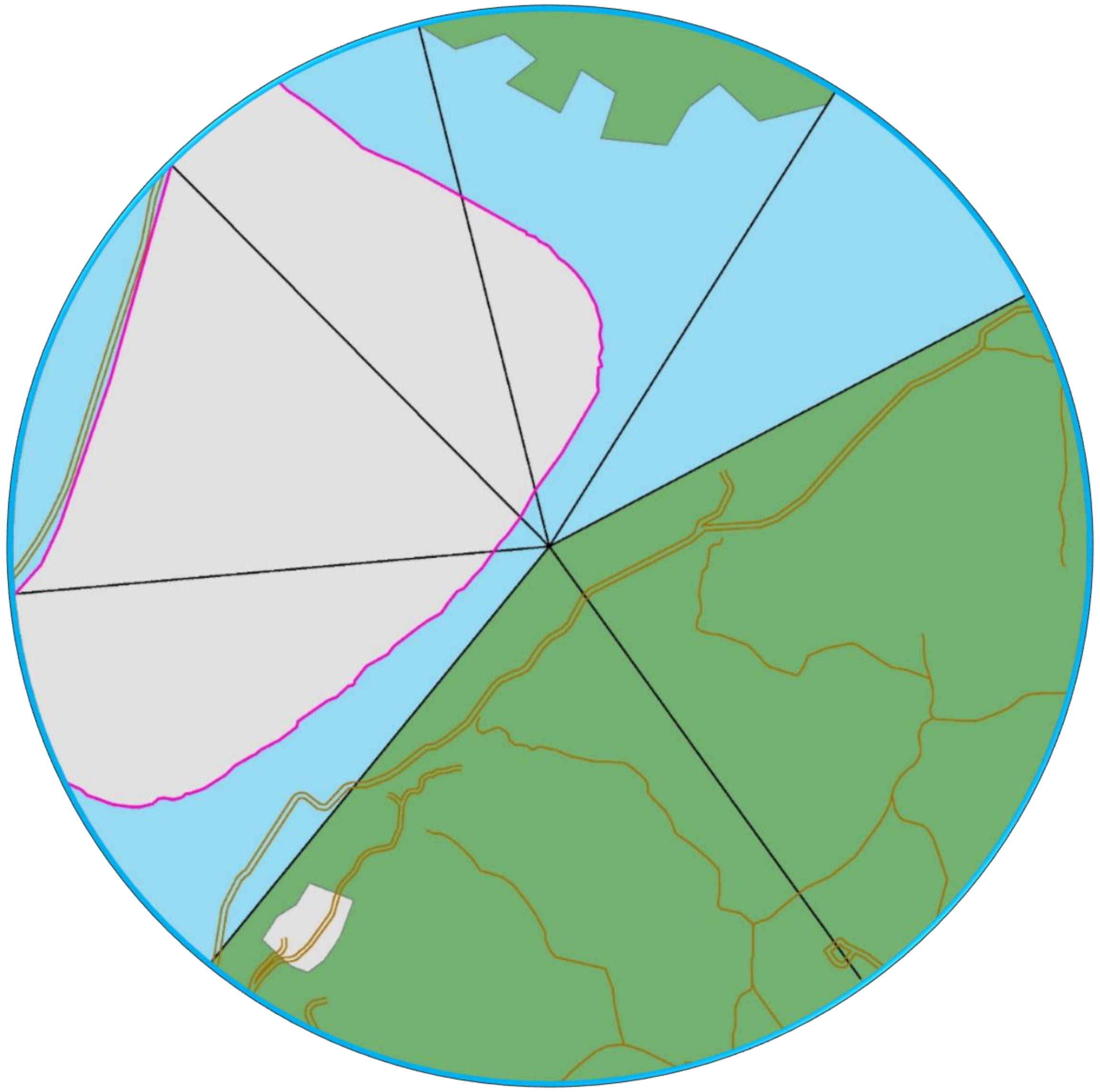
Note: Grey area is classified as urban area. Blue area is classified as water area. Green area is classified as grassland area.

Appendix 4.4a Determination of Surface Characteristics Parameters for AERMET (Lok Ma Chau Loop)

1km Boundary from Grid 3056



1km Boundary from Grid 3155



Legend

- Project Site
- 1km boundary from Grid 3056

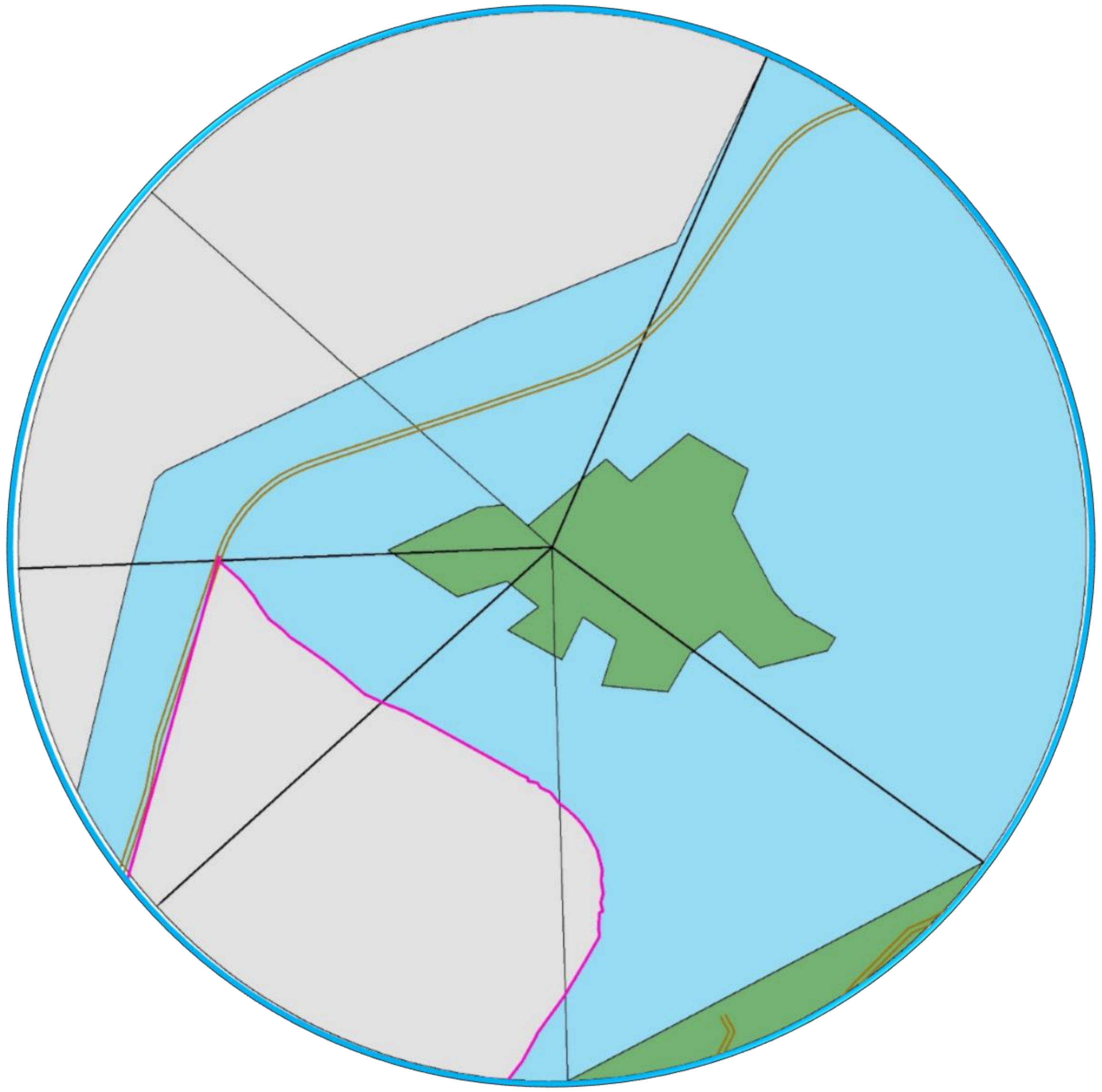
Legend

- Project Site
- 1km boundary from Grid 3155

Note: Grey area is classified as urban area. Blue area is classified as water area. Green area is classified as grassland area.

Appendix 4.4a Determination of Surface Characteristics Parameters for AERMET (Lok Ma Chau Loop)

1km Boundary from Grid 3156



Legend

Project Site

1km boundary from Grid 3156

Note: Grey area is classified as urban area. Blue area is classified as water area. Green area is classified as grassland area.

Appendix 4.4b Determination of Surface Characteristics Parameters for AERMET (Lok Ma Chau Loop)

Land Type	Season	Default Albedo from AERMET	Default Bowen Ratio from AERMET	Default Surface Roughness(m) from AERMET
Urban	Spring	0.14	1.00	1.0000
	Summer	0.16	2.00	1.0000
	Autumn	0.18	2.00	1.0000
	Average	0.160	1.667	1.0000
Grassland	Spring	0.18	0.40	0.0500
	Summer	0.18	0.80	0.1000
	Autumn	0.20	1.00	0.0100
	Average	0.187	0.733	0.0533
Water	Spring	0.12	0.10	0.0010
	Summer	0.10	0.10	0.0010
	Autumn	0.14	0.10	0.0010
	Average	0.120	0.100	0.0010

Appendix 4.4a Determination of Surface Characteristics Parameters for AERMET (Lok Ma Chau Loop)

Grid :3055

Sector (degrees in Clockwise)	Land type	Area (m^2)	Distance	Weighting (Area Fraction/Distance)	Weighting Sum	Albedo	Bowen Ratio	Surface Roughness	Remarks
13-84	Water	126440	533.96	0.0003840	0.001534	0.1629	0.9361	0.17732	Urban development and water from north to east
	Urban	490153	691.50	0.0011496					
84-164	Water 1	4910	57.06	0.0001243	0.001740			0.07792	Urban development, grassland and water from east to south
	Urban 1	323442	503.26	0.0009288					
	Water 2	200609	701.75	0.0004131					
	Grassland	146945	854.41	0.0002485					
	Urban 2	16068	912.25	0.0000255					
164-198	Water 1	4711	84.67	0.0001851	0.001852			0.11012	Urban development, grassland and water at south
	Urban 1	23789	256.57	0.0003086					
	Water 2	29792	495.91	0.0001999					
	Urban 2	14663	502.88	0.0000970					
	Grassland	134760	642.46	0.0002727					
	Urban 3	67625	825.34	0.0006980					
	Water 3	25156	922.39	0.0000908					
198-230	Water 1	28126	206.56	0.0004918	0.001798			0.01465	Urban development, grassland and water from south to southwest
	Grassland 1	26197	414.97	0.0002280					
	Urban	62817	592.36	0.0003830					
	Grassland 2	67733	764.22	0.0003201					
	Water 2	91991	886.49	0.0003748					
230-262	Water 1	34583	222.03	0.0005581	0.001839			0.00723	Urban development, grassland and water from southwest to west
	Urban 1	23971	403.49	0.0002129					
	Grassland	37773	719.89	0.0001880					
	Water 2	129469	687.86	0.0006745					
	Urban 2	53269	928.66	0.0002055					
262-13	Urban	975799	-	-	-			1.00000	Urban development and water from west to north

Grid :3056

Sector (degrees in Clockwise)	Land type	Area (m^2)	Distance	Weighting (Area Fraction/Distance)	Weighting Sum	Albedo	Bowen Ratio	Surface Roughness	Remarks
65-114	Urban 1	27872	158.49	0.0004118	0.001921	0.1629	0.9361	0.01006	Urban development, grassland and water at east
	Urban 2	25962	341.26	0.0001781					
	Water	339554	640.91	0.0012405					
	Grassland	33710	874.22	0.0000903					
114-181	Urban 1	109528	442.46	0.0004281	0.001584			0.21599	Urban development and water from east to south
	Water	115674	569.27	0.0003514					
	Urban 2	353044	758.99	0.0008044					
181-65	Urban	2135832	-	-	-			1.00000	Urban development from south to northeast

Appendix 4.4a Determination of Surface Characteristics Parameters for AERMET (Lok Ma Chau Loop)

Grid :3155

Sector (degrees in Clockwise)	Land type	Area (m^2)	Distance	Weighting (Area Fraction/Distance)	Weighting Sum	Albedo	Bowen Ratio	Surface Roughness	Remarks
30-60	Water	278825	-	-	-	0.1629	0.9361	0.00100	Water at northeast
60-142	Grassland	710275	-	-	-			0.05333	Grassland from northeast to southeast
142-216	Grassland	636031	618.71	0.0015764	0.001606			0.05626	Urban development and grassland from southeast to southwest
	Urban	16068	842.05	0.0000293					
216-263	Water	181486	632.70	0.0006847	0.001514			0.04403	Urban development and water from southwest to west
	Urban	237468	683.11	0.0008298					
263-307	Water 1	5226	73.25	0.0001809	0.001716			0.27676	Urban development and water from west to northwest
	Urban	337531	612.73	0.0013971					
	Water 2	51528	945.43	0.0001382					
307-340	Water 1	4386	78.63	0.0001895	0.001983			0.00533	Urban development and water from northwest to north
	Water 2	52531	371.52	0.0013133					
	Urban	237386	614.19	0.0004804					
340-30	Water	247313	417.42	0.0015091	0.003043			0.01064	Urban development, grassland and water from north to northeast
	Urban	60307	411.35	0.0003734					
	Grassland	84987	186.51	0.0011606					

Grid :3156

Sector (degrees in Clockwise)	Land type	Area (m^2)	Distance	Weighting (Area Fraction/Distance)	Weighting Sum	Albedo	Bowen Ratio	Surface Roughness	Remarks
22-132	Grassland	103424	238.89	0.0004503	0.001913	0.1629	0.9361	0.00255	Grassland and water from northeast to sourtheast
	Water	857958	610.01	0.0014630					
132-179	Grassland	23449	183.80	0.0003089	0.001720			0.00269	Urban development, grassland and water from sourtheast to south
	Water 1	313237	638.76	0.0011872					
	Urban	18190	644.47	0.0000683					
	Water 2	58188	903.45	0.0001559					
179-225	Grassland	11690	111.53	0.0002540	0.001888			0.09850	Urban development, grassland and water from south to southwest
	Water 1	61494	296.84	0.0005021					
	Urban	330246	722.29	0.0011082					
	Water 2	9148	942.32	0.0000235					
225-267	Grassland	14446	157.47	0.0002531	0.001807			0.99337	Urban development, grassland and water from southwest to west
	Water 1	84222	383.85	0.0006053					
	Urban 1	146326	703.41	0.0005738					
	Water 2	75734	833.32	0.0002507					
	Urban 2	41784	927.98	0.0001242					
267-313	Grassland	19702	157.69	0.0003040	0.001814			0.02185	Urban development, grassland and water from west to northwest
	Water	176659	491.24	0.0008750					
	Urban	214618	822.65	0.0006348					
313-22	Water	155491	333.23	0.0008034	0.001795			0.04538	Urban development and water from northwest to northeast
	Urban	425279	738.82	0.0009911					

Note:

1. Reference to AERMOD Implementation Guide, the determination of the Bowen ratio should be based on a simple unweighted geometric mean (i.e., no direction or distance dependency) for a representative domain, with a default domain defined by a 10km by 10km region centered on the measurement site.
2. Reference to AERMOD Implementation Guide, the determination of the albedo should be based on a simple unweighted arithmetic mean (i.e., no direction or distance dependency) for the same representative domain as defined for Bowen ratio, with a default domain defined by a 10km by 10km region centered on the measurement site.
3. Surface roughness length is based on an upwind distance of 1km relative to the concerned site.
4. Land use within 10km by 10km region centered on the measurement site included 59.04% urban (59036785km2), 28.89% grassland (28887354km2), 12.08% water (12075861km2).
5. For the parameters including albedo, Bowen Ratio and surface roughness, the default value for "Winter" is excluded from calculating the representative values.

Appendix 4.4b

Determination of Surface Characteristics Parameters for AERMET
(Binhe WWTP)

Appendix 4.4b Determination of Surface Characteristics Parameters for AERMET (Binhe WWTP)

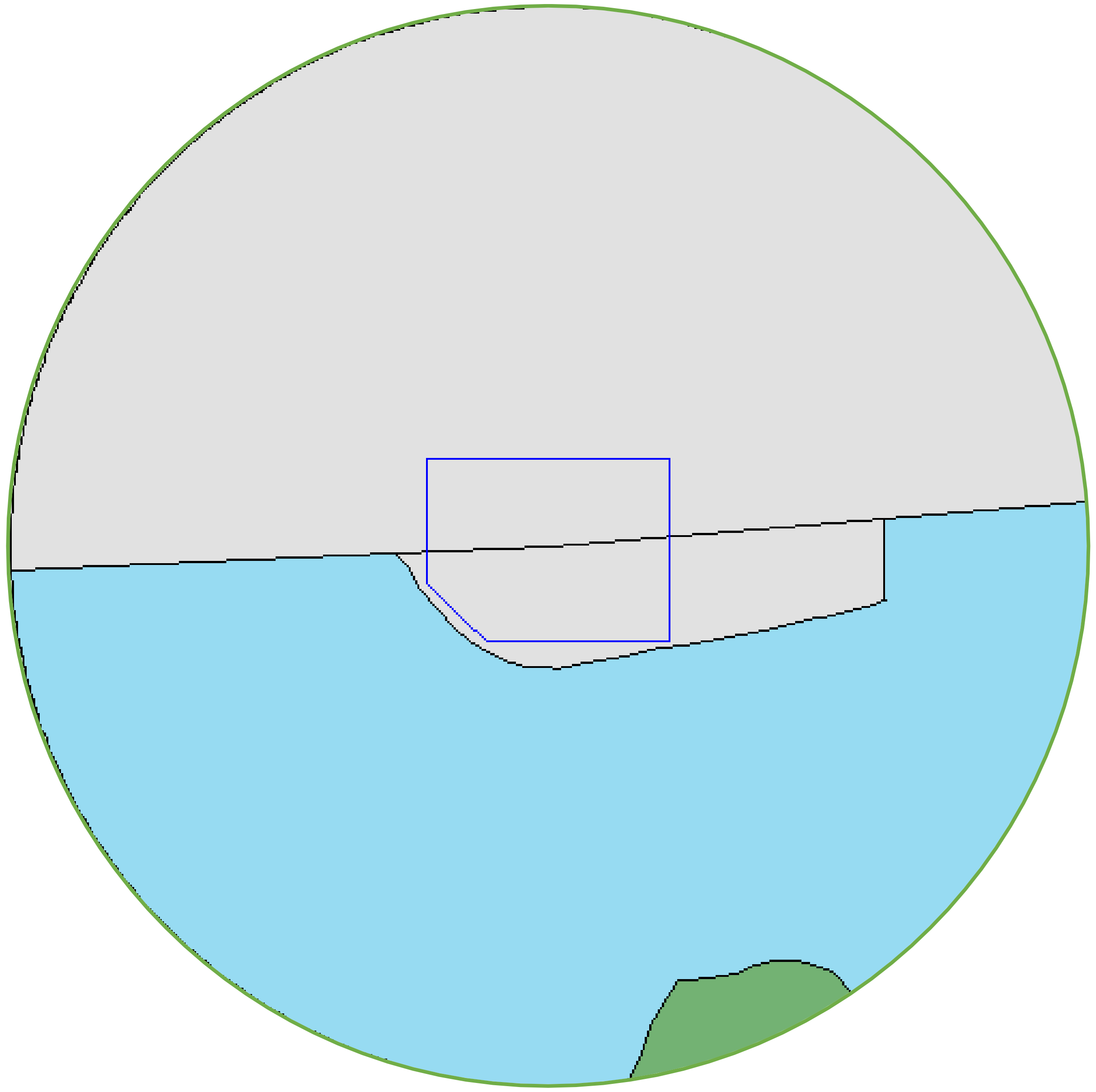
10km by 10km Region Centered on the Project Site

Legend

10km by 10km Region Centered on the Project Site

Project Site

1km Boundary from Grid 3257



Legend

Project Site

1km boundary from Grid 3257

Note: Grey area is classified as urban area. Blue area is classified as water area. Green area is classified as grassland area.

Appendix 4.4b Determination of Surface Characteristics Parameters for AERMET (Binhe WWTP)

Land Type	Season	Default Albedo from AERMET	Default Bowen Ratio from AERMET	Default Surface Roughness(m) from AERMET
Urban	Spring	0.14	1.00	1.0000
	Summer	0.16	2.00	1.0000
	Autumn	0.18	2.00	1.0000
	Average	0.160	1.667	1.0000
Grassland	Spring	0.18	0.40	0.0500
	Summer	0.18	0.80	0.1000
	Autumn	0.20	1.00	0.0100
	Average	0.187	0.733	0.0533
Water	Spring	0.12	0.10	0.0010
	Summer	0.10	0.10	0.0010
	Autumn	0.14	0.10	0.0010
	Average	0.120	0.100	0.0010

Appendix 4.4b Determination of Surface Characteristics Parameters for AERMET (Binhe WWTP)

Summary of Surface Characteristics for the Study Area

Grid 3257

Sector (degrees in Clockwise)	Land type	Area (m^2)	Distance	Weighting (Area Fraction/Distance)	Weighting Sum	Albedo	Bowen Ratio	Surface Roughness	Remarks
85-267	Urban	162439	200.24	0.0005100	0.002505	0.1602	1.1071	0.00430	Urban development, grassland and water from east to west
	Water	1378520	441.88	0.0019613					
	Grassland	49611	930.38	0.0000335					
267-85	Urban	-	-	-	-			1.00000	Urban development from west to east

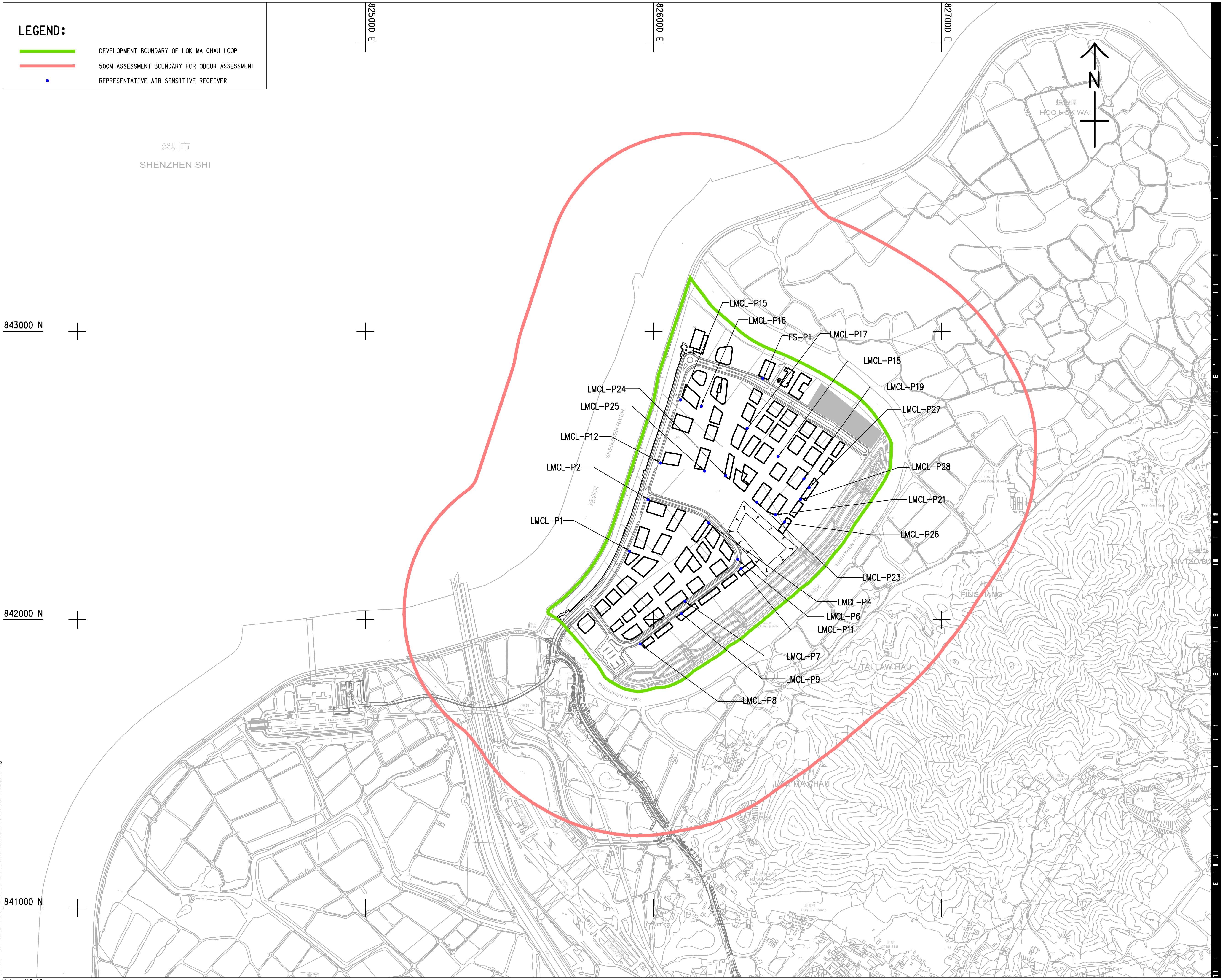
Note:
1. Reference to AERMOD Implementation Guide, the determination of the Bowen ratio should be based on a simple unweighted geometric mean (i.e., no direction or distance dependency) for a representative domain, with a default domain defined by a 10km by 10km region centered on the measurement site.
2. Reference to AERMOD Implementation Guide, the determination of the albedo should be based on a simple unweighted arithmetic mean (i.e., no direction or distance dependency) for the same representative domain as defined for Bowen ratio, with a default domain defined by a 10km by 10km region centered on the measurement site.
3. Surface roughness length is based on an inverse distance weighted geometric mean for a default upwind distance of 1 kilometer relative to the grid.
4. Land use within 10km by 10km region centered on the measurement site included (74311937 m2) 74.31% urban, (15743199 m2) 15.74% grassland and (9944863 m2) 9.94% water.
5. For the parameters including albedo, Bowen Ratio and surface roughness, the default value for "Winter" is excluded from calculating the representative values.

Environmental Review Report for Variation of Environmental Permit Application on Odour Remediation at Shenzhen River

Figure

Figure 4.1

Locations of Representative Air Sensitive Receivers



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Approved:

Checked:

Designer:

Project Management Initials:

Plot File by: Siting.guo 21/04/2021

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AECOM

PROJECT 項目

DEVELOPMENT OF LOK MA CHAU LOOP MAIN WORKS PACKAGE 1 DESIGN AND CONSTRUCTION

CLIENT 業主

土木工程拓展署
CEDD Civil Engineering and Development Department

CONSULTANT 工程顧問公司

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ISSUE/REVISION 修訂

I/R 修訂	DATE 日期	DESCRIPTION 內容摘要	CHK. 複核

STATUS 階段

SCALE 比例

A1 1 : 6000

DIMENSION UNIT 尺寸單位

METRES

KEY PLAN 索引圖

PROJECT NO. 項目編號

60588085

CONTRACT NO. 合約編號

SHEET TITLE 圖紙名稱

LOCATION PLAN OF AIR SENSITIVE RECEIVERS

SHEET NUMBER 圖紙編號

Figure 4.1

Figure 4.2

Contour Plot of Predicted 5-second Average Odour concentration in OU

at 5m above ground in Lok Ma Chau Loop

NOTE:

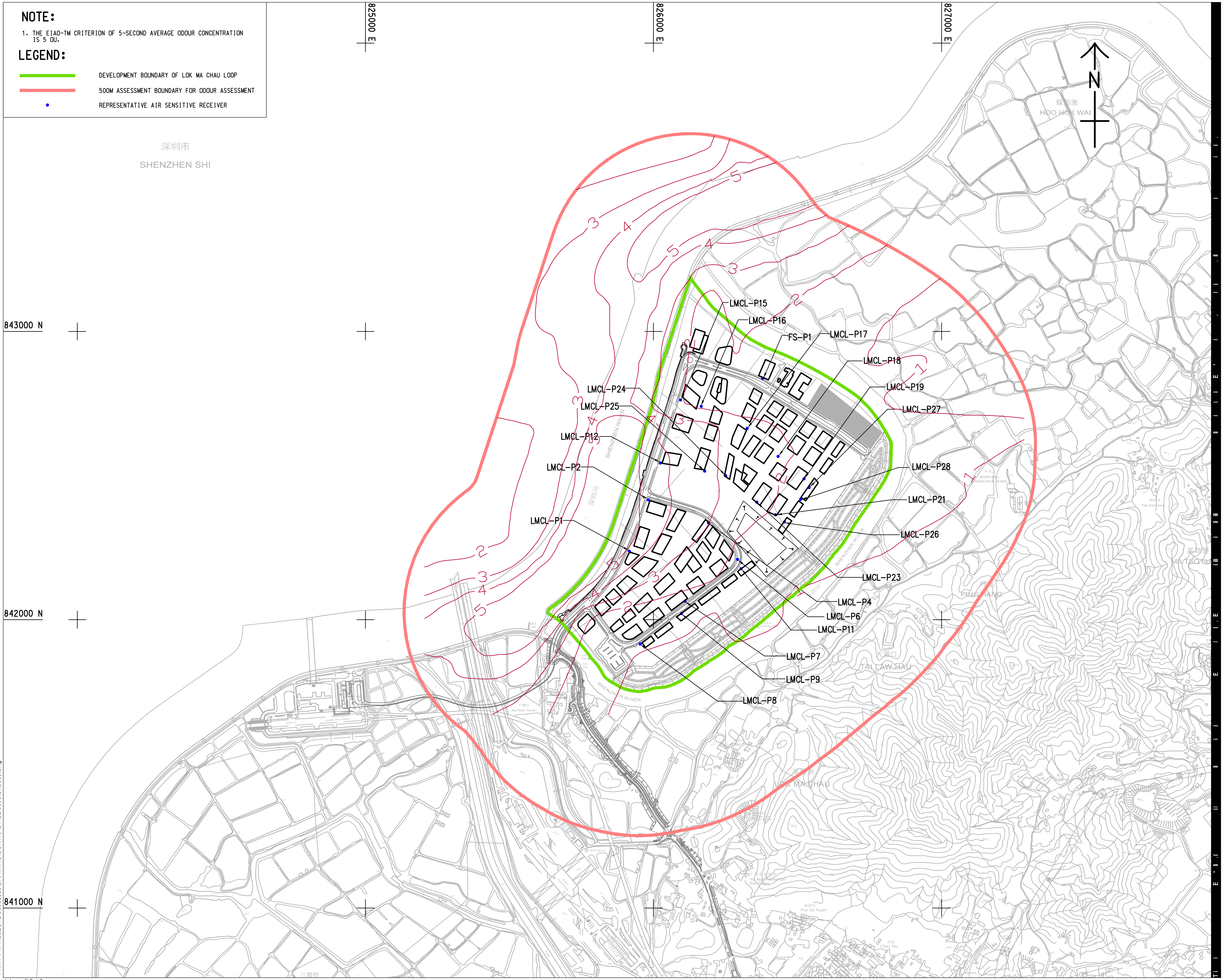
1. THE EIAO-TM CRITERION OF 5-SECOND AVERAGE ODOUR CONCENTRATION IS 5 OU.

LEGEND:

DEVELOPMENT BOUNDARY OF LOK MA CHAU LOOP

500M ASSESSMENT BOUNDARY FOR ODOUR ASSESSMENT

REPRESENTATIVE AIR SENSITIVE RECEIVER



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KEY PLAN 索引圖

PROJECT NO. 項目編號: 60588085

CONTRACT NO. 合約編號

SHEET TITLE 圖紙名稱

CONTOUR PLOT OF PREDICTED 5-SECOND AVERAGE ODOUR CONCENTRATION IN OU AT 5m ABOVE GROUND IN LOK MA CHAU LOOP

SHEET NUMBER 圖紙編號

Figure 4.2

ISO A1 594mm x 841mm
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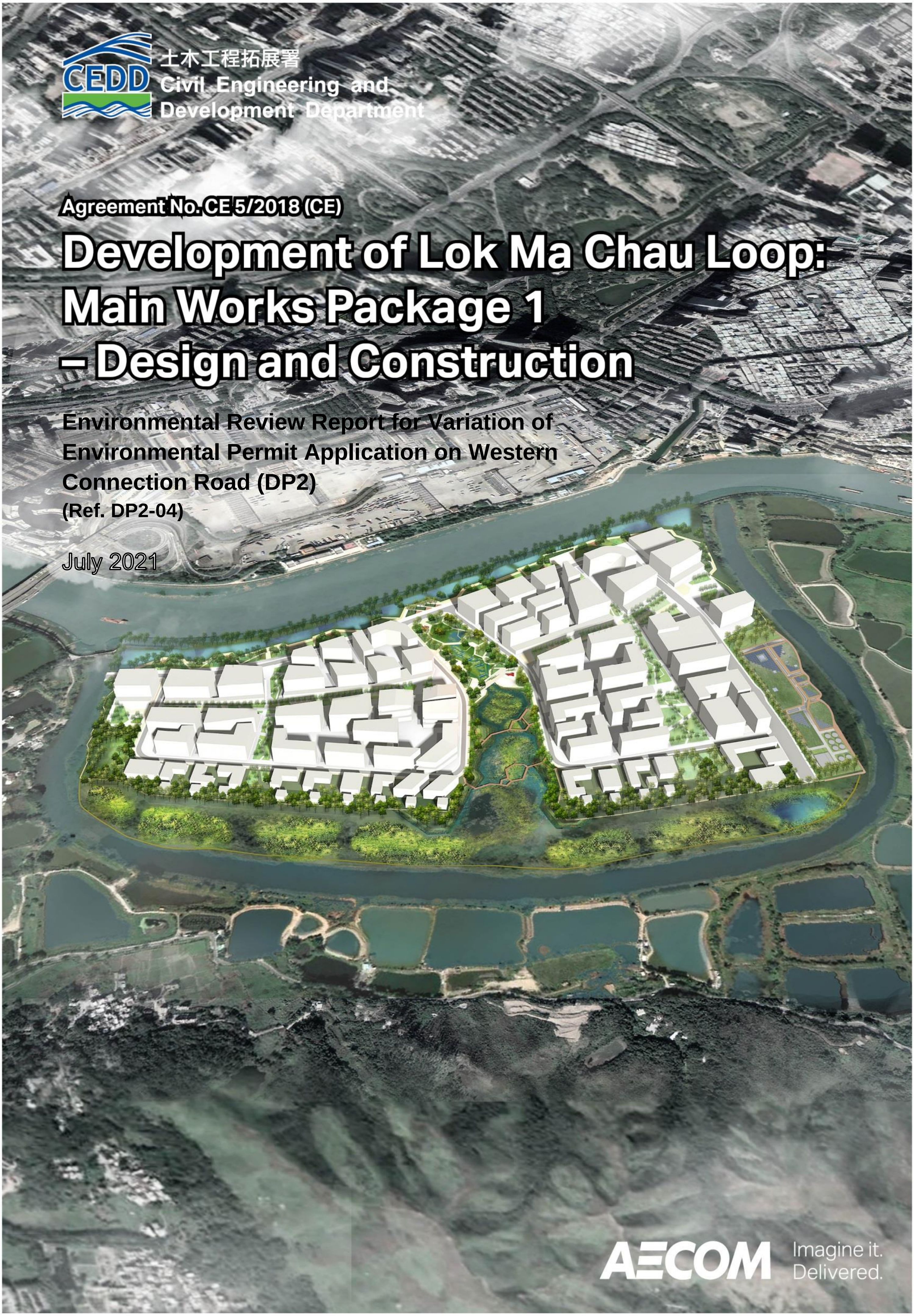

土木工程拓展署
Civil Engineering and
Development Department

Agreement No. CE 5/2018 (CE)

Development of Lok Ma Chau Loop: Main Works Package 1 – Design and Construction

Environmental Review Report for Variation of Environmental Permit Application on Western Connection Road (DP2)

(Ref. DP2-04)

July 2021

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土木工程拓展署
Civil Engineering and Development Department

Agreement No. CE 5/2018 (CE)

Development of Lok Ma Chau Loop: Main Works Package 1 – Design and Construction

Environmental Review Report for Variation of Environmental Permit Application on Western Connection Road (DP2) (Final) (Ref. DP2-04)

July 2021

Reviewed: Kelvin Cheng 14 July 2021

Approved for Issue: pp Conrad Ng 14 July 2021

AECOM ASIA COMPANY LIMITED

Disclaimer:

This report is prepared for Civil Engineering and Development Department (CEDD) and is given for its sole benefit in relation to and pursuant to Agreement No. CE 5/2018 (CE) Development of Lok Ma Chau Loop: Main Works Package 1 – Design and Construction and may not be disclosed to, quoted to or relied upon by any person other than CEDD without our prior written consent. No person (other than CEDD) into whose possession a copy of this report comes may rely on this report without our express written consent and CEDD may not rely on it for any purpose other than as described above.

CEDD 土木工程拓展署
Civil Engineering and Development Department

Agreement No. CE 5/2018 (CE)

Development of Lok Ma Chau Loop: Main Works Package 1 – Design and Construction

Environmental Review Report for Variation of Environmental Permit Application on Western Connection Road (DP2) (Final) (Ref. DP2-04)

July 2021

Reviewed:	Kelvin Cheng	14 July 2021
Approved for Issue:	Conrad Ng	14 July 2021

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1. INTRODUCTION

1.1 Background

1.1.1 As a result of the training of Shenzhen (SZ) River, which serves as the administrative boundary between Hong Kong Special Administrative Region (HKSAR) and SZ, an area of about 87 hectares, previously lying to the north of the river course, became situated to the south of the re-aligned river and therefore within the boundary of the HKSAR. This area, commonly known as the Loop, was once used as a dumping ground for mud dredged from the river regulation works.

1.1.2 The Loop is located near several major cross-boundary transport nodes including the Lok Ma Chau Boundary Control Point, the MTR Lok Ma Chau Station of the Lok Ma Chau Spur Line and the San Tin Interchange. To the north across SZ River is the Huanggang Control Point of SZ. To the southwest is the Mai Po Nature Reserve and to the east is Hoo Hok Wai, comprising fish ponds of high ecological value.

1.1.3 The Loop development is one of the ten major infrastructure projects announced in the 2007-08 Policy Address for economic growth. The Planning and Engineering Study (P&E Study), Agreement No. CE 53/2008 (CE) “Planning and Engineering Study on Development of Lok Ma Chau Loop – Investigation”, funded under PWP Item No. 735CL, was completed in 2014. The P&E Study investigated the feasibility of and formulated a comprehensive development plan for the Loop, taking into account the prevailing planning circumstances and public views collected through public engagement.

1.1.4 The P&E Study development plan is a Designated Project under Schedule 3 of the Environmental Impact Assessment Ordinance (EIAO). In October 2013, the Environmental Impact Assessment (EIA) Report for the Loop development (AEIAR-176/2013) was approved by Director of Environmental Protection (DEP) pursuant to the EIAO. The Environmental Permit (EP) (EP No. EP-477/2013) for the Loop to construct and operate the relevant Designated Projects (DP) was granted by DEP on 22 November 2013.

1.1.5 On 3 January 2017, the Government of Hong Kong Special Administrative Region (HKSARG) and Shenzhen Municipal People’s Government (SZMPG) signed a Memorandum of Understanding (the MoU) on “Jointly Developing the Lok Ma Chau Loop by Hong Kong and Shenzhen between the Hong Kong Special Administrative Region Government and Shenzhen Municipal People’s Government.” The MoU outlined the intention to jointly develop the Loop into the Hong Kong-Shenzhen Innovation and Technology Park (HSITP) under the "one country, two systems" principle and in accordance with the Basic Law. The HSITP will establish a key base for Information & Technology (I&T) industries, co-operation in scientific research with related higher education, cultural & creative and other complementary facilities. According to the MoU, HKSARG will be responsible for the construction of the infrastructure within the Loop (including site formation and infrastructural facilities) and the provision of supporting infrastructure outside the Loop. HKSARG will lease the formed land to Hong Kong Science and Technology Parks Corporation (HKSTPC) by appropriate land disposal means for the development of HSITP. The HKSTPC has set up a wholly-owned subsidiary company vested with the responsibility to develop the HSITP, as well as to operate, maintain and manage the HSITP. On 6 October 2017, the subsidiary company named Hong Kong Shenzhen Innovation and Technology Park Limited (HSITPL) was incorporated.

1.1.6 The draft Lok Ma Chau Loop Outline Zoning Plan (OZP) was approved by the Chief Executive in Council on 30 January 2018. The approved Lok Ma Chau Loop OZP, numbered as S/LMCL/2, was published on 9 February 2018. The old SZ River meander is zoned "Conservation Area" ("CA") on the approved OZP.

1.1.7 The development of the Loop into the HSITP is being taken forward by the Innovation and Technology Bureau (ITB) as the lead policy bureau. The Development Bureau (DEVB) and the Civil Engineering and Development Department (CEDD) support the development by undertaking the associated site formation and infrastructure works to provide the formed land to ITB/ HKSTPC for development of the HSITP as well as the supporting infrastructural facilities. To take forward the HSITP development, HSITPL has commenced its preparatory work, among others, to study the positioning and business model of the subject development. A master plan with development phasing/ programme, detailed land use and other relevant assessments would be submitted by HSITPL for HKSARG's approval.

Work Packaging

1.1.8 The Loop has been planned to be developed into a sustainable, environmentally friendly, energy efficient and people-oriented community. According to the recommendations in the P&E Study, the Loop development will be implemented in three works packages: Advance Works, Main Works Package 1 and Main Works Package 2. Advance Works (covered by PWP item No. 748CL – Development of Lok Ma Chau Loop – Land Decontamination and Advance Engineering Works), is to pave way for the ensuing construction works within the Loop. Main Works Package 1 pertinent to this Project, covered by PWP item No. 760CL – Development of Lok Ma Chau Loop – Main Works Package 1, is to form the site for the subsequent development of buildings and associated facilities for Phase 1 of HSITP, as well as providing the infrastructure and supporting facilities for Phase 1 of the Loop development. Main Works Package 2, to be covered by PWP item yet to be created, is to provide the infrastructure and supporting facilities for the remaining development of the Loop.

1.1.9 The Advance Works under PWP Item No. 748CL include the provision of construction access to the Loop, land decontamination required for proposed land uses within the Loop, creating and establishing an Ecological Area (EA) zone and other associated environmental mitigation measures. The detailed design for the Advance Works was completed under another consultancy, with construction works commencing on 22 June 2018.

1.1.10 Some of the works under the Project involve time-demanding procedures (i.e., land resumption, Vesting Deed modification and legislative amendment procedures, road works gazettal and authorisation). Therefore, site formation, infrastructure and associated works under the Project will be implemented as two separate sub-packages. Works in Sub-package A do not involve time-demanding procedures and comprise the site formation and infrastructure works inside the Loop, fresh water service reservoir and associated waterworks, Sewage Treatment Works (STW), sediment treatment works in SZ River near the Loop, associated ecological compensation/ enhancement works outside the Loop and any other works. Works in Sub-package B do involve time-demanding procedures, and comprise the Western Connection Road (WCR) recommended for implementation with reference to the P&E Study, the Lok Ma Chau Road/ San Tin Highway Connection, the Direct Road Link (DRL), associated infrastructure works and any other works. Generally, the works in Sub-package A and the works in Sub-package B will start in 2021 for commissioning by phases. It is expected that Phase 1 of HSITP will begin operation from 2023 the earliest.

1.2 The Project

1.2.1 AECOM Asia Co Ltd (hereafter refers as the *Consultant*) was commissioned by CEDD to undertake Agreement No. CE5/2018 (CE) – Development of Lok Ma Chau Loop: Main Works Package 1 – Design and Construction. The *starting date* of *services* is 14 September 2018 and the *completion date* for the whole of the *services* is the date of 101 months after the *starting date*.

1.2.2 The scope of the Project comprises the following principal works elements:

<u>Sub-Package A</u>

a) Site formation of the Loop;

b) Construction of internal roads, footpaths and cycle tracks, where appropriate in the Loop;

c) Provision of infrastructure/ supporting facilities for Phase 1 of the HSITP, including open spaces, sewage treatment works (Phase 1), water service reservoir and associated waterworks, combined utilities enclosure (CUE) as well as drainage and sewerage works;

d) Carrying out sediment treatment works in SZ River near the Loop;

e) Provision of landscape hardworks and soft works;

f) Provision of offsite ecological compensation/ enhancement; and

g) Other works.

<u>Sub-Package B</u>

a) Construction of WCR comprising widening of existing Ha Wan Tsuen East Road/ Lok Ma Chau Road with footpaths and cycle tracks, as well as connection roads to Fanling/San Tin Highway;

b) Construction of a DRL for environmentally friendly transport system (EFTS) connecting MTR Lok Ma Chau Station and the Loop and the associated modification works to the MTR Lok Ma Chau Station and the existing structures including but not limited to the footbridges and public transport interchange (PTI);

c) Provision of noise mitigation works; and

d) Other works.

1.2.3 A layout plan of the project is enclosed in **Appendix 1.1**.

1.3 Scope of this Report

1.3.1 This Environmental Review Report (ERR) is prepared to identify and assess the likely environmental issues pertinent to the proposed design changes in traffic noise mitigation measures (noise barriers) in the vicinity of WCR and DRL due to local stakeholders' comments received during the objection period of the road gazette and/or detail design requirement, and to identify any additional environmental mitigation measures that may be required for compliance with environmental standards. The purpose of this ERR is to demonstrate that no unacceptable impacts would be resulted from the proposed changes as mentioned in **Section 2** and hence a Variation of Environmental Permit (VEP) could be granted.

1.3.2 In addition, Table 3 of the EP specifies that the types of the noise mitigation measures for on-site Sewage Treatment Works shall be installed. However, referring to section 4.7.2.2 of the approved EIA report, noise mitigation measures such as acoustic silencers, noise barriers or acoustic enclosures shall be installed as appropriate to ensure that the specified maximum SWLs shown in Table 4.21 of approved EIA Report will not be exceeded (i.e. Maximum allowable sound power level of 75 dB(A) is specified to control impact on any noise sensitive use at the “Unspecified Use” area in Hoo Hok Wai (the “Unspecified Use” area in Hoo Hok Wai was rezoned to “Conservation Area (1)” (“CA(1)”) on the draft Ma Tso Lung and Hoo Hok Wai OZP No. S/NE-MTL/1 on 19 July 2013, and the draft OZP was subsequently approved by CE in C and exhibited on 19 June 2015); or maximum allowable sound power level of 84 dB(A) is specified for the scenario with no sensitive use at the Hoo Hok Wai area). To allow consideration of cost-effectiveness in designing/procuring the LMCLSTW with good acoustic performance, potentially include build-in noise insulation design, such that the need of installing noise mitigation measures may not be required. Therefore, it is suggested to variate condition 2.22 (b) and Table 3 of the EP to specify the maximum SWLs instead of types of noise mitigation measures.

1.3.3 This report will form part of the submission to the Environmental Protection Department (EPD) for the application of a Variation of Environmental Permit (EP) of the current EP (EP-477/2013) on Condition 2.22 (a), 2.22 (b), Table 3, Figure 6a, 6b and 6c. Details of the EP conditions to be varied are presented in **Section 3** of this Report.

1.4 Structure of this Report

1.4.1 Apart from this introductory section, there will be other sections in this Report as follows:

- Section 2 – Proposed Design Changes;
- Section 3 – Proposed Variation of Environmental Permit;
- Section 4 – Review on Operational Phase Noise Impacts;
- Section 5 – Review on Landscape and Visual Impacts; and
- Section 6 – Conclusion.

2. PROPOSED DESIGN CHANGES

2.1 Introduction

2.1.1 Under the Agreement of LMCL Main Works Package 1 D&C, the construction methods and engineering designs in P&E Study stage were reviewed and assessed, taking into account the site constraints, latest geological information, interfacing with other parts of the Project, comments from local stakeholders, as well as programme and cost aspects. Design changes had been made to cater for concerns from these aspects, including the changes to noise barriers along Western Connection Road (WCR) and Direct Road Link (DRL) as recommended in the approved EIA report.

2.1.2 **Section 2.2** presents the reasons of changes to noise barriers. The associated environmental aspects of concern are presented in **Section 2.3**.

2.2 Reasons of Changes to Noise Barriers

Sightline Issue

2.2.1 Referring to the approved LMCL EIA Report, road-side noise barriers were recommended along WCR and DRL. During the Design Phase, further review on the designs was conducted and the findings indicated that the erection of the road-side noise barriers at some locations would induce potential safety issues due to sightline obstruction against traffic. Changes to the design requirement of these noise barriers would be required to address the safety issue, while providing the same noise protection for the nearby noise sensitive receivers, while there is no change to the proposed road alignment, traffic volume and traffic composition compared with the EIA Report.

Change of Identified Sensitive Uses

2.2.2 In the approved LMCL EIA Report, noise sensitive uses have been identified within 300m from the Project boundary. Since the approval of the EIA study, some of the sensitive uses have been removed. On the other hand, some of the land resumption recommended in P&E Study have been cancelled due to latest design changes. Hence, some sensitive uses recommended to be removed in the P&E Study are now retained. Due to these changes, the recommended noise mitigation measures would be modified so as to provide adequate environmental protection on the affected noise sensitive receivers (NSRs). **Table 2.1** summarized the changes of identified NSRs under this ERR:

Table 2.1 Summary of Change of Identified NSRs

Location of NSRs	Noise Assessment Point ID	Reason of Change
Ha Wan Tsuen	HWT-8	NSR will be retained due to land resumption cancelled
Lok Ma Chau Road	LMCR-12	NSR will be removed due to land resumption
Lok Ma Chau Road	LMCR-16	NSR will be removed due to land resumption

Request from Local Stakeholders

2.2.3 In the approved LMCL EIA Report, a noise barrier was recommended in front of a local store, Lun Kee Store. The local stakeholder requested that the noise barrier with an opening directly in front of the store could facilitate the future operation of the store.

2.3 Environmental Aspects of Concern

2.3.1 A preliminary review of potential environmental impacts associated with the proposed variations has been conducted based on the nature and scope of the proposed changes which are presented below.

2.3.2 As described above in **Section 2.2**, a number of design requirements would pose changes to the noise barriers recommended in the approved LMCL EIA Report. With the same construction areas, construction programme, alignment of proposed roads as considered in the EIA study, most of the environmental impacts evaluated in the EIA report are still valid, with the exceptions of operational road traffic noise impact, operational air quality impact and landscape and visual impact, which are presented below. Operational air quality impact evaluated in the EIA report is also valid (elaboration is presented below).

Noise Impact

2.3.3 The changes of noise barrier arrangement along the WCR and DRL would not change the construction programme, construction method, plant inventory and work area as assumed in the EIA study. Thus, no change to the findings of the construction noise impact assessment predicted in the approved LMCL EIA Report would be anticipated due to the noise barrier arrangement changes.

2.3.4 There is no fixed plant noise issue arising from the proposed changes on noise barriers. No change to the findings of fixed plant noise impact assessment in the approved LMCL EIA Report would be anticipated.

2.3.5 Operational phase traffic noise impact due to the proposed changes to noise barriers would be discussed in detail in **Section 4**, while the extent of low-noise road surfacing (LNRS) recommended in the EIA would remain unchanged.

Air Quality Impact

2.3.6 The changes of the noise barrier arrangement along the WCR and DRL would not change the construction programme, construction method, plant inventory and work area as assumed in the EIA study. Thus, no change to the findings of the construction dust impact assessment predicted in the approved LMCL EIA Report would be anticipated.

2.3.7 Based on the latest available information, the operation phase traffic data, traffic composition and road alignment for the Project would remain generally unchanged as compared to that assumed under the approved LMCL EIA Report and hence the traffic emission presented in the approved LMCL EIA Report would remain valid.

2.3.8 With reference to section 3.7.2 of the approved LMCL EIA Report, given the air sensitive receivers (ASRs) are low-rise structures, the inclusion of noise barriers into the assessment will not materially affect the worst scenario air quality impact at the ASRs. Therefore, the effect of noise barriers were excluded in the EIA study. The predicted air quality impacts due to the vehicular emission were found well within the acceptable levels when comparing to the Air Quality Objectives (AQO). Thus, it is considered that the operation phase air quality implication due to the design changes of noise barrier would still be negligible. Therefore, the design changes of noise barriers will not change the findings of the operational phase air quality impact assessment predicted in the approved LMCL EIA Report.

Landscape and Visual Impact

2.3.9 The proposed changes of noise barrier from the previously approved EIA will result in some variation on the potential landscape and visual impact. As reviewed, the Landscape Resources, Landscape Character Areas and Visual Sensitive Receivers as identified in the approved EIA are generally remained valid. It is considered that the change of noise barrier is minor and similar to the result identified in the approved EIA. The proposed changes would not create any insurmountable adverse landscape and visual impact.

2.3.10 Based on the variations on the potential landscape and visual impact, the proposed mitigation measures are reviewed and are considered valid. With mitigation measures as illustrated in the previous approved EIA, the visual impact of noise barrier shall reduce to acceptable level.

2.3.11 **Section 5** presents the assessment for Landscape and Visual Impact induced from the changes of the noise barrier design.

Summary

2.3.12 Summary of potential environmental impacts due to design changes in noise barriers recommended in the approved LMCL EIA Report is listed in below **Table 2.2**.

Table 2.2 Summary of Potential Environmental Impacts Associated with the Proposed Design Changes

Potential Environmental Impact		**Changes to noise barriers along WCR and DRL**
Noise	Operational Road Traffic Noise	v
	Operational Fixed Plant Noise	X
	Construction Noise	X
Air Quality	Construction Dust	X
	Operational Phase Air Quality	X
Landscape and Visual		v
Water Quality		X
Sewerage and Sewage Treatment Implication		X
Waste Management Implication		X
Land Contamination		X
Cultural Heritage		X
Ecology		X
Fisheries		X
Hazard to Life		X
Landfill Gas Hazard Assessment		X
Food Safety Implication		X

Note:
v Potential impact to be further reviewed in this ERR
X Potential impact associated with the proposed variations is not expected

3. PROPOSED VARIATIONS OF ENVIRONMENTAL PERMIT

3.1.1 The proposed VEP application includes variations of EP condition 2.22 (a), 2.22 (b), Table 3 and Figures 6a, 6b and 6c. The proposed amendments on the EP conditions 2.22 (a) and 2.22 (b) are presented in **Table 3.1**, while Table 3 and Figures 6a, 6b and 6c are proposed to be deleted.

Table 3.1 Variations to the Environmental Permit

	Original EP Condition	Proposed EP Condition	Reasons for Variations
EP Condition 2.22(a)	noise barriers shall be installed to screen road traffic noise during the operation stage of the Project as described in Table 3 and Figures 6a, 6b and 6c of this Permit;	traffic noise mitigation measures including noise barriers and low noise road surfacing at the connecting roads including Ha Wan Tsuen Road, Lok Ma Chau Road and Direct Link for the Project. The Permit Holder shall, no later than one month before the commencement of construction of the traffic noise mitigation measures for the Project, deposit with the Director 3 hard copies and 1 electronic copy of Traffic Noise Mitigation Plan (TNMP). The TNMP shall include design details of the traffic noise mitigation measures, locations of noise barriers and low noise road surfacing, dimensions of noise barriers, traffic noise mitigation performance with the traffic noise mitigation measures in place and aesthetic design of noise barriers. The TNMP shall demonstrate that the traffic noise performance requirements set out in the approved EIA report (Register No.: AEIAR-176/2013) will not be exceeded or violated with the mitigation measures in place. Before submission to the Director, the TNMP shall be certified by the ET Leader and verified by the IEC as conforming to the relevant information and recommendations contained in the EIA Report and application document for variation of an environmental permit. All measures as recommended in the TNMP shall be fully and properly implemented and maintained;	Various reasons including: - - To avoid causing sight-line issue to traffic; - Local stakeholder comment; - To match with the proposed pedestrian crossing; and - Changes of noise sensitive receivers
Figures 6a, 6b and 6c	-	Deleted.	

	Original EP Condition	Proposed EP Condition	Reasons for Variations
EP Table 3	-	Deleted.	
EP Condition 2.22(b)	noise mitigation measures such as silencers, acoustic louvers and acoustic enclosures for fixed plant noise as described in Table 3 and with reference to the typical designs as shown in Figure 4 of this Permit;	the total sound power level of the fixed plant noise generated from the on-site Sewage Treatment Works during operation shall not be more than 75dB(A);	To allow consideration of cost-effectiveness in designing/procuring the LMCLSTW with good acoustic performance, potentially include build-in noise insulation design, such that the need of installing noise mitigation measures may not be required

4. REVIEW ON OPERATION PHASE NOISE IMPACTS

4.1 Introduction

4.1.1 This section reviews and addresses potential noise impact induced from the proposed variations.

4.2 Environmental Legislation, Standards and Guidelines

4.2.1 The criteria for road traffic noise are stipulated in Annex 5, Table 1A "A Summary of Noise Criteria" of the Technical Memorandum on Environmental Impact Assessment Process (EIAO-TM), which defines the criteria $L_{10(1\ hour)}$ for the road traffic noise at various noise sensitive receivers (NSRs). The relevant criteria are listed below:

- 70 dB(A) at 1m from the external façades of residential dwellings; and
- 65 dB(A) at 1m from the external façades of schools, places of public worship.

4.3 Noise Sensitive Receivers

4.3.1 The approved LMCL EIA Report has identified various NSRs. The NSRs located in the vicinity of the proposed changes are identified as representative NSRs for assessment supporting this EP variation, further to a site survey conducted on 22 May 2019. The photos indicating the existing NSRs are presented in **Appendix 4.1**. Their locations are shown in **Figure 4.1** and details are summarised in **Table 4.1** below.

Table 4.1 Representative Noise Sensitive Receivers

Location of NSRs	Noise Assessment Point ID	Use
Ha Wan Fisherman San Tsuen	HWFST-2	Residential
Ha Wan Tsuen	HWT-3 to HWT-8[1]	Residential
Ha Wan Tsuen Road	HWTR-1a to HWTR-1b	Residential
	HWTR-2 to HWTR-18	Residential
	HWTR-20	Residential
	HWTR 22 to HWTR-23	Residential
LMC Road[2]	LMCR-1 to LMCR-11	Residential
	LMCR-14 to LMCR-15	Residential
	LMCR-17	Residential
LMC San Tsuen	LMCST-1 to LMCST-2	Residential
San Sham Road	SSR-1 to SSR-2	Residential

Remarks:
1. NSR No. HWT-8 will be retained due to land resumption cancelled
2. NSR No. LMCR-12 and LMCR-16 will be removed due to land resumption
3. NSR No. HWTR-21 no longer exists.

4.4 Assessment Methodology

4.4.1 The assessment methodology and modelling assumptions in this assessment are same as that in the approved LMCL EIA Report, below recap the details. Traffic noise assessment is carried out according to the Calculation of Road Traffic Noise, 1988 (CRTN) of UK Department of Transport. Road traffic noise levels are presented in terms of noise levels exceeded for 10% of the one-hour period during the peak hour traffic flow, i.e. $L_{10(1hr)}$ dB(A). The assessment is based on year 2042 traffic flow and vehicle compositions used in the LMCL EIA study, as the latest design information indicate the traffic data would remain valid. The roads within 300m from the proposed Project alignment are included in the model.

4.4.2 With reference to EIAO-TM and EIAO Guidance Note No. 12/2010, direct mitigation measures are required to reduce the noise from the concerned road project(s) to a level that it:

- is not higher than the standard (listed in Section 3.2.1); and
- has no significant contribution (less than 1.0 dB(A) $L_{10\ (1\ hr)}$) to the overall noise from other existing roads, if the cumulative noise level, i.e. noise from the road project under the subject designated project together with other existing roads, exceeds the standard.

4.4.3 If any façades of NSRs are still exposed to predicted noise levels exceeding the relevant noise criteria after the implementation of all direct mitigation measures, provision of Indirect Technical Remedies (ITRs) in the form of acoustic insulation and air conditioning should be considered under the EIAO-TM and EIAO Guidance Note No. 12/2010. The eligibility for ITRs shall be tested against the following three criteria:

- the predicted overall noise level from the road project together with other traffic noise in the vicinity must be above a specified noise level (e.g. 70 dB(A) for domestic premises and 65 dB(A) for education institutions, all in $L_{10\ (1hr)}$); and
- the predicted overall noise level is at least 1.0 dB(A) more than the prevailing traffic noise level, i.e. the total traffic noise level existing before the works to construct the road were commenced; and
- the contribution to the increase in the predicted overall noise level from the road project must be at least 1.0dB(A).

4.5 Evaluation on Operation Phase Road Traffic Noise Impact

Changes in Noise Barrier Arrangement along WCR and DRL

4.5.1 Due to the design changes as stated in **Section 2.2**, the noise barrier arrangement along the WCR and DRL have been modified. **Table 4.2** summarizes the proposed changes to the noise barriers (NBs) and corresponding reasons for modification. **Appendix 4.2** shows the locations of the modified noise barriers.

Table 4.2 Proposed Changes on the Noise Barrier Design Along Western Connection Road

Noise Barrier	EIA Mitigated Scenario	Revised Mitigated Scenario	Reasons for Variations
NB 6	Approx. 50m long 0.8m high noise barrier at road kerb	Approx. 50m long 1m high noise barrier at the edge of footpath	- To avoid causing sightline issue to traffic at Lok Ma Chau Road
NB 7	Approx. 8m long 0.8m high noise barrier at road kerb	Approx. 8m long 1m high noise barrier at the edge of footpath	
NB 8	Approx. 10m long 3m high noise barrier at road kerb	Approx. 10m long 3m high noise barrier at edge of footpath	

Noise Barrier	EIA Mitigated Scenario	Revised Mitigated Scenario	Reasons for Variations
NB 9	Approx. 33m long 5m high noise barrier at road kerb	Approx. 33m long 5m high noise barrier at the edge of footpath, with a 1.6m wide opening in front of Lun Kee Store	- Local stakeholder comment
NB 10	Approx. 12m long 3m high noise barrier at road kerb	Approx. 12m long 3m high noise barrier at the edge of footpath	- To avoid causing sightline issue to traffic at Lok Ma Chau Road
NB 11	Approx. 12m long 5m high noise barrier at road kerb	Approx. 10m long 5m high noise barrier at the edge of footpath	
NB 12	Approx. 36m long 3m high noise barrier at road kerb	Approx. 36m long 3m high noise barrier at the edge of footpath	
NB 14	Approx. 32m long 0.8m high noise barrier at road kerb	Approx. 30m long 1.2m high noise barrier at the edge of footpath next to the bus stop.	- Setback of NB 14 require higher noise barrier for adequate mitigation at LMCR-8 and LMCR-9
NB 15	Approx. 27m long 3m high noise barrier at road kerb	Approx. 27m long 3m high noise barrier at the edge of footpath	- To avoid causing sightline issue to traffic at Lok Ma Chau Road - Local stakeholder comment
NB 16	Approx. 57m long 3m high noise barrier at road kerb	Approx. 57m long 3m high noise barrier at the edge of Amenity Area	- To avoid causing sightline issue to traffic at Lok Ma Chau Road
NB 19	Approx. 730m long 0.8m high noise barrier at road kerb	Approx. 710m long 0.8m high noise barrier at both sides of road kerb	- To match with the proposed pedestrian crossing at road junction with Ha Wan Tsuen East Road
		Approx. 50m long 2m high noise barrier (NB25)	
NB 23	Approx. 16m long 3m high noise barrier at road kerb	Approx. 16m long 3m high noise barrier at the edge of footpath	- To avoid causing sightline issue to traffic at Lok Ma Chau Road
NB 24	Approx. 80m long 0.8m high noise barrier at road kerb	Approx. 80m long 1m high noise barrier at the edge of footpath	
NB 25	Part of NB19 (0.8m high noise barrier at road kerb)	Approx. 50m long 2m high noise barrier	- Land resumption at NSR HWT-8 cancelled and additional traffic noise mitigation is required.

Remarks:
- N/A denotes “Not Applicable”.

- To avoid sightline issue to traffic, the noise barrier is proposed to set back by about 2 m from the road kerb to the edge of footpath/amenity area.

4.5.2 The predicted noise levels at the representative NSRs under the revised mitigated scenario are summarised in **Table 4.3** and detailed in **Appendix 4.3**.

Table 4.3 Predicted Traffic Noise Levels at NSRs under Revised Mitigated Scenario at Year 2042

NSR ID	Criterion	Predicted Overall Noise Level, L10(1hr), dB(A)
HWFST-2	70	70
HWT-3	70	67
HWT-4	70	68
HWT-5	70	68
HWT-6	70	67
HWT-7	70	66 - 69
HWT-8	70	65 - 70
HWTR-1	70	66 - 70
HWTR-2	70	62 - 67
HWTR-3	70	56
HWTR-4	70	55 - 65
HWTR-5	70	51 - 64
HWTR-6	70	62 - 66
HWTR-7	70	69
HWTR-8	70	65 - 70
HWTR-9	70	70
HWTR-10	70	70
HWTR-11	70	66
HWTR-12	70	69
HWTR-13	70	67
HWTR-14	70	68
HWTR-15	70	68
HWTR-16	70	67
HWTR-17	70	68 - 69
HWTR-18	70	67
HWTR-20	70	67
HWTR-22	70	69
HWTR-23	70	70
LMCR-1	70	66 - 70
LMCR-2	70	67 - 70
LMCR-3	70	62 - 68
LMCR-4	70	66 - 70
LMCR-5	70	66 - 68
LMCR-6	70	69
LMCR-7	70	67
LMCR-8	70	69 - 70
LMCR-9	70	68 - 69
LMCR-10	70	70
LMCR-11	70	66
LMCR-14	70	70
LMCR-15	70	70
LMCR-17	70	66 - 70

NSR ID	Criterion	Predicted Overall Noise Level, L10(1hr), dB(A)
LMCST-1	70	65 - 66
LMCST-2	70	68
SSR-1	70	70
SSR-2	70	69 - 70

4.5.3 Under the revised mitigated scenario, noise level at all representative NSRs would comply with the 70 dB(A) road traffic noise criterion for residential dwellings. Therefore, no adverse traffic noise impact would be anticipated at the representative NSRs due to the Project under the revised mitigated scenario. No further mitigation measures are required.

4.6 Evaluation on Operation Phase Fixed Noise Impact

4.6.1 As stated in **Section 1.3.2** and **Table 3.1**, there would be variation of EP condition 2.22(b) and Table 3. Such change would not change the requirement of the fixed noise requirement as stated in the approved LMCL EIA Report. Hence, the associated fixed noise impact due to the on-site STW assessed in the EIA Report would still be valid. Same as that presented in the EIA Report, there would be no adverse fixed noise impact due to the variation. No adverse effect to the environment and community.

4.7 Change in EM&A Requirements Associated with Proposed Variations

4.7.1 Based on the above findings, most of the EM&A requirements recommended in the EM&A Manual would remain applicable. In view of the retained NSR HWT-8 and the revised NB9, additional noise measurement points at HWT-8 and HWTR-9 are recommended. The monitoring requirements at the additional noise measurement points would follow section 5.10 and 5.11 of the EM&A manual.

4.8 Review on Environmental Permit Conditions

4.8.1 Referring to the Environmental Permit (EP No.: EP-477/2013) for the approved LMCL EIA, numbers of noise barriers recommended in the EIA study as noise mitigation measures are listed in Table 3 of the EP. The locations of the noise barriers are also shown in Figure 6a, 6b and 6c. Due to the compliance of driver's sightline requirements and objection from local stakeholders received during road gazette objection period, several design changes on the noise barriers along WCR and DCR are proposed. No adverse road traffic noise impact is predicted with the revised noise mitigation measures in place. Therefore, an application for variation of the EP would be required for the necessary changes to the barriers. The proposed variations to the EP are summarized in **Section 3**.

5. REVIEW ON LANDSCAPE AND VISUAL IMPACTS

5.1 Introduction

5.1.1 This chapter is to present the findings and recommendations of the landscape and visual impact assessment. The potential landscape and visual impacts during operation of the proposed revised noise barrier design are reviewed in this chapter. The aesthetic design of the updated direct noise mitigating measures, including their landscape and visual characteristics are reviewed and optimized in accordance with the Environmental Permit.

5.1.2 The landscape and visual impact due to the changes of noise barrier of the Project as compared with the scheme presented in the EIA Report (Register No.: AEIAR-176/2013) approved on 25 October 2013 is reviewed. This review also takes into account on any changes in circumstances, including the changes existing and planned developments.

5.2 Environmental Legislation, Standards and Guidelines

5.2.1 The following legislation, standards and guidelines which have been identified under the approved EIA Report are still applicable for the evaluation of landscape and visual impacts for this Review Report.

- Environmental Impact Assessment Ordinance (Cap.499 S.16) and the Technical Memorandum on EIA Process (EIAO-TM), particularly Annexes 10 and 18;
- ETWB TC(W) No. 17/2000 – Improvement to the Appearance of Slopes
- Town Planning Ordinance (Cap 131)
- Land Administration Office Instruction (LAOI) Section D-12 – Tree Preservation
- WBTC No.7/2002 – Tree Planting in Public Works
- ETWB TC(W) No. 34/2003 – Community Involvement in Greening Works
- DEVB TC(W) No. 6/2015 – Maintenance of Vegetation and Hard Landscape Features
- ETWB TC(W) No. 11/2004 – Cyber Manual for Greening
- DEVB TC(W) No. 5/2020 – Registration and Preservation of Old and Valuable Trees
- DEVB TC(W) No. 1/2018 – Soft Landscape Provisions for Highway Structures
- DEVB TC(W) No. 4/2020 – Tree Preservation
- Forests and Countryside Ordinance (Cap 96) and its subsidiary legislations
- GEO publication (1999) – Use of Vegetation as Surface Protection on Slopes
- GEO 1/2000 – Technical Guidelines on Landscape Treatment and Bio-engineering of Man-made Slopes and Retaining Walls
- HyD TC No. 7/2006 – Independent vetting of Tree Works under the Maintenance of Highways Department
- Government General Regulation 740 – restrictions on the preservation and felling of trees in Hong Kong

- Hong Kong Planning Standards and Guidelines Chapter 4 and Chapter 11
- Study on Landscape Value Mapping of Hong Kong

5.2.2 The Environmental Impact Assessment Ordinance Guidance Note 8/2002 has been updated since the approval of EIA Report. The Environmental Impact Assessment Ordinance Guidance Note 8/2010 will be followed for this study.

5.2.3 The Outline Zoning Plan (OZP) gazetted under the Town Planning Ordinance provides the statutory framework for land use development. Reference has been made to the Approved San Tin Outline Zoning Plan No. S/YL-ST/8 (15/12/2006), the Approved Lok Ma Chau Loop Outline Zoning Plan No. S/LMCL/2 (09/02/2018) and the Approved Ma Tso Lung and Hoo Hok Wai OZP No. S/NE-MTL/3 (19/06/2015).

5.3 Proposed Changes of Noise Barrier from Previously Approved EIA Scheme

5.3.1 The proposed changes to noise barrier from previously approved EIA Report are discussed in **Sections 2**.

5.3.2 Changes on the proposed noise barriers are reviewed and potential landscape and visual impacts are assessed in the latest section of this chapter.

5.4 Review of Planning and Development Control Framework

5.4.1 The approved OZPs of San Tin S/YL-ST/8 (15/12/2006) and Lok Ma Chau Loop S/LMCL/2 (09/02/2018) are reviewed. There is no substantial change in land use and layout in these OZPs within the study area. The Hoo Hok Wai area to east of the Loop development previously zoned “Unspecified Use” is currently zoned “CA(1)” on the approved Ma Tso Lung and Hoo Hok Wai Wai OZP No. S/NE-MTL/3 (19/06/2015).

5.5 Review of Changes to Baseline Findings Prepared under Previously Approved EIA

5.5.1 Baseline Landscape Resources (LR), Landscape Character Areas (LCA) and Visually Sensitive Receivers (VSRs) are reviewed following the baseline findings prepared under previously approved EIA based on site visit, desktop study of topographical maps and site photographs.

5.6 Baseline Landscape Resources and Landscape Character Areas

5.6.1 Based on the review of baseline findings of the EIA Report and recent site visit, desktop study of topographical maps and site photographs, no additional LRs and LCAs were identified to be affected by the proposed road scheme and the baseline conditions of LRs and LCAs presented in the approved EIA Report would remain valid.

5.7 Visually Sensitive Receivers (VSRs)

5.7.1 Based on the review of the latest OZPs of San Tin S/YL-ST/8 (15/12/2006), Lok Ma Chau Loop S/LMCL/2 (09/02/2018) and Ma Tso Lung and Hoo Hok Wai S/NE-MTL/3 (19/06/2015), there is no changes in land use or proposed new development that fall within the visual envelope of the project. The baseline findings presented in the approved EIA report would remain valid.

5.8 Landscape Impact Assessment

5.8.1 The proposed changes of noise barrier would not cause any discernible changes in impact on existing landscape resources, including both the existing trees and roadside amenity areas.

5.8.2 The impact on existing trees due to the change of noise barrier would be same as identified in the approved EIA. No additional tree would be directly affected by the change of noise barrier. Therefore, there would not be any discernible changes in the impact on landscape resources as assessed in the approved EIA.

5.8.3 The proposed changes of noise barrier are considered as minor and would not change the threshold impact significance on LCAs. It is considered that there would not be any discernible changes in impact on LCAs as identified in the Approved EIA.

5.8.4 The potential landscape impacts due to the proposed changes are itemized and described in **Table 5.1**.

Table 5.1 Proposed Changes in Direct Noise Mitigation Measures and Associated Potential Landscape and Visual Impact

Noise Barrier	EIA Scheme	Current Scheme	Potential Landscape and Visual Impact
NB 6	Approx. 50m long 0.8m high NB at road kerb	Approx. 50m long 1m high NB at the edge of footpath	There are minor changes in the height of the NB. It is considered that there would not be any discernible changes in landscape and visual impact.
NB 7	Approx. 8m long 0.8m high NB at road kerb	Approx. 8m long 1m high NB at the edge of footpath	There are minor changes in the height of the NB. It is considered that there would not be any discernible changes in landscape and visual impact.
NB 8	Approx. 10m long 3m high NB at road kerb	Approx. 10m long 3m high NB at edge footpath	No change in potential Landscape and Visual Impact.
NB 9	Approx. 33m long 5m high NB at road kerb	Approx. 33m long 5m high NB at the edge of footpath, with a 1.6m wide opening in front of Lun Kee Store	There would be some visual enhancement to the design of the proposed NB. However, such enhancement is considered as minor. It is anticipated that potential change in magnitude of impact on adjacent VSRs would be insignificant.
NB 10	Approx. 12m long 3m high NB at road kerb	Approx. 12m long 3m high NB at the edge of footpath	No change in potential Landscape and Visual Impact.

Noise Barrier	EIA Scheme	Current Scheme	Potential Landscape and Visual Impact
NB 11	Approx. 12m long 5m high NB at road kerb	Approx. 10m long 5m high NB at the edge of footpath	There would be some visual enhancement to the design of the proposed NB. However, such enhancement is considered as minor. It is anticipated that potential change in magnitude of impact on adjacent VSRs would be insignificant.
NB 12	Approx. 36m long 3m high NB at road kerb	Approx. 36m long 3m high NB at the edge of footpath	No change in potential Landscape and Visual Impact.
NB 14	Approx. 32m long 0.8m high NB at road kerb	Approx. 30m long 1.2m high NB at the edge of footpath	The change is considered as minor. It is anticipated that potential change in magnitude of impact on adjacent VSRs would be insignificant.
NB 15	Approx. 27m long 3m high NB at road kerb	Approx. 27m long 3m high NB at the edge of footpath	No change in potential Landscape and Visual Impact.
NB 16	Approx. 57m long 3m high NB at road kerb	Approx. 57m long 3m high NB at the edge of Amenity Area	No change in potential Landscape and Visual Impact.
NB 19	Approx. 730m long 0.8m high noise barrier at road kerb	Approx. 710m long 0.8m high noise barrier at road kerb	The change is considered as minor. It is anticipated that potential change in magnitude of impact on adjacent VSRs would be insignificant.
NB 23	Approx. 16m long 3m high NB at road kerb	Approx. 16m long 3m high NB at the edge of footpath	No change in potential Landscape and Visual Impact.
NB 24	Approx. 80m long 0.8m high NB at road kerb	Approx. 80m long 1.1m high NB at the edge of footpath	There are minor changes in the height of the NB. It is considered that there would not be any discernible changes in landscape and visual impact.
NB 25	N/A	Approx. 50m long 2m high NB	The change is considered as minor. It is anticipated that potential change in magnitude of impact on adjacent VSRs would be insignificant.

5.9 Visual Impact Assessment

5.9.1 The proposed changes would fall within the works area as identified in the approved EIA Report. The nature of works and scale of development between the current scheme and the approved scheme are the same. Therefore, the findings and recommendations to visual impact on the approved EIA are still valid.

5.9.2 Having reviewed the proposed changes as identified in **Section 2**, it is considered that there would not be any insurmountable change in visual impact on adjacent VSRs. However, the proposed changes of noise barrier would be the main source of potential visual impact. The potential visual impacts due to the proposed changes are assessed and described in **Table 5.1**.

5.9.3 Based on the review of potential landscape and visual impact, changes of noise barrier are mainly minor adjustment on height and length. No insurmountable adverse impact to the adjacent landscape is imposed. With the implementation of mitigation measure in the approved EIA, the changes of noise barrier could be mitigated to an acceptable level. The viewpoints as illustrated in the approved EIA report are still valid.

5.10 Optimization of Aesthetic Design of the Updated Direct Noise Mitigation Measures

5.10.1 As identified in the approved EIA, the proposed noise barriers have imposed adverse visual impact on road users. Through the design development process, aesthetic design of the updated direct noise mitigation measures including their landscape and visual characteristics are optimised. ACABAS Submission for Noise Barriers along WCR was submitted on 2 June 2020 and the aesthetic design of the noise barrier s were agreed in principle during the ACABAS meeting held on 16 June 2020.

5.11 Landscape and Visual Mitigation Measures

5.11.1 During the Design Phase, landscape and visual mitigation measures for the proposed road works as associated direct noise mitigation measures have been considered as far as practicable. The opportunity of providing landscape and visual mitigation measures is limited by the need of maintaining a clear sightline for road travellers of the traffic lanes, structural loading constraint, maintaining an open area around the portal for emergency use and maintaining pedestrian free connection for the public.

5.12 Residual Impact

5.12.1 There would not be any discernible changes in the residual impact on landscape resources and landscape character areas assessed in the approved EIA.

5.13 Cumulative Impact

5.13.1 Key concurrent projects identified in the vicinity of the proposed road scheme in the approved EIA report include the proposed cycle tracks in the North West New Territories and North East New Territories, new development areas in the North East New Territories and the construction of the secondary boundary fence and new sections of primary boundary fence and Boundary Patrol Road. There are no additional concurrent projects identified within the vicinity. There would not be any insurmountable cumulative landscape and visual impact aroused from the proposed changes to approved EIA.

6. CONCLUSION

6.1.1 Due to the design requirement during design stage of the Project and local stakeholder comments, the design of the noise barriers recommended for WCR and DRL would be changed. The operational road traffic noise impact associated with the modified design of noise barriers have been assessed. No adverse operational road traffic noise impact would be anticipated due to the design changes. The air quality impact due to the design changes would be anticipated negligible. No other environmental impact is anticipated. No additional environmental monitoring and audit requirements are required.

6.1.2 The potential impact on the existing and planning control frameworks is reviewed. Based on the variations on the potential landscape and visual impact, the proposed mitigation measures are reviewed and are considered valid. In general, the proposed changes of noise barrier from the previously approved EIA will result in some variation on the potential landscape and visual impact. However, it is considered that the proposed changes would not create any insurmountable adverse landscape and visual impact.

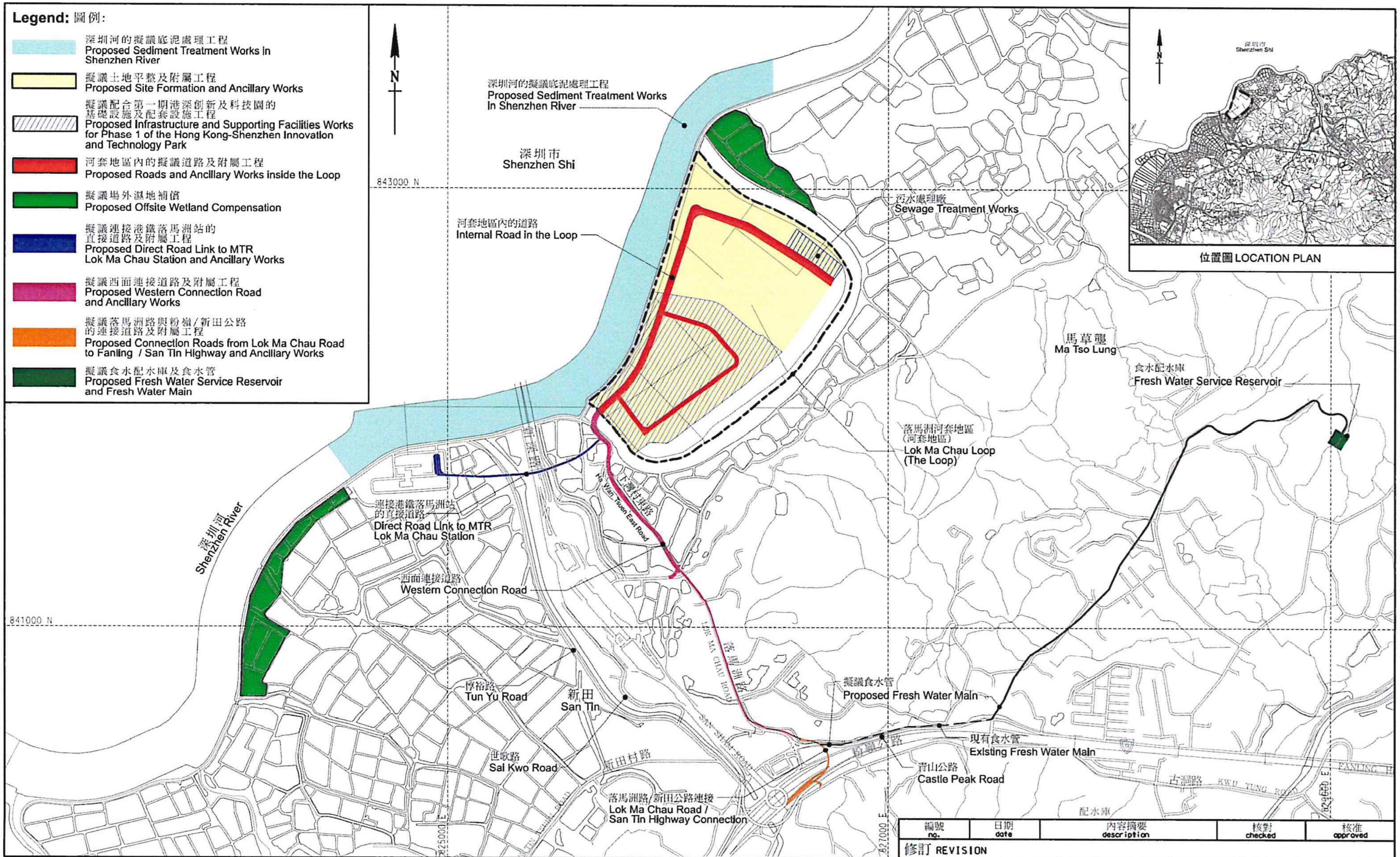
6.1.3 The EP condition regarding noise performance of the on-site Sewage Treatment Works is also reviewed. It is recommended to state the maximum allowable sound power level arising from the plant allowing consideration of cost-effectiveness in designing/procuring the LMCLSTW with good acoustic performance, potentially include build-in noise insulation design, such that the need of installing noise mitigation measures may not be required.

6.1.4 Application for variation of the EP with respect to the revised road traffic noise mitigation measures along WCR and DRL and noise performance of the on-site Sewage Treatment Works would be proceeded.

Appendices

Appendix 1.1

Project Layout Plan



編號 no.	日期 date	內容摘要 description	核對 checked	核准 approved

修訂 REVISION

圖則名稱 drawing title

落馬洲河套地區發展 - 第一期主體工程 - 設計及建造

DEVELOPMENT OF LOK MA CHAU LOOP - MAIN WORKS PACKAGE 1 - DESIGN AND CONSTRUCTION

繪圖 drawn: T.C. TSANG	簽署 initial: SIGNED	日期 date: 09.08.2018	項目編號 item no.
核對 checked: S.C. YEUNG	簽署 initial: SIGNED	日期 date: 09.08.2018	比例 scale: 1:16000 on A3
核准 approved: F.C. LEE	簽署 initial: SIGNED	日期 date: 09.08.2018	圖則編號 drawing no.: WDOST-Z0034

辦事處 office

西拓展處

WEST DEVELOPMENT OFFICE

CEDD 土木工程拓展署 CIVIL ENGINEERING AND DEVELOPMENT DEPARTMENT

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9/8/2018

A3 420MM X 297MM

Appendix 4.1

Existing Photos of NSRs

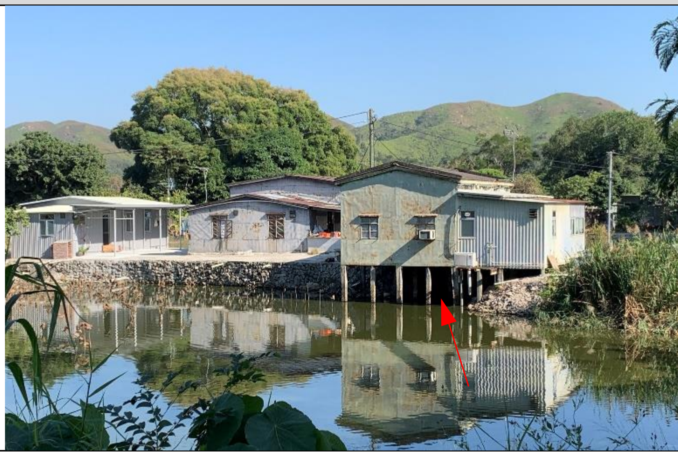
Appendix 4.1 Photos of Representative Noise Sensitive Receivers along WCR and for the two slip roads

NSR No.	Location	Photo
HWFST-2	Village house, Ha Wan Fisherman San Tsuen	
HWT-3	Village house, Ha Wan Tsuen	
HWT-4	Village house, Ha Wan Tsuen	
HWT-5	Village house, Ha Wan Tsuen	

Appendix 4.1 Photos of Representative Noise Sensitive Receivers along WCR and for the two slip roads

NSR No.	Location	Photo
HWT-6	Village house, Ha Wan Tsuen	
HWT-7	Village house, Ha Wan Tsuen	
HWT-8	Village house, Ha Wan Tsuen	
HWTR-1	Village house, Ha Wan Tsuen Road	

Appendix 4.1 Photos of Representative Noise Sensitive Receivers along WCR and for the two slip roads

NSR No.	Location	Photo
HWTR-2	Village house, Ha Wan Tsuen Road	
HWTR-3	Village house, Ha Wan Tsuen Road	
HWTR-4	Village house, Ha Wan Tsuen Road	
HWTR-5	Village house, Ha Wan Tsuen Road	

Appendix 4.1 Photos of Representative Noise Sensitive Receivers along WCR and for the two slip roads

NSR No.	Location	Photo
HWTR-6	Village house, Ha Wan Tsuen Road	
HWTR-7	Village house, Ha Wan Tsuen Road	
HWTR-8	Village house, Ha Wan Tsuen Road	
HWTR-9	Village house, Ha Wan Tsuen Road	

Appendix 4.1 Photos of Representative Noise Sensitive Receivers along WCR and for the two slip roads

NSR No.	Location	Photo
HWTR-10	Village house, Ha Wan Tsuen Road	
HWTR-11	Village house, Ha Wan Tsuen Road	
HWTR-12	Village house, Ha Wan Tsuen Road	
HWTR-13	Village house, Ha Wan Tsuen Road	

Appendix 4.1 Photos of Representative Noise Sensitive Receivers along WCR and for the two slip roads

NSR No.	Location	Photo
HWTR-14	Village house, Ha Wan Tsuen Road	
HWTR-15	Village house, Ha Wan Tsuen Road	
HWTR-16	Village house, Ha Wan Tsuen Road	
HWTR-17	Village house, Ha Wan Tsuen Road	

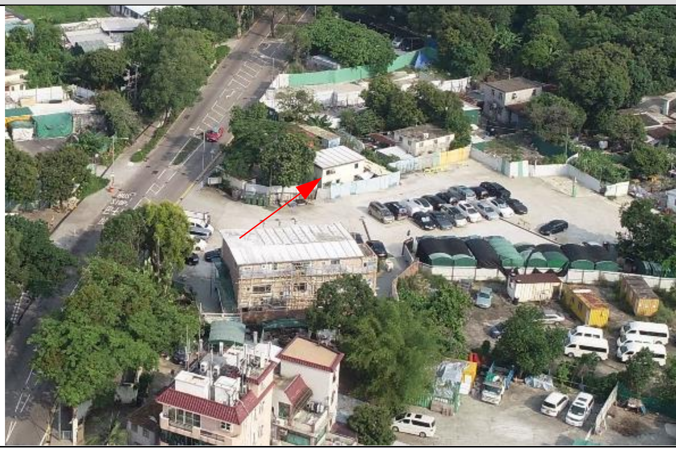
Appendix 4.1 Photos of Representative Noise Sensitive Receivers along WCR and for the two slip roads

NSR No.	Location	Photo
HWTR-18	Village house, Ha Wan Tsuen Road	
HWTR-20	Village house, Ha Wan Tsuen Road	
HWTR-22	Village house, Ha Wan Tsuen Road	
HWTR-23	Village house, Ha Wan Tsuen Road	

Appendix 4.1 Photos of Representative Noise Sensitive Receivers along WCR and for the two slip roads

NSR No.	Location	Photo
LMCR-1	Village house, Lok Ma Chau Road	
LMCR-2	Village house, Lok Ma Chau Road	
LMCR-3	Village house, Lok Ma Chau Road	
LMCR-4	Village house, Lok Ma Chau Road	

Appendix 4.1 Photos of Representative Noise Sensitive Receivers along WCR and for the two slip roads

NSR No.	Location	Photo
LMCR-5	Village house, Lok Ma Chau Road	
LMCR-6	Village house, Lok Ma Chau Road	
LMCR-7	Village house, Lok Ma Chau Road	
LMCR-8	Village house, Lok Ma Chau Road	

Appendix 4.1 Photos of Representative Noise Sensitive Receivers along WCR and for the two slip roads

NSR No.	Location	Photo
LMCR-9	Village house, Lok Ma Chau Road	
LMCR-10	Village house, Lok Ma Chau Road	
LMCR-11	Village house, Lok Ma Chau Road	
LMCR-14	Village house, Lok Ma Chau Road	

Appendix 4.1 Photos of Representative Noise Sensitive Receivers along WCR and for the two slip roads

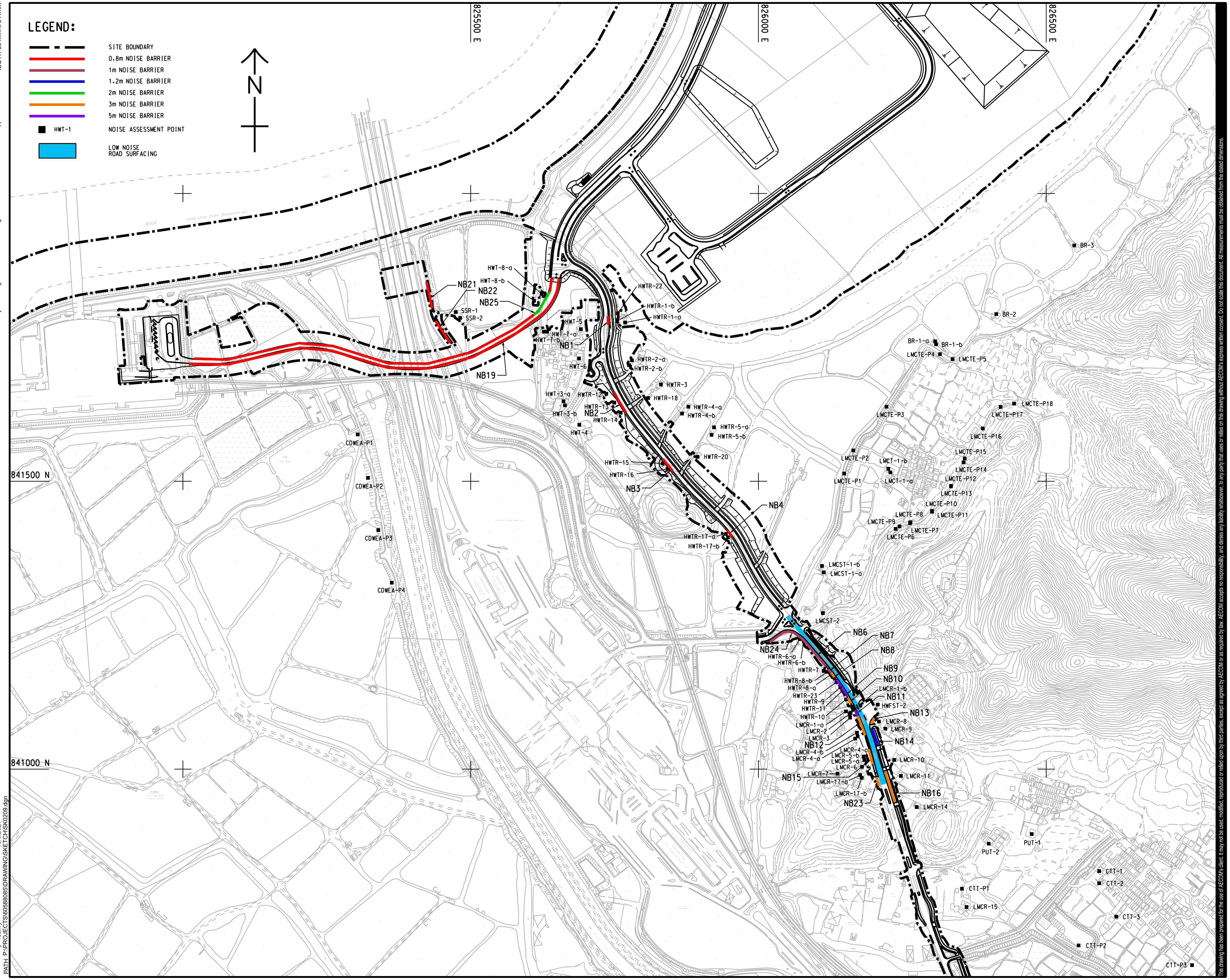
NSR No.	Location	Photo
LMCR-15	Village house, Lok Ma Chau Road	
LMCR-17	Village house, Lok Ma Chau Road	
LMCST-1	Village house, Lok Ma Chau San Tsuen	
LMCST-2	Village house, Lok Ma Chau San Tsuen	

Appendix 4.1 Photos of Representative Noise Sensitive Receivers along WCR and for the two slip roads

NSR No.	Location	Photo
SSR-1	Village house, San Shan Road	
SSR-2	Village house, San Shan Road	

Appendix 4.2

Revised Traffic Noise Mitigation Measures



AECOM

PROJECT 項目

DEVELOPMENT OF LOK MA CHAU LOOP MAIN WORKS PACKAGE 1 DESIGN AND CONSTRUCTION

CLIENT 業主

土木工程拓展署 CEDD Civil Engineering and Development Department

CONSULTANT 工程顧問公司

AECOM Asia Company Ltd.
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SUB-CONSULTANTS 分判工程顧問公司

ISSUE/REVISION 修訂

I/R 修訂	DATE 日期	DESCRIPTION 內容摘要	CHK. 覆核

STATUS 階段

SCALE 比例: A1 1 : 3000

DIMENSION UNIT 尺寸單位: METRES

KEY PLAN 索引圖

PROJECT NO. 項目編號: 60588085

CONTRACT NO. 合約編號: CE 5/2018(CE)

SHEET TITLE 圖紙名稱

EXTENTS AND LOCATIONS OF OPERATIONAL ROAD TRAFFIC NOISE BARRIER

SHEET NUMBER 圖紙編號

Appendix 4.2

ISO A1 594mm x 841mm
Approved:
Checked:
Designer:
Project Management Initials:
18/6/2021
Plot File by: Tsuiwy
PATH P:\PROJECTS\60588085\DRAWING\SKETCH\SK0209.dgn

Appendix 4.3

Predicted Traffic Noise Levels at NSRs under Revised Mitigated Scenario at year 2042

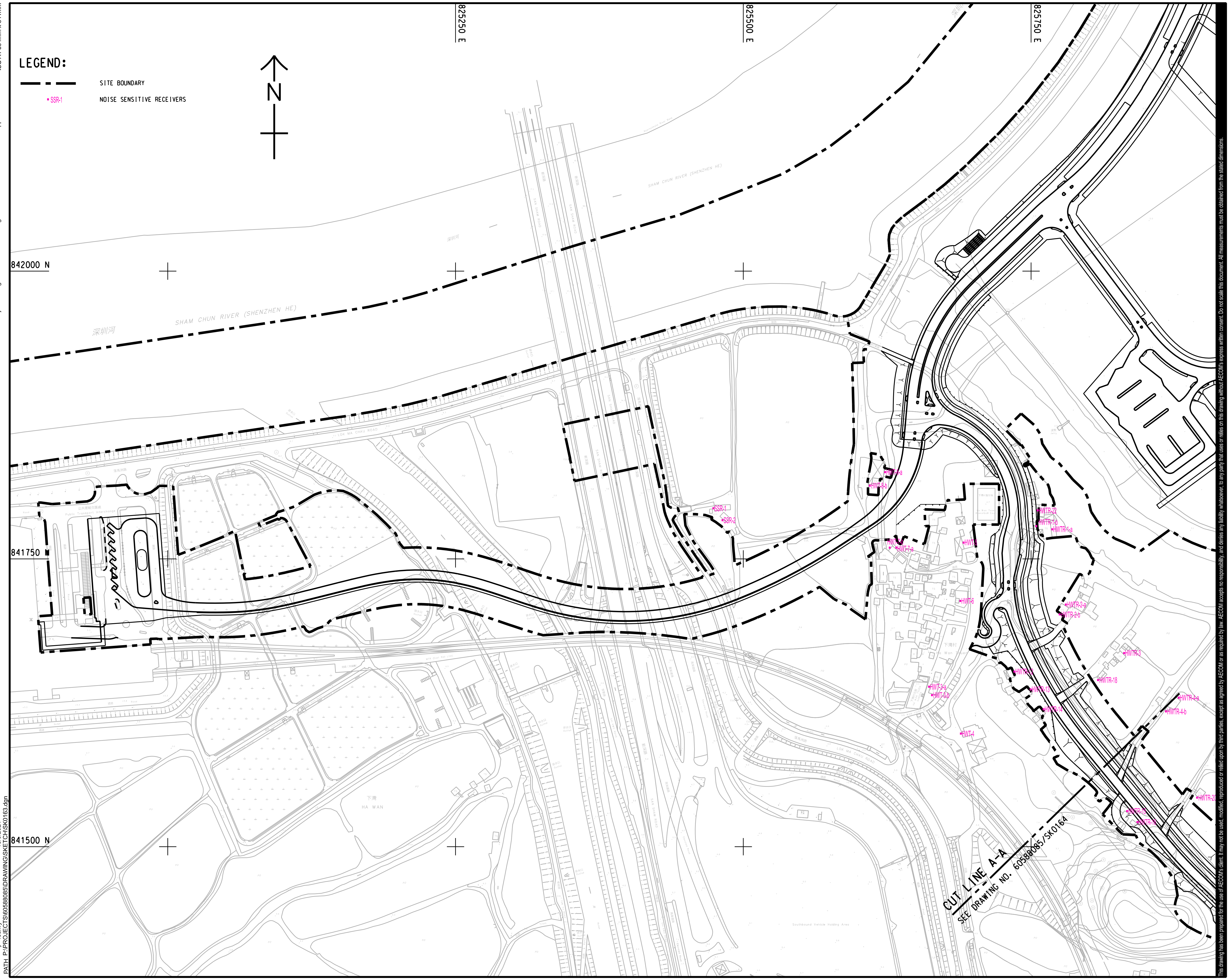
Appendix 4.1 Predicted Traffic Noise Levels at NSRs under Revised Mitigated Scenario at Year 2042

Receiver ID	Floor Level	Use	Criteria, L10(1hr), dB(A)	Staus	Noise Level, L10(1hr), dB(A)		Overall Noise Level, L10(1hr), dB(A)	Project Contribution	Project Contribution <1.0 dB(A)	Overall Complience to Criteria
					Existing Road	Project Road				
HWFST-2	1	Residential	70	Existing	55	70	70	15.3	**No**	Yes
HWT-3-a	1	Residential	70	Existing	66	60	67	1.0	**No**	Yes
HWT-3-b	1	Residential	70	Existing	67	53	67	0.2	Yes	Yes
HWT-4	1	Residential	70	Existing	68	53	68	0.2	Yes	Yes
HWT-5	1	Residential	70	Existing	53	68	68	14.5	**No**	Yes
HWT-6	1	Residential	70	Existing	60	66	67	7.0	**No**	Yes
HWT-7-a	1	Residential	70	Existing	52	66	66	14.6	**No**	Yes
	2	Residential	70	Existing	52	67	67	15.1	**No**	Yes
HWT-7-b	1	Residential	70	Existing	63	66	68	5.0	**No**	Yes
	2	Residential	70	Existing	63	67	69	5.8	**No**	Yes
HWT-8-a	1	Residential	70	Existing	<50	69	69	26.8	**No**	Yes
	2	Residential	70	Existing	<50	70	70	23.8	**No**	Yes
HWT-8-b	1	Residential	70	Existing	63	62	65	2.5	**No**	Yes
	2	Residential	70	Existing	63	64	67	3.6	**No**	Yes
HWTR-1-a	1	Residential	70	Existing	<50	58	58	22.0	**No**	Yes
HWTR-1-b	1	Residential	70	Existing	58	69	70	11.2	**No**	Yes
HWTR-2-a	1	Residential	70	Existing	<50	62	62	19.8	**No**	Yes
HWTR-2-b	1	Residential	70	Existing	60	67	67	7.8	**No**	Yes
HWTR-3	1	Residential	70	Existing	<50	57	57	22.2	**No**	Yes
HWTR-4-a	1	Residential	70	Existing	<50	55	55	8.6	**No**	Yes
HWTR-4-b	1	Residential	70	Existing	59	64	65	5.9	**No**	Yes
HWTR-5-a	1	Residential	70	Existing	<50	<50	51	3.9	**No**	Yes
HWTR-5-b	1	Residential	70	Existing	58	63	64	6.3	**No**	Yes
HWTR-6-a	1	Residential	70	Existing	57	66	66	9.5	**No**	Yes
HWTR-6-b	1	Residential	70	Existing	<50	62	62	23.3	**No**	Yes
HWTR-7	1	Residential	70	Existing	61	69	69	8.9	**No**	Yes
HWTR-8-a	1	Residential	70	Existing	<50	65	65	23.9	**No**	Yes
HWTR-8-b	1	Residential	70	Existing	60	69	70	9.3	**No**	Yes
HWTR-9	1	Residential	70	Existing	<50	70	70	32.7	**No**	Yes
	2	Residential	70	Existing	<50	70	70	28.7	**No**	Yes
HWTR-10	1	Residential	70	Existing	<50	70	70	26.9	**No**	Yes
HWTR-11	1	Residential	70	Existing	<50	66	66	26.8	**No**	Yes
HWTR-12	1	Residential	70	Existing	<50	69	69	24.2	**No**	Yes
HWTR-13	1	Residential	70	Existing	<50	67	67	21.5	**No**	Yes
HWTR-14	1	Residential	70	Existing	<50	68	68	24.4	**No**	Yes
HWTR-15	1	Residential	70	Existing	<50	68	68	26.2	**No**	Yes
HWTR-16	1	Residential	70	Existing	<50	67	67	27.6	**No**	Yes
HWTR-17-a	1	Residential	70	Existing	<50	68	68	20.1	**No**	Yes
HWTR-17-b	1	Residential	70	Existing	59	69	70	10.5	**No**	Yes
HWTR-18	1	Residential	70	Existing	60	67	67	7.8	**No**	Yes
HWTR-20	1	Residential	70	Existing	60	66	67	7.7	**No**	Yes
HWTR-22	1	Residential	70	Existing	57	69	70	12.8	**No**	Yes
HWTR-23	1	Residential	70	Existing	<50	70	70	30.3	**No**	Yes
	2	Residential	70	Existing	<50	70	70	27.0	**No**	Yes
LMCR-1-a	1	Residential	70	Existing	59	67	68	9.0	**No**	Yes
	2	Residential	70	Existing	59	68	68	9.6	**No**	Yes
	3	Residential	70	Existing	59	68	69	10.0	**No**	Yes
LMCR-1-b	1	Residential	70	Existing	<50	66	66	18.0	**No**	Yes
	2	Residential	70	Existing	50	68	69	18.2	**No**	Yes
	3	Residential	70	Existing	51	70	70	19.6	**No**	Yes
LMCR-2	1	Residential	70	Existing	53	67	67	14.7	**No**	Yes
	2	Residential	70	Existing	54	70	70	16.0	**No**	Yes
LMCR-3	1	Residential	70	Existing	<50	62	62	28.8	**No**	Yes
	2	Residential	70	Existing	<50	63	63	25.0	**No**	Yes
	3	Residential	70	Existing	<50	68	68	18.0	**No**	Yes
LMCR-4-a	1	Residential	70	Existing	<50	68	68	30.5	**No**	Yes
	2	Residential	70	Existing	<50	68	68	28.3	**No**	Yes
	3	Residential	70	Existing	<50	69	69	25.7	**No**	Yes
LMCR-4-b	1	Residential	70	Existing	<50	66	66	24.9	**No**	Yes
	2	Residential	70	Existing	<50	67	67	19.9	**No**	Yes
	3	Residential	70	Existing	<50	68	68	19.8	**No**	Yes
LMCR-4-c	1	Residential	70	Existing	<50	69	69	28.3	**No**	Yes
	2	Residential	70	Existing	<50	70	70	27.1	**No**	Yes
	3	Residential	70	Existing	<50	70	70	25.3	**No**	Yes
LMCR-5-a	1	Residential	70	Existing	<50	68	68	20.8	**No**	Yes
	2	Residential	70	Existing	<50	68	68	20.4	**No**	Yes
LMCR-5-b	1	Residential	70	Existing	56	66	66	10.8	**No**	Yes
	2	Residential	70	Existing	56	66	67	10.9	**No**	Yes
LMCR-6	1	Residential	70	Existing	<50	69	69	19.8	**No**	Yes
	2	Residential	70	Existing	<50	69	69	19.5	**No**	Yes
LMCR-7	1	Residential	70	Existing	55	67	67	12.2	**No**	Yes
	2	Residential	70	Existing	55	67	67	12.1	**No**	Yes

Appendix 4.1 Predicted Traffic Noise Levels at NSRs under Revised Mitigated Scenario at Year 2042

Receiver ID	Floor Level	Use	Criteria, L10(1hr), dB(A)	Staus	Noise Level, L10(1hr), dB(A)		Overall Noise Level, L10(1hr), dB(A)	Project Contribution	Project Contribution <1.0 dB(A)	Overall Complience to Criteria
					Existing Road	Project Road				
LMCR-8	1	Residential	70	Existing	*<50*	69	69	23.1	**No**	Yes
	2	Residential	70	Existing	52	70	70	18.0	**No**	Yes
LMCR-9	1	Residential	70	Existing	*<50*	68	68	22.8	**No**	Yes
	2	Residential	70	Existing	*<50*	69	69	20.2	**No**	Yes
LMCR-10	1	Residential	70	Existing	*<50*	70	70	23.6	**No**	Yes
	2	Residential	70	Existing	*<50*	70	70	23.1	**No**	Yes
LMCR-11	1	Residential	70	Existing	*<50*	66	66	20.1	**No**	Yes
LMCR-14	1	Residential	70	Existing	51	70	70	18.4	**No**	Yes
	2	Residential	70	Existing	51	70	70	18.4	**No**	Yes
	3	Residential	70	Existing	51	70	70	18.5	**No**	Yes
LMCR-15	1	Residential	70	Existing	60	70	70	9.8	**No**	Yes
	2	Residential	70	Existing	60	70	70	9.8	**No**	Yes
	3	Residential	70	Existing	60	70	70	9.8	**No**	Yes
LMCR-17-a	1	Residential	70	Existing	55	66	66	11.6	**No**	Yes
	2	Residential	70	Existing	55	66	67	11.6	**No**	Yes
LMCR-17-b	1	Residential	70	Existing	53	70	70	17.2	**No**	Yes
	2	Residential	70	Existing	53	70	70	17.2	**No**	Yes
LMCST-1-a	1	Residential	70	Existing	61	63	65	3.9	**No**	Yes
LMCST-1-b	1	Residential	70	Existing	64	62	66	2.2	**No**	Yes
LMCST-2	1	Residential	70	Existing	62	67	68	6.2	**No**	Yes
SSR-1	1	Residential	70	Existing	70	55	70	0.2	Yes	Yes
	2	Residential	70	Existing	70	56	70	0.2	Yes	Yes
SSR-2	1	Residential	70	Existing	69	58	69	0.3	Yes	Yes
	2	Residential	70	Existing	70	59	70	0.4	Yes	Yes

Figures



ISO A1 594mm x 841mm

Approved:

Checked:

Designer:

Project Management Initials:

18/6/2021

Plot File by: Tsuiwy
PATH P:\PROJECTS\60588085\DRAWING\SKETCH\SK0163.dgn

AECOM

PROJECT
項目

DEVELOPMENT OF
LOK MA CHAU LOOP
MAIN WORKS PACKAGE 1
DESIGN AND
CONSTRUCTION

CLIENT
業主

CEDD 土木工程拓展署
Civil Engineering and
Development Department

CONSULTANT
工程顧問公司

AECOM Asia Company Ltd.
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SUB-CONSULTANTS
分判工程顧問公司

ISSUE/REVISION
修訂

I/R 修訂	DATE 日期	DESCRIPTION 內容摘要	CHK. 複核

STATUS
階段

SCALE
比例

A1 1 : 1500

DIMENSION UNIT
尺寸單位

METRES

KEY PLAN
索引圖

PROJECT NO.
項目編號

60588085

CONTRACT NO.
合約編號

CE 5/2018(CE)

SHEET TITLE
圖紙名稱

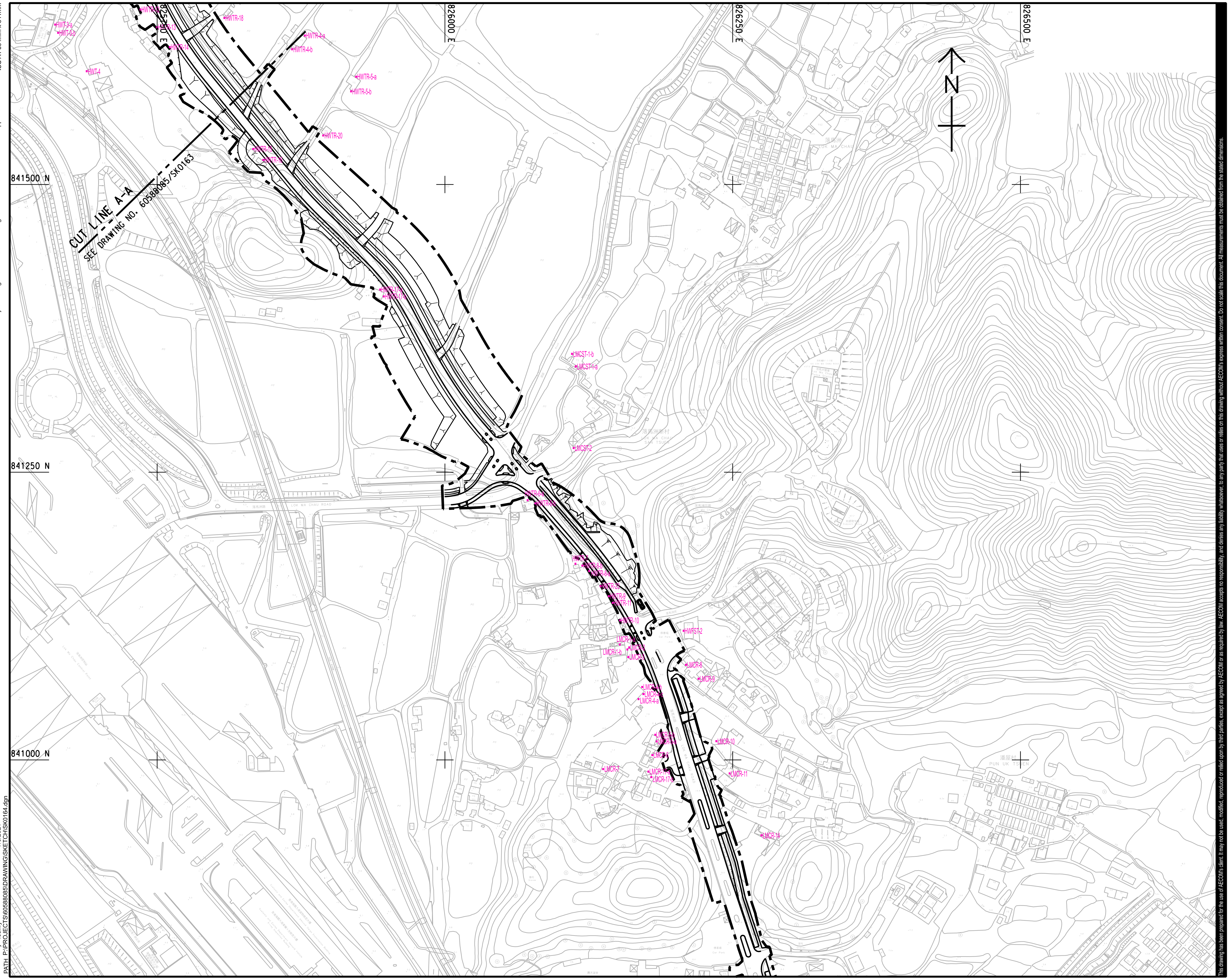
LOCATION OF
NOISE SENSITIVE RECEIVERS

SHEET 1 OF 2

SHEET NUMBER
圖紙編號

Figure 4.1

Project Management Initials: Designer: Checked: Approved: ISO A1 594mm x 841mm



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ISSUE/REVISION

I/R	DATE	DESCRIPTION	CHK.

STATUS

SCALE

A1 1 : 1500

DIMENSION UNIT

METRES

KEY PLAN

PROJECT NO.

60588085

CONTRACT NO.

CE 5/2018(CE)

SHEET TITLE

LOCATION OF
NOISE SENSITIVE RECEIVERS

SHEET 2 OF 2

SHEET NUMBER

Figure 4.1

Plot File by: Tsuiwy 7/5/2021
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