

# Agreement No. CE 59/2020 (EP) Environmental Monitoring and Audit for Disposal Facility to the East of Sha Chau (2021-2026) – Investigation

Monthly EM&A Report for Contaminated Mud Pits to the East of Sha Chau – December 2023

January 2024

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#### Dredging, Management and Capping of Contaminated Sediment Disposal

#### Facility at Sha Chau

#### **Environmental Certification Sheet**

#### Environmental Permit No. EP-312/2008/A

#### **Reference Document /Plan**

Document/Plan to be Certified/ Verified:	Monthly EM&A Report for Contaminated Mud Pits to the East of Sha Chau – December 2023
Date of Report:	22 January 2024
Date prepared by ET:	22 January 2024
Date received by IA:	22 January 2024

#### **Reference EP Condition**

Environmental Permit Condition:

Condition 3.4 of EP-312/2008/A:

4 hard copies and 1 electronic copy of monthly EM&A Report shall be submitted to the Director within 10 working days after the end of the reporting month. The EM&A Reports shall include a summary of all non-compliance (exceedances) of the environmental quality performance limits (Action and Limit Levels). The submissions shall be verified by the Independent Auditor. Additional copies of the submission shall be provided to the Director upon request by the Director.

#### ET Certification

I hereby certify that the above referenced document/plan complies with the above referenced condition of EP-312/2008/A.

Ir Thomas Chan, Environmental Team Leader (ETL):

Date: 22 January 2024

#### **IA Verification**

I hereby verify that the above	referenced	document/ <del>plan</del>	complies	with	the	above	referenced
condition of EP-312/2008/A.							
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Dr Wang Wen Xiong,	(AD)	1/ lan	g	Date	e: 22	Janua	гу 2024
Independent Auditor (IA).	0	V	0				

### **Issue and Revision Record**

Revision	Date	Originator	Checker	Approver	Description
A	Jan 2024	Various	Liz Lo	Thomas Chan	Revision A of Submission
В	Jan 2024	Various	Liz Lo	Thomas Chan	Revision B of Submission
-					

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# **1** Introduction

#### 1.1 Background

The Civil Engineering and Development Department (CEDD) is managing a number of marine disposal facilities in Hong Kong waters, including the Contaminated Mud Pits (CMPs) to the East of Sha Chau (ESC) for the disposal of contaminated sediment, and various open-sea disposal grounds located to the South of Cheung Chau (SCC), East of Tung Lung Chau (ETLC) and East of Ninepins (ENP) for the disposal of uncontaminated sediment.

Environmental Permits (EPs) (Ref. No. EP-312/2008/A) was issued by the Environmental Protection Department (EPD) to the CEDD, the Permit Holder, on 28 November 2008 for the Project - Disposal of Contaminated Sediment – Dredging, Management and Capping of Sediment Disposal Facility at Sha Chau.

Under the requirements of the EP, EM&A programmes which encompass water and sediment chemistry, fisheries assessment, tissue and whole body analysis, sediment toxicity and benthic recolonisation studies as set out in the EM&A Manuals are required to be implemented. EM&A programmes have been continuously carried out during the operation of the CMPs at ESC. A review of the collection and analysis of such environmental data from the monitoring programme demonstrated that there had not been any adverse environmental impacts resulting from disposal activities.<sup>1,2</sup> The current programme will assess the impacts resulting from dredging, disposal and capping operations of CMP V.

A proposal on the change of number of sample replication of water quality and sediment monitoring as well as combination of routine water quality monitoring and water quality monitoring during capping operation was submitted to EPD and agreed by EPD on 3 December 2020. The proposed changes have been effective for the EM&A activities since December 2020. In early 2022, after implementing the Phase 1 optimisation for at least one year, a further data review was conducted. The monitoring data has been reviewed and demonstrated that the data robustness and representativeness are maintained. Therefore, a technical note presenting the data review results served as a supplementary information was submitted to EPD and presented that Phase 2 optimization of sample replication of water quality and sediment monitoring for the Project will be implemented in 2022. EPD expressed no comment on the review and note the implementation of Phase 2 optimization of sample replication on 18 May 2022, and thus this optimization has been effective for the EM&A activities since July 2022.

The latest sampling schedule is provided in Appendix A.

The present EM&A programme under Agreement No. CE 59/2020 (EP) covers the dredging, disposal and capping operations of the ESC CMP V (see **Appendix A** for the EM&A programme.) Detailed works schedule for ESC CMP V is shown in **Table 1.1**. In December 2023, the following works were undertaken:

- Disposal of contaminated mud at ESC CMP Vb; and
- Capping operations at ESC CMP Vd.

<sup>&</sup>lt;sup>1</sup> ERM (2013) Final Report. Submitted under Agreement No. CE 4/2009 (EP) Environmental Monitoring and Audit for Contaminated Mud Pit at East Sha Chau. For CEDD.

<sup>&</sup>lt;sup>2</sup> ERM (2017) Final Report. Submitted under Agreement No. CE 23/2012 (EP) Environmental Monitoring and Audit for Contaminated Mud Pits to the South of The Brothers and at East Sha Chau (2012 - 2017). For CEDD.

#### Table 1.1: Works Schedule for ESC CMP V



#### **1.2 Reporting Period**

This Monthly EM&A Report for Contaminated Mud Pits to the East of Sha Chau – November 2023 covers the EM&A activities for the reporting period of December 2023 (from 1 to 31 December 2023).

#### 1.3 Details of Sampling and Laboratory Testing Activities

The following monitoring activities were undertaken for ESC CMP V during the reporting period:

- Water Column Profiling of ESC CMP Vb;
- Routine Water Quality Monitoring of ESC CMPs;
- Pit Specific Sediment Chemistry of ESC CMP Vb; and
- Cumulative Impact Sediment Chemistry of ESC CMPs.

#### 1.4 Details of Outstanding Sampling or Analysis

No outstanding sampling remained for the reporting month (December 2023).

# 2 Brief Discussion of Monitoring Results for ESC CMP V

#### 2.1 Introduction

This section presents a brief discussion of the results obtained from the following monitoring activities for ESC CMP V during the reporting period:

- Water Column Profiling of ESC CMP Vb;
- Routine Water Quality Monitoring of ESC CMPs;
- Pit Specific Sediment Chemistry of ESC CMP Vb; and
- Cumulative Impact Sediment Chemistry of ESC CMPs.

#### 2.2 Water Column Profiling of ESC CMP Vb – in December 2023

Water Column Profiling was undertaken at a total of two sampling stations (Upstream and Downstream stations) on 7 December 2023. The monitoring results have been assessed for compliance with the Water Quality Objectives (WQOs) set by Environmental Protection Department (EPD). This consists of a review of the EPD routine water quality monitoring data for the dry season period (November to March) of 2013 – 2022 from stations in the North Western Water Control Zone (WCZ), where the ESC CMPs are located.<sup>3</sup> For Salinity, the averaged value obtained from the Reference (Upstream) station was used for the basis as the WQO. Levels of Dissolved Oxygen (DO) and Turbidity were also assessed for compliance with the Action and Limit Levels (see **Table B1** of **Appendix B** for details).

#### 2.2.1 In-situ Measurements

Analyses of results for December 2023 indicated that levels of Salinity, pH and DO complied with the WQOs at both Downstream and Upstream stations (**Table B2** of **Appendix B**). Levels of DO and Turbidity at all stations complied with the Action and Limit Levels (**Tables B1 and B2** of **Appendix B**).

#### 2.2.2 Laboratory Measurements for Suspended Solids (SS)

Analyses of results for December 2023 indicated that the SS level at both Upstream and Downstream stations complied with the WQO and the Action and Limit Levels (**Tables B1 and B2** of **Appendix B**).

Overall, the monitoring results indicated that the mud disposal operation at ESC CMP Vb did not appear to cause any deterioration in water quality during this reporting period.

#### 2.3 Routine Water Quality Monitoring of ESC CMPs – in December 2023

Routine Water Quality Monitoring of ESC CMPs was undertaken on 6 December 2023. The monitoring results have been assessed for compliance with the WQOs (see Section 2.2 above for details). The monitoring results are shown in Tables B3, B4 and B5 of Appendix B and Figures 1 to 11 of Appendix C. A total of ten (10) monitoring stations were sampled in December 2023 as shown in Figure 2.1.

<sup>&</sup>lt;sup>3</sup> http://epic.epd.gov.hk/EPICRIVER/marine/?lang=en

#### 2.3.1 In-situ Measurements

Graphical presentation of the monitoring results (Temperature, DO, pH, Salinity and Turbidity) is shown in **Figures 1 to 6** of **Appendix C**. Analyses of results indicated that the levels of pH, Salinities and DO complied with the WQOs at all stations in December 2023. The levels of DO and Turbidity complied with the Action and Limit Levels at all stations (**Table B3** of **Appendix B**; **Figures 3 and 6** of **Appendix C**).

Overall, *in-situ* measurement results of the Routine Water Quality Monitoring indicated that the disposal and capping operation at ESC CMPs did not appear to cause any unacceptable impacts in water quality in December 2023.

#### 2.3.2 Laboratory Measurements

Laboratory analysis of samples obtained during the reporting period indicated that the concentrations of Arsenic, Cadmium, Chromium, Copper, Mercury, Nickel and Zinc were detected in the samples at some/ all stations and their concentrations were generally similar across stations; except the concentrations of Zinc were higher at Impact (IPF) and Intermediate (INF) stations. (**Table B4** of **Appendix B**; **Figure 7 and 8 of Appendix C**).

For nutrients, concentrations of Total Inorganic Nitrogen (TIN) were lower than the WQO (0.5 mg/L) at all stations (**Table B5** of **Appendix B**; **Figure 9** of **Appendix C**). The concentration of Ammonia Nitrogen (NH<sub>3</sub>-N) and Biochemical Oxygen Demand (BOD<sub>5</sub>) were generally similar across all stations (**Table B5** of **Appendix B**; **Figure 9** of **Appendix C**).

Analyses of results for the reporting period indicated that the SS levels complied with the dry season WQO (13.2 mg/L) and Action and Limit Levels at all stations. (**Tables B1 and B5** of **Appendix B**; **Figure 10** of **Appendix C**).

Based on the available results of the Routine Water Quality Monitoring which indicated that the disposal and capping operation at ESC CMPs did not appear to cause any unacceptable deterioration in water quality during the reporting period. Detailed statistical analysis will be presented in the Quarterly EM&A Report to investigate any spatial and temporal trends of potential concern.

#### 2.4 Pit Specific Sediment Chemistry of ESC CMP Vb – in December 2023

Monitoring locations for Pit Specific Sediment Chemistry for ESC CMP Vb are shown in **Figure 2.2**. A total of six (6) monitoring stations were sampled on 4 December 2023.

The concentrations of most inorganic contaminants were lower than the Lower Chemical Exceedance Levels (LCELs) at all stations, except for Chromium, Copper, Nickel, Lead, Zinc, Mercury and Silver at Active-Pit stations. (Figures 12 and 13 of Appendix C). The concentrations of Chromium were higher than the LCELs at Active-Pit station ESC-NPCA. The concentrations of Copper were higher than the Upper Chemical Exceedance Levels (UCELs) at Active-Pit stations ESC-NPCA and ESC-NPCB. The concentration of Nickel, Lead, Zinc, Mercury and Silver were higher than the UCELs at Active-Pit station ESC-NPCA. (Figures 12 and 13 of Appendix C).

Considering that the higher levels of Chromium, Copper, Nickel, Lead, Zinc, Mercury and Silver occurred within Active-Pit stations only but not at the Pit-Edge and Near-Pit stations, there is no evidence indicating any unacceptable environment impacts to sediment quality as a result of the contaminated mud disposal operation at ESC CMP Vb in December 2023.

The concentrations of Arsenic were higher than the LCEL at Near-Pit station ESC-NNCA, Pit-Edge stations ESC-NECA and ESC-NECB. (Figures 12 and 13 of Appendix C).

Whilst the average concentration of Arsenic in the Earth's crust is generally ~2mg/kg, significantly higher Arsenic concentrations (median = 14 mg/kg) have been recorded in Hong Kong's onshore

sediments.<sup>4</sup> It is presumed that the natural concentrations of Arsenic are similar in onshore and offshore sediments,<sup>5</sup> and relatively high Arsenic levels may thus occur throughout Hong Kong. Therefore, the LCEL exceedances of Arsenic are unlikely to be caused by the disposal operations at ESC CMP Vb but rather as a result of naturally occurring deposits.

For organic contaminants, the concentrations of Total Organic Carbon (TOC) were higher at Active-Pit station ESC-NPCA. (**Figure 14** of **Appendix C**). The concentrations of Low Molecular Weight Polycyclic Aromatic Hydrocarbons (PAHs) were higher than LCEL (Lower Chemical Exceedance Level) at Near-Pit station ESC-NNCA and Pit-Edge station ESC-NECA, and were higher than UCEL at Active-Pit stations ESC-NPCA and ESC-NPCB. (**Figures 15b** of **Appendix C**).

For High Molecular Weight Polycyclic Aromatic Hydrocarbons (PAHs), the concentrations were higher than LCEL at Near-Pit station ESC-NNCA and Pit-Edge station ESC-NECA, and were higher than UCEL at Active-Pit stations ESC-NPCA and ESC-NPCB. (Figures 15a and 15b of Appendix C).

The concentrations of Tributyltin (TBT) were higher at Active-Pit station ESC-NPCA. (Figure 16 of **Appendix C**) The concentrations of Total Polychlorinated Biphenyls (PCBs) were higher at Active-Pit station ESC-NPCA. The concentrations of Total dichloro-diphenyl-trichloroethane (DDT) and 4,4'-dichlorodiphenyldichloroethylene (DDE) were below the limit of reporting at all stations during the reporting period.

Noting that higher levels (i.e. concentrations higher than UCEL) of Low Molecular Weight and High Molecular Weight PAHs are only occurred within Active-Pit station ESC-NPCA and ESC-NPCB. While only concentrations of Low Molecular Weight PAH and High Molecular Weight PAH at Near-Pit and Pit-Edge stations were higher than LCELs but the concentrations of most inorganic contaminants were lower than the LCELs at Near-Pit and Pit-Edge stations.

The slightly elevated level of Low Molecular Weight PAH and High Molecular Weight PAH at Near-Pit and Pit-Edge stations are possible induced by external factors rather than disposal operations. Therefore, there is no evidence indicating any unacceptable environmental impacts to sediment quality outside the pit area as a result of the contaminated mud disposal operations at ESC CMP Vb during the reporting period.

Statistical analysis will be undertaken and presented in the corresponding Quarterly EM&A Report to investigate whether there are any unacceptable impacts in the area caused by the contaminated mud disposal.

#### 2.5 Cumulative Impact Sediment Chemistry of ESC CMPs – in December 2023

Monitoring locations for Cumulative Impact Sediment Chemistry for ESC CMPs are shown in **Figure 2.3**. A total of nine (9) monitoring stations were sampled on 5 December 2023.

Analyses of results for the Cumulative Impact Sediment Chemistry Monitoring indicated that the concentrations of most inorganic contaminants were below the LCEL at most stations during the reporting period, except concentrations of Arsenic were higher than the LCEL at Near-field stations ESC-RNB1, Mid-field stations ESC-RMA, and Far-field stations ESC-RFA, ESC-RFB. as well as concentrations of Silver were higher than the LCEL at Ma Wan station MW1.(Figures 17 and 18 of Appendix C). For Arsenic, as discussed in Section 2.4, the LCEL exceedances of Arsenic are unlikely to be caused by the disposal operations at ESC CMP Vb but rather as a result of naturally occurring deposits. For Silver, Ma Wan station is comparatively apart from the ESC

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<sup>&</sup>lt;sup>4</sup> Sewell RJ (1999) Geochemical Atlas of Hong Kong. Geotechnical Engineering Office, Government of the Hong Kong Special Administrative Region

<sup>&</sup>lt;sup>5</sup> Whiteside PGD (2000) Natural geochemistry and contamination of marine sediments in Hong Kong. In: The Urban Geology of Hong Kong (ed. Page A & Reels SJ). Geological Society of Hong Kong Bulletin No. 6, p109-121

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CMP. In addition, no exceedance of LCEL in Silver concentrations being observed at the Nearfield, Mid-field, Far-field and Capped pits stations. Considering the aforementioned factors, there is no evidence indicating the exceedances of Silver to be caused by the disposal operations at ESC CMP Vb.

For organic contaminants, the concentration of TOC was higher at Capped Pit station ESC-RCA1 (**Figure 19** of **Appendix C**). The concentrations of High Molecular Weight PAHs and Low Molecular Weight PAH were higher at Capped Pit ESC-RCB1 stations. (**Figure 20** of **Appendix C**)

The concentrations of TBT were higher at Ma Wan station MW1. (**Figure 21** of **Appendix C**). The concentrations of Total PCBs, Total DDT, 4,4'-DDE, 2,4'-DDT, 4,4'-DDT were below the limit of reporting at all stations during the reporting period.

Overall, there is no evidence indicating any unacceptable environmental impacts to sediment quality as a result of the contaminated mud disposal operations at ESC CMP Vb during the reporting period. Statistical analysis will be undertaken and presented in the corresponding Quarterly EM&A Report to investigate whether there are any unacceptable impacts in the area caused by the contaminated mud disposal.

# 3 Future Key Issues

#### 3.1 Activities Scheduled for the Next Reporting Period

The following monitoring activities will be conducted in the next reporting period of January 2024 for ESC CMP V (see **Appendix A** for the sampling schedule):

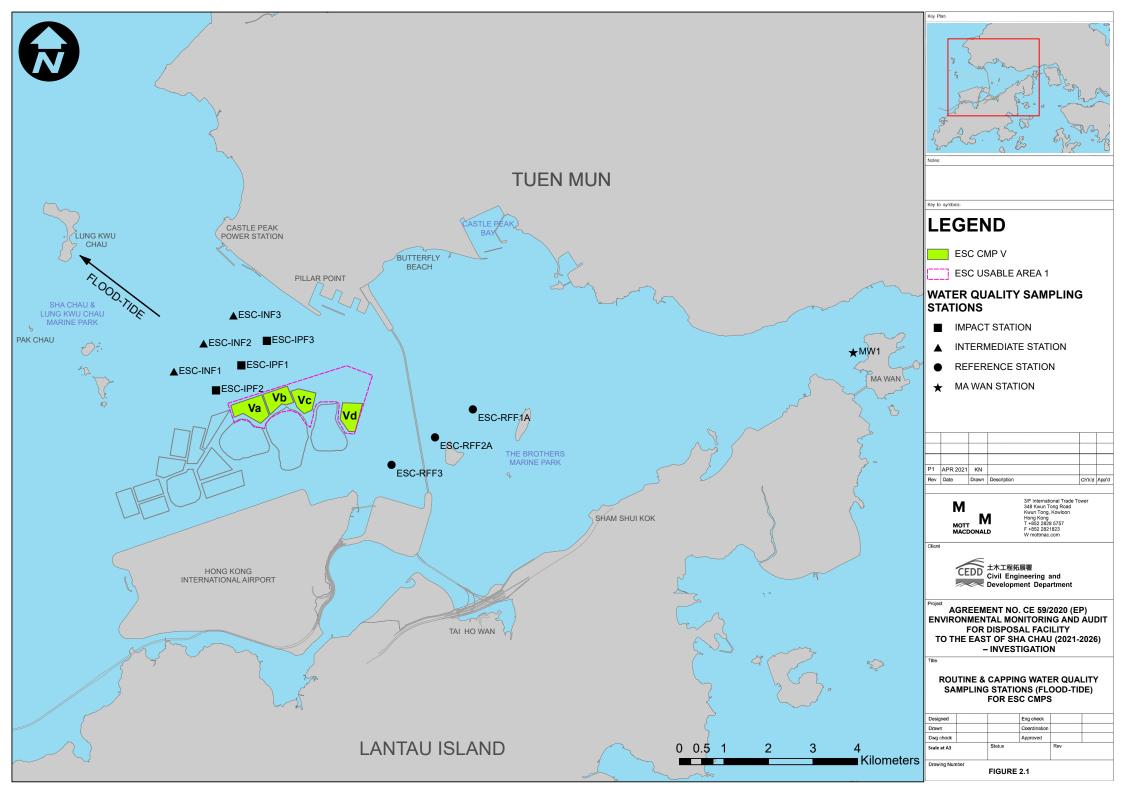
- Water Column Profiling of ESC CMP Vb;
- Routine Water Quality Monitoring of ESC CMPs;
- Pit Specific Sediment Chemistry of ESC CMP Vb; and
- Demersal Trawling for ESC CMPs.

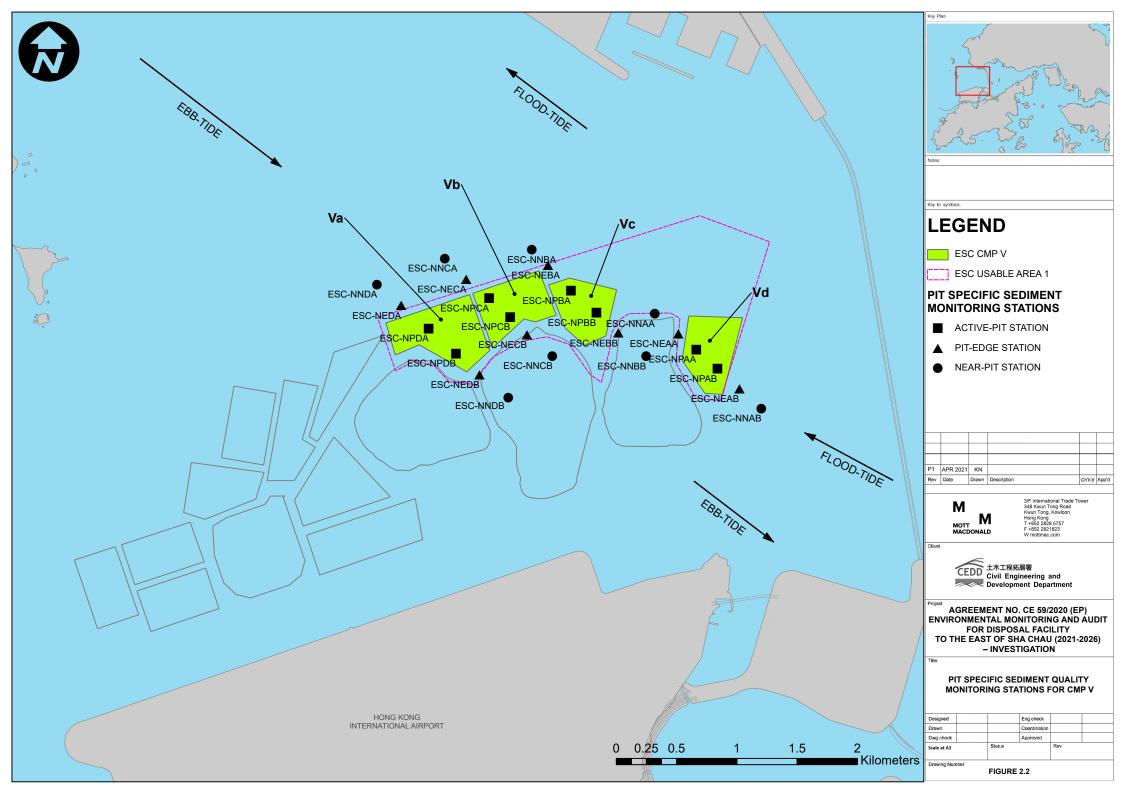
#### 3.2 Study Programme

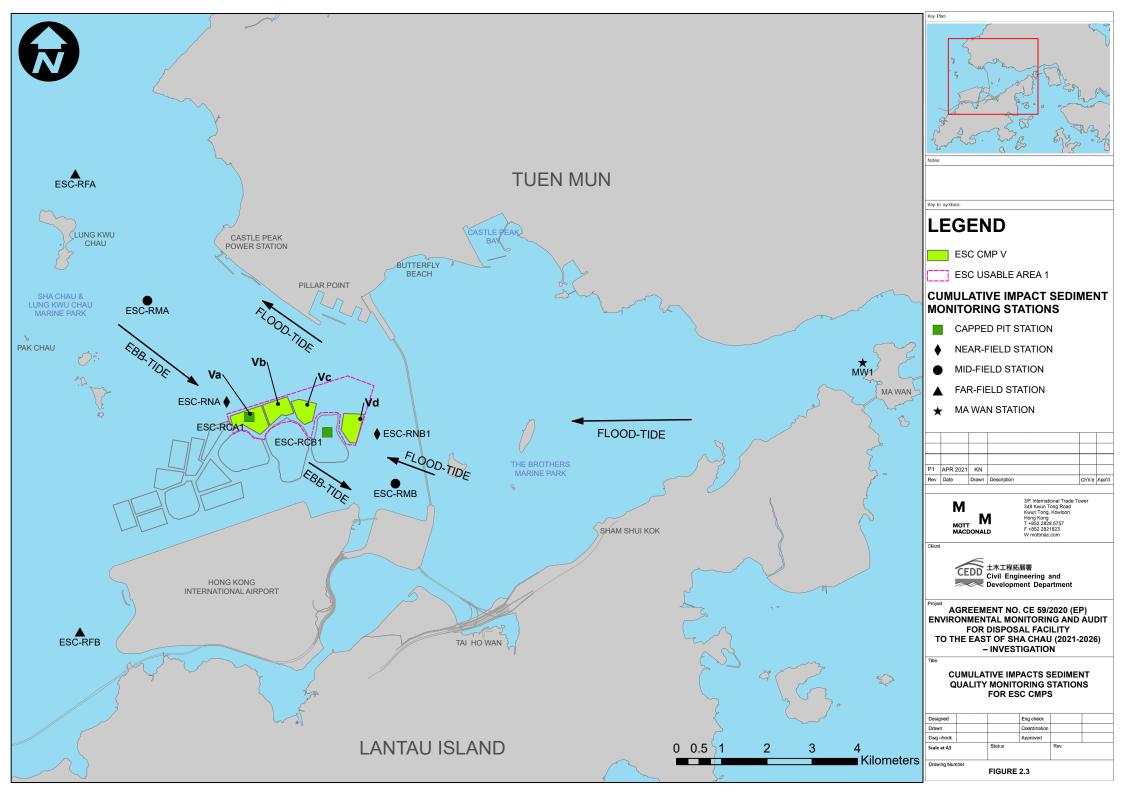
A summary of the Study Programme is presented in Appendix D.

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# **Figures**







# Appendices

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- Appendix B Water Quality Monitoring Results
- Appendix C Graphical Presentations
- Appendix D Study Programme

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# **Appendix A. Sampling Schedule**

# East of Sha Chau CMPs Environmental Monitoring and Audit Sampling Schedule (January 2021 - March 2026)

Parameter / Station Type Pit Specific Sediment Ch		Frequency	2022 b Mar Apr May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr	May Jun Jul Aug Sep Oct Nov Dec	2023 Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec	2024 Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec	2025 Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar
Active-Pit	ESC-NPAA ESC-NPAB	Monthly Monthly	6       6	6         6         2         2         2         2         2         2           6         6         2         2         2         2         2         2         2	2     2     2     2     2     2     2     2     2     2     2       2     2     2     2     2     2     2     2     2     2     2       2     2     2     2     2     2     2     2     2     2     2	2       2	2       2
Pit-Edge	ESC-NEAA ESC-NEAB	Monthly Monthly					2         2
Near-Pit	ESC-NNAA ESC-NNAB	Monthly Monthly	6     6     6     6     6     6     6     6     6       6     6     6     6     6     6     6     6     6     6       6     6     6     6     6     6     6     6     6     6	6         6         2	2         2	2     2     2     2     2     2     2     2     2     2     2     2     2       2     2     2     2     2     2     2     2     2     2     2     2	2         2
Cumulative Impact Sedin Near-field Stations	nent Chemistry	*	b Mar Apr May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr	May   Jun   Jul   Aug   Sep   Oct   Nov   Dec	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar
Mid-field Stations	ESC-RNA ESC-RNB1	4 times per year 4 times per year		6 2 2 6 2 2	2         2         2         2           2         2         2         2         2	2         2	2         2         2         2         2         2         2           2         2         2         2         2         2         2         2         2
Capped Pit Stations	ESC-RMA ESC-RMB	4 times per year 4 times per year		6         2         2           6         2         2	2         2         2         2           2         2         2         2         2	2         2	2         2         2         2         2         2         2           2         2         2         2         2         2         2         2         2
Far-field Stations	ESC-RCA1 ESC-RCB1	4 times per year 4 times per year		6         2         2           6         2         2	2         2         2         2         2           2         2         2         2         2         2	2         2         2         2         2           2         2         2         2         2         2	2         2         2         2         2         2         2           2         2         2         2         2         2         2         2         2
Ma Wan Station	ESC-RFA ESC-RFB	4 times per year 4 times per year		6         2         2           6         2         2	2         2         2         2         2           2         2         2         2         2         2	2         2	2         2
Sediment Toxicity Tests	MW1	4 times per year	6 6 6 6 6	6 2 2		2 2 2 2 2 2	2 2 2 2 2 2 2 3 2 2 3 2 3 2 2 3 2 3 2 2 3 2 3 2 2 3 2
Near-pit Stations	ESC-TDA	2 times per year	5 5	5	5 5	5 5	5 5 5 5
Reference Stations	ESC-TDB1 ESC-TRA	2 times per year 2 times per year	5 5 5	5	5 5 5	5 5 5	5 5 5
Ma Wan Station	ESC-TRB	2 times per year 2 times per year	5 5	5 5	5 5	5 5	5         5         5           5         5         5
Tissue / Whole Body San Near-pit Stations				May   Jun   Jul   Aug   Sep   Oct   Nov   Dec	Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec		Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec   Jan   Feb   Mar
Reference North	ESC-INA ESC-INB	2 times per year 2 times per year					
Reference South	TNA TNB	2 times per year 2 times per year					
	TSA TSB	2 times per year 2 times per year					
Demersal Trawling Near-pit Stations	ESC-INA	4 times per year	b Mar Apr May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr	May Jun Jul Aug Sep Oct Nov Dec	Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
Reference North	ESC-INA ESC-INB	4 times per year 4 times per year 4 times per year		5^ 5^		5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	3     5     5     5     5     5       5     5     5     5     5     5
Reference South	TNA TNB TSA	4 times per year 4 times per year 4 times per year		5^ 5^	5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	3     5     5     5     5     5       5     5     5     5     5     5
Capping *	TSA TSB	4 times per year 4 times per year	5 5 5 5	5^ 5^	5 5 5 5 5	5 5 5	5 5 5 5 5 5
Capping * Ebb Tide Impact Station Downcurr	rent	4 times per year *			waar, waa maar waar maay suun suun suun sug seep Oct Nov Dec	waare ou maar Ayer may juuri Juri Aug joop Ucti Nov Dec	Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec   Jan   Feb   Mar
	ESC-IPE1A ESC-IPE2A ESC-IPE3 ESC-IPE4	4 times per year * 4 times per year *					
Intermediate Station Dow	ESC-IPE5	4 times per year * 4 times per year *					
	ESC-INE2A ESC-INE3A	4 times per year * 4 times per year * 4 times per year * 4 times per year *					
Reference Station Upcur	ESC-INE5A	4 times per year *					
	ESC-RFE2 ESC-RFE3	4 times per year * 4 times per year * 4 times per year *					
Ma Wan Station		4 times per year * 4 times per year * 4 times per year *					
Flood Tide Impact Station Downcurr		4 unes per year					
impact station Downcum	ESC-IPF1 ESC-IPF2 ESC-IPF3	4 times per year * 4 times per year * 4 times per year *					
Intermediate Station Dow		4 times per year * 4 times per year *					
Reference Station Upcur	ESC-INF3	4 times per year * 4 times per year *					
Ma Wan Station	ESC-RFF2A	4 times per year * 4 times per year *					
Routine Water Quality Me	MW1	4 times per year *	h Mari Apri May Juni Juli Aug Seni Octi Novi Deci Jani Febi Mari Apri	May Jun Jul Aug Sen Oct Nov Dec	Jan Feb Mari Apri May Juni Juli Aug Seni Octi Novi Deci	Jan Feb Mari Anri May Juni Juli Aug Sen Octi Novi Dec	Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec   Jan   Feb   Mar
Ebb Tide Impact Station Downcurr		Monthly*		4 4 2 2 1			
	ESC-IPE1A ESC-IPE2A ESC-IPE3 ESC-IPE4	Monthly* Monthly* Monthly*	4     4     4     4     4     4     4       4     4     4     4     4     4     4     4	4     4     2     2       4     4     2     2	1     1     1     1     1     1       2     2     2     2     2     2       2     2     2     2     2       2     2     2     2     2       2     2     2     2     2       2     2     2     2     2       2     2     2     2     2	2     2 <th>2     2</th>	2     2
Intermediate Station Dow	ESC-IPE5	Monthly*		4 4 2 2			1       1
	ESC-INE2A ESC-INE3A ESC-INE4A	Monthly* Monthly*	4     4     4     4     4     4     4       4     4     4     4     4     4     4       4     4     4     4     4     4     4       4     4     4     4     4     4     4	4     4     2     2       4     4     2     2       4     4     2     2	2     2     2     2     2     2       2     2     2     2     2     2       2     2     2     2     2     2       2     2     2     2     2     2	2       2	2       2
Reference Station Upcur		Monthly* Monthly*		4 4 2 2	2 2 2 2 2 2 2 2	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	2       2
	ESC-RFE2 ESC-RFE3 ESC-RFE4	Monthly* Monthly* Monthly*	4     4     4     4     4     4       4     4     4     4     4     4	4 4 2 2	2     2     2     2     2     2       2     2     2     2     2     2       2     2     2     2     2     2       2     2     2     2     2     2	2       2	2       2
Ma Wan Station	ESC-RFE5	Monthly* Monthly*		4 4 2 2			2       2
Flood Tide Impact Station Downcurr	rent	-					
	ESC-IPF1 ESC-IPF2 ESC-IPF3	Monthly* Monthly* Monthly*	4     4     4     4     4       4     4     4     4     4       4     4     4     4     4       4     4     4     4     4	2         2         2         2           2         2         2         2         2           2         2         2         2         2	2         2	2       2	2       2
Intermediate Station Dow		Monthly* Monthly*				2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	2       2
Reference Station Upcur	ESC-INF3 rent ESC-RFF1A	Monthly*			2 2 2 2 2 2 2	2 2 2 2 2 2 2 2 2 2 2 2 2 2	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2
Ma Wan Station	ESC-RFF2A ESC-RFF3	Monthly* Monthly*	4     4     4     4     4     4       4     4     4     4     4     4       4     4     4     4     4     4	2 2 2 2 2 2 2 2 2 2	2 2 2 2 2 2 2	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	2       2
Water Column Profiling *	MW1	Monthly*	4     4   4   4   4   4   4   5   5	2 2 2 2 2 4 2 2 2 2 2 2 2 2 2 2 2 2 2 2			2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2
Plume Stations	WCP1 WCP2	Monthly* Monthly*		2 2 2 2 2 2 2 2 2		2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	2         2
Benthic Recoloinisation	Studies	montany					2   2   2   2   2   2   2   2   2   2
Capped Stations at CMP	ESCV-CPA ESCV-CPB	2 times per year					
Reference Stations	ESCV-CPD	2 times per year 2 times per year					
	RBA RBB RBC1	2 times per year 2 times per year 2 times per year					

RBC1	2 times per year																			1

Impact Monitoring for Dredging	Jan Feb	Mar A	or May	Jun J	Jul Au	g Sep C	Oct No	v Dec	Jan F	b Mar	Apr	May	Jun	Jul	Aug S	Sep O	ct N	ov De	Jan	Feb M	ar Ap	May	Jun	lul Au	ig Sej	Oct	Nov D	ec Ja	n Feb	Mar	Apr I	/lay Ju	n Jul	Aug	Sep	Oct No	ov Dec	Jan	Feb M	ar Apr	May	Jun	Jul A	ug S	ep Oc	t Nov	Dec	Jan I	b Mar
Upstream Stations																																																	
US1 3 times per week										2 2	2	2	2																																				
US2 3 times per week										2 2	2	2	2																																				
Downstream Stations								-																																									
DS1 3 times per week										2 2	2	2	2																																				
DS2 3 times per week										2 2	2	2	2																																				T
DS3 3 times per week									1	2 2	2	2	2																																				
DS4 3 times per week										2 2	2	2	2																																				
DS5 3 times per week										2 2	2	2	2																																				1
Ma Wan Station		_	-																<u> </u>					_	_				-				_												_	-			-
MW1 3 times per week										2 2	2	2	2																																				

Notes: Cance particular to an optimize the numbers of replicates per monitoring station. The number shown in green bolded text represented monitoring works have been conducted before/ during the reporting period of this Monthly EM&A Report, while the numbers of replicates per monitoring works after the reporting period of this Monthly EM&A Report.

(2) For the planned Routine Water Quality Monitoring (i.e. the numbers of replicates per monitoring station shown in black), the monitoring will be conducted at mid-ebb OR mid-flood tide. The yearly tidal selection of this monitoring will be based on a principle to obtain 6 months monitoring data at mid-ebb, and 6 months monitoring data at mid-flood.

(3) Impact Monitoring for Dredging will be scheduled when dredging operations commence.

(3) Impact Monitoring for Dredging will be scheduled when dredging operations commence.
 (4) Benthic Recolonisation Studies for CMP V will be scheduled when dredging operations commence.
 (4) Benthic Recolonisation Studies for CMP V will be scheduled when dredging operations commence.
 (4) Benthic Recolonisation Studies for CMP V will be scheduled when dredging operations commence.
 (4) Benthic Recolonisation Studies for CMP V will be scheduled when dredging operations for CMP V is completed.
 \* A proposal on the change of number of sample replication of water quality Aster Quality Monitoring and water quality monitoring during capping operation and Routine Water Quality Monitoring are combined such that Routine Water Quality Monitoring have been conducted monthy starting in December 2020. A technical note presenting the data review results served as a supplementary information was submitted to EPD and presented that Phase 2 optimization of sample replication of water quality and deversely affecting the supply of international species adopted in testing programme of Sediment Toxicity Tests, as such, Sediment Toxicity Tests, as such, Sediment Toxicity Tests, as such, Sediment Toxicity Tests, as such set or singinally scheduled in February 2022 were postponed to March 2022.
 \* To enable the required Research Fishing Permit could be granted by the time undertaking the Demersal Trawling, trawling originally scheduled in July and August 2022 was postponed to August and September 2022.

# Appendix B. Water Quality Monitoring Results



Parameters	Action	Limit
Dissolved Oxygen (DO)	Surface and Middle Depth <sup>(2)</sup>	Surface and Middle Depth <sup>(2)</sup>
in mg L <sup>-1</sup> (Surface, Middle & Bottom) <sup>(1)</sup>	5%-ile of baseline data for surface and middle layer = <b>3.76</b>	1%-ile of baseline data for surface and middle layer = <b>3.11</b> <sup>(3)</sup>
	and	and
	Significantly less than the reference station's mean DO (at the same tide of the same day)	Significantly less than the reference station's mean DO (at the same tide of the same day)
	Bottom	Bottom
	5%-ile of baseline data for surface and middle layer = <b>2.96</b>	The average of the impact station readings are < <b>2</b>
	and	and
	Significantly less than the reference station's mean DO (at the same tide of the same day)	Significantly less than the reference station's mean DO (at the same tide of the same day)
Suspended Solids (SS) in mg L <sup>-1</sup>	95%-ile of baseline data for depth- averaged = <b>37.88</b>	99%-ile of baseline data for depth- averaged = <b>61.92</b>
(depth-averaged) <sup>(5)</sup>	and	and
	120% of control station's SS at the same tide of the same day	130% of control station's SS at the same tide of the same day
Turbidity	95%-ile of baseline data = 28.14	99%-ile of baseline data = <b>38.32</b>
in NTU	and	and
(depth-averaged) <sup>(4)(5)</sup>	120% of control station's Turbidity at the same tide of the same day	130% of control station's Turbidity at the same tide of the same day

# Table B1: Action and Limit Levels of Water Quality for Dredging, Disposal and Capping Activities at ESC CMP V

Notes:

1. For DO, non-compliance of the water quality limits occurs when monitoring result is lower than the limits.

2. Action and Limit Levels for DO for Surface and Middle layers were calculated from the combined pool of baseline surface layer data and baseline middle layer data.

 Given the Action Level for DO for Surface and Middle layers has already been lower than 4 mg L<sup>-1</sup>, it is proposed to set the Limit Level at 3.11 mg L<sup>-1</sup> which is the first percentile of the baseline data.

4. "Depth-averaged" is calculated by taking the arithmetic means of reading of all three depths.

5. For turbidity and SS, non-compliance of the water quality limits occurs when monitoring result is higher than the limits.



#### Table B2: Water Column Profiling Results for ESC CMP Vb in December 2023

Station	Temp.	Salinity	Turbidity	Dissolve	ed Oxygen	рН	Suspended Solids
	(°C)	(ppt)	(NTU)	(%)	(mg L <sup>-1</sup> )		(mg L <sup>-1</sup> )
WCP 1 (Downstream)	22.77	31.38	2.50	91.21	6.56	8.00	3.5
WCP 2 (Upstream)	22.79	31.20	2.19	93.85	6.75	7.94	3.0
WQO (Dry Season)	N/A	28.08-34.32#	N/A	N/A	>4	6.5-8.5	13.2

Notes:

1. \* Not exceeding 10% of natural ambient level which is the result obtained from the Reference Station.

2. Cell shaded yellow / red indicates value exceeding the Action/Limit levels.

3. Cell shaded grey indicates value exceeding the WQO.

#### Table B3: In-situ Monitoring Results for Routine Water Quality Monitoring of ESC CMPs in December 2023

Station	Temp.	Salinity	Turbidity	Dissolve	ed Oxygen	рН
	(°C)	(ppt)	(NTU)	(%)	(mg L <sup>-1</sup> )	
RFF (Reference)	23.10	31.33	2.62	92.10	6.58	7.95
IPF (Impact)	23.13	31.18	3.30	91.60	6.55	7.97
INF (Intermediate)	23.15	31.21	2.90	91.82	6.56	7.99
Ma Wan	23.36	32.37	3.78	85.24	6.03	7.92
WQO (Dry Season)	N/A	28.20-34.47#	N/A	N/A	>4	6.5-8.5

Notes:

1. \* Not exceeding 10% of natural ambient level which is the result obtained from the Reference Station.

2. Cell shaded yellow / red indicates value exceeding the Action/Limit levels.

3. Cell shaded grey indicates value exceeding the WQO.



# Table B4: Laboratory Results for Dissolved Metals and Metalloid in Routine Water Quality Monitoring of ESC CMPs in December 2023

Station	As	Cd	Cr	Cu	Pb	Hg	Ni	Ag	Zn
	(µg/L)								
RFF	1.67	0.03	0.12	0.56	ND	0.002	0.61	ND	0.11
IPF	1.72	0.03	0.12	0.57	0.01	0.001	0.69	ND	2.10
INF	1.72	0.03	0.11	0.53	ND	0.001	0.67	ND	2.99
Ma Wan	1.69	0.02	0.12	0.41	ND	0.001	0.40	ND	0.70

Note:

1. "ND" indicates the concentrations of metals and metalloids are not detected.

# Table B5: Laboratory Results for Nutrients and Suspended Solid in Routine Water Quality Monitoring of ESC CMPs in December 2023

Station	NH <sub>3</sub>	TIN	BOD <sub>5</sub>	SS		
	(mg/L)	(mg/L)	(mg/L)	(mg/L)		
RFF	0.04	0.34	0.63	5.5		
IPF	0.04	0.36	0.82	4.5		
INF	0.03	0.35	0.73	4.2		
Ma Wan	0.06	0.28	0.55	5.5		
				WQO of TIN: 0.5 mg/L		

Dry Season WQO of SS: 13.2 mg/L

Notes:

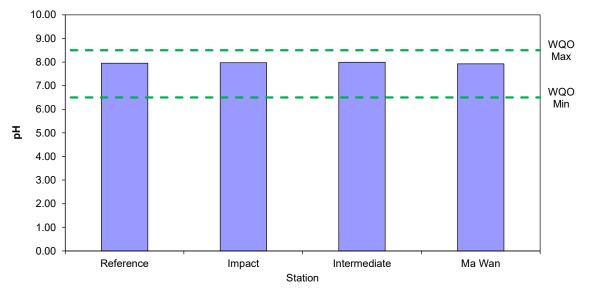
1. "<LOR" indicates the concentrations of contaminants are below the limit of reporting.

2. Cell shaded yellow / red indicates value exceeding the Action/Limit levels.

3. Cell shaded grey indicates value exceeding the WQO.

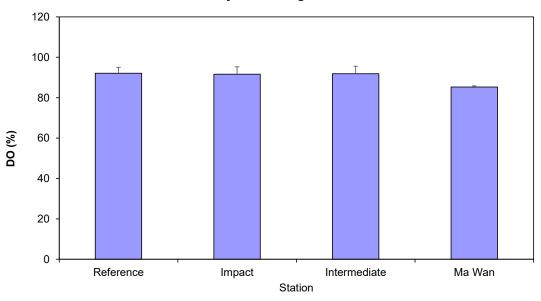
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# **Appendix C. Graphical Presentations**



#### Routine Water Quality Monitoring for ESC CMP V - December 2023

Figure 1: Level of pH recorded during Routine Water Quality Monitoring for disposal operations at ESC CMP V in December 2023

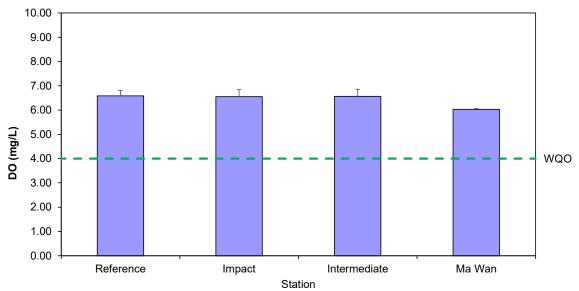


Routine Water Quality Monitoring for ESC CMP V - December 2023

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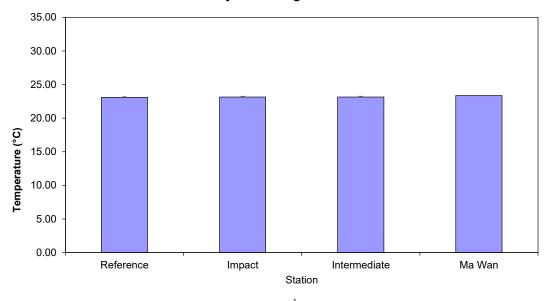
Figure 2: Level of Dissolved Oxygen (DO) (% saturation; mean + SD)<sup>1</sup> recorded during Routine Water Quality Monitoring for disposal operations at ESC CMP V in December 2023

The mean and standard deviation (SD) for in-situ data are the mean and SD for water columns within the area.



Routine Water Quality Monitoring for ESC CMP V - December 2023

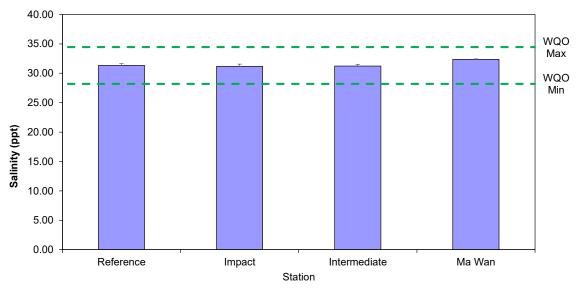
Figure 3: Concentration of Dissolved Oxygen (DO) (mg/L; mean + SD) recorded during Routine Water Quality Monitoring for disposal operations at ESC CMP V in December 2023



Routine Water Quality Monitoring for ESC CMP V - December 2023

 
 Figure 4:
 Level of Temperature (°C; mean + SD) recorded during Routine Water Quality Monitoring for disposal operations at ESC CMP V in December 2023

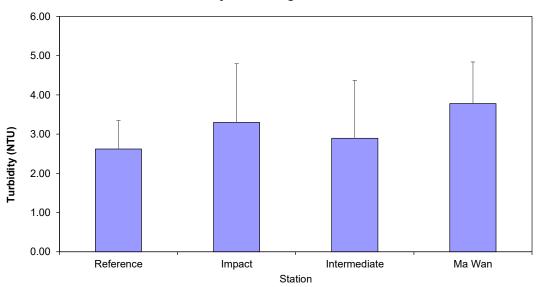
<sup>&</sup>lt;sup>1</sup> The mean and standard deviation (SD) for in-situ data are the mean and SD for water columns within the area.



Routine Water Quality Monitoring for ESC CMP V - December 2023

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Figure 5: Level of Salinity (ppt; mean + SD) recorded during Routine Water Quality Monitoring for disposal operations at ESC CMP V in December 2023

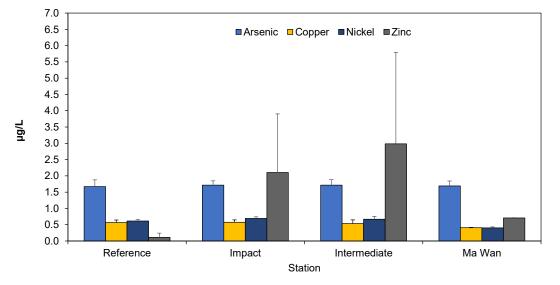


Routine Water Quality Monitoring for ESC CMP V - December 2023

Level of Turbidity (NTU; mean + SD) recorded during Routine Water Quality Monitoring for disposal operations at ESC CMP V in December 2023 Figure 6:

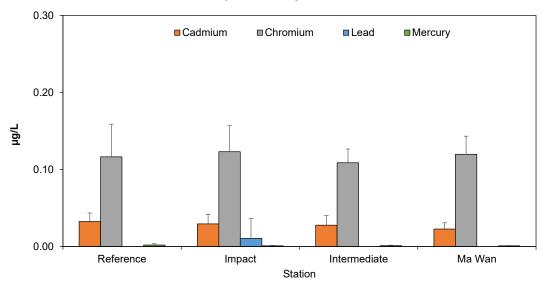
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The mean and standard deviation (SD) for in-situ data are the mean and SD for water columns within the area.



#### Routine Water Quality Monitoring for ESC CMP V December 2023

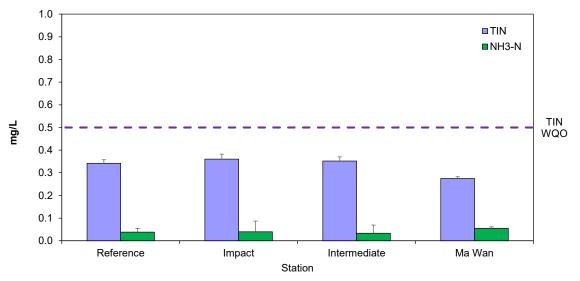
Figure 7: Concentration of Arsenic, Copper, Nickel, and Zinc (µg/L; mean + SD) in water samples collected from Routine Water Quality Monitoring for disposal operations at ESC CMP V in December 2023



#### Routine Water Quality Monitoring for ESC CMP V December 2023

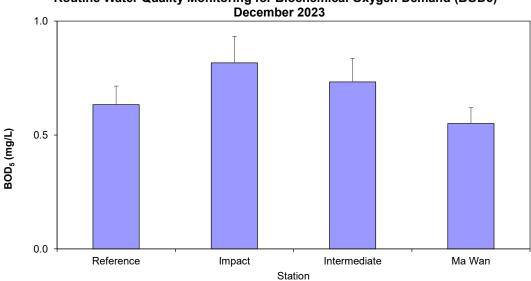
**Figure 8:** Concentration of Cadmium, Chromium, Lead, Mercury and Silver, (µg/L; mean + SD) in water samples collected from Routine Water Quality Monitoring for disposal operations at ESC CMP V in December 2023

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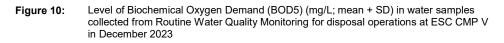


#### **Routine Water Quality Monitoring for Nutrients - December 2023**

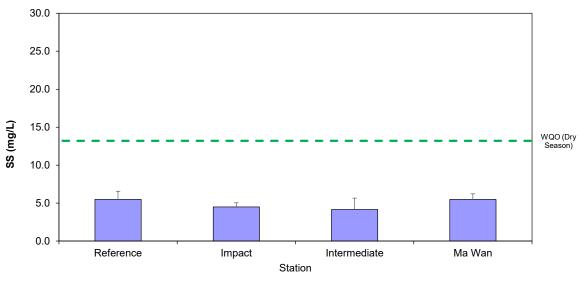
Concentration of Total Inorganic Nitrogen (TIN) and Ammonia Nitrogen (NH3-N) (mg/L; mean + SD) in water samples collected from Routine Water Quality Monitoring for disposal operations at ESC CMP V in December 2023 Figure 9:



Routine Water Quality Monitoring for Biochemical Oxygen Demand (BOD5) -

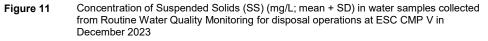


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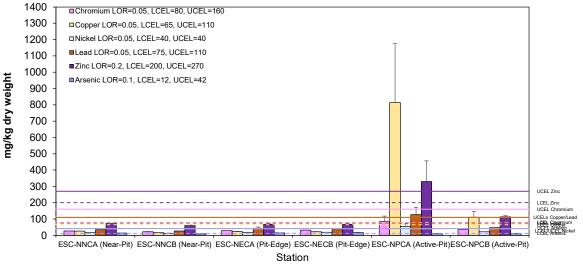


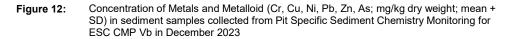
#### **Routine Water Quality Monitoring for Suspended Solids - December 2023**

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#### Pit Specific Sediment Chemistry for Metal and Metalloid Contaminants at ESC CMP Vb - December 2023





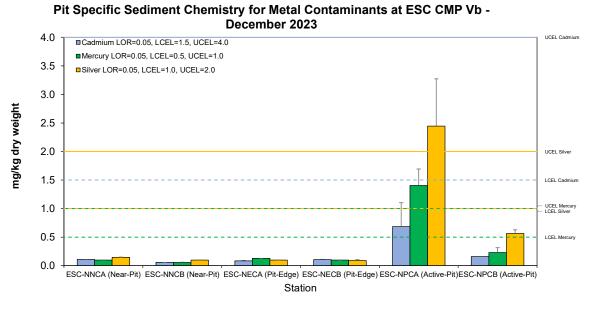
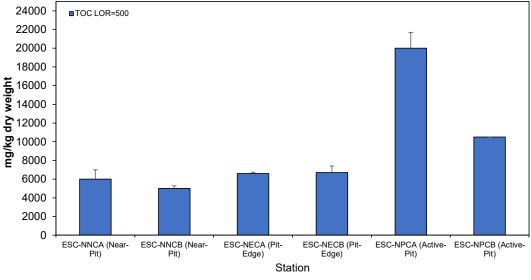


Figure 13: Concentration of Metals (Cd, Hg, Ag; mg/kg dry weight; mean + SD) in sediment samples collected from Pit Specific Sediment Chemistry Monitoring for ESC CMP Vb in December 2023



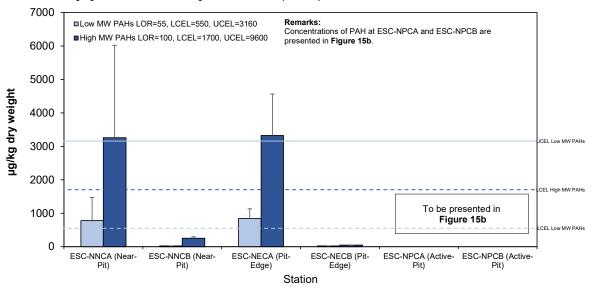
#### Pit Specific Sediment Chemistry for Total Organic Carbon (TOC) at ESC CMP Vb - December 2023

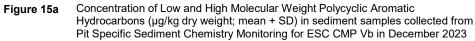
Figure 14: Concentration of Total Organic Carbon (TOC) (mg/kg dry weight; mean + SD) in sediment samples collected from Pit Specific Sediment Chemistry Monitoring for ESC CMP Vb in December 2023

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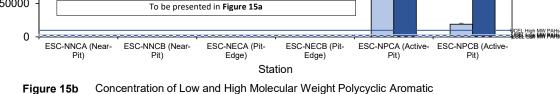


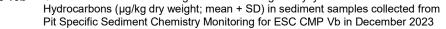
#### Pit Specific Sediment Chemistry for Low and High Molecular Weight Polycyclic Aromatics Hydrocarbons (PAHs) at ESC CMP Vb - December 2023



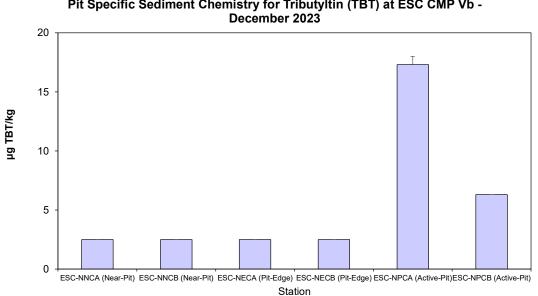


# Pit Specific Sediment Chemistry for Low and High Molecular Weight Polycyclic Aromatics Hydrocarbons (PAHs) at ESC CMP Vb - December 2023

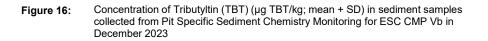




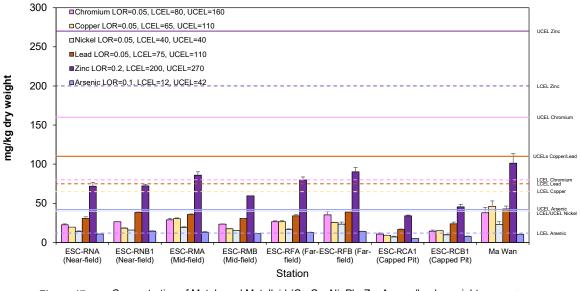
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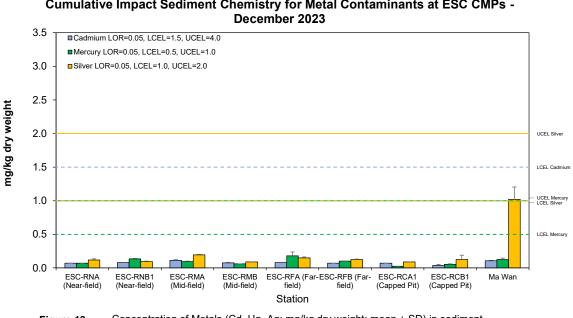
## Pit Specific Sediment Chemistry for Tributyltin (TBT) at ESC CMP Vb -



#### **Cumulative Impact Sediment Chemistry for Metal and Metalloid Contaminants** at ESC CMPs - December 2023



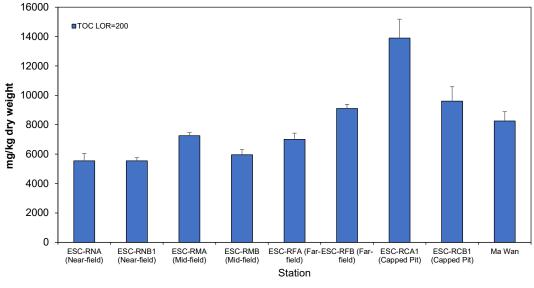
Concentration of Metals and Metalloid (Cr, Cu, Ni, Pb, Zn, As; mg/kg dry weight; mean + Figure 17: SD) in sediment samples collected from Cumulative Impact Sediment Chemistry Monitoring for ESC CMPs in December 2023



Cumulative Impact Sediment Chemistry for Metal Contaminants at ESC CMPs -

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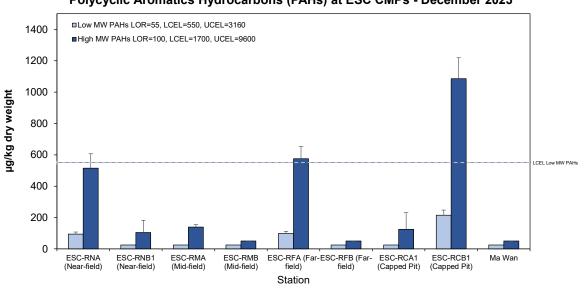
Concentration of Metals (Cd, Hg, Ag; mg/kg dry weight; mean + SD) in sediment samples collected from Cumulative Impact Sediment Chemistry Monitoring for ESC Figure 18: CMPs in December 2023



Cumulative Impact Sediment Chemistry for Total Organic Carbon (TOC) at ESC CMPs - December 2023

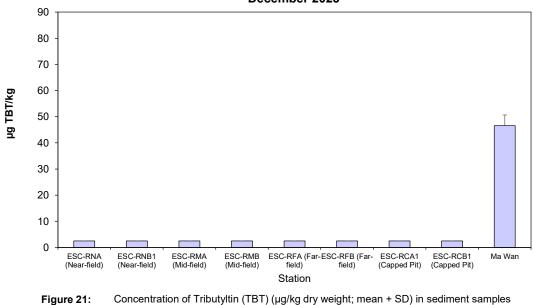
Concentration of Total Organic Carbon (TOC) (mg/kg dry weight; mean + SD) in Figure 19: sediment samples collected from Cumulative Impact Sediment Chemistry Monitoring for ESC CMPs in December 2023

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#### Cumulative Impact Sediment Chemistry for Low and High Molecular Weight Polycyclic Aromatics Hydrocarbons (PAHs) at ESC CMPs - December 2023

Figure 20: Concentration of Low and High Molecular Weight Polycyclic Aromatics (mg/kg dry weight; mean + SD) in sediment samples collected from Cumulative Impact Sediment Chemistry Monitoring for ESC CMPs in December 2023



Cumulative Impact Sediment Chemistry for Tributyltin (TBTs) at ESC CMPs -December 2023

Figure 21: Concentration of Tributyltin (TBT) (μg/kg dry weight; mean + SD) in sediment samples collected from Cumulative Impact Sediment Chemistry Monitoring for ESC CMPs in December 2023

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# **Appendix D. Study Programme**

# Study Programme

#### Agreement No. CE 59/2020 (EP) Environmental Monitoring and Audit for Disposal Facility to the East of Sha Chau (2021-2026) - Investigation

Mott MacDonald Hong Kong Limited

		to the E	ast of Sha Cr	1au (2021-202	26) - Investig	ation								
D	Task Name		Start	Finish		2022 24 Q1 Q2 Q3 NDJFMAMJJA	Q4 Q1	3 Q2 Q3	202 Q4 Q1		2025 24 Q1		2026 4 Q1	02 03
1	COMMENCEMENT OF AGREEMENT NO	). CE 59/2020 (EP)	01/04/21		•		30001			MANNJJAJA		AIMITTATSIO		
2	EAST OF SHA CHAU CONTAMINATED N	NUD PITS (ESC CMPs) BETWEEN 2021 & 2026	01/04/21	25/06/26										-
3	Draft Report of First Review of EM&A Manual	(for ESC CMPs)		30/04/21	•									
4	Final Report of First Review of EM&A Manual	(for ESC CMPs)		20/05/21	•									
5	Draft Report of Subsequent Review of EM&A	Manual (for ESC CMPs) - annual basis assumed	30/04/22	30/04/25		\$		\$		\$		\$		
10	Final Report of Subsequent Review of EM&A	Nanual (for ESC CMPs) - annual basis assumed	20/05/22	20/05/25		\$		\$		\$		\$		
15	Regular Site Inspections of CMP Contractors		01/04/21	31/03/26										
16	Monthly EM&A Report		14/05/21	14/04/26	\$\$\$\$\$\$		\$\$\$\$\$	\$\$\$\$\$\$	\$\$\$\$\$	00000000	•00000·	\$\$\$\$\$\$\$	>>>>>	>
77	Quarterly EM&A Report		30/07/21	30/04/26	♦	$\diamond \diamond \diamond \diamond$	♦ ♦	♦ ♦	♦ ♦	$\diamond \diamond$	◊ ◊	$\diamond \diamond \diamond$	>	\$
98	Annual EM&A Report		30/01/22	30/01/26		\$	\$		\$		\$		\$	
104	Annual Risk Assessment Report		31/05/22	31/05/26		\$		\$		\$		\$		\$
110	Draft Final Report			30/04/26										•
111	Final Report			04/06/26										٠
112	Draft Executive Summary			04/06/26										•
113				25/06/26										•
114	EAST OF TUNG LUNG CHAU (ETLC) DISI SEPTEMBER 2021 & MARCH-APRIL 202	POSAL FACILITY (MONITORING PERIOD: 2)	23/11/21	31/08/22			I							
115	Monthly EM&A Report		23/11/21	06/06/22		$\diamond$ $\diamond \diamond$								
119	Quarterly EM&A Report		15/07/22	15/07/22		\$								
121	Annual EM&A Report		31/08/22	31/08/22		<	>							
	amme Revision: C 11/05/22	Start/End of ET Services Location Repeating Task	Start of Agreen Submission Multiple-Occas	nent sion Submission	<ul> <li>◆</li> <li>◆</li> <li>◇</li> </ul>									