

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 – October 2023

November 2023

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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 – October 2023Date of Report:10 November 2023Date prepared by ET:10 November 2023Date received by IA:10 November 2023

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): /

thom Chen Date: 10 November 2023

IA Verification

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

Dr Wang Wen Xiong, Independent Auditor (IA);

up Mang

Date: 10 November 2023

Issue and Revision Record

Revision	Date	Originator	Checker	Approver	Description
A	Nov 2023	Various	Liz Lo	Thomas Chan	Revision A of Submission
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-					

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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.^{1,2} 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.

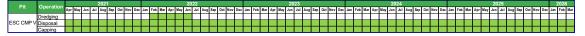
The present EM&A programme under Agreement No. CE 59/2020 (EP) covers the dredging, disposal and capping operations of the ESC CMP V (see **Appendix A** for the EM&A programme.) Detailed works schedule for ESC CMP V is shown in **Table 1.1**. In October 2023, the following works were undertaken:

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

¹ 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.

² 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 – October 2023* covers the EM&A activities for the reporting period of October 2023 (from 1 to 31 October 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
- Sediment Chemistry after a Major Storm of ESC CMP V.

1.4 Details of Outstanding Sampling or Analysis

No outstanding sampling remained for the reporting month (October 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
- Sediment Chemistry after a Major Storm of ESC CMP V.

2.2 Water Column Profiling of ESC CMP Vb – in October 2023

Water Column Profiling was undertaken at a total of two sampling stations (Upstream and Downstream stations) on 6 October 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 wet season period (April to October) of 2012 – 2021 from stations in the North Western Water Control Zone (WCZ), where the ESC CMPs are located.³ 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 October 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 October 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 October 2023

Routine Water Quality Monitoring of ESC CMPs was undertaken on 5 October 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 October 2023 as shown in Figure 2.1.

³ <u>http://epic.epd.gov.hk/EPICRIVER/marine/?lang=en</u>

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 and DO complied with the WQOs at all stations in October 2023, except for higher levels of Salinity were recorded at Ma Wan station. The higher Salinities recorded at Ma Wan station are likely to be caused by the larger separation distance to Pearl River Delta mouth, which releases a large amount of freshwater runoff in the area during wet season, when compared to the Reference stations.

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 October 2023.

2.3.2 Laboratory Measurements

Laboratory analysis of samples obtained during the reporting period indicated that the concentrations of Arsenic, Cadmium, Chromium, Copper, Lead, 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 Ma Wan (MW) station. The concentrations of Lead were only detected at Impact (IPF), Intermediate (INF) and Ma Wan (MW) stations. (**Table B4** of **Appendix B**; **Figure 7 and 8 of Appendix C**).

For nutrients, concentrations of Total Inorganic Nitrogen (TIN) were higher than the WQO (0.5 mg/L) at Reference (RFF), Impact (IPF) and Intermediate (INF) stations. (**Table B5** of **Appendix B**; **Figure 9** of **Appendix C**). It should be noted that due to the effect of the Pearl River, the North Western WCZ has historically experienced higher levels of TIN.⁴ Therefore, the exceedances of TIN WQO at these stations are unlikely to be caused by the disposal operation at ESC CMPs. The concentrations of Ammonia Nitrogen (NH₃-N) were generally similar across all stations. (**Table B5** of **Appendix B**; **Figure 9** of **Appendix C**). The concentrations of Biochemical Oxygen Demand (BOD₅) were below limit of reporting at most stations. (**Table B5** of **Appendix B**).

Analyses of results for the reporting period indicated that the SS levels complied with the wet season WQO (11.7 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 October 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 October 2023.

The concentrations of most inorganic contaminants were lower than the Lower Chemical Exceedance Levels (LCELs) at all stations, except for Arsenic. The concentrations of Arsenic were higher than the LCEL at Near-Pit station ESC-NNCA, Pit-Edge station ESC-NECA and Active-Pit station ESC-NPCB. (**Figures 12 and 13** of **Appendix C**).

⁴ https://www.epd.gov.hk/epd/misc/marine_quality/1986-2005/eng/08_western_content.htm

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.⁵ It is presumed that the natural concentrations of Arsenic are similar in onshore and offshore sediments,⁶ 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-NPCB. (**Figure 14** of **Appendix C**). The concentrations of Low Molecular Weight Polycyclic Aromatic Hydrocarbons (PAHs) were higher than UCEL (Upper Chemical Exceedance Level) 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 (Lower Chemical Exceedance Level) at Near-Pit station ESC-NNCA, and were higher than UCEL at Active-Pit stations ESC-NPCA and ESC-NPCB. (Figures 15a and 15b of **Appendix C**). The concentrations of High Molecular Weight PAH at Pit-Edge stations were lower than LCEL and UCEL.

The concentrations of Tributyltin (TBT), Total Polychlorinated Biphenyls (PCBs), Total dichlorodiphenyl-trichloroethane (DDT) and 4,4'-dichlorodiphenyldichloroethylene (DDE) were below the limit of reporting at all stations during the reporting period.

Considering that the higher levels (i.e. concentrations higher than LCEL) of Low Molecular Weight and High Molecular Weight PAHs are only occurred within Active-Pit station ESC-NPCA and ESC-NPCB only, 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 Sediment Chemistry after a Major Storm of ESC CMP V – in October 2023

Sampling for Sediment Chemistry after a Major Storm Event was conducted at nine (9) monitoring stations (see **Figure 2.3** for the locations of the monitoring stations) on 11 October 2023 after the visit of tropical cyclones Koinu, which led to the issue of No. 8 Storm Signal on 9 October 2023. The tracks of Koinu are shown in **Figure 2.4**.

⁵ Sewell RJ (1999) Geochemical Atlas of Hong Kong. Geotechnical Engineering Office, Government of the Hong Kong Special Administrative Region

⁶ 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



Figure 2.4: Track of Tropical Cyclone Koinu (Source: Hong Kong Observatory)

Analyses of results for the Sediment Chemistry after a Major Storm indicated that the concentrations of all inorganic contaminants were below the LCEL in October 2023, except for Arsenic. The concentrations of Arsenic were higher than the LCEL at Mid-field stations ESC-RMA and Far-field stations ESC-RFB. (Figures 16 and 17 of Appendix C).

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.

Overall, there appeared to be no evidence showing the failure of ESC CMP V in retaining disposed mud or causing contamination of sediments after the major storm event in October 2023.

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 November 2023 for ESC CMP V (see **Appendix A** for the sampling schedule):

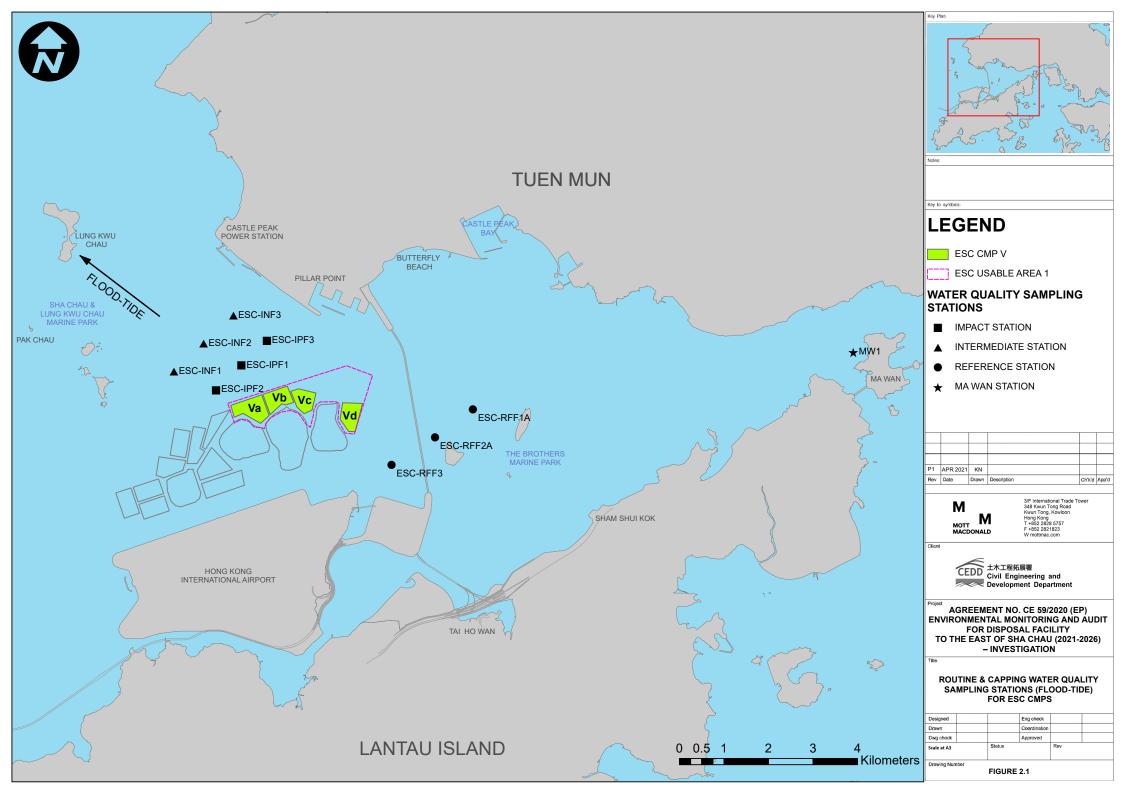
- Water Column Profiling of ESC CMP Vb;
- Routine Water Quality Monitoring of ESC CMPs; and
- Pit Specific Sediment Chemistry of ESC CMP Vb.

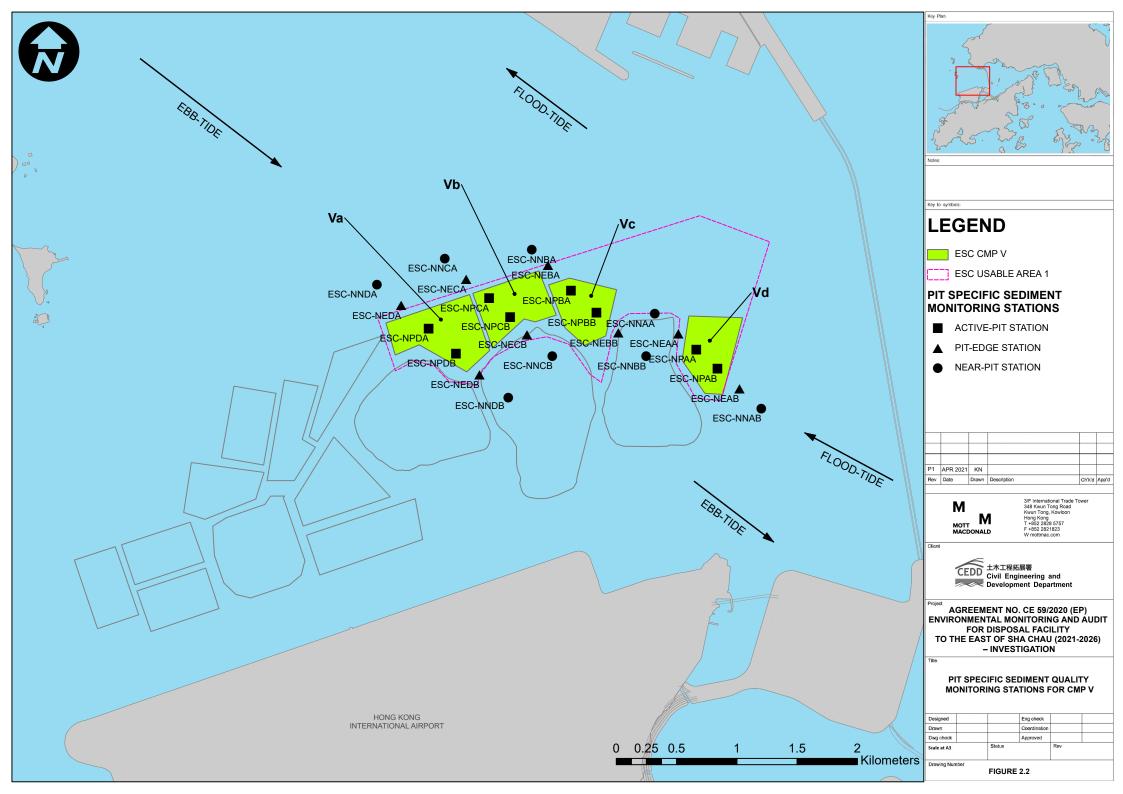
3.2 Study Programme

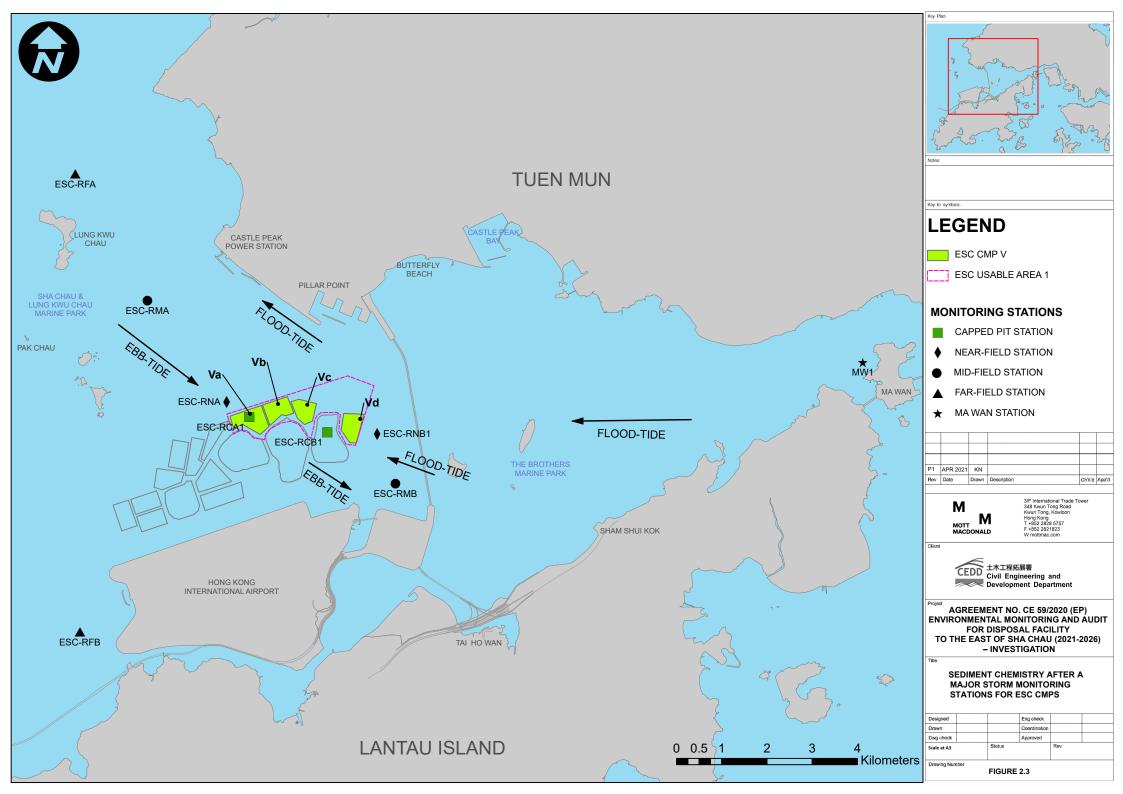
A summary of the Study Programme is presented in Appendix D.

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Figures







Appendices

- Appendix A Sampling Schedule
- 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	2021 Jan	Feb Mar	Apr N	lay Jur	n Jul A	ug Sep	Oct N	ov Dec	2022 Jan Feb	Mar A	pr Mav	/ Jun J	ul Aug	Sep Oc	t Nov D	2023 Jec Jan I	eb Mar	Apr M	ay Jun	Jul Au	g Sep	Oct Nov	Dec J	2024 Jan Feb	Mar Apr	May J	ın Jul A	ug Sep (Oct Nov [202 Dec Jan	25 1 Feb N	lar Apr	May J	un Jul	Aug Se	p Oct N	2 DV Dec	2026 <mark>Jan Feb Ma</mark>
Active-Pit	ESC-NPAA ESC-NPAB	Monthly Monthly																											_											2 2 2 2 2 2
Pit-Edge	ESC-NEAA ESC-NEAB	Monthly	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	2 2	2	2 2	2	2 2	2 2	2 2	2 2	2 2 2 2 2 2
Near-Pit	ESC-NNAA	-	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 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	2 2 2 2 2 2
Cumulative Impact Sedir Near-field Stations	ment Chemistry	*	Jan	Feb <mark> </mark> Mar	Apr N	lay Jur	a <mark> Jul A</mark>	ug Sep	Oct N	ov Dec	Jan Feb	Mar A	pr May	/ Jun J	ul Aug	Sep Oc	t Nov D	lec Jan I	eb Mar	Apr M	ay Jun	Jul Au	g Sep	Oct Nov	Dec J	Jan Feb	Mar Apr	May J	ın Jul A	ug Sep C	Oct Nov [Dec Jan	n Feb N	Apr	May J	un Jul	Aug Se	p Oct N	v Dec J	Jan Feb Ma
Mid-field Stations	ESC-RNA ESC-RNB1	4 times per year 4 times per year		6		6	Ħ	6 6		6	6			6 6	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 6		6	Ħ	6 6		6	6			6 6	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 6		6 6		6 6		6 6	6 6			6 6	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 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
	MW1	4 times per year		6		6		6		6	6			6	2				2		2	2			2	2			2	2		2	2				2		2	2
Sediment Toxicity Tests Near-pit Stations	ESC-TDA	2 times per year	r	5	Apr N	lay Jun		5		ov Dec	Jan Feb	5"	or May		5	Sep UC			5	Apr M	ay Jun	5				5	Mar Api	May J		5		Jec Jan	5	nar Apr	May J		5		V Dec J	Jan Feb Ma
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
Ma Wan Station	ESC-TRB	2 times per year 2 times per year	r	5		Ŧ		5				5"			5				5			5				5				5			5				5		+	5
Tissue / Whole Body Sar		2 times per year			Apr N	lay Jur			Oct N	ov Dec	Jan Feb		pr May	/ Jun J		Sep Oc	t Nov D			Apr M	ay Jun	Jul Au	g Sep	Oct Nov	Dec J		Mar Apı	May J	ın Jul A	ug Sep (Oct Nov [Dec Jan	÷	Aar Apr	May J	un Jul	•	p Oct N	v Dec J	Jan Feb Ma
Near-pit Stations	ESC-INA ESC-INB	2 times per year 2 times per year		•		\pm	H	•			•					*			*			*				*				*			*				*		Ŧ	*
Reference North	TNA TNB	2 times per year 2 times per year		•		\pm	H	:			*					*			*							*		\square		*			*				*		++	*
Reference South	TSA TSB	2 times per year 2 times per year		•		\pm	<u> </u>	•			•					*			*			*				*				*			*				*			*
Demersal Trawling Near-pit Stations					Apr M	lay Jun			Oct N	ov Dec			pr May	Jun J			t Nov D			Apr M				Oct Nov			Mar Apr	MayJ			Oct Nov [Mar Apr	May J			p Oct N		Jan Feb Ma
Reference North	ESC-INA ESC-INB	4 times per year 4 times per year	r 5	5	H	Ŧ	5	5	H		5 5 5 5			H		5^ 5^	H	5	5	H		5 5 5 5				5 5 5		H	5	5		5	5			5	5	H		5 5 5
Reference South	TNA TNB	4 times per year 4 times per year			\square	Ŧ	5			-	5 5 5 5	\square	-		5^ 5^	5^ 5^	H	5	-	H		5 5 5 5	_	F		5 5 5 5	F	H	5 5	5 5			5 5	F		5 5		H	\pm	5 5 5 5
	TSA TSB	4 times per year 4 times per year				\pm	5				5 5 5 5				5^ 5^			5 5				5 5 5 5				5 5 5 5		H	5				5 5	F		5 5				5 5 5 5
Capping * Ebb Tide Impact Station Downcur	rent			Feb Mar	Apr N	lay Jun	i Jul A	ug Sep	Oct N	ov Dec	Jan Feb	Mar A	or May	/ Jun J	ul Aug	Sep Oc	t Nov D	ec Jan I	eb Mar	Apr M	ay Jun	Jul Au	g Sep	Oct Nov	Dec J	Jan Feb	Mar Apı	May J	ın Jul A	ug Sep (Dct Nov [Dec Jan	n Feb N	Aar Apr	May J	un Jul	Aug Se	p Oct N	v Dec J	Jan Feb Ma
	ESC-IPE1A ESC-IPE2A ESC-IPE3	4 times per year * 4 times per year * 4 times per year *	r*			Ŧ	Ħ																				-												\mp	\mp
Intermediate Station Dov	ESC-IPE4 ESC-IPE5	4 times per year * 4 times per year *	r*			Ŧ	Ħ																					\square											#	#
		4 times per year * 4 times per year * 4 times per year *	r*			Ŧ	Ħ								-												-												Ŧ	\mp
Reference Station Upcu	ESC-INE4A ESC-INE5A	4 times per year * 4 times per year *	r*			Ŧ	<u></u>																		H		-												#	<u>+</u>
	ESC-RFE1 ESC-RFE2	4 times per year * 4 times per year * 4 times per year *	r*			Ŧ	Ħ																				-												Ŧ	\mp
Ma Wan Station	ESC-RFE4	4 times per year * 4 times per year * 4 times per year *	r*			Ŧ	Ħ																				+	Ħ											#	#
Ma wan Station	MW1	4 times per year *	r* 🗖																												1 1								-	
Impact Station Downcur	rent ESC-IPF1 ESC-IPF2	4 times per year * 4 times per year *		_		+	Ŧ					T T							-									I I	ŦŦ		+ +		I I			++		T.T.	=	++
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Reference Station Upcu	ESC-RFF1A ESC-RFF2A	4 times per year * 4 times per year *	r* 🖂		H	Ŧ	Ħ			-		H	-	H	+				-		\square			+			+	H	\square		++		H	+	\square			++	Ŧ	\mp
Ma Wan Station	MW1	4 times per year * 4 times per year *				<u> </u>	<u> </u>																																<u>+</u>	
Routine Water Quality M Ebb Tide			Jan	Feb Mar	Apr N	lay Jun	i Jul A	ug Sep	Oct N	ov Dec	Jan Feb	Mar A	or May	/ Jun J	ul Aug	Sep Oc	t Nov D	ec Jan I	eb Mar	Apr M	ay Jun	Jul Au	g Sep	Oct Nov	Dec J	Jan Feb	Mar Apı	May J	ın Jul A	ug Sep C	Dct Nov [Dec Jan	n Feb N	Mar Apr	May J	un Jul	Aug Se	p Oct N	v Dec J	Jan <mark>Feb</mark> Ma
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Water Column Profiling * Plume Stations	•																																							Jan Feb Ma
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Benthic Recoloinisation Capped Stations at CMP	v	2 times per year		Feb Mar	Apr N	lay Jun	i Jul A	ug Sep	Oct N	ov Dec	Jan Feb	Mar A	or May	/ Jun J	ul Aug	Sep Oc	t Nov D)ec Jan I	eb Mar	Apr M	ay Jun	Jul Au	g Sep	Oct Nov	DecJ	Jan Feb	Mar Apr	May J	in Jul A	ug Sep C	Dct Nov [Dec Jan	n Feb M	Mar Apr	May J	un Jul	Aug Se	p Oct N	v Dec J	Jan Feb Ma
	ESCV-CPB ESCV-CPC	2 times per year 2 times per year 2 times per year	r 📙	-	Ħ	\mp	Ħ	-		-		Ħ	-	\square	-		\square	\mp	-	\square		-		-	\square		+	Ħ	+	+	+		\square		\Rightarrow		+	\square	\mp	\mp
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1	RBC1	2 times per year		-	\vdash	+	++			-			-	++	-		+		_			-	+		++				++			-		-	\vdash		-	++	++	++

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
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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 ⁽²⁾	Surface and Middle Depth ⁽²⁾
in mg L ⁻¹ (Surface, Middle & Bottom) ⁽¹⁾	5%-ile of baseline data for surface and middle layer = 3.76	1%-ile of baseline data for surface and middle layer = 3.11 ⁽³⁾
	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 = 2.96	The average of the impact station readings are < 2
	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 ⁻¹	95%-ile of baseline data for depth- averaged = 37.88	99%-ile of baseline data for depth- averaged = 61.92
(depth-averaged) ⁽⁵⁾	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 = 38.32
in NTU	and	and
(depth-averaged) ⁽⁴⁾⁽⁵⁾	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⁻¹, it is proposed to set the Limit Level at 3.11 mg L⁻¹ 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 October 2023

Station	Temp.	Salinity	Turbidity	Dissolve	d Oxygen	рН	Suspended Solids
	(°C)	(ppt)	(NTU)	(%)	(mg L ⁻¹)		(mg L ⁻¹)
WCP 1 (Downstream)	29.49	27.90	4.24	91.92	6.01	8.02	4.0
WCP 2 (Upstream)	29.55	28.35	5.72	93.56	6.10	8.00	6.5
WQO (Wet Season)	N/A	25.52-31.19#	N/A	N/A	>4	6.5-8.5	11.7

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 October 2023

Station	Temp.	Salinity	Turbidity	Dissolve	ed Oxygen	рН
	(°C)	(ppt)	(NTU)	(%)	(mg L ⁻¹)	
RFF (Reference)	29.76	26.36	7.29	84.43	5.54	7.93
IPF (Impact)	29.76	25.97	6.44	83.53	5.50	7.95
INF (Intermediate)	29.74	26.03	6.98	83.28	5.48	7.95
Ma Wan	29.36	30.19	5.09	82.46	5.34	7.94
WQO (Wet Season)	N/A	23.72-28.99#	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 October 2023

Station	As	Cd	Cr	Cu	Pb	Hg	Ni	Ag	Zn
	(µg/L)								
RFF	1.95	0.03	0.10	0.60	ND	0.007	0.70	ND	0.06
IPF	2.02	0.03	0.12	0.73	0.01	0.007	0.73	ND	1.09
INF	1.95	0.03	0.11	0.76	0.01	0.006	0.81	ND	0.18
Ma Wan	1.60	0.02	0.10	0.30	0.01	0.006	0.43	ND	11.84

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 October 2023

Station	NH ₃	TIN	BOD ₅	SS
	(mg/L)	(mg/L)	(mg/L)	(mg/L)
RFF	0.05	0.55	<lor< td=""><td>8.8</td></lor<>	8.8
IPF	0.03	0.61	0.50	5.8
INF	0.03	0.62	<lor< td=""><td>5.8</td></lor<>	5.8
Ma Wan	0.07	0.28	<lor< td=""><td>7.5</td></lor<>	7.5
				WQO of TIN: 0.5 mg/L

Wet Season WQO of SS: 11.7 mg/L

Notes:

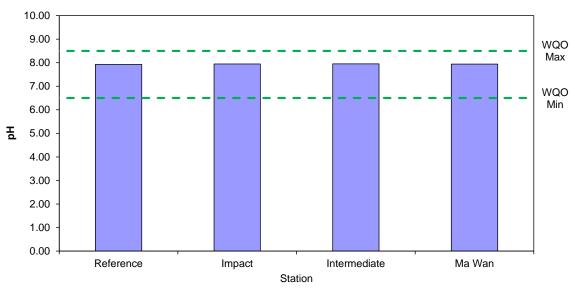
1. "<LOR" indicates the concentrations of contaminants are below the limit of reporting.

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

3. Cell shaded grey indicates value exceeding the WQO.

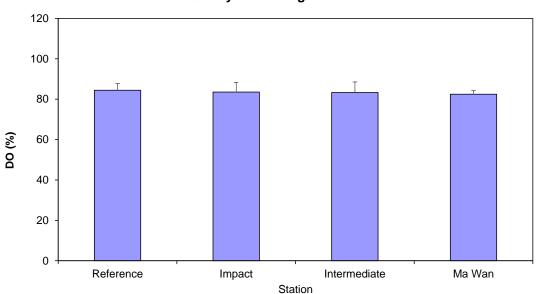
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Appendix C. Graphical Presentations



Routine Water Quality Monitoring for ESC CMP V - October 2023

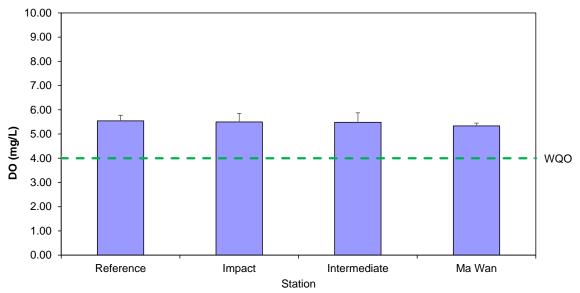
Figure 1: Level of pH recorded during Routine Water Quality Monitoring for disposal operations at ESC CMP V in October 2023



Routine Water Quality Monitoring for ESC CMP V - October 2023

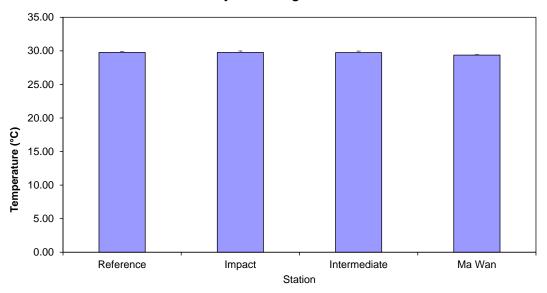
 Figure 2:
 Level of Dissolved Oxygen (DO) (% saturation; mean + SD) recorded during Routine Water Quality Monitoring for disposal operations at ESC CMP V in October 2023

¹ 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 - October 2023

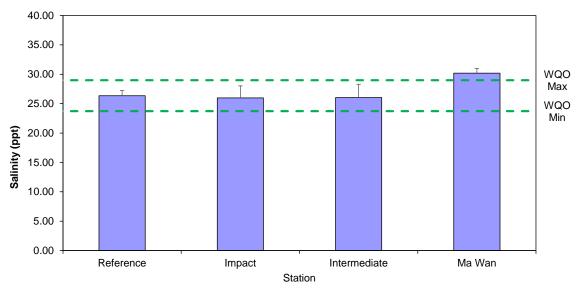
Figure 3: Concentration of Dissolved Oxygen (DO) (mg/L; mean + SD) recorded during Routine Water Quality Monitoring for disposal operations at ESC CMP V in October 2023



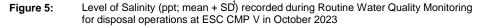
Routine Water Quality Monitoring for ESC CMP V - October 2023

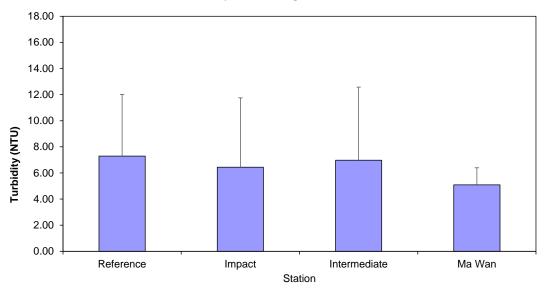
Figure 4:Level of Temperature (°C; mean + SD) recorded during Routine Water Quality
Monitoring for disposal operations at ESC CMP V in October 2023

¹ 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 - October 2023





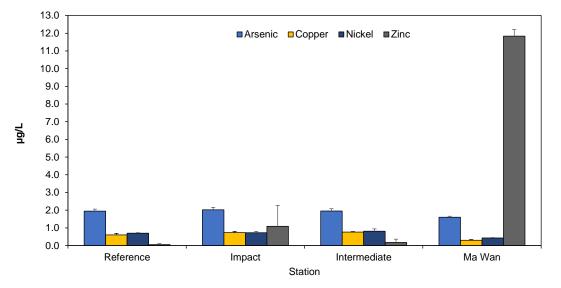
Routine Water Quality Monitoring for ESC CMP V - October 2023

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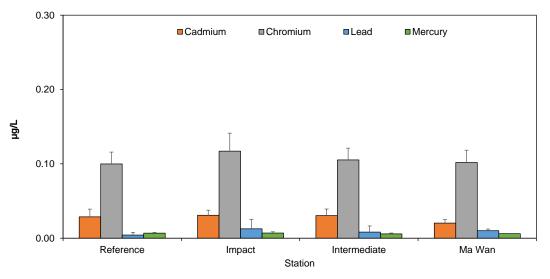
Level of Turbidity (NTU; mean + SD^{1}) recorded during Routine Water Quality Figure 6: Monitoring for disposal operations at ESC CMP V in October 2023

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 October 2023

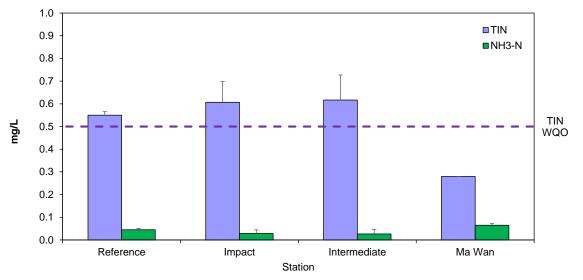
Figure 7: Concentration of Arsenic, Copper, Nickel, and Zinc (μg/L; mean + SD) in water samples collected from Routine Water Quality Monitoring for disposal operations at ESC CMP V in October 2023



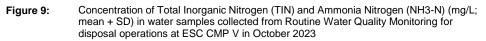
Routine Water Quality Monitoring for ESC CMP V October 2023

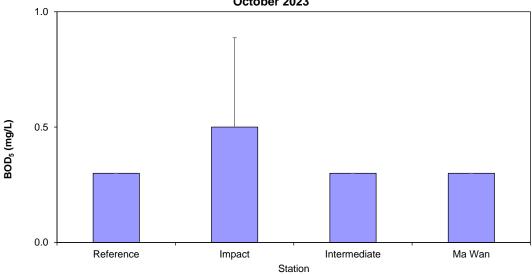
Figure 8:

Concentration of Cadmium, Chromium, Lead and Mercury, (μ g/L; mean + SD) in water samples collected from Routine Water Quality Monitoring for disposal operations at ESC CMP V in October 2023



Routine Water Quality Monitoring for Nutrients - October 2023

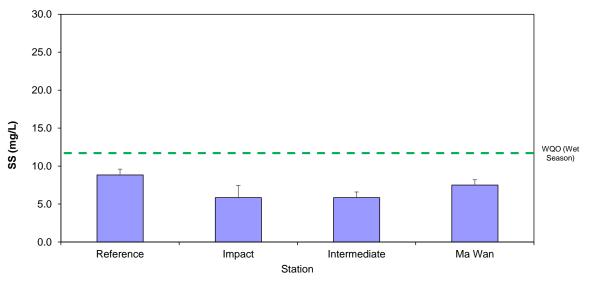




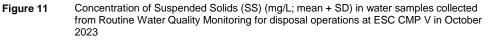
Routine Water Quality Monitoring for Biochemical Oxygen Demand (BOD5) -October 2023

Figure 10:

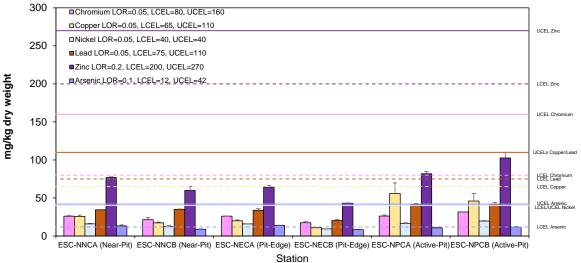
Level of Biochemical Oxygen Demand (BOD5) (mg/L; mean + SD) in water samples collected from Routine Water Quality Monitoring for disposal operations at ESC CMP V in October 2023

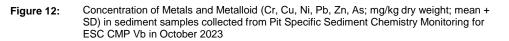


Routine Water Quality Monitoring for Suspended Solids - October 2023









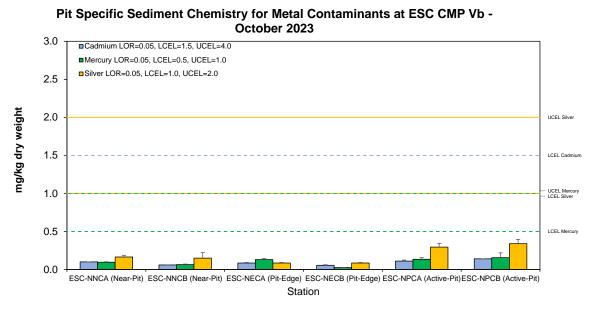
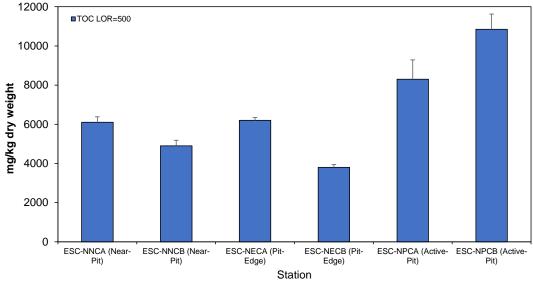


Figure 13: Concentration of Metals (Cd, Hg, Ag; mg/kg dry weight; mean + SD) in sediment samples collected from Pit Specific Sediment Chemistry Monitoring for ESC CMP Vb in October 2023



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

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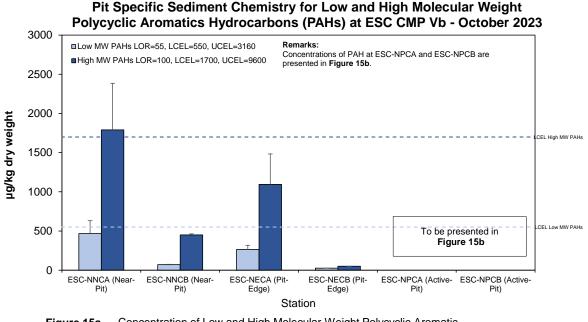
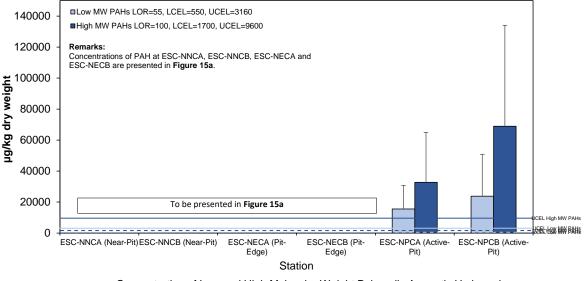
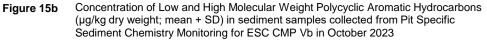


Figure 15a Concentration of Low and High Molecular Weight Polycyclic Aromatic Hydrocarbons (µg/kg dry weight; mean + SD) in sediment samples collected from Pit Specific Sediment Chemistry Monitoring for ESC CMP Vb in October 2023

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







Sediment Chemistry after a Major Storm for Metal and Metalloid Contaminants at ESC CMPs - October 2023

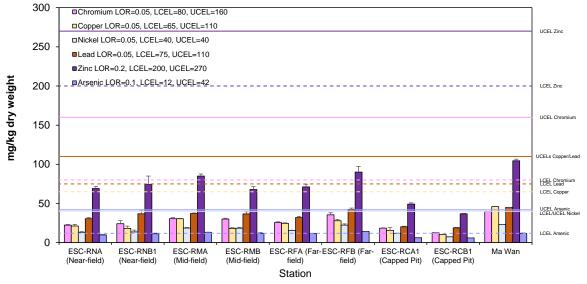
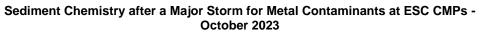
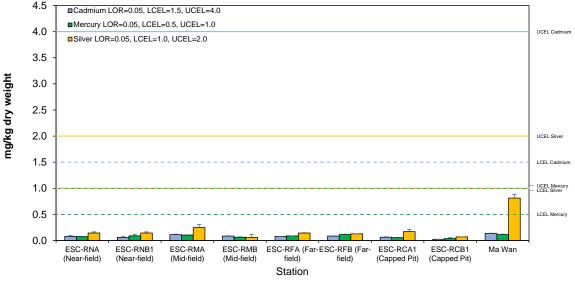
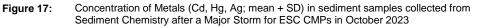


Figure 16 Concentration of Metals (Cr, Cu, Ni, Pb, Zn, As; mean + SD) in sediment samples collected from Sediment Chemistry after a Major Storm for ESC CMPs in October 2023







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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) - Investiga	ation								
D	Task Name		Start	Finish		2022 4 Q1 Q2 Q3 NDJFMAMJJAS	2023 Q4 Q1	02 03	202 Q4 Q1		2025 Q4 Q1	02 03 0	2026 24 Q1	02 03
1	COMMENCEMENT OF AGREEMENT NO). CE 59/2020 (EP)	01/04/21		•				SIGINIDIJIE					
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 I	Manual (for ESC CMPs) - annual basis assumed	20/05/22	20/05/25		\$		\$		\diamond		\$		
15	Regular Site Inspections of CMP Contractors		01/04/21	31/03/26										I
16	Monthly EM&A Report		14/05/21	14/04/26	\$\$\$\$	\$\$\$\$\$\$\$\$\$\$	>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>	>>>>>	>>>>>>	\$\$\$\$\$\$\$	><>	0000000	\$\$\$\$\$	\$
77	Quarterly EM&A Report		30/07/21	30/04/26	♦ <	\diamond \diamond \diamond	◊ ◊	◊ ◊	♦ ♦	$\diamond \diamond$	\$	\diamond \diamond	>	\$
98	Annual EM&A Report		30/01/22	30/01/26		\diamond	\$		\$		\$		\$	
104	Annual Risk Assessment Report		31/05/22	31/05/26		\$		\$		\diamond		\$		\$
110	Draft Final Report			30/04/26										•
111	Final Report			04/06/26										•
112	Draft Executive Summary			04/06/26										•
113	Final Executive Summary			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										
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		\diamond								
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	 ◆ ◆ ◇ 									