

- Investigation

Monthly EM&A Report for Contaminated Mud Pits to the East of Sha Chau – September 2021

October 2021

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# 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 – September 2021

October 2021





# **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 - September 2021

Date of Report:

8 October 2021

Date prepared by ET:

8 October 2021

Date received by IA:

8 October 2021

### 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: 8 October 2021

# IA Verification

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

Mean Nang

Dr Wang Wen Xiong, Independent Auditor (IA): Date: 8 October 2021

### i

# **Issue and Revision Record**

0-4-0004				Description
Oct 2021	Various	Thomas Chan	Eric Ching	Revision A of Submission
	OCI 2021	OCI 2021 VAIIOUS	Oct 2021 Various Momas Chan	Oct 2021 Various Infomas Chan Enc Ching

**Document reference:** 423134 | 06/05/06 | A

Information class: Standard

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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. 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. 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 September 2021, the following works were undertaken:

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

Table 1.1: Works Schedule for ESC CMP V



<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.

# 1.2 Reporting Period

This Monthly EM&A Report for Contaminated Mud Pits to the East of Sha Chau – September 2021 covers the EM&A activities for the reporting period of September 2021 (from 1 to 30 September 2021).

# 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; and
- Pit Specific Sediment Chemistry of ESC CMP Vb.

# 1.4 Details of Outstanding Sampling or Analysis

No outstanding sampling remained for the reporting month (September 2021).

# 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; and
- Pit Specific Sediment Chemistry of ESC CMP Vb.

# 2.2 Water Column Profiling of ESC CMP Vb – in September 2021

Water Column Profiling was undertaken at a total of two sampling stations (Upstream and Downstream stations) on 7 September 2021. 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 2010 – 2019 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 September 2021 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 September 2021 indicated that the SS levels at both Downstream and Upstream 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 September 2021

Routine Water Quality Monitoring of ESC CMPs was undertaken on 9 September 2021. 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 and B4** of **Appendix B** and **Figures 1 to 10** of **Appendix C**. A total of ten (10) monitoring stations were sampled in September 2021 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, Salinity and DO complied with the WQOs at all stations in September 2021.

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 September 2021.

### 2.3.2 Laboratory Measurements

Laboratory analysis of samples obtained during the reporting period indicated that the concentrations of Arsenic, Chromium, Copper, Lead, Mercury, Nickel, Silver and Zinc were detected in the samples at some/all stations and their concentrations of most metals and metalloids were generally similar across stations, except the concentrations of Copper and Nickel which were higher at Impact (IPF) and Ma Wan stations respectively (**Table B4** of **Appendix B**; **Figure 7** of **Appendix C**).

For nutrients, concentrations of Total Inorganic Nitrogen (TIN) at the Reference (RFF), Impact (IPF) and Intermediate (INF) stations were higher than the WQO (0.5 mg/L) (**Table B4** of **Appendix B**; **Figure 8** 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.<sup>4</sup> Therefore, the exceedances of TIN WQO at these stations are unlikely to be caused by the disposal operation at ESC CMPs. The concentration of Ammonia Nitrogen (NH<sub>3</sub>-N) was generally similar across stations (**Table B4** of **Appendix B**; **Figure 8** of **Appendix C**). The concentration of Biochemical Oxygen Demand (BOD<sub>5</sub>) was slightly higher at Ma Wan station in the reporting month (**Table B4** of **Appendix B**; **Figure 9** of **Appendix C**).

Analyses of results for the reporting period indicated that the SS level at Ma Wan station complied with the wet season WQO (11.8 mg/L) and the Action and Limit Levels. SS levels at Reference (RFF), Impact (IPF) and Intermediate (INF) stations were above the wet season WQO but in compliance with the Action and Limit Levels (**Tables B1 and B4** of **Appendix B**; **Figure 10** of **Appendix C**).

Overall, results of the Routine Water Quality Monitoring 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 September 2021

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 2 September 2021.

The concentrations of all inorganic contaminants were lower than the Lower Chemical Exceedance Levels (LCELs) at all stations (**Figures 11 and 12** of **Appendix C**).

For organic contaminants, the concentrations of Total Organic Carbon (TOC) were higher at Active-Pit station ESC-NPCA during the reporting period (**Figure 13** of **Appendix C**). The concentrations of Low Molecular Weight and High Molecular Weight Polycyclic Aromatic Hydrocarbons (PAHs) were lower than the LECLs at all stations (**Figure 14** of **Appendix C**). The

<sup>&</sup>lt;sup>4</sup> http://www.epd.gov.hk/epd/misc/marine\_quality/1986-2005/textonly/eng/index.htm

concentrations of Tributyltin (TBT) were higher at Near-Pit station ESC-NNCA and Pit-Edge station ESC-NECB (**Figure 15** of **Appendix C**). The concentrations of Total Polychlorinated Biphenyls (PCBs), Total dichloro-diphenyl-trichloroethane (DDT) and 4,4'-dichlorodiphenyldichloroethylene (DDE) 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 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.

# 3 Future Key Issues

# 3.1 Activities Scheduled for the Next Reporting Period

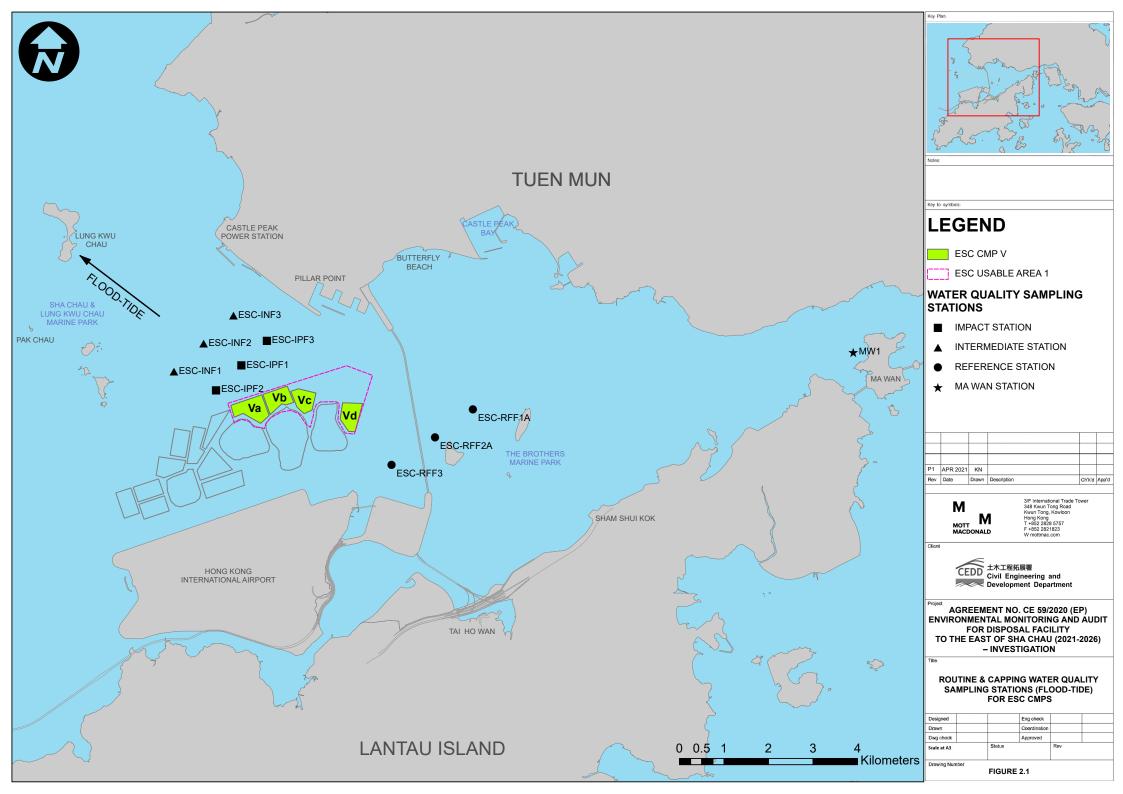
The following monitoring activities will be conducted in the next reporting period of October 2021 for ESC CMP V (see **Appendix A** for the sampling schedule):

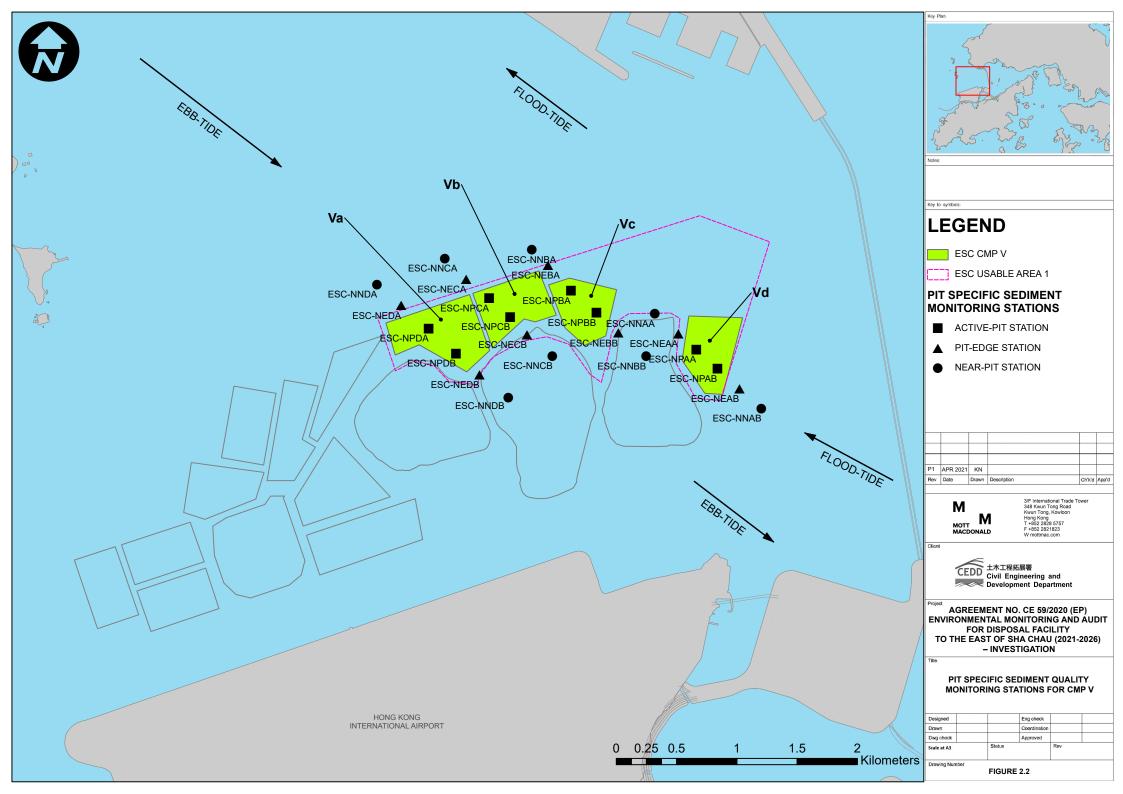
- Water Column Profiling of ESC CMP Vb;
- · Routine Water Quality Monitoring of ESC CMPs; and
- Pit Specific Sediment Chemistry of ESC CMP Vb.

# 3.2 Study Programme

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

# **Figures**





# **Appendices**

Appendix A Sampling Schedule

Appendix B Water Quality Monitoring Results

Appendix C Graphical Presentations

Appendix D Study Programme

# Appendix A. Sampling Schedule

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

Parameter / Station Type	Station ID	Frequency	2021				2022				2023				2024				2025				2026
Pit Specific Sediment Ch Active-Pit		Monthly	Jan Feb Mar																			Sep         Oct         Nov         De           6         6         6         6         6	
Pit-Edge	ESC-NPAB	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 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 6
Near-Pit	ESC-NEAA ESC-NEAB	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 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 6 6
	ESC-NNAA ESC-NNAB	Monthly Monthly																				6 6 6 6 6 6 6 6	
Cumulative Impact Sedion Near-field Stations			Jan Feb Mar	Apr May Jui	n Jul Aug	Sep Oct Nov D		r Apr May Ju						ep Oct Nov De								Sep Oct Nov De	
Mid-field Stations	ESC-RNA ESC-RNB1	4 times per year 4 times per year	6	6	6		6 6	6		6	6	6	6	6		6	6	6	6		6	6	6
Capped Pit Stations	ESC-RMA ESC-RMB	4 times per year 4 times per year	6	6			, ,	6	6	6		6		6	6	6		6	6		6 6	6	
Far-field Stations	ESC-RCA1 ESC-RCA2	4 times per year 4 times per year	6	6			, ,	6	6	6		6		6	6	6		6	6	(	6 6	6	
	ESC-RFA ESC-RFB	4 times per year 4 times per year	6	6			-	6	6	6		6	-	6	6	6		6	6			6	
Ma Wan Station	MW1	4 times per year	6	6	6			6	6	6		6	1 1 -	6	6	6	1 1 -	6	6		6 6	6	
Sediment Toxicity Tests Near-pit Stations	ESC-TDA	2 times per year	Jan Feb Mar	Apr May Ju	n Jul Aug	Sep Oct Nov D	ec Jan Feb Ma	r Apr May Ju	Jul Aug Se	Det Nov De	Jan Feb Mai	Apr May Ju	n Jul Aug S	ep Oct Nov De	Jan Feb Mar	Apr May Jui	Jul Aug Sep	Oct Nov Dec	Jan Feb M	lar Apr May J	ın Jul Aug	Sep Oct Nov De	c Jan Feb Mar
Reference Stations	ESC-TDB1	2 times per year	5		5		5		5		5		5		5		5		5		5		5
Ma Wan Station	ESC-TRA ESC-TRB	2 times per year 2 times per year	5		5		5		5		5		5		5		5		5		5		5
Tissue / Whole Body Sar	MW1	2 times per year	Jan Feb Mar	r Apr May Ju	n Jul Aug	Sep Oct Nov D	ec Jan Feb Ma	r Apr May Ju	Jul Aug Se	p Oct Nov De	Jan Feb Mai	Apr May Ju	n Jul Aug Se	ep Oct Nov De	5 Jan Feb Mar	Apr May Jui	Jul Aug Sep	Oct Nov Dec	Jan Feb M	ar Apr May Ji	ın Jul Aug	Sep Oct Nov De	c Jan Feb Mar
Near-pit Stations	ESC-INA ESC-INB	2 times per year 2 times per year	1:				*		1 .				1 .		*		*		*				*
Reference North	TNA	2 times per year									*				*		*		*				
Reference South	TNB	2 times per year 2 times per year	1.		1 .				1 .				1 .		*		1 .				1 1 .		
Demersal Trawling	TSB	2 times per year	Jan Feb Mar	r Apr May Ju	n Jul Aug	Sep Oct Nov D	ec Jan Feb Ma	r Apr May Ju	Jul Aug Sei	n Oct Nov De	Jan Feb Mai	Apr May Ju	n Jul Aug Se	ep Oct Nov De	* Jan Feb Mar	Apr May Ju	Jul Aug Sen	Oct Nov Dec	Jan Feb M	ar Apr May J	ın Jul Aug	Sep Oct Nov De	c Jan Feb Mar
Near-pit Stations	ESC-INA	4 times per year	5 5	, , , ,, ou	5 5		5 5	,,	5 5	1 100	5 5	, , , ,	5 5	1   1	5 5	,	5 5	1 1 1	5 5	,	5 5	1 1 1 1 1 1	5 5
Reference North	ESC-INB	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
Reference South	TNB	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	T	5 5		5 5
On the state of th	TSB	4 times per year	5 5		5 5	See Oat New D	5 5		5 5	- O-t Nov De	5 5	A M L	5 5	Oct New De	5 5	And Mary Ive	5 5	Oct Nov Dec	5 5	les Anni Mari II	5 5	Sep Oct Nov De	5 5
Capping * Ebb Tide Impact Station Downcur			Jan Feb Mar	r Apr May Jul	n j Jui j Augj	Sep Oct Nov D	ec Jan Feb Ma	r Apr May Jul	i Jui Aug Se	p Oct Nov De	Jan reb Mai	Apr   May   Ju	n Jui Aug Si	ep Oct Nov De	C Jan Feb Mar	Apr   May Jul	i Jui Aug Sep	Oct   Nov   Dec	Jan reb w	ar Apr   May   Ji	in Jui Aug	Sep Oct Nov De	C Jan reb mar
	ESC-IPE1A ESC-IPE2A ESC-IPE3	4 times per year * 4 times per year * 4 times per year *																					
Intermediate Station Dov	ESC-IPE4 ESC-IPE5	4 times per year * 4 times per year *																			$\blacksquare$		
intermediate station box	ESC-INE1A ESC-INE2A	4 times per year *																					
	ESC-INE4A ESC-INE5A	4 times per year * 4 times per year * 4 times per year *																					
Reference Station Upcur		4 times per year * 4 times per year *														H		H		$\Box$	$\Box$		
	ESC-RFE3 ESC-RFE4 ESC-RFE5	4 times per year * 4 times per year * 4 times per year *																					
Ma Wan Station	MW1	4 times per year *																					
Flood Tide Impact Station Downcur																							
	ESC-IPF1 ESC-IPF2 ESC-IPF3	4 times per year * 4 times per year * 4 times per year *																					
Intermediate Station Dov	vncurrent ESC-INF1 ESC-INF2	4 times per year * 4 times per year *								$\Box$						H		H		$\overline{+}$	$\overline{\Box}$		
Reference Station Upcur		4 times per year * 4 times per year *																					
	ESC-RFF2A	4 times per year * 4 times per year *																					
Ma Wan Station	MW1	4 times per year *																					
Routine Water Quality M Ebb Tide Impact Station Downcur			Jan Feb Mar	Apr May Ju	n Jul Aug	Sep Oct Nov D	ec Jan Feb Ma	r Apr May Ju	Jul Aug Se	Det Nov De	Jan Feb Mai	Apr May Ju	n Jul Aug S	ep Oct Nov De	Jan Feb Mar	Apr May Jui	Jul Aug Sep	Oct Nov Dec	Jan Feb M	lar Apr May J	ın Jul Aug	Sep Oct Nov De	c Jan Feb Mar
	ESC-IPE1A ESC-IPE2A ESC-IPE3			4 4 4 4 4 4 4 4 4	_	4 4	1 4 4 4	4 4 4	4 4 4	4 4 4	4 4 4	4 4 4	4 4 4	1 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 4 4 4 4	4 4 4
	ESC-IPE4 ESC-IPE5	Monthly* Monthly*		4 4 4 4 4 4 4 4 4	4	4 4	1 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	4 4 4	4 4	4 4 4	4 4	4 4 4 4 4 4 4 4	4 4 4
Intermediate Station Dov	ESC-INE1A ESC-INE2A	Monthly* Monthly*		4 4 4	4	4 4	1 4 4 4	4 4 4	4 4 4	4 4 4	4 4 4	4 4 4	4 4 4	1 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	4 4 4
	ESC-INE3A ESC-INE4A ESC-INE5A	Monthly* Monthly* Monthly*		4 4 4 4 4 4 4 4 4	4	4 4	1 4 4 4	4 4 4	4 4 4	4 4 4	4 4 4	4 4 4	4 4 4	1 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 4 4 4 4 4	4 4 4
Reference Station Upcur	rent ESC-RFE1 ESC-RFE2	Monthly*		4 4 4																		4 4 4 4 4 4 4 4	
	ESC-RFE3 ESC-RFE4	Monthly* Monthly*		4 4 4	4	4 4 4	1 4 4 4 1 4 4 4	4 4 4 4 4 4	4 4 4	1 4 4 4 1 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 4 4							
Ma Wan Station	ESC-RFE5	Monthly*		4 4 4																		4 4 4 4	
Flood Tide Impact Station Downcur																							
	ESC-IPF1 ESC-IPF2 ESC-IPF3	Monthly* Monthly* Monthly*	4 4 4 4 4 4 4 4 4			4 4 4	1 4 4 4	4 4 4	4 4 4	4 4 4	4 4 4	4 4 4	4 4 4	1 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 4 4 4 4 4	4 4 4
Intermediate Station Dov	vncurrent ESC-INF1	Monthly*	4 4 4		4	4 4 4	1 4 4 4	4 4 4	4 4 4	4 4 4	4 4 4	4 4 4	4 4 4	1 4 4 4	4 4 4	4 4 4	4 4 4	4 4 4	4 4	4 4 4 4	1 4 4	4 4 4 4	4 4 4
Reference Station Upcur		Monthly* Monthly*	4 4 4		4	4 4 4	1 4 4 4	4 4 4	4 4 4	4 4 4	4 4 4	4 4 4	4 4 4	1 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
	ESC-RFF1A ESC-RFF2A ESC-RFF3		4 4 4 4 4 4 4 4 4		4	4 4 4	1 4 4 4	4 4 4	4 4 4	4 4 4	4 4 4	4 4 4	4 4 4	1 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 4 4 4 4	4 4 4
Ma Wan Station	MW1	Monthly*	4 4 4																			4 4 4 4	
Water Column Profiling Plume Stations		Manathic	Jan Feb Mar					1 1 1 7														Sep Oct Nov De	
	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 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
Benthic Recoloinisation Capped Stations at CMP	V	2 times per year	Jan Feb Mar	Apr May Jui	n Jul Aug	Sep Oct Nov D	ec Jan Feb Ma	r Apr May Jui	Jul Aug Se	p Oct Nov De	Jan Feb Mai	Apr May Ju	n Jul Aug Se	ep Oct Nov De	Jan Feb Mar	Apr May Ju	Jul Aug Sep	Oct Nov Dec	Jan Feb M	ar Apr May J	ın Jul Aug	Sep Oct Nov De	c Jan Feb Mar
	ESCV-CPB ESCV-CPC	2 times per year 2 times per year																					
Reference Stations	RBA	2 times per year 2 times per year																					
	RBB RBC1	2 times per year 2 times per year																					
Impact Monitoring for Di Upstream Stations		2.1	Jan Feb Mar	Apr May Jui	n Jul Aug	Sep Oct Nov D	ec Jan Feb Ma	r Apr May Ju	Jul Aug Se	p Oct Nov De	Jan Feb Mai	Apr May Ju	n Jul Aug Se	ep Oct Nov De	Jan Feb Mar	Apr May Jui	Jul Aug Sep	Oct Nov Dec	Jan Feb M	ar Apr May J	ın Jul Aug	Sep Oct Nov De	c Jan Feb Mar
Downstream Stations	US1 US2	3 times per week 3 times per week																					
	DS1 DS2 DS3	3 times per week 3 times per week 3 times per week																					
Ma W C	DS3 DS4 DS5	3 times per week 3 times per week 3 times per week																					
Ma Wan Station  Notes:	MW1	3 times per week																					
(4) The countries of some in-	anah anli ransan	ents the numbers of	ranliaataa nar																			-	

Notes:
(1) The number shown in each cell represents 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 shown in black represent planned 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.

<sup>(3)</sup> Impact Monitoring for Dredging will be scheduled when dredging operations commence.

(4) Benthic Recolonisation Studies for CMP V will be scheduled when capping operation for CMP V is completed.

Remarks:

A proposal on the change of number of sample replication of water quality & sediment monitoring and combination of routine water quality monitoring during capping operation was submitted to EPD and agreed by EPD on 3 December 2020. The proposed changes have been implemented for the EM&A activities since December 2020. Water Quality Monitoring during Capping Operation and Routine Water Quality Monitoring are combined such that Routine Water Quality Monitoring have be conducted monthly starting in December 2020. The number of sampling replicates can be further reduced according to Sections 3 and 4, subject to the findings of the further data review.

# **Appendix B. Water Quality Monitoring Results**



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

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 < 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 <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)(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 = <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				

### 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.
- 3. 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 September 2021

Station	Temp.	Salinity	<b>Turbidity</b>	Dissolve	ed Oxygen	рН	Suspended Solids		
	(°C)	(ppt)	(NTU)	(%)	(mg L <sup>-1</sup> )		(mg L <sup>-1</sup> )		
WCP 1 (Downstream)	28.52	28.14	9.27	86.10	5.71	8.00	6.3		
WCP 2 (Upstream)	28.53	28.01	16.01	84.61	5.62	8.00	11.5		
WQO (Wet Season)	N/A	25.21 - 30.81#	N/A	N/A	>4	6.5 - 8.5	11.8		

### 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 September 2021

Station	Temp.	Salinity	Turbidity	Dissolve	рН	
	(°C)	(ppt)	(NTU)	(%)	(mg L <sup>-1</sup> )	
RFF (Reference)	28.50	28.72	17.78	75.07	4.97	7.94
IPF (Impact)	28.36	28.94	22.73	72.92	4.83	7.91
INF (Intermediate)	28.47	28.86	23.87	74.12	4.90	7.89
Ma Wan	28.08	29.48	4.94	72.03	4.78	7.89
WQO (Wet Season)	N/A	25.85 - 31.60#	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 Routine Water Quality Monitoring of ESC CMPs in September 2021

Station	As	Cd	Cr	Cu	Pb	Hg	Ni	Ag	Zn	$NH_3$	TIN	BOD <sub>5</sub>	SS
	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)
RFF	5.20	<lor< td=""><td>2.78</td><td>23.26</td><td>1.52</td><td>0.27</td><td>6.06</td><td>0.56</td><td>40.95</td><td>0.15</td><td>0.59</td><td>1.33</td><td>16.1</td></lor<>	2.78	23.26	1.52	0.27	6.06	0.56	40.95	0.15	0.59	1.33	16.1
IPF	3.45	<lor< td=""><td>1.95</td><td>31.43</td><td>2.23</td><td><lor< td=""><td>1.08</td><td><lor< td=""><td>39.44</td><td>0.19</td><td>0.89</td><td>1.46</td><td>22.6</td></lor<></td></lor<></td></lor<>	1.95	31.43	2.23	<lor< td=""><td>1.08</td><td><lor< td=""><td>39.44</td><td>0.19</td><td>0.89</td><td>1.46</td><td>22.6</td></lor<></td></lor<>	1.08	<lor< td=""><td>39.44</td><td>0.19</td><td>0.89</td><td>1.46</td><td>22.6</td></lor<>	39.44	0.19	0.89	1.46	22.6
INF	4.44	<lor< td=""><td>2.68</td><td>19.34</td><td>1.78</td><td><lor< td=""><td>2.58</td><td><lor< td=""><td>39.47</td><td>0.17</td><td>0.54</td><td>1.44</td><td>21.5</td></lor<></td></lor<></td></lor<>	2.68	19.34	1.78	<lor< td=""><td>2.58</td><td><lor< td=""><td>39.47</td><td>0.17</td><td>0.54</td><td>1.44</td><td>21.5</td></lor<></td></lor<>	2.58	<lor< td=""><td>39.47</td><td>0.17</td><td>0.54</td><td>1.44</td><td>21.5</td></lor<>	39.47	0.17	0.54	1.44	21.5
Ma Wan	5.45	<lor< td=""><td>2.53</td><td>16.25</td><td>0.78</td><td><lor< td=""><td>9.15</td><td><lor< td=""><td>43.55</td><td>0.16</td><td>0.44</td><td>1.58</td><td>7.3</td></lor<></td></lor<></td></lor<>	2.53	16.25	0.78	<lor< td=""><td>9.15</td><td><lor< td=""><td>43.55</td><td>0.16</td><td>0.44</td><td>1.58</td><td>7.3</td></lor<></td></lor<>	9.15	<lor< td=""><td>43.55</td><td>0.16</td><td>0.44</td><td>1.58</td><td>7.3</td></lor<>	43.55	0.16	0.44	1.58	7.3

 $\label{eq:wqo} WQO \mbox{ of TIN: } 0.5 \mbox{ mg/L} \\ Wet \mbox{ Season WQO of SS: } 11.8 \mbox{ mg/L} \\$ 

# Notes:

- 1. "<LOR" indicates the concentrations of metals and metalloids are below the limit of reporting.
- 2. Cell shaded yellow / red indicates value exceeding the Action/Limit levels.
- Cell shaded grey indicates value exceeding the WQO.

# **Appendix C. Graphical Presentations**

# Routine Water Quality Monitoring for ESC CMP V - September 2021

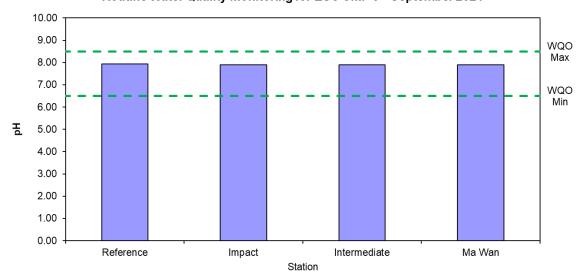


Figure 1: Level of pH recorded during Routine Water Quality Monitoring for disposal operations at ESC CMP V in September 2021

# Routine Water Quality Monitoring for ESC CMP V - September 2021

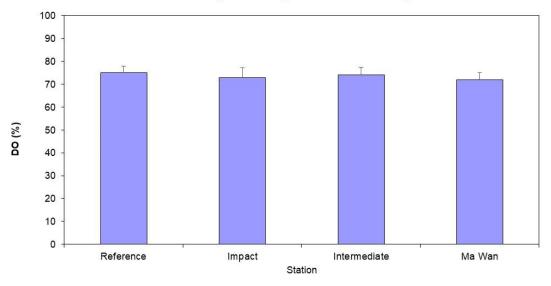


Figure 2: Level of Dissolved Oxygen (DO) (% saturation; mean + SD)¹recorded during Routine Water Quality Monitoring for disposal operations at ESC CMP V in September 2021

<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 - September 2021

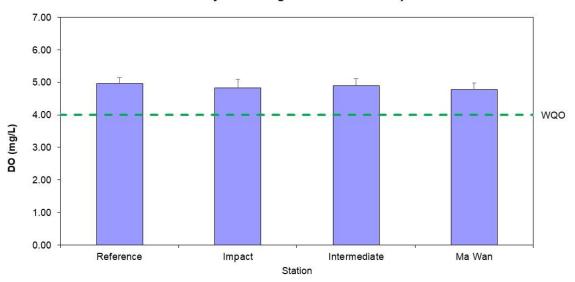


Figure 3: Concentration of Dissolved Oxygen (DO) (mg/L; mean + SD)<sup>1</sup>recorded during Routine Water Quality Monitoring for disposal operations at ESC CMP V in September 2021

# Routine Water Quality Monitoring for ESC CMP V - September 2021

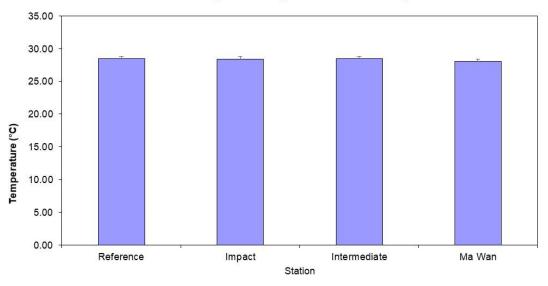
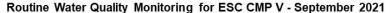


Figure 4: Level of Temperature (°C; mean + SD)¹recorded during Routine Water Quality Monitoring for disposal operations at ESC CMP V in September 2021

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



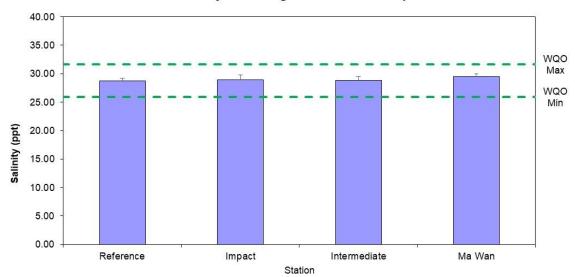


Figure 5: Level of Salinity (ppt; mean + SD)<sup>1</sup>recorded during Routine Water Quality Monitoring for disposal operations at ESC CMP V in September 2021

## Routine Water Quality Monitoring for ESC CMP V - September 2021

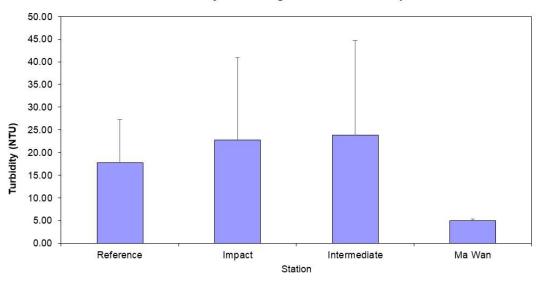


Figure 6: Level of Turbidity (NTU; mean + SD)<sup>1</sup>recorded during Routine Water Quality Monitoring for disposal operations at ESC CMP V in September 2021

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 September 2021

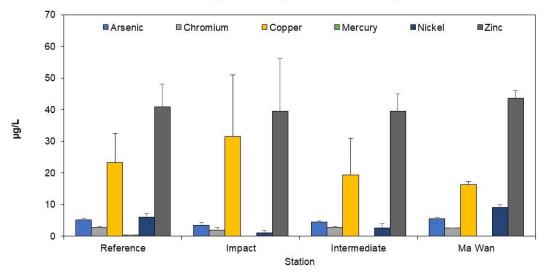


Figure 7: Concentration of Arsenic, Chromium, Copper, Lead, Mercury, Nickel, Silver, and Zinc (μg/L; mean + SD) in water samples collected from Routine Water Quality Monitoring for disposal operations at ESC CMP V in September 2021

# Routine Water Quality Monitoring for Nutrients - September 2021

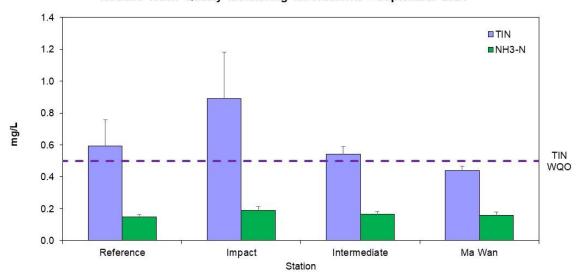


Figure 8: Concentration of Total Inorganic Nitrogen (TIN) and Ammonia Nitrogen (NH3-N) (mg/L; mean + SD) in water samples collected from Routine Water Quality Monitoring for disposal operations at ESC CMP V in September 2021



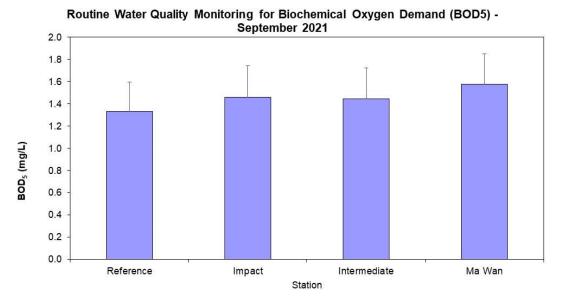


Figure 9: Level of Biochemical Oxygen Demand (BOD5) (mg/L; mean + SD) in water samples collected from Routine Water Quality Monitoring for disposal operations at ESC CMP V in September 2021

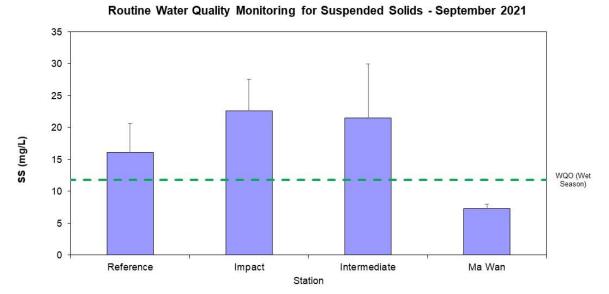


Figure 10: Concentration of Suspended Solids (SS) (mg/L; mean + SD) in water samples collected from Routine Water Quality Monitoring for disposal operations at ESC CMP V in September 2021



## Pit Specific Sediment Chemistry for Metal and Metalloid Contaminants at ESC CMP Vb - September 2021

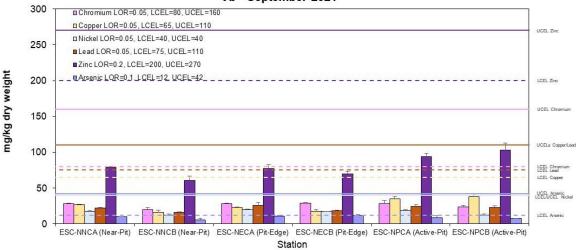


Figure 11: Concentration of Metals and Metalloid (Cr, Cu, Ni, Pb, Zn, As; mg/kg dry weight; mean + SD) in sediment samples collected from Pit Specific Sediment Chemistry Monitoring for ESC CMP Vb in September 2021

# Pit Specific Sediment Chemistry for Metal Contaminants at ESC CMP Vb - September 2021



Figure 12: 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 September 2021



# Pit Specific Sediment Chemistry for Total Organic Carbon (TOC) at ESC CMP Vb - September 2021

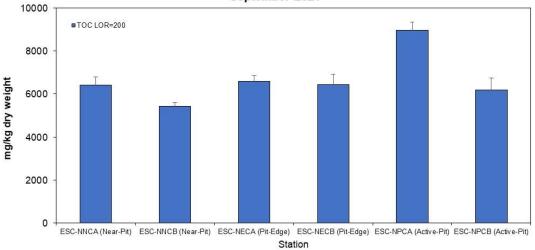


Figure 13: Concentration of Total Organic Carbon (TOC) (mg/kg dry weight; mean + SD) in sediment samples collected from Pit Specific Sediment Chemistry Monitoring for ESC CMP Vb in September 2021

# Pit Specific Sediment Chemistry for Low and High Molecular Weight Polycyclic Aromatics Hydrocarbons (PAHs) at ESC CMP Vb - September 2021

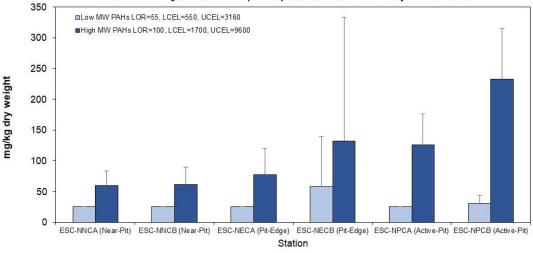


Figure 14: Concentration of Low and High Molecular Weight Polycyclic Aromatic Hydrocarbons (mg/kg dry weight; mean + SD) in sediment samples collected from Pit Specific Sediment Chemistry Monitoring for ESC CMP Vb in September 2021

0



# Pit Specific Sediment Chemistry for Tributyltin (TBT) at ESC CMP Vb - September 2021 12 10 8 ng TBT/kg 6 4 2

Concentration of TributyItin (TBT) ( $\mu g$  TBT/kg; mean + SD) in sediment samples collected from Pit Specific Sediment Chemistry Monitoring for ESC CMP Vb in September 2021

ESC-NNCA (Near-Pit) ESC-NNCB (Near-Pit) ESC-NECA (Pit-Edge) ESC-NECB (Pit-Edge) ESC-NPCA (Active-Pit) ESC-NPCB (Active-Pit) Station

# **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

