土木工程拓展署
Civil Engineering and Development Department

Agreement No. CE 63/2016 (EP)

Environmental Monitoring and Audit for Disposal Facility to the East of Sha Chau (2017-2020) – Investigation

Monthly EM&A Report for Contaminated Mud Pits to the East of Sha Chau and the South of The Brothers – March 2018

Revision 0

April 2018

Environmental Resources Management
16/F Berkshire House
25 Westlands Road
Quarry Bay, Hong Kong
Telephone (852) 2271 3000
Facsimile (852) 2723 5660

www.erm.com

ERM

The business of sustainability

Agreement No. CE 63/2016 (EP) Environmental Monitoring and Audit for Disposal Facility to the East of Sha Chau (2017-2020) – Investigation

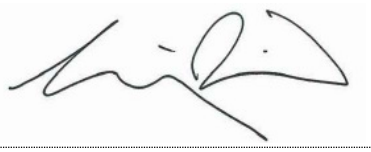
Monthly EM&A Report for Contaminated Mud Pits to the East of Sha Chau and the South of The Brothers – March 2018

Revision 0

Document Code: 0400720_Monthly March 2018_v0.doc

Environmental Resources Management

16/F
Berkshire House
25 Westlands Road
Quarry Bay
Hong Kong
Telephone: (852) 2271 3000
Facsimile: (852) 2723 5660
E-mail: post.hk@erm.com
http://www.erm.com

Client: Civil Engineering and Development Department (CEDD)	Project No: 0400720
Summary: This document presents the Monthly EM&A Report for *Environmental Monitoring and Audit for Disposal Facility to the East of Sha Chau and the South of The Brothers*.	Date: 17 April 2018 Approved by:  Craig A. Reid *Partner*

Revision	Description	By	Checked	Approved	Date
v0	Monthly EM&A Report for ESC CMPs and SB CMPs	CY	JT	CAR	17/4/18

Distribution

☐ Internal

☒ Public

☐ Confidential

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

ERM

Dredging, Management and Capping of Contaminated Sediment Disposal Facility at Sha Chau and to the South of The Brothers

Environmental Certification Sheet
EP-312/2008/A & EP-427/2011/A

Reference Document/Plan

Document/~~Plan~~ to be ~~Certified~~/ Verified:	Quarterly EM&A Report for Contaminated Mud Pits to the East of Sha Chau and the South of The Brothers – October to December 2017
Date of Report:	16 April 2018
Date prepared by ET:	16 April 2018
Date received by IA:	16 April 2018

Reference EP Condition

Environmental Permit Condition:

Condition 3.1 of EP-312/2008/A and Condition 4.1 of EP-427/2011/A
The EM&A programme shall be implemented in accordance with the procedures and requirements in the EM&A Manual. Any changes to the monitoring and audit requirements shall be justified by the ET leader and verified by the Independent Auditor as conforming to the requirements set out in the EM&A Manual, and shall seek the prior approval from the Director before implementation.

ET Certification

I hereby certify that the above referenced document/~~plan~~ complies with the above referenced condition of EP-312/2008/A and EP-427/2011/A

Jovy Tam,
Environmental Team Leader: 

Date: 16/4/2018

IA Verification

I hereby verify that the above referenced document/~~plan~~ complies with the above referenced condition of EP-312/2008/A and EP-427/2011/A

Dr Wang Wen Xiong,
Independent Auditor: 

Date: 16/4/2018

CONTENTS

ANNEXES

Agreement No. CE 63/2016 (EP)
Environmental Monitoring and Audit
for Disposal Facility to the East of Sha Chau (2017-2020) - Investigation

MONTHLY EM&A REPORT FOR MARCH 2018

1.1 BACKGROUND

1.1.1 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 South of The Brothers (SB) and to the East of Sha Chau (ESC) for the disposal of contaminated sediment, and 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. Two Environmental Permits (EPs), EP-312/2008/A and EP-427/2011/A, were issued by the Environmental Protection Department (EPD) to the CEDD, the Permit Holder, on 28 November 2008 and 23 December 2011 for the Dredging, Management and Capping of Contaminated Sediment Disposal Facilities at ESC CMP V and SB CMPs, respectively.

1.1.2 Under the requirements of the two EPs for ESC CMP V and SB CMPs, 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 and SB. 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 as well as capping operations of SB CMPs.

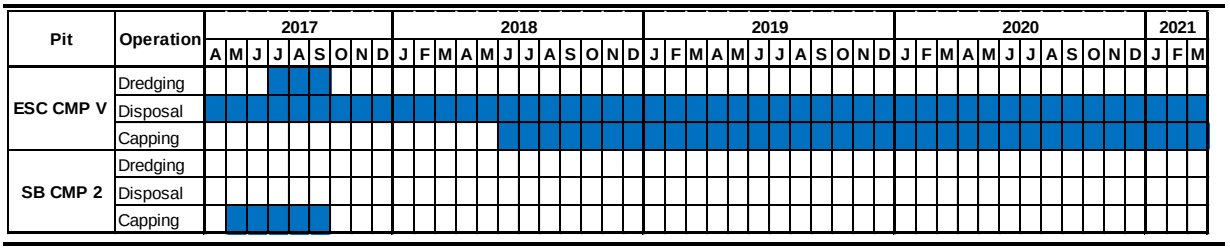
1.1.3 The present EM&A programme under *Agreement No. CE 63/2016 (EP)* covers the dredging, disposal and capping operations of the ESC CMP V as well as the capping operations of the SB CMPs (see *Annex A* for the EM&A programme). Detailed works schedule for ESC CMP V and SB CMPs is shown in *Figure 1.1*. In March 2018, the following work was being undertaken:

- Disposal of contaminated mud 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.

Figure 1.1 Works Schedule for ESC CMP V and SB CMPs



1.2 REPORTING PERIOD

1.2.1 This *Monthly EM&A Report for March 2018* covers the EM&A activities for the reporting month of March 2018.

1.3 DETAILS OF SAMPLING AND LABORATORY TESTING ACTIVITIES

1.3.1 The following monitoring activities were undertaken for ESC CMP V in March 2018:

- *Water Column Profiling of ESC CMP Vd*; and
- *Pit Specific Sediment Chemistry of ESC CMP Vd.*

1.3.2 No monitoring activities were undertaken for SB CMP in March 2018.

1.4 DETAILS OF OUTSTANDING SAMPLING AND/OR ANALYSIS

1.4.1 No outstanding sampling remained for March 2018.

1.5 BRIEF DISCUSSION OF THE MONITORING RESULTS FOR ESC CMP V

1.5.1 Brief discussion of the monitoring results of the following activities for ESC CMP V is presented in this *Monthly EM&A Report for March 2018*:

- *Water Column Profiling of ESC CMP Vd* in March 2018;
- *Pit Specific Sediment Chemistry of ESC CMP Vd* in February and March 2018; and
- *Cumulative Impact Sediment Chemistry for ESC CMP V* in February 2018.

1.5.2 ***Water Column Profiling of ESC CMP Vd – March 2018***

1.5.3 *Water Column Profiling* was undertaken at a total of two sampling stations (Upstream and Downstream stations) on 6 March 2018. 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 2007 - 2016 from stations in the Northwestern Water Control Zone (WCZ), where the ESC CMPs are located [1]. 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 *Annex B* for details).

In-situ Measurements

1.5.4 Analyses of results for March 2018 indicated that levels of DO, Salinity and pH complied with the WQOs at both Downstream and Upstream stations (*Table B2* of *Annex B*). In addition, levels of DO and Turbidity at all stations complied with the Action and Limit Levels (*Tables B1* and *B2* of *Annex B*).

Laboratory Measurements for Suspended Solids (SS)

1.5.5 Analyses of results for March 2018 indicated that the SS levels complied with the WQO and the Action and Limit Levels at both Upstream and Downstream stations (*Tables B1* and *B2* of *Annex B*).

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

[1] http://epic.epd.gov.hk/EPICRIVER/marine/?lang=en

1.5.7 ***Pit Specific Sediment Chemistry of ESC CMP Vd – February and March 2018***

1.5.8 Monitoring locations for *Pit Specific Sediment Chemistry for ESC CMP Vd* are shown in *Figure 1.2*. A total of six (6) monitoring stations were sampled in February and March 2018.

1.5.9 The concentrations of all inorganic contaminants were lower than the Lower Chemical Exceedance Level (LCEL) at most stations in February and March 2018, except the exceedance of LCEL for Arsenic at Active Pit station ESC-NPAB in March 2018 (*Figures 1, 2, 5* and *6* of *Annex C*).

1.5.10 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 [(1)]. It is presumed that the natural concentrations of Arsenic are similar in onshore and offshore sediments [(2)], and relatively high Arsenic levels may thus occur throughout Hong Kong. Therefore, the LECL exceedances of Arsenic are unlikely to be caused by the disposal operations at ESC CMP Vd but rather as a result of naturally occurring deposits.

1.5.11 For organic contaminants, the concentrations of Total Organic Carbon (TOC) were generally similar in February and March 2018 (*Figures 3* and *7* of *Annex C*). The concentration of Tributyltin (TBT) was generally higher at Active-Pit stations ESC-NPAB and ESC-NPAA in February and March 2018, respectively (*Figure 4* and *8* of *Annex C*). Low and High Molecular Weight Polycyclic Aromatic Hydrocarbons (PAHs), Total Polychlorinated Biphenyls (PCBs), Total dichloro-diphenyl-trichloroethane (DDT) and 4,4'-dichlorodiphenyldichloroethylene (DDE) concentrations were below the limit of reporting at all stations in February and March 2018.

1.5.12 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 Vd in February and March 2018. Statistical analysis will be undertaken and presented in the corresponding quarterly report to investigate whether there are any unacceptable impacts in the area caused by the contaminated mud disposal.

1.5.13 ***Cumulative Impact Sediment Chemistry of ESC CMP V – February 2018***

1.5.14 Monitoring locations for *Cumulative Impact Sediment Chemistry for ESC CMP V* are shown in *Figure 1.3*. A total of nine (9) monitoring stations were sampled in February 2018.

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

(2) 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

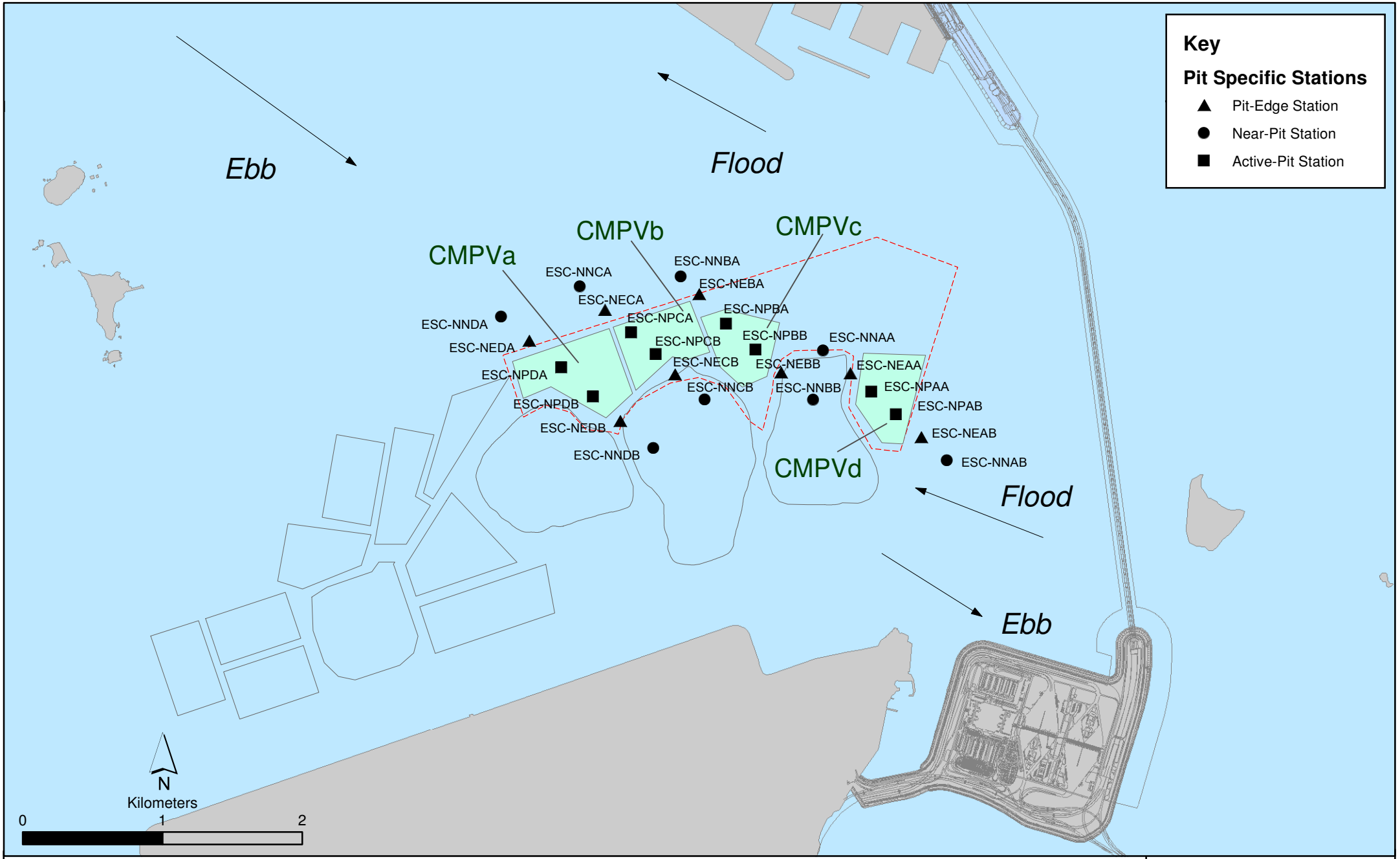


Figure 1.2

Pit Specific Sediment Quality Monitoring Stations for CMPV

File: T:\GIS\CONTRACT\0400720\Mxd\0400720_SQMS_pit specific.mxd
Date: 9/5/2017

Environmental Resources Management

ERM

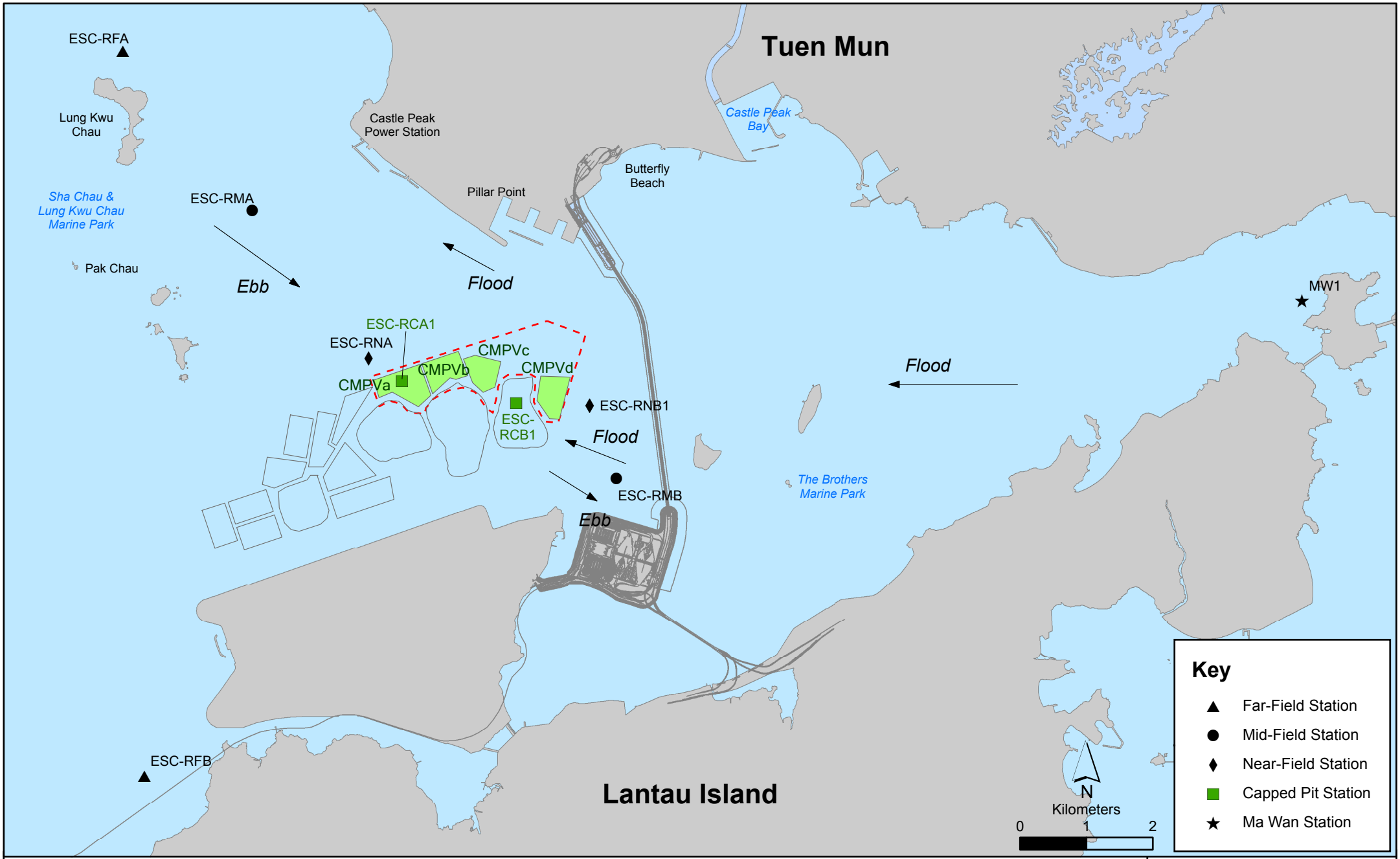


Figure 1.3

Cumulative Impacts Sediment Quality Monitoring Stations for ESC CMPs

File: T:\GIS\CONTRACT\0175086\Mxd\updated_20170419\0175086_SQMS_cum_impact.mxd
Date: 19/4/2017

Environmental Resources Management

ERM

1.5.15 Analyses of results for the *Cumulative Impact Sediment Chemistry Monitoring* indicated that the concentrations of most inorganic contaminants were below the LCEL at all stations in February 2018, except Arsenic exceeded the LCEL at Mid Field stations ESC-RMA and ESC-RMB as well as the Far Field stations ESC-RFA and ESC-RFB (*Figures 9* and 10 of *Annex C*).

1.5.16 As discussed in *Section 1.5.10*, the natural concentrations of Arsenic are relatively high in Hong Kong. Therefore, the LCEL exceedances of Arsenic are unlikely to be caused by the disposal operations at ESC CMP Vd but rather as a result of naturally occurring deposits.

1.5.17 For organic contaminants, the concentrations of TOC were generally similar in February 2018 with lower concentrations recorded at Capped Pit stations ESC-RCA and ESC-RCB (*Figure 11* of *Annex C*). The concentrations of TBT were recorded to be higher at Ma Wan station (*Figure 12* of *Annex C*). Low and High Molecular Weight PAHs, PCBs, DDT and DDE concentrations were generally recorded below the limit of reporting at all stations, except concentrations of High Molecular Weight PAHs was higher than the limit of reporting at Capped Pit station ESC-RCA (*Figure 13* of *Annex C*).

1.5.18 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 Vd in February 2018. Statistical analysis will be undertaken and presented in the corresponding quarterly report to investigate whether there are any unacceptable impacts in the area caused by the contaminated mud disposal.

1.6 ACTIVITIES SCHEDULED FOR THE NEXT MONTH

1.6.1 The following monitoring activities will be conducted in the next monthly period of April 2018 for ESC CMP V (see *Annex A* for the sampling schedule):

- *Water Column Profiling of ESC CMP Vd*;
- *Routine Water Quality Monitoring of ESC CMP V;* and
- *Pit Specific Sediment Chemistry of ESC CMP Vd.*

1.6.2 No monitoring activities are scheduled to be undertaken for SB CMPs in April 2018.

1.7 STUDY PROGRAMME

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

Annex A

Sampling Schedule

Annex A1 - East of Sha Chau Environmental Monitoring and Audit Sampling Schedule for CMP (April 2017 - March 2021)

			2017									2018												2019		
Pit Specific Sediment Chemistry	Code	Frequency	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M
Active-Pit																										
	ESC-NPAA	Monthly	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
	ESC-NPAB	Monthly	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
Pit-Edge																										
	ESC-NEAA	Monthly	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
	ESC-NEAB	Monthly	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
Near-Pit																										
	ESC-NNAA	Monthly	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
	ESC-NNAB	Monthly	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
Cumulative Impact Sediment Chemistry			A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M
Near-field Stations																										
	ESC-RNA	4 times per year			12		12				12		12				12		12				12		12	
	ESC-RNB1	4 times per year			12		12				12		12				12		12				12		12	
Mid-field Stations																										
	ESC-RMA	4 times per year			12		12				12		12				12		12				12		12	
	ESC-RMB	4 times per year			12		12				12		12				12		12				12		12	
Capped Pit Stations																										
	ESC-RCA1	4 times per year			12		12				12		12				12		12				12		12	
	ESC-RCB1	4 times per year			12		12				12		12				12		12				12		12	
Far-Field Stations																										
	ESC-RFA	4 times per year			12		12				12		12				12		12				12		12	
	ESC-RFB	4 times per year			12		12				12		12				12		12				12		12	
Ma Wan Station																										
	MW1	4 times per year			12		12				12		12				12		12				12		12	
Sediment Toxicity Tests			A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M
Near-Pit Stations																										
	ESC-TDA	2 times per year					5						5						5						5	
	ESC-TDB1	2 times per year					5						5						5						5	
Reference Stations																										
	ESC-TRA	2 times per year					5						5						5						5	
	ESC-TRB	2 times per year					5						5						5						5	
Ma Wan Station																										
	MW1	2 times per year					5						5						5						5	
Tissue/ Whole Body Sampling			A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M
Near-Pit Stations																										
	ESC-INA	2 times per year					*						*						*						*	
	ESC-INB	2 times per year					*						*						*						*	
Reference North																										
	TNA	2 times per year					*						*						*						*	
	TNB	2 times per year					*						*						*						*	
Reference South																										
	TSA	2 times per year					*						*						*						*	
	TSB	2 times per year					*						*						*						*	
Demersal Trawling			A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M
Near Pit Stations																										
	ESC-INA	4 times per year				5	5					5	5					5	5					5	5	
	ESC-INB	4 times per year				5	5					5	5					5	5					5	5	
Reference North																										
	TNA	4 times per year				5	5					5	5					5	5					5	5	
	TNB	4 times per year				5	5					5	5					5	5					5	5	
Reference South																										
	TSA	4 times per year				5	5					5	5					5	5					5	5	
	TSB	4 times per year				5	5					5	5					5	5					5	5	
Capping			A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M
Ebb Tide																										
Impact Station Downcurrent																										
	ESC-IPE1A	4 times per year															3		3				3		3	
	ESC-IPE2A	4 times per year															3		3				3		3	
	ESC-IPE3	4 times per year															3		3				3		3	
	ESC-IPE4	4 times per year															3		3				3		3	
	ESC-IPE5	4 times per year															3		3				3		3	
Intermediate Station Downcurrent																										
	ESC-INE1A	4 times per year															3		3				3		3	
	ESC-INE2A	4 times per year															3		3				3		3	
	ESC-INE3A	4 times per year															3		3				3		3	
	ESC-INE4A	4 times per year															3		3				3		3	
	ESC-INE5A	4 times per year															3		3				3		3	
Reference Station Upcurrent																										
	ESC-RFE1	4 times per year															3		3				3		3	
	ESC-RFE2	4 times per year															3		3				3		3	
	ESC-RFE3	4 times per year															3		3				3		3	
	ESC-RFE4	4 times per year															3		3				3		3	
	ESC-RFE5	4 times per year															3		3				3		3	
Ma Wan Station																										
	MW1	4 times per year															3		3				3		3	
Flood Tide																										
Impact Station Downcurrent																										
	ESC-IPF1	4 times per year															3		3				3		3	
	ESC-IPF2	4 times per year															3		3				3		3	
	ESC-IPF3	4 times per year															3		3				3		3	
Intermediate Station Downcurrent																										
	ESC-INF1	4 times per year															3		3				3		3	
	ESC-INF2	4 times per year															3		3				3		3	
	ESC-INF3	4 times per year															3		3				3		3	
Reference Station Upcurrent																										
	ESC-RFF1A	4 times per year															3		3				3		3	
	ESC-RFF2A	4 times per year															3		3				3		3	
	ESC-RFF3	4 times per year															3		3				3		3	
Ma Wan Station																										
	MW1	4 times per year															3		3				3		3	
Routine Water Quality Monitoring			A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M
Ebb Tide																										
Impact Station Downcurrent																										
	ESC-IPE1A	8 times per year	8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8	
	ESC-IPE2A	8 times per year	8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8	
	ESC-IPE3	8 times per year	8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8	
	ESC-IPE4	8 times per year	8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8	
	ESC-IPE5	8 times per year	8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8	
Intermediate Station Downcurrent																										
	ESC-INE1A	8 times per year	8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8	
	ESC-INE2A	8 times per year	8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8	
	ESC-INE3A	8 times per year	8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8	
	ESC-INE4A	8 times per year	8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8	
	ESC-INE5A	8 times per year	8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8	
Reference Station Upcurrent																										
	ESC-RFE1	8 times per year	8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8	
	ESC-RFE2	8 times per year	8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8	
	ESC-RFE3	8 times per year	8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8	
	ESC-RFE4	8 times per year	8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8	
	ESC-RFE5	8 times per year	8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8	
Ma Wan Station																										
	MW1	8 times per year	8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8	
Flood Tide																										
Impact Station Downcurrent																										
	ESC-IPF1	8 times per year	8	8		8	8		8	8					8	8		8	8		8	8		8	8	
	ESC-IPF2	8 times per year	8	8		8	8		8	8					8	8		8	8		8	8		8	8	
	ESC-IPF3	8 times per year	8	8		8	8		8	8					8	8		8	8		8	8		8	8	
Intermediate Station Downcurrent																										
	ESC-INF1	8 times per year	8	8		8	8		8	8					8	8		8	8		8	8		8	8	
	ESC-INF2	8 times per year	8	8		8	8		8	8					8	8		8	8		8	8		8	8	
	ESC-INF3	8 times per year	8	8		8	8		8	8					8	8		8	8		8	8		8	8	
Reference Station Upcurrent																										
	ESC-RFF1A	8 times per year	8	8		8	8		8	8					8	8		8	8		8	8		8	8	
	ESC-RFF2A	8 times per year	8	8		8	8		8	8					8	8		8	8		8	8		8	8	
	ESC-RFF3	8 times per year	8	8		8	8		8	8					8	8		8	8		8	8		8	8	
Ma Wan Station																										
	MW1	8 times per year	8	8		8	8		8	8					8	8		8	8		8	8		8	8	
Water Column Profiling			A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M
Plume Stations	WCP1	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
	WCP2	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
Benthic Recolonisation Studies			A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M
Capped Stations at CMPV																										
	ESCV-CPA	2 times per year																								
	ESCV-CPB	2 times per year																								
	ESCV-CPC	2 times per year																								
	ESCV-CPD	2 times per year																								
Reference Stations																										
	RBA	2 times per year																								
	RBB	2 times per year																								
	RBC1	2 times per year																								
Impact Monitoring for Dredging			A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M
Upstream Stations																										
	US1	3 times per week				2	2	2																		
	US2	3 times per week				2	2	2																		
Downstream Stations																										
	DS1	3 times per week				2	2	2																		
	DS2	3 times per week				2	2	2																		
	DS3	3 times per week				2	2	2																		
	DS4	3 times per week				2	2	2																		
	DS5	3 times per week				2	2	2																		
Ma Wan Station																										
	MW1	3 times per week				2	2	2																		

			2019									2020												2021		
Pit Specific Sediment Chemistry	Code	Frequency	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M
Active-Pit																										
	ESC-NPAA	Monthly	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
	ESC-NPAB	Monthly	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
Pit-Edge																										
	ESC-NEAA	Monthly	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
	ESC-NEAB	Monthly	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
Near-Pit																										
	ESC-NNAA	Monthly	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
	ESC-NNAB	Monthly	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
Cumulative Impact Sediment Chemistry			A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M
Near-field Stations																										
	ESC-RNA	4 times per year			12		12				12		12				12		12				12		12	
	ESC-RNB1	4 times per year			12		12				12		12				12		12				12		12	
Mid-field Stations																										
	ESC-RMA	4 times per year			12		12				12		12				12		12				12		12	
	ESC-RMB	4 times per year			12		12				12		12				12		12				12		12	
Capped Pit Stations																										
	ESC-RCA1	4 times per year			12		12				12		12				12		12				12		12	
	ESC-RCB1	4 times per year			12		12				12		12				12		12				12		12	
Far-Field Stations																										
	ESC-RFA	4 times per year			12		12				12		12				12		12				12		12	
	ESC-RFB	4 times per year			12		12				12		12				12		12				12		12	
Ma Wan Station																										
	MW1	4 times per year			12		12				12		12				12		12				12		12	
Sediment Toxicity Tests			A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M
Near-Pit Stations																										
	ESC-TDA	2 times per year					5						5						5						5	
	ESC-TDB1	2 times per year					5						5						5						5	
Reference Stations																										
	ESC-TRA	2 times per year					5						5						5						5	
	ESC-TRB	2 times per year					5						5						5						5	
Ma Wan Station																										
	MW1	2 times per year					5						5						5						5	
Tissue/ Whole Body Sampling			A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M
Near-Pit Stations																										
	ESC-INA	2 times per year					*						*						*						*	
	ESC-INB	2 times per year					*						*						*						*	
Reference North																										
	TNA	2 times per year					*						*						*						*	
	TNB	2 times per year					*						*						*						*	
Reference South																										
	TSA	2 times per year					*						*						*						*	
	TSB	2 times per year					*						*						*						*	
Demersal Trawling			A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M
Near Pit Stations																										
	ESC-INA	4 times per year				5	5					5	5					5	5					5	5	
	ESC-INB	4 times per year				5	5					5	5					5	5					5	5	
Reference North																										
	TNA	4 times per year				5	5					5	5					5	5					5	5	
	TNB	4 times per year				5	5					5	5					5	5					5	5	
Reference South																										
	TSA	4 times per year				5	5					5	5					5	5					5	5	
	TSB	4 times per year				5	5					5	5					5	5					5	5	
Capping			A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M
Ebb Tide																										
Impact Station Downcurrent																										
	ESC-IPE1A	4 times per year			3		3				3		3				3		3				3		3	
	ESC-IPE2A	4 times per year			3		3				3		3				3		3				3		3	
	ESC-IPE3	4 times per year			3		3				3		3				3		3				3		3	
	ESC-IPE4	4 times per year			3		3				3		3				3		3				3		3	
	ESC-IPE5	4 times per year			3		3				3		3				3		3				3		3	
Intermediate Station Downcurrent																										
	ESC-INE1A	4 times per year			3		3				3		3				3		3				3		3	
	ESC-INE2A	4 times per year			3		3				3		3				3		3				3		3	
	ESC-INE3A	4 times per year			3		3				3		3				3		3				3		3	
	ESC-INE4A	4 times per year			3		3				3		3				3		3				3		3	
	ESC-INE5A	4 times per year			3		3				3		3				3		3				3		3	
Reference Station Upcurrent																										
	ESC-RFE1	4 times per year			3		3				3		3				3		3				3		3	
	ESC-RFE2	4 times per year			3		3				3		3				3		3				3		3	
	ESC-RFE3	4 times per year			3		3				3		3				3		3				3		3	
	ESC-RFE4	4 times per year			3		3				3		3				3		3				3		3	
	ESC-RFE5	4 times per year			3		3				3		3				3		3				3		3	
Ma Wan Station																										
	MW1	4 times per year			3		3				3		3				3		3				3		3	
Flood Tide																										
Impact Station Downcurrent																										
	ESC-IPF1	4 times per year			3		3				3		3				3		3				3		3	
	ESC-IPF2	4 times per year			3		3				3		3				3		3				3		3	
	ESC-IPF3	4 times per year			3		3				3		3				3		3				3		3	
Intermediate Station Downcurrent																										
	ESC-INF1	4 times per year			3		3				3		3				3		3				3		3	
	ESC-INF2	4 times per year			3		3				3		3				3		3				3		3	
	ESC-INF3	4 times per year			3		3				3		3				3		3				3		3	
Reference Station Upcurrent																										
	ESC-RFF1A	4 times per year			3		3				3		3				3		3				3		3	
	ESC-RFF2A	4 times per year			3		3				3		3				3		3				3		3	
	ESC-RFF3	4 times per year			3		3				3		3				3		3				3		3	
Ma Wan Station																										
	MW1	4 times per year			3		3				3		3				3		3				3		3	
Routine Water Quality Monitoring			A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M
Ebb Tide																										
Impact Station Downcurrent																										
	ESC-IPE1A	8 times per year	8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8	
	ESC-IPE2A	8 times per year	8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8	
	ESC-IPE3	8 times per year	8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8	
	ESC-IPE4	8 times per year	8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8	
	ESC-IPE5	8 times per year	8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8	
Intermediate Station Downcurrent																										
	ESC-INE1A	8 times per year	8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8	
	ESC-INE2A	8 times per year	8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8	
	ESC-INE3A	8 times per year	8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8	
	ESC-INE4A	8 times per year	8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8	
	ESC-INE5A	8 times per year	8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8	
Reference Station Upcurrent																										
	ESC-RFE1	8 times per year	8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8	
	ESC-RFE2	8 times per year	8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8	
	ESC-RFE3	8 times per year	8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8	
	ESC-RFE4	8 times per year	8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8	
	ESC-RFE5	8 times per year	8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8	
Ma Wan Station																										
	MW1	8 times per year	8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8	
Flood Tide																										
Impact Station Downcurrent																										
	ESC-IPF1	8 times per year	8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8	
	ESC-IPF2	8 times per year	8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8	
	ESC-IPF3	8 times per year	8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8	
Intermediate Station Downcurrent																										
	ESC-INF1	8 times per year	8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8	
	ESC-INF2	8 times per year	8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8	
	ESC-INF3	8 times per year	8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8	
Reference Station Upcurrent																										
	ESC-RFF1A	8 times per year	8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8	
	ESC-RFF2A	8 times per year	8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8	
	ESC-RFF3	8 times per year	8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8	
Ma Wan Station																										
	MW1	8 times per year	8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8	
Water Column Profiling			A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M
Plume Stations	WCP1	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
	WCP2	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
Benthic Recolonisation Studies			A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M
Capped Stations at CMPV																										
	ESCV-CPA	2 times per year																								
	ESCV-CPB	2 times per year																								
	ESCV-CPC	2 times per year																								
	ESCV-CPD	2 times per year																								
Reference Stations																										
	RBA	2 times per year																								
	RBB	2 times per year																								
	RBC1	2 times per year																								
Impact Monitoring for Dredging			A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M
Upstream Stations																										
	US1	3 times per week																								
	US2	3 times per week																								
Downstream Stations																										
	DS1	3 times per week																								
	DS2	3 times per week																								
	DS3	3 times per week																								
	DS4	3 times per week																								
	DS5	3 times per week																								
Ma Wan Station																										
	MW1	3 times per week																								

Notes:
The number shown in each cell represents the numbers of replicates per monitoring station
Impact Monitoring for Dredging will be scheduled when dredging operations commence.
Benthic Recolonisation Studies for CMP V will be scheduled when capping operation for CMP V is completed.

Annex A2 - Environmental Monitoring and Audit Sampling Schedule for South of The Brothers (April 2017 - December 2018)

			2017									2018												
Capping Water Quality Monitoring			**A**	**M**	**J**	**J**	**A**	**S**	**O**	**N**	**D**	**J**	**F**	**M**	**A**	**M**	**J**	**J**	**A**	**S**	**O**	**N**	**D**
Ebb Tide																								
Impact Stations Downcurrent																								
	SB-IPE1	4 times per year		3	3		3	3																
	SB-IPE2	4 times per year		3	3		3	3																
	SB-IPE3	4 times per year		3	3		3	3																
	SB-IPE4	4 times per year		3	3		3	3																
	SB-IPE5	4 times per year		3	3		3	3																
Intermediate Stations Downcurrent																								
	SB-INE1	4 times per year		3	3		3	3																
	SB-INE2	4 times per year		3	3		3	3																
	SB-INE3	4 times per year		3	3		3	3																
	SB-INE4	4 times per year		3	3		3	3																
	SB-INE5	4 times per year		3	3		3	3																
Reference Stations Upcurrent																								
	SB-RFE1	4 times per year		3	3		3	3																
	SB-RFE2	4 times per year		3	3		3	3																
	SB-RFE3	4 times per year		3	3		3	3																
	SB-RFE4	4 times per year		3	3		3	3																
	SB-RFE5	4 times per year		3	3		3	3																
Sensitive Receiver Stations																								
	MW1	4 times per year		3	3		3	3																
	THB1	4 times per year		3	3		3	3																
	THB2	4 times per year		3	3		3	3																
	WSR45C	4 times per year		3	3		3	3																
	WSR46	4 times per year		3	3		3	3																
Flood Tide																								
Impact Stations Downcurrent																								
	SB-IPF1	4 times per year		3	3		3	3																
	SB-IPF2	4 times per year		3	3		3	3																
	SB-IPF3	4 times per year		3	3		3	3																
Intermediate Stations Downcurrent																								
	SB-INF1	4 times per year		3	3		3	3																
	SB-INF2	4 times per year		3	3		3	3																
	SB-INF3	4 times per year		3	3		3	3																
Reference Stations Upcurrent																								
	SB-RFF1	4 times per year		3	3		3	3																
	SB-RFF2	4 times per year		3	3		3	3																
	SB-RFF3	4 times per year		3	3		3	3																
Sensitive Receiver Stations																								
	MW1	4 times per year		3	3		3	3																
	THB1	4 times per year		3	3		3	3																
	THB2	4 times per year		3	3		3	3																
	WSR45C	4 times per year		3	3		3	3																
	WSR46	4 times per year		3	3		3	3																

Benthic Recolonisation Studies			**A**	**M**	**J**	**J**	**A**	**S**	**O**	**N**	**D**	**J**	**F**	**M**	**A**	**M**	**J**	**J**	**A**	**S**	**O**	**N**	**D**
Capped Contaminated Mud Pits																							
	SB-CPA	2 times per year					12				12								12				12
	SB-CPB	2 times per year					12				12								12				12
Reference Stations																							
	RBA	2 times per year					12				12								12				12
	RBB	2 times per year					12				12								12				12
	RBC	2 times per year					12				12								12				12

Notes:
The number shown in each cell represents the numbers of replicates per monitoring station
Capping works are planned to be conducted between May and December 2017.

Annex B

Water Quality Monitoring Results

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

Parameter	Action Level	Limit Level
Dissolved Oxygen (DO) (1)	Surface and Mid-depth (2) 5%-ile of baseline data for surface and middle layer = **3.76 mg L^{-1}** and Significantly less than the reference stations mean DO (at the same tide of the same day)	Surface and Mid-depth (2) 1%-ile of baseline data for surface and middle layer = **3.11 mg L^{-1}** (3) and Significantly less than the reference stations mean DO (at the same tide of the same day)
	Bottom 5%-ile of baseline data for bottom layers = **2.96 mg L^{-1}** and Significantly less than the reference stations mean DO (at the same tide of the same day)	Bottom The average of the impact station readings are **<2 mg/L^{-1}** and Significantly less than the reference stations mean DO (at the same tide of the same day)
Depth-averaged Suspended Solids (SS) (4) (5)	95%-ile of baseline data for depth average = **37.88 mg L^{-1}** and 120% of control station's SS at the same tide of the same day	99%-ile of baseline data for depth average = **61.92 mg L^{-1}** and 130% of control station's SS at the same tide of the same day
Depth-averaged Turbidity (Tby) (4) (5)	95%-ile of baseline data = **28.14 NTU** and 120% of control station's Tby at the same tide of the same day	99%-ile of baseline data = **38.32 NTU** and 130% of control station's Tby 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) The Action and Limit Levels for DO for Surface & 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 & 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 Vd in March 2018

Stations	Temp	Salinity	Turbidity	Dissolved Oxygen		pH	Suspended Solids
	(°C)	(ppt)	(NTU)	(%)	(mg L^{-1})		(mg L^{-1})
WCP 1 (Downstream)	19.57	29.60	6.54	103.35	7.96	8.12	6.33
WCP 2 (Upstream)	19.45	29.79	4.55	101.95	7.85	8.10	5.18
WQO (Dry season)	N/A	26.81–32.77#	N/A	N/A	>4	6.5-8.5	12.8

Note:
#Not exceeding 10% of natural ambient level which is the result obtained from the Reference Station.
Cell shaded yellow / red indicate value exceeding the Action/Limit levels.
Cell shaded grey indicate value exceeding the WQO.

Annex C

Graphical Presentations

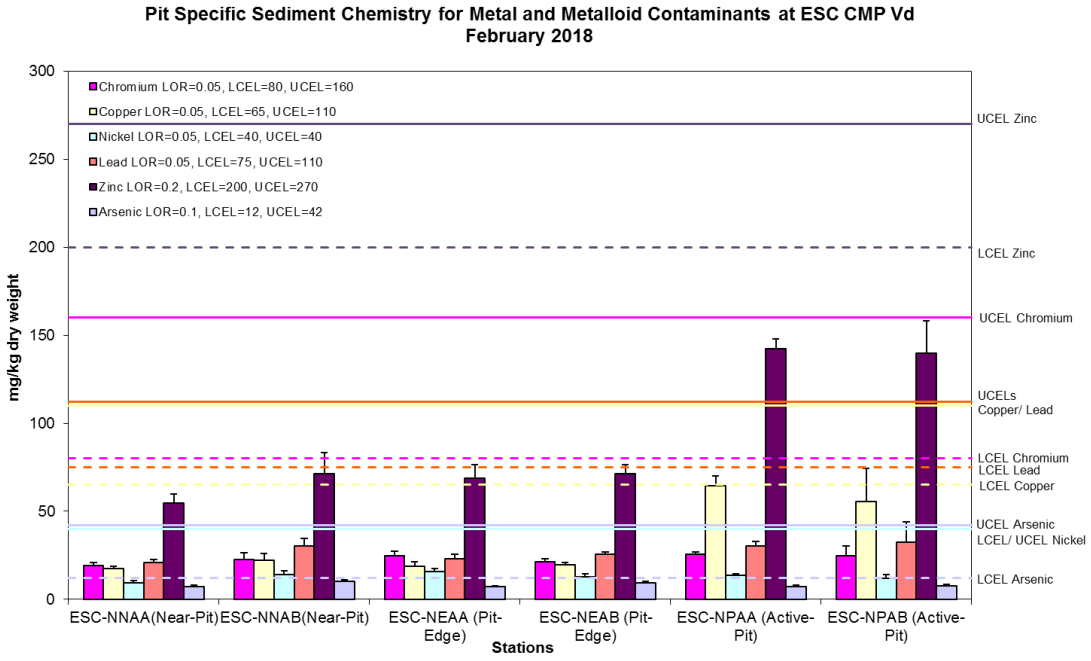


Figure 1: Concentration of Metals and Metalloid (Cr, Cu, Ni, Pb, Zn, As; mg/kg dry weight; mean +SD) in sediment samples collected from Pit Specific Sediment Chemistry Monitoring for ESC CMP Vd in February 2018.

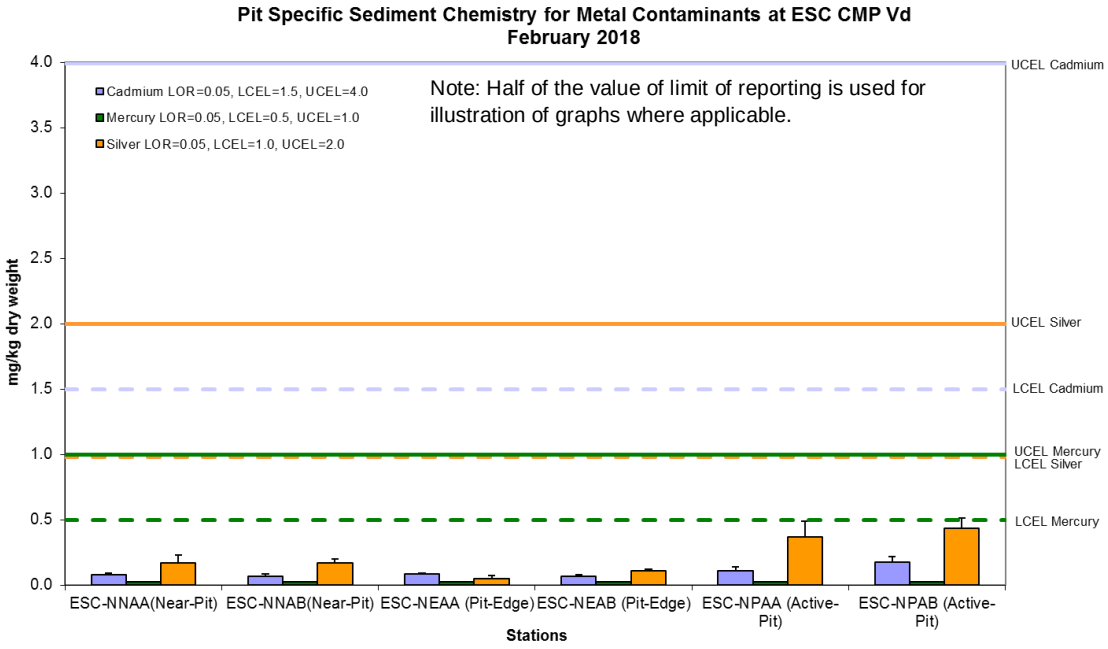


Figure 2: Concentration of Metals (Cd, Hg, Ag; mg/kg dry weight; mean +SD) in sediment samples collected from Pit Specific Sediment Chemistry Monitoring for ESC CMP Vd in February 2018.

Source: H:\Team\EM\GMS Projects\0400720 CEDD CMP EM&A 2017-2020\02 Deliverable\05 CMP Monthly Report\March 2018)

Date: April 2018

Environmental Resources Management

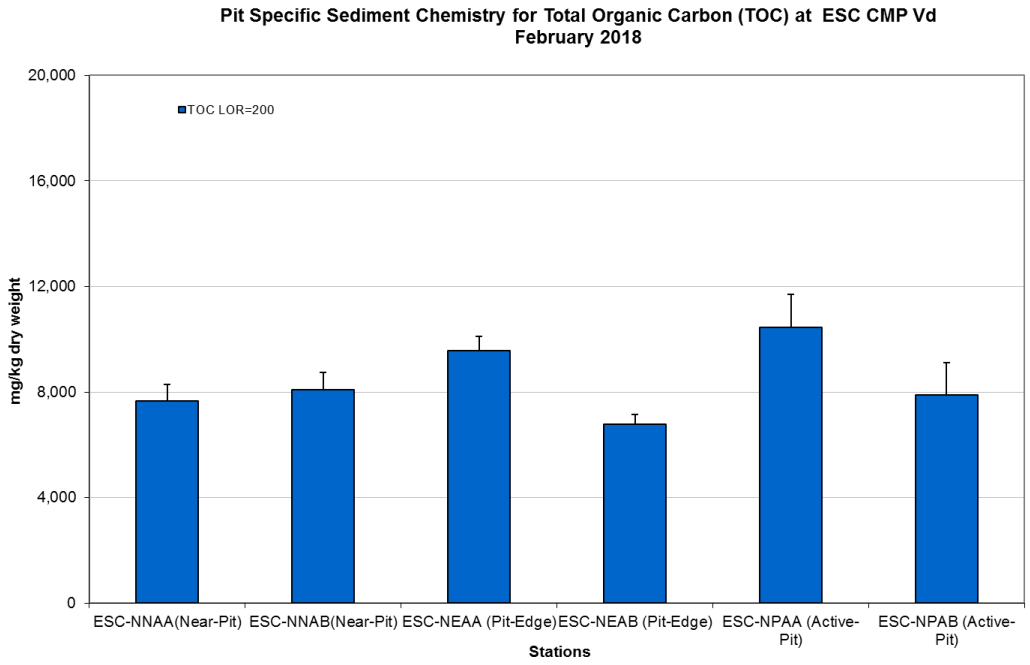


Figure 3: Concentration of Total Organic Carbon (TOC) (mg/kg dry weight; mean +SD) in sediment samples collected from Pit Specific Sediment Chemistry Monitoring for ESC CMP Vd in February 2018.

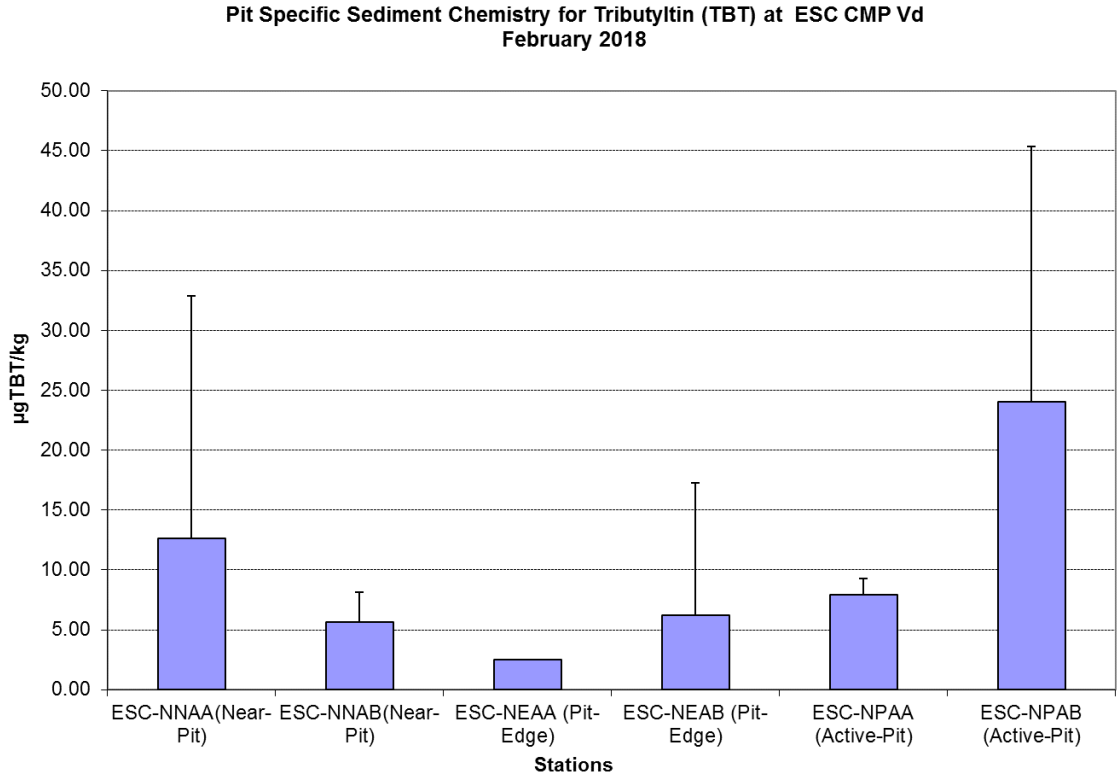


Figure 4: Concentration of Tributyltin (TBT) (µg TBT/kg; mean +SD) in sediment samples collected from Pit Specific Sediment Chemistry Monitoring for ESC CMP Vd in February 2018.

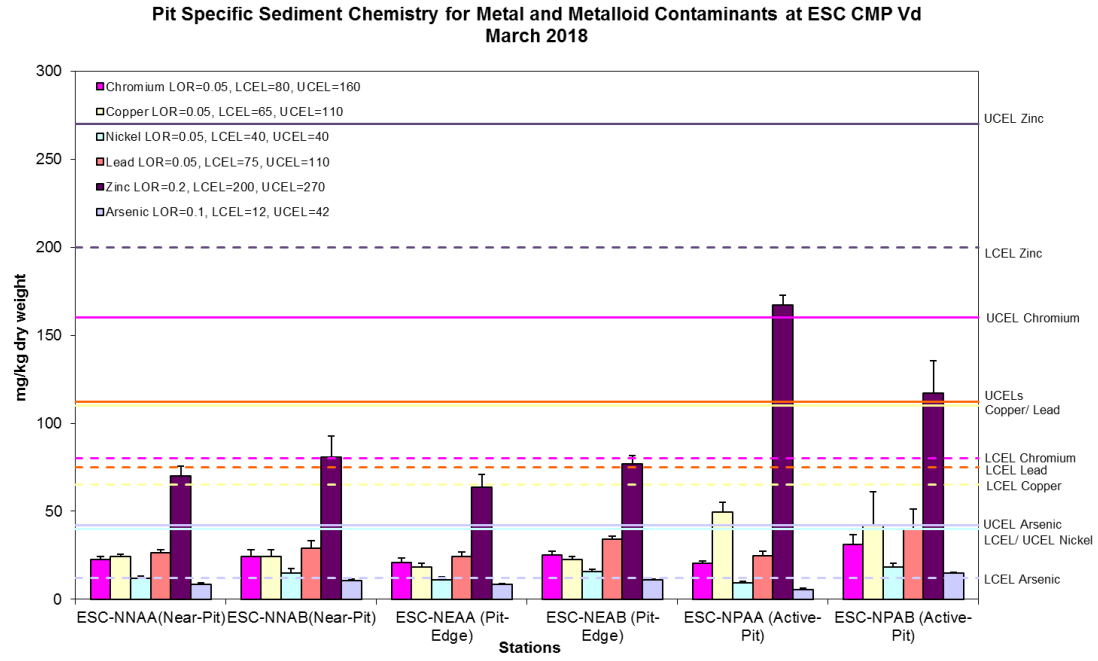


Figure 5: Concentration of Metals and Metalloid (Cr, Cu, Ni, Pb, Zn, As; mg/kg dry weight; mean +SD) in sediment samples collected from Pit Specific Sediment Chemistry Monitoring for ESC CMP Vd in March 2018.

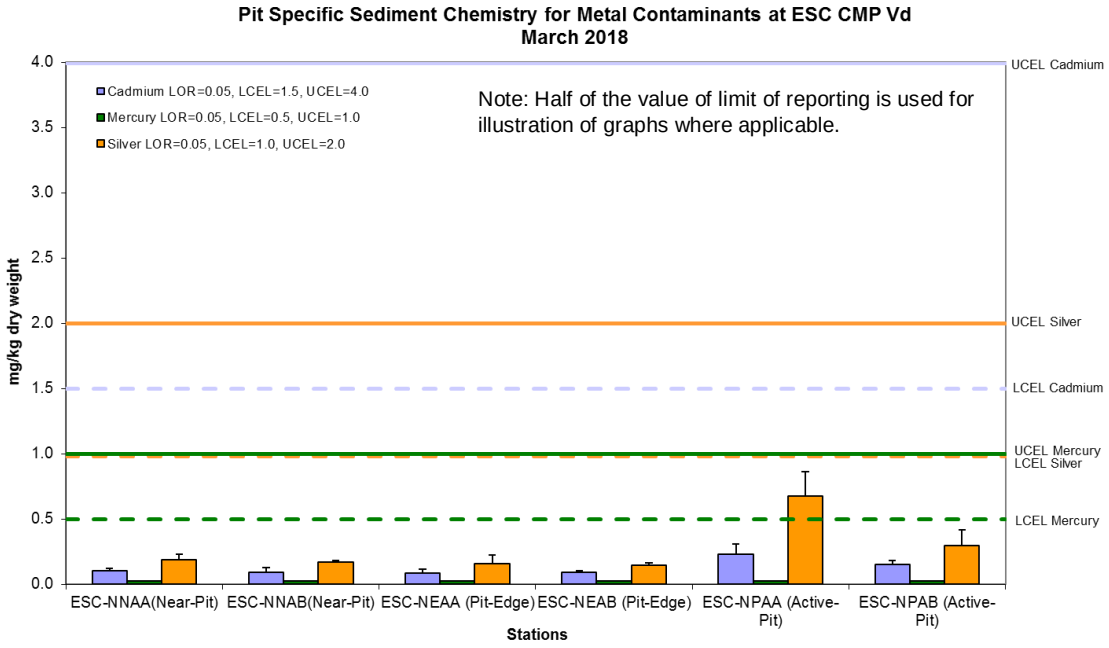


Figure 6: Concentration of Metals (Cd, Hg, Ag; mg/kg dry weight; mean +SD) in sediment samples collected from Pit Specific Sediment Chemistry Monitoring for ESC CMP Vd in March 2018.

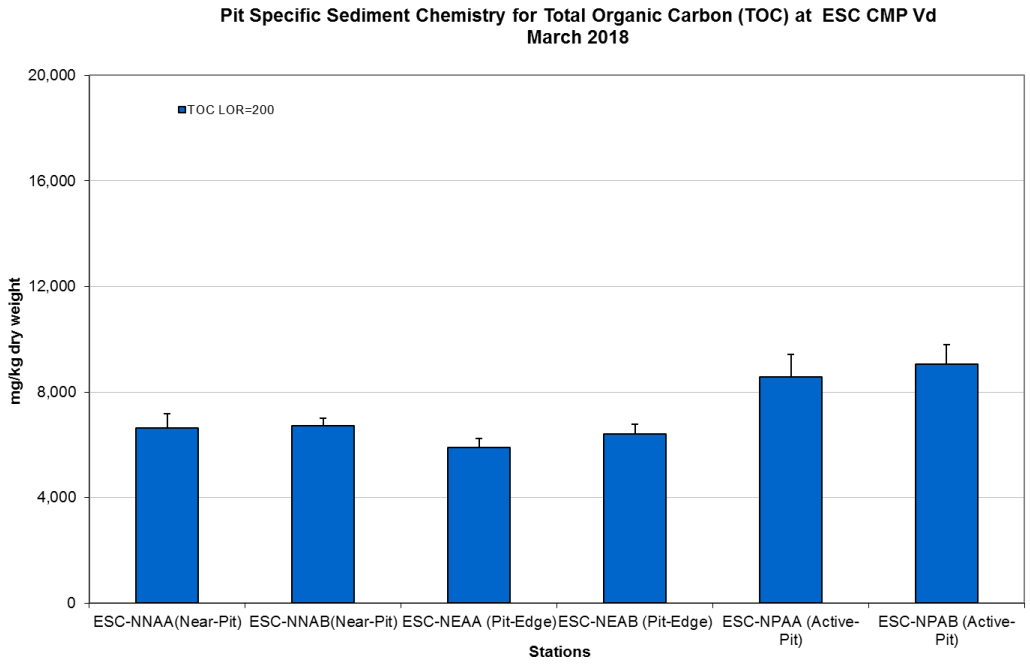


Figure 7: Concentration of Total Organic Carbon (TOC) (mg/kg dry weight; mean +SD) in sediment samples collected from Pit Specific Sediment Chemistry Monitoring for ESC CMP Vd in March 2018.

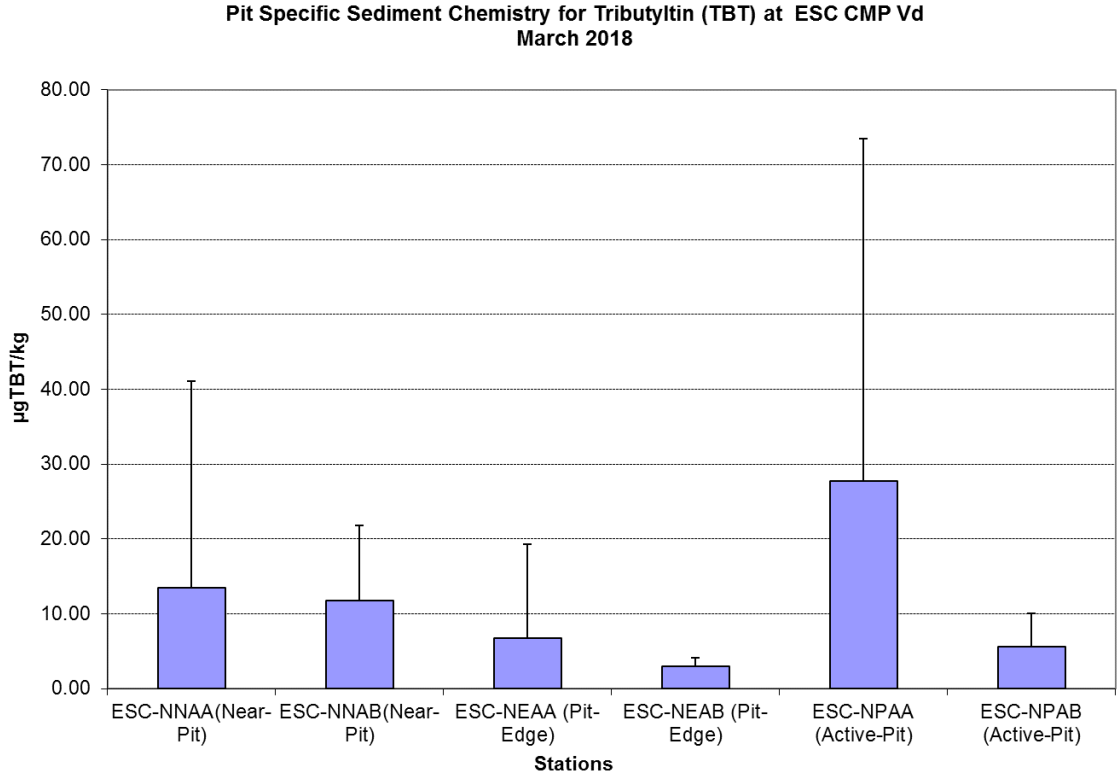


Figure 8: Concentration of Tributyltin (TBT) (µg TBT/kg; mean +SD) in sediment samples collected from Pit Specific Sediment Chemistry Monitoring for ESC CMP Vd in March 2018.

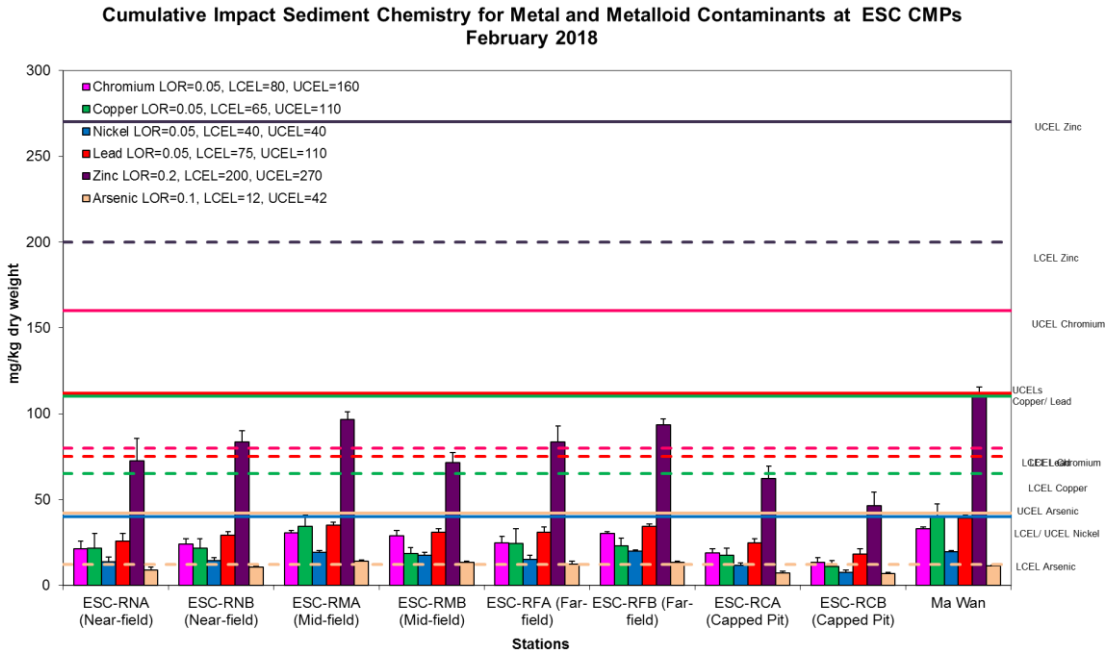


Figure 9: Concentration of Metals and Metalloid (Cr, Cu, Ni, Pb, Zn, As; mean +SD) in sediment samples collected from Cumulative Impact Sediment Chemistry Monitoring for ESC CMPs in February 2018.

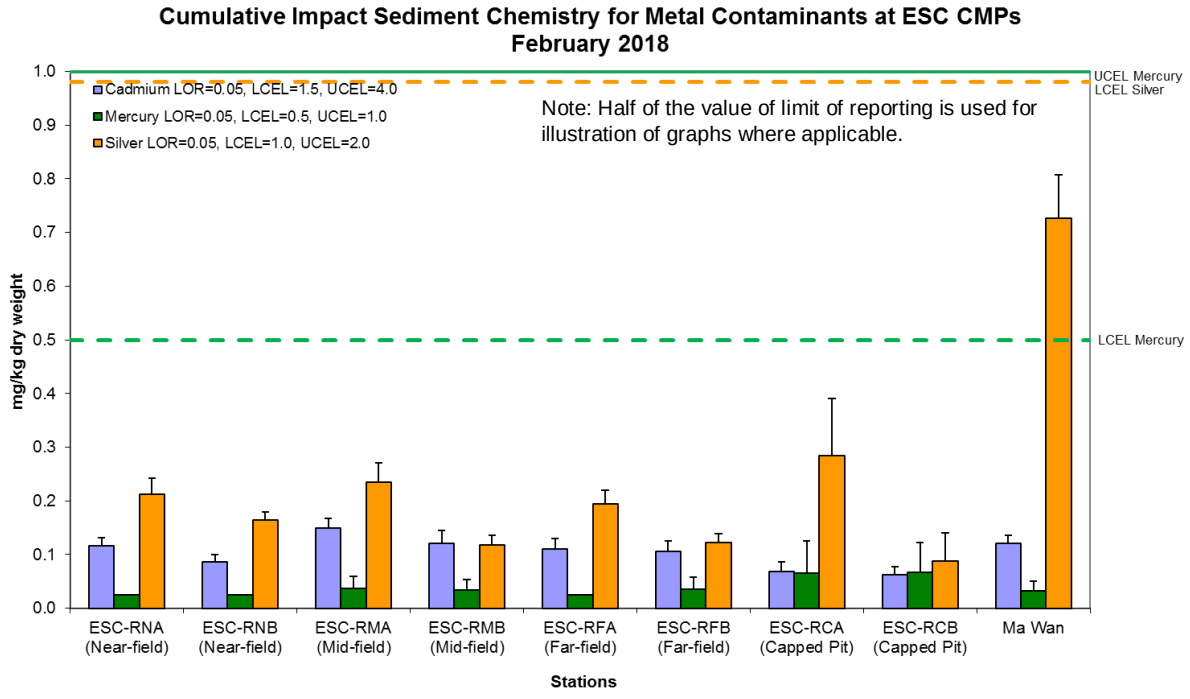


Figure 10: Concentration of Metals (Cd, Hg, Ag; mean +SD) in sediment samples collected from Cumulative Impact Sediment Chemistry Monitoring for ESC CMPs in February 2018.

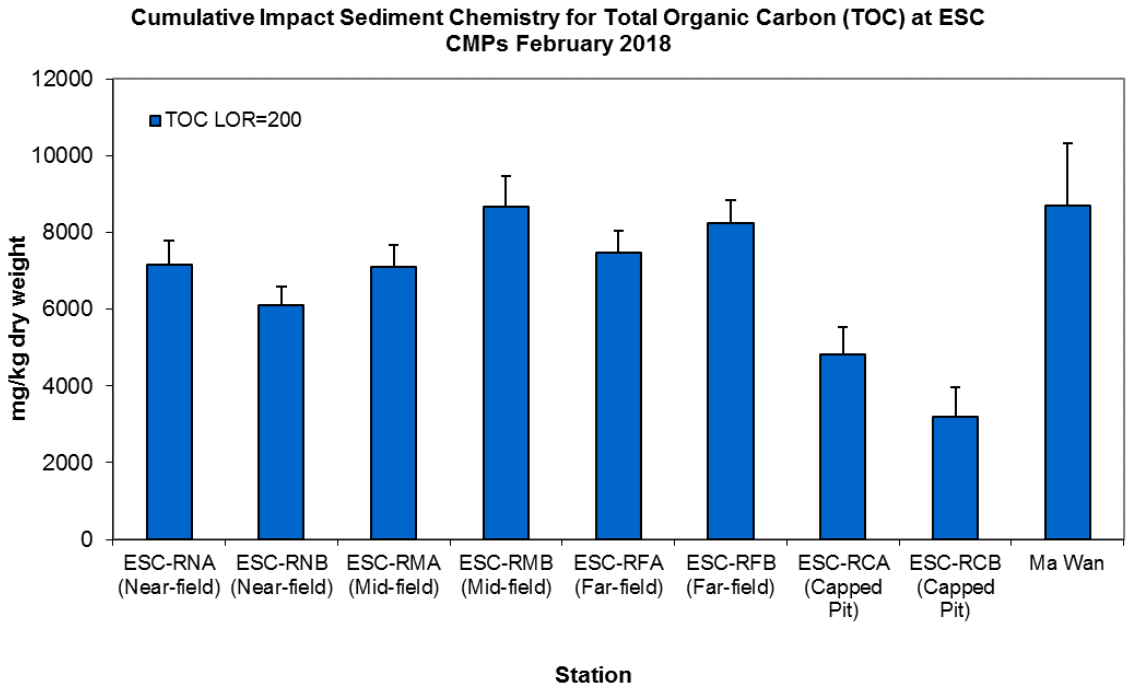


Figure 11: Concentration of Total Organic Carbon (TOC) (mg/kg dry weight; mean +SD) in sediment samples collected from Cumulative Impact Sediment Chemistry Monitoring for ESC CMPs in February 2018.

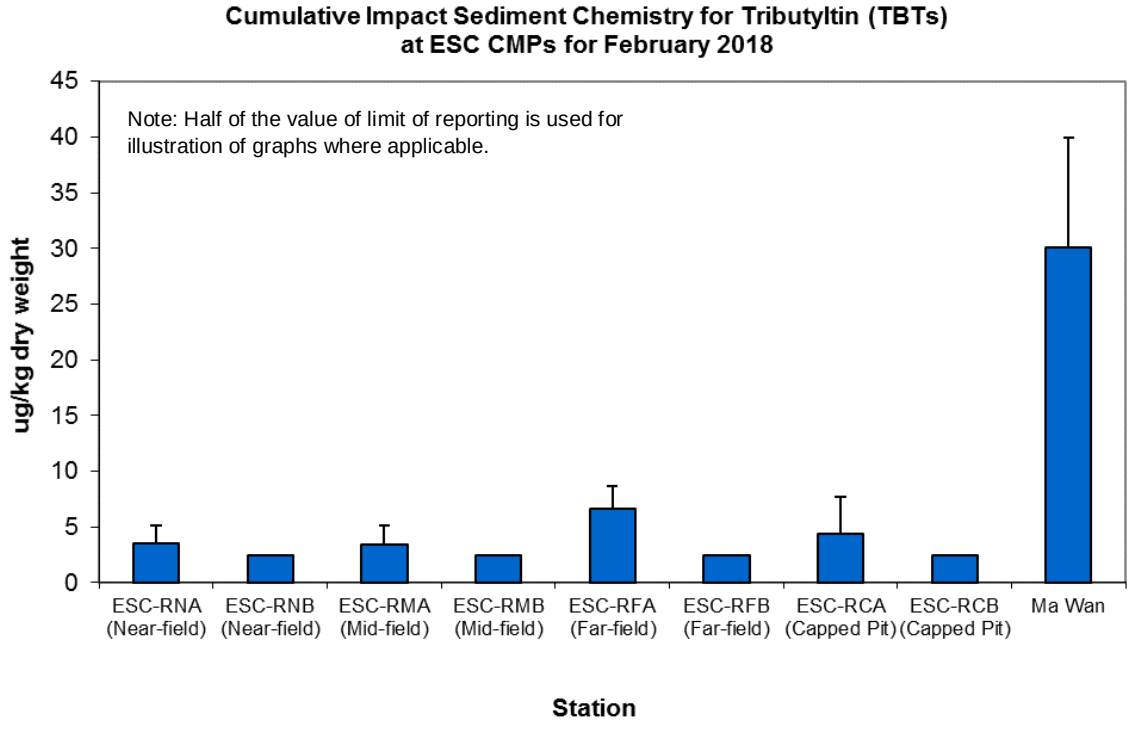


Figure 12: Concentration of Tributyltin (µg TBT/kg; mean +SD) in sediment samples collected from Cumulative Impact Sediment Chemistry Monitoring for ESC CMPs in February 2018.

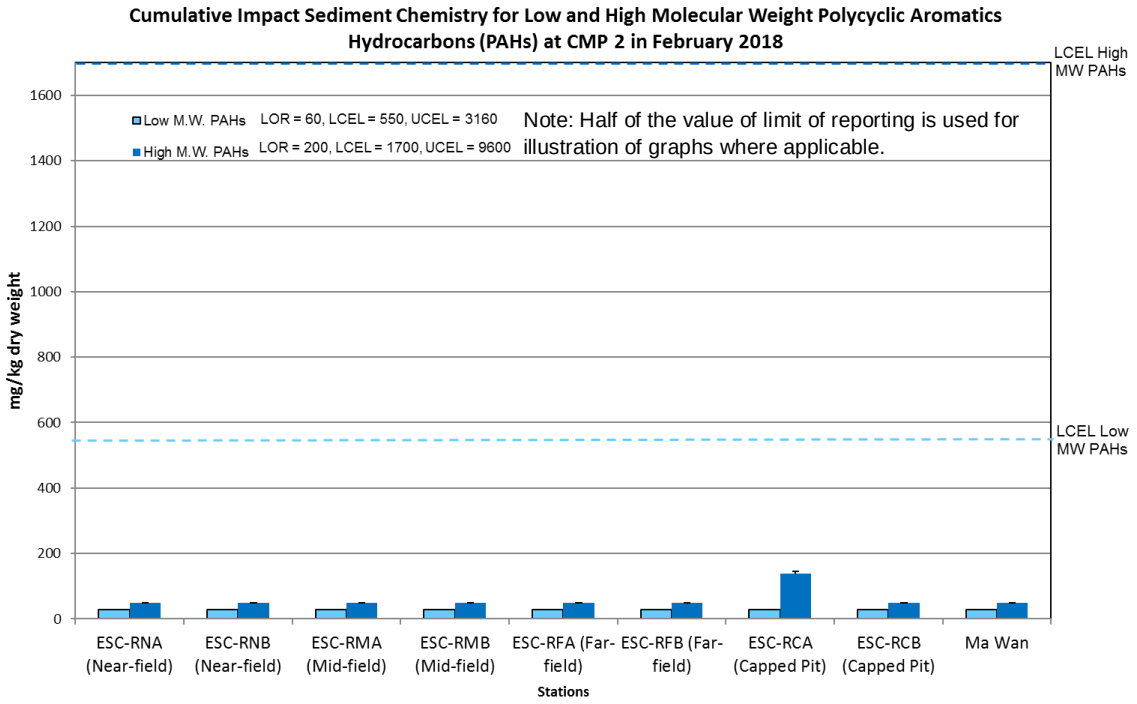
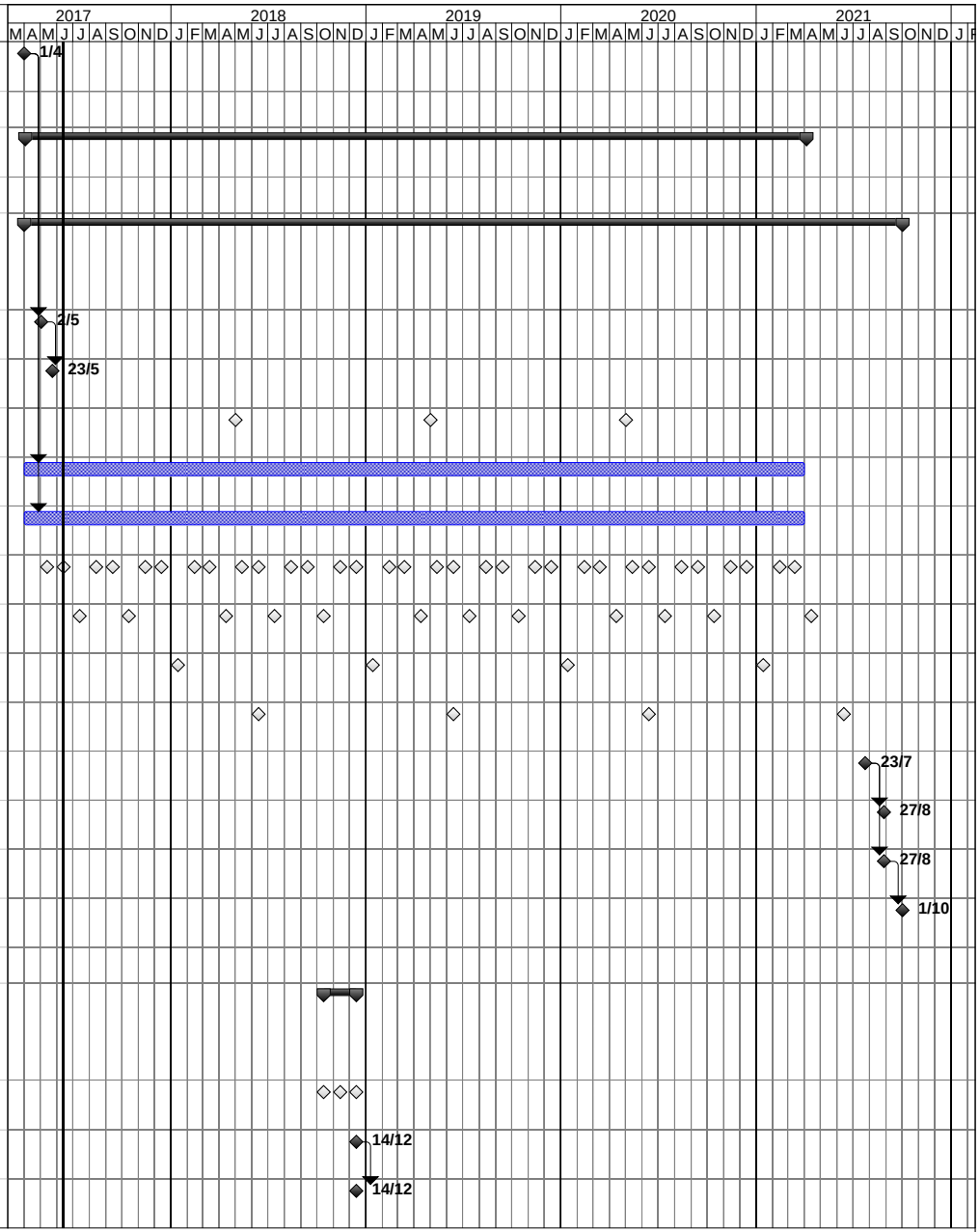


Figure 13: Concentration of Low and High Molecular Weight Polycyclic Aromatics (mg/kg dry weight; mean +SD) in sediment samples collected from Cumulative Impact Sediment Chemistry Monitoring for ESC CMPs in December 2017.

Annex D

Study Programme

Task Name	Start	Finish
Commencement of Agreement No. CE 63/2016 (EP)	Sat 1/4/17	Sat 1/4/17
Project Management and General Deliverables	**Mon 3/4/17**	**Mon 5/4/21**
For the disposal facilities to the East of Sha Chau (ESC) (between 2017 and 2021) and the South of The Brothers (SB) (between 2017 and 2018)	**Sat 1/4/17**	**Fri 1/10/21**
Draft Report on Review of EM&A Manual	Tue 2/5/17	Tue 2/5/17
Final Report on Review of EM&A Manual	Tue 23/5/17	Tue 23/5/17
Regular Review of EM&A Manual	**Wed 2/5/18**	**Sat 2/5/20**
Regular Site Inspections of CMP Contractors	Sat 1/4/17	Wed 31/3/21
Participate in Liaison Group Meetings/ Consultations as required by CEDD	Sat 1/4/17	Wed 31/3/21
Submission of Monthly EM&A Report	**Sun 14/5/17**	**Sun 14/3/21**
Submission of Quarterly EM&A Report	**Fri 14/7/17**	**Wed 14/4/21**
Submission of Annual EM&A Report	**Sun 14/1/18**	**Thu 14/1/21**
Submission of Annual Risk Assessment Report	**Thu 14/6/18**	**Mon 14/6/21**
Submission of Draft Final Report (including database of all data collected)	Fri 23/7/21	Fri 23/7/21
Submission of Final Report (including database of all data collected)	Fri 27/8/21	Fri 27/8/21
Submission of Draft Executive Summary	Fri 27/8/21	Fri 27/8/21
Submission of Final Executive Summary	Fri 1/10/21	Fri 1/10/21
For East Tung Lung Chau Disposal Facility (subject to the actual disposal programme to be confirmed by CEDD)	**Sun 14/10/18**	**Fri 14/12/18**
Submission of Monthly EM&A Report	**Sun 14/10/18**	**Fri 14/12/18**
Submission of Quarterly EM&A Report	Fri 14/12/18	Fri 14/12/18
Submission of Annual EM&A Report	Fri 14/12/18	Fri 14/12/18



Study Programme
Tue 13/6/17

Task | Milestone | Summary | Rolled Up Milestone