



**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 –
May 2020**

Revision 0

June 2020

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Client: Civil Engineering and Development Department (CEDD)		Project No: 0400720			
Summary: This document presents the Monthly EM&A Report for <i>Environmental Monitoring and Audit for Disposal Facility to the East of Sha Chau</i> .		Date: 12 June 2020			
		Approved by:  Craig A. Reid Partner			
v0	Monthly EM&A Report for ESC CMPs	GS	RC	CAR	12/06/20
Revision	Description	By	Checked	Approved	Date
<p>This report has been prepared by Environmental Resources Management the trading name of 'ERM Hong-Kong, Limited', with all reasonable skill, care and diligence within the terms of the Contract with the client, incorporating our General Terms and Conditions of Business and taking account of the resources devoted to it by agreement with the client.</p> <p>We disclaim any responsibility to the client and others in respect of any matters outside the scope of the above.</p> <p>This report is confidential to the client and we accept no responsibility of whatsoever nature to third parties to whom this report, or any part thereof, is made known. Any such party relies on the report at their own risk.</p>		<p>Distribution</p> <p><input type="checkbox"/> Internal</p> <p><input checked="" type="checkbox"/> Public</p> <p><input type="checkbox"/> Confidential</p> <div style="text-align: right;">   </div>			

Dredging, Management and Capping of Contaminated Sediment Disposal Facility at Sha Chau

Environmental Certification Sheet 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 - May 2020
Date of Report:	12 June 2020
Date prepared by ET:	12 June 2020
Date received by IA:	12 June 2020

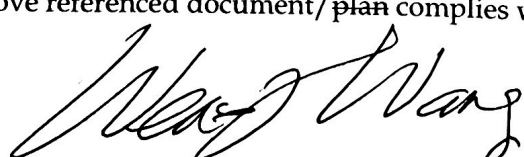
Reference EP Condition

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 2 weeks 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 certified by the ET Leader and 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	
Craig Reid, Environmental Team Leader:	
	Date: 12/06/2020

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:	
	Date: 12/06/2020

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Agreement No. CE 63/2016 (EP)
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MONTHLY EM&A REPORT FOR MAY 2020

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). The scheduled EM&A programme for SB CMPs was completed in December 2018. Detailed works schedule for ESC CMP V is shown in *Figure 1.1*. In May 2020, 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.

1.5.2 ***Water Column Profiling of ESC CMP Vb - May 2020***

1.5.3 *Water Column Profiling* was undertaken at a total of two sampling stations (Upstream and Downstream stations) on 7 May 2020. 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 2009 - 2018 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 May 2020 indicated that levels of Salinity, pH and DO complied with the WQOs at both Downstream and Upstream stations (*Table B2 of Annex B*). 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 May 2020 indicated that the SS levels at both Downstream and Upstream stations were higher than the WQO, but both complied with the Action and Limit Levels (*Tables B1 and B2 of Annex B*).

1.5.6 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.

1.5.7 ***Routine Water Quality Monitoring of ESC CMPs - May 2020***

1.5.8 *Routine Water Quality Monitoring of ESC CMPs* was undertaken on 6 May 2020. The monitoring results have been assessed for compliance with the WQOs (see *Section 1.5.3* for details). The monitoring results are shown in *Tables B3 and B4 of Annex B* and *Figures 1 - 10 of Annex C*. A total of sixteen (16) monitoring stations were sampled in May 2020 as shown in *Figure 1.2*.

(1) <http://epic.epd.gov.hk/EPICRIVER/marine/?lang=en>

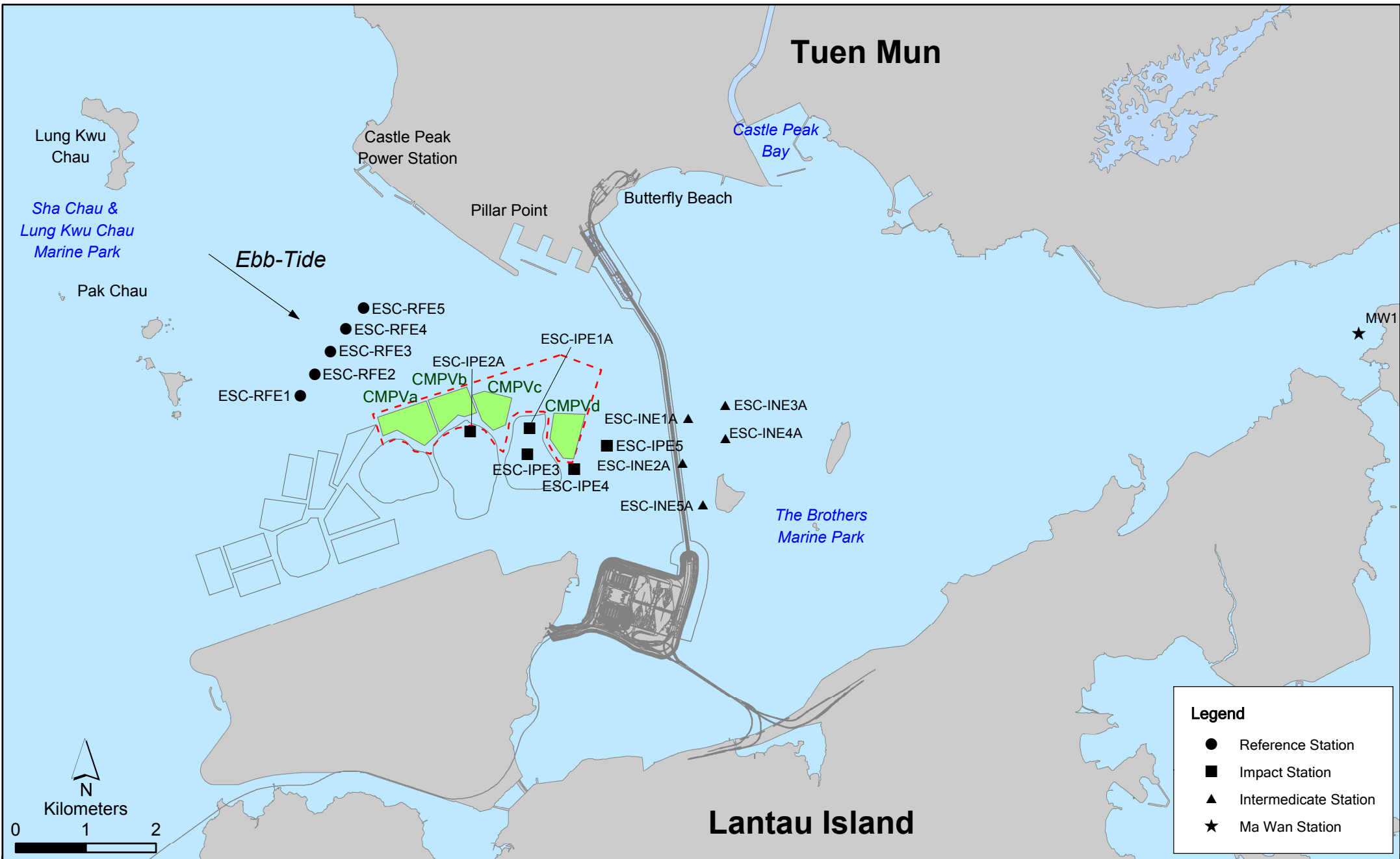


Figure 1.2

Routine & Capping Water Quality Sampling Stations (Ebb-Tide) for ESC CMPs

In-situ Measurements

- 1.5.9 Graphical presentation of the monitoring results (Temperature, DO, pH, Salinity and Turbidity) is shown in *Figures 1 - 6 of Annex C*. Analyses of results for May 2020 indicated that the levels of pH, Salinity and DO complied with the WQOs at all stations in May 2020.
- 1.5.10 The levels of DO and Turbidity complied with the Action and Limit Levels at all stations (*Table B3 of Annex B; Figures 3 and 6 of Annex C*). There is no evidence indicating any unacceptable environmental impacts to nearby water sensitive receivers as a result of the mud disposal operations at ESC CMPs in May 2020.

Laboratory Measurements

- 1.5.11 Laboratory analysis of May 2020 results indicated that concentrations of Arsenic, Cadmium, Chromium, Copper, Mercury, Lead, Nickel and Zinc were detected in May 2020 samples at most stations and the concentrations of these metals and metalloids were similar amongst the stations, except the concentrations of Copper were higher at Reference stations, and the concentrations of Zinc was lower at Ma Wan Station (*Table B4 of Annex B; Figure 7 of Annex C*).
- 1.5.12 For nutrients, concentrations of Total Inorganic Nitrogen (TIN) at all stations were higher than the WQO (0.5 mg/L) (*Table B4 of Annex B; Figure 8 of Annex 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 ⁽¹⁾. 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) and 5-day Biochemical Oxygen Demand (BOD₅) were similar across the stations in May 2020 (*Table B4 of Annex B; Figure 8 and 9 of Annex C*).
- 1.5.13 Analyses of results for May 2020 indicated that the SS levels at Ma Wan station complied with the WQO, and the SS levels at all stations complied with the Action and Limit Levels (*Tables B1 and B4 of Annex B; Figure 10 of Annex C*). There is no evidence indicating any unacceptable environmental impacts to nearby water sensitive receivers as a result of the mud disposal operations at ESC CMPs in May 2020.
- 1.5.14 Overall, results of the Routine Water Quality Monitoring indicated that the disposal operation at ESC CMPs did not appear to cause any unacceptable deterioration in water quality in May 2020. Detailed statistical analysis will be presented in the Quarterly Report to investigate any spatial and temporal trends of potential concern.

(1) http://www.epd.gov.hk/epd/misc/marine_quality/1986-2005/textonly/eng/index.htm

- 1.5.15 ***Pit Specific Sediment Chemistry of ESC CMP Vb – May 2020***
- 1.5.16 Monitoring locations for *Pit Specific Sediment Chemistry for ESC CMP Vb* are shown in *Figure 1.3*. A total of six (6) monitoring stations were sampled on 5 May 2020.
- 1.5.17 The concentrations of most inorganic contaminants were lower than the Lower Chemical Exceedance Levels (LCELs) at most stations, except for Arsenic (*Figures 11 and 12 of Annex C*). The concentrations of Arsenic were higher than the LCEL at Pit-Edge stations ESC-NECA & ESC-NECB.
- 1.5.18 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 Vb but rather as a result of naturally occurring deposits.
- 1.5.19 ***For*** organic contaminants, the concentrations of Total Organic Carbon (TOC) were higher at Active-Pit station ESC-NPCB in May 2020 (*Figure 13 of Annex C*). The concentrations of Low Molecular Weight and High Molecular Weight Polycyclic Aromatic Hydrocarbons (PAHs) were lower than the LCELs at all stations (*Figure 14 of Annex C*). The concentrations of Total Polychlorinated Biphenyls (PCBs), Tributyltin (TBT), Total dichloro-diphenyl-trichloroethane (DDT) and 4,4’-dichlorodiphenyldichloroethylene (DDE) were below the limit of reporting at all stations in May 2020.
- 1.5.20 Overall, there is no evidence indicating any unacceptable environmental impacts to sediment quality as a result of the contaminated mud disposal operations at ESC CMP Vb in May 2020. 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) 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

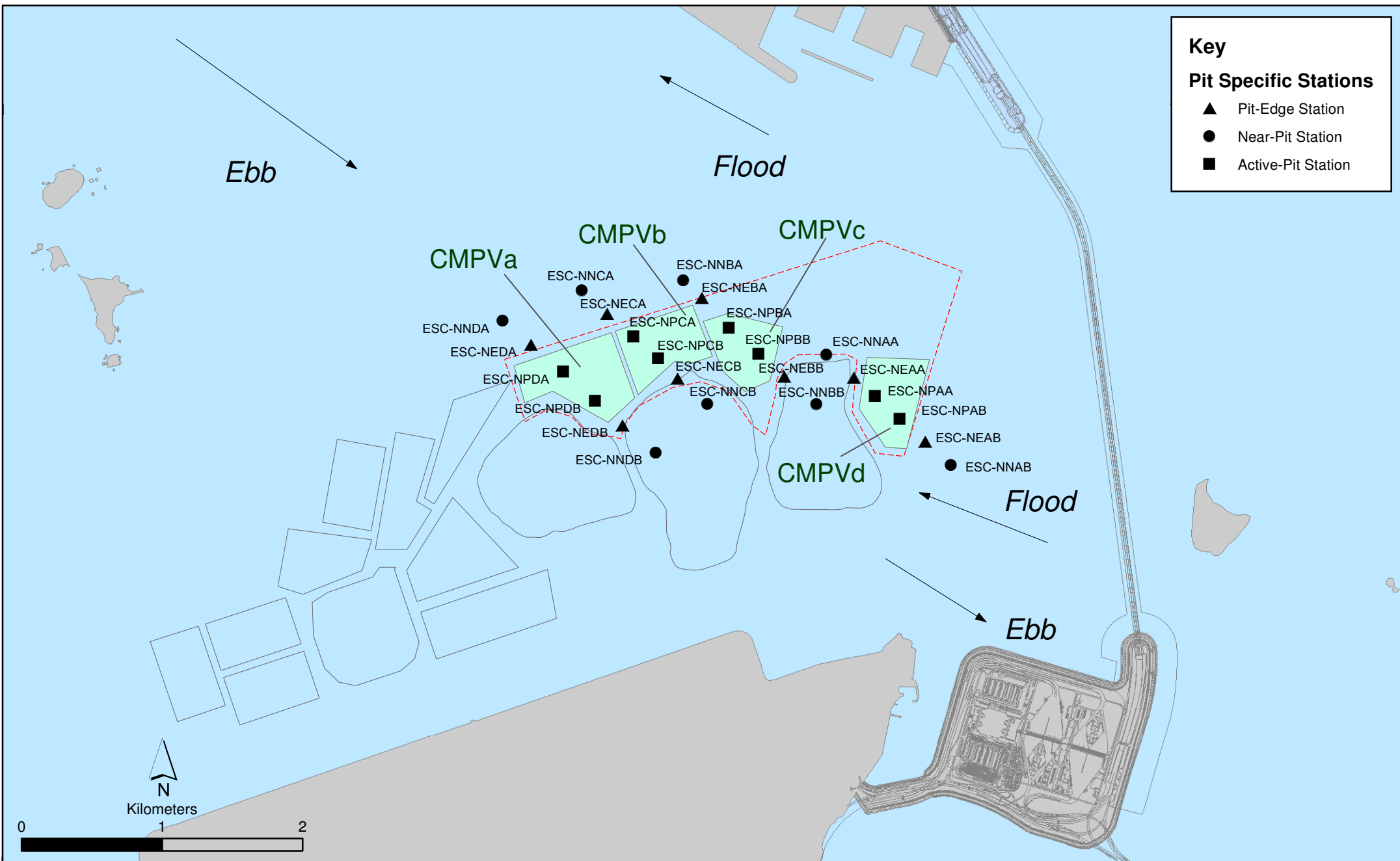


Figure 1.3

Pit Specific Sediment Quality Monitoring Stations for CMPV

1.6 *ACTIVITIES SCHEDULED FOR THE NEXT MONTH*

1.6.1 The following monitoring activities will be conducted in the next monthly period of June 2020 for ESC CMP V (see *Annex A* for the sampling schedule ⁽¹⁾):

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

1.7 *STUDY PROGRAMME*

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

(1) The scheduled EM&A Programme for SB CMPs was completed in December 2018.

Annex A

Sampling Schedule

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⁾	<u>Surface and Mid-depth</u> ⁽²⁾ 5%-ile of baseline data for surface and middle layer = 3.76 mg L⁻¹	<u>Surface and Mid-depth</u> ⁽²⁾ 1%-ile of baseline data for surface and middle layer = 3.11 mg L⁻¹ ⁽³⁾
	and	and
	Significantly less than the reference stations mean DO (at the same tide of the same day)	Significantly less than the reference stations mean DO (at the same tide of the same day)
	<u>Bottom</u> 5%-ile of baseline data for bottom layers = 2.96 mg L⁻¹	<u>Bottom</u> The average of the impact station readings are <2 mg/L⁻¹
	and	and
	Significantly less than the reference stations mean DO (at the same tide of the same day)	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	99%-ile of baseline data for depth average = 61.92 mg L⁻¹
	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
Depth-averaged Turbidity (Tby) ^{(4) (5)}	95%-ile of baseline data = 28.14 NTU	99%-ile of baseline data = 38.32 NTU
	and	and
	120% of control station's Tby at the same tide of the same day	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 Vb in May 2020

Stations	Temp (°C)	Salinity (ppt)	Turbidity (NTU)	Dissolved Oxygen		pH	Suspended Solids (mg L ⁻¹)
				(%)	(mg L ⁻¹)		
WCP 1 (Downstream)	26.04	25.46	16.27	85.91	6.03	7.93	14.38
WCP 2 (Upstream)	26.25	24.86	14.05	86.17	6.05	7.90	12.05
WQO (Wet Season)	N/A	22.37-27.34 [#]	N/A	N/A	>4	6.5-8.5	10.8

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.

Table B3 In-situ Monitoring Results for Routine Water Quality Monitoring of ESC CMPs in May 2020

Sampling Period	Stations	Temp (°C)	Salinity (ppt)	Turbidity (NTU)	Dissolved Oxygen		pH (mg L ⁻¹)
					(%)	(mg L ⁻¹)	(mg L ⁻¹)
May 2020	RFE (Reference)	25.70	24.81	14.37	86.56	6.14	7.91
	IPE (Impact)	25.80	24.98	15.13	87.48	6.18	7.92
	INE (Intermediate)	25.64	25.25	18.17	87.37	6.18	7.90
	Ma Wan	25.70	25.16	12.06	87.96	6.23	7.87
	WQO	N/A	22.33- 27.29 [#]	N/A	N/A	>4	6.5-8.5

Notes:

[#]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 higher than the WQO.

Table B4 Laboratory Results for Routine Water Quality Monitoring of ESC CMPs in May 2020

Sampling Period	Stations	As (µg/L)	Cd (µg/L)	Cr (µg/L)	Cu (µg/L)	Pb (µg/L)	Hg (µg/L)	Ni (µg/L)	Ag (µg/L)	Zn (µg/L)	NH ₃ (mg/L)	TIN (mg/L)	BOD ₅ (mg/L)	SS (mg/L)
May 2020	RFE	2.48	0.26	1.94	20.00	1.60	0.25	2.31	<1	24.07	0.19	0.71	1.71	15.71
	IPE	2.27	0.25	1.59	11.82	1.92	0.33	2.35	<1	17.84	0.19	0.86	1.62	18.76
	INE	2.38	0.25	2.23	8.69	1.77	0.42	2.92	<1	22.63	0.21	0.73	1.44	21.07
	Ma Wan	2.54	0.29	2.51	3.70	1.99	0.36	2.43	<1	12.09	0.19	0.72	1.19	9.98

WQO of TIN: 0.5 mg/L

Wet Season WQO of SS : 10.8 mg/L

Notes:

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

Cell shaded grey indicate value higher than the WQO.

Annex C

Graphical Presentations

Routine Water Quality Monitoring for ESC CMP V - May 2020

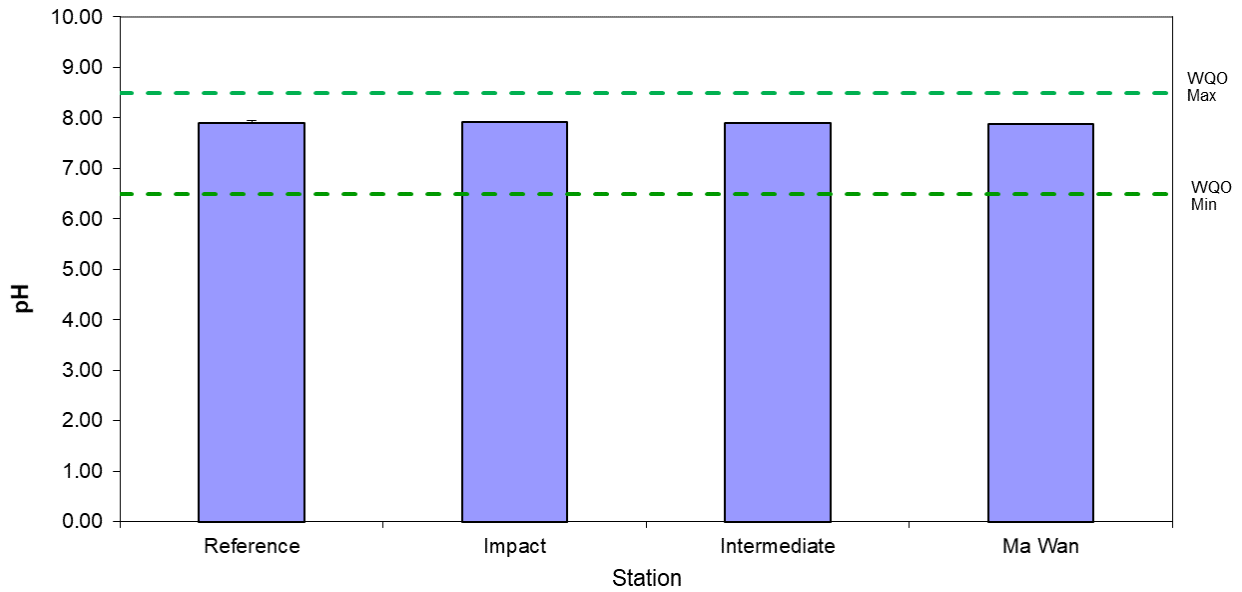


Figure 1: Level of pH recorded during Routine Water Quality Monitoring for disposal operations at ESC CMP V in May 2020.

Routine Water Quality Monitoring ESC CMP V - May 2020

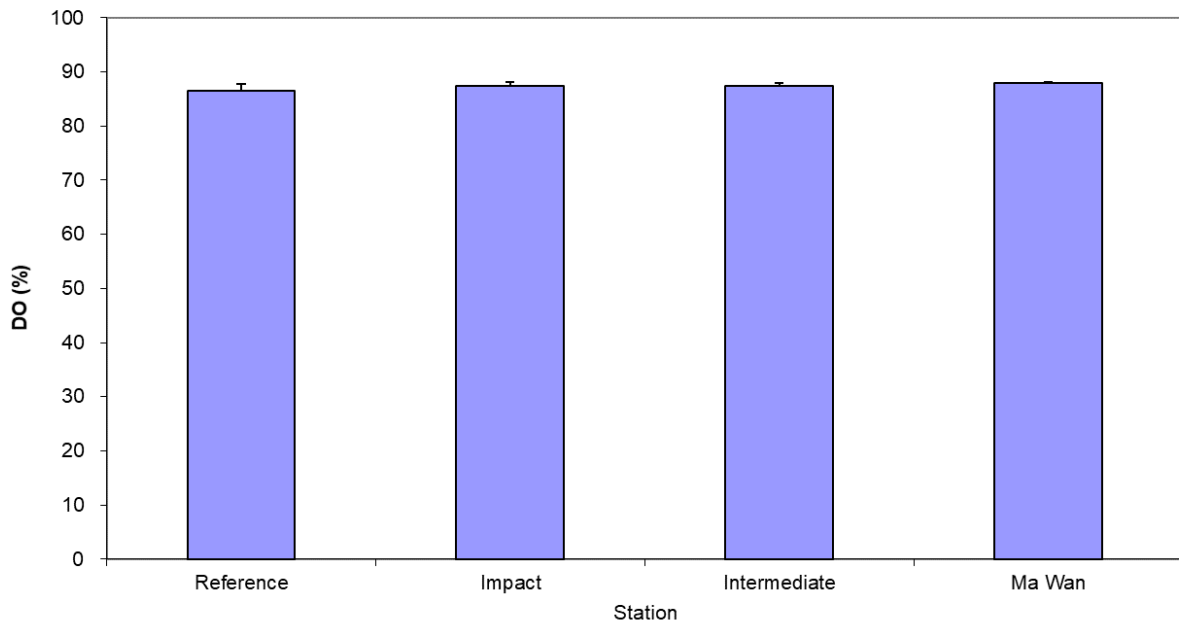


Figure 2: Level of Dissolved Oxygen (DO) (% saturation; mean + SD) recorded during Routine Water Quality Monitoring for disposal operations at ESC CMP V in May 2020.

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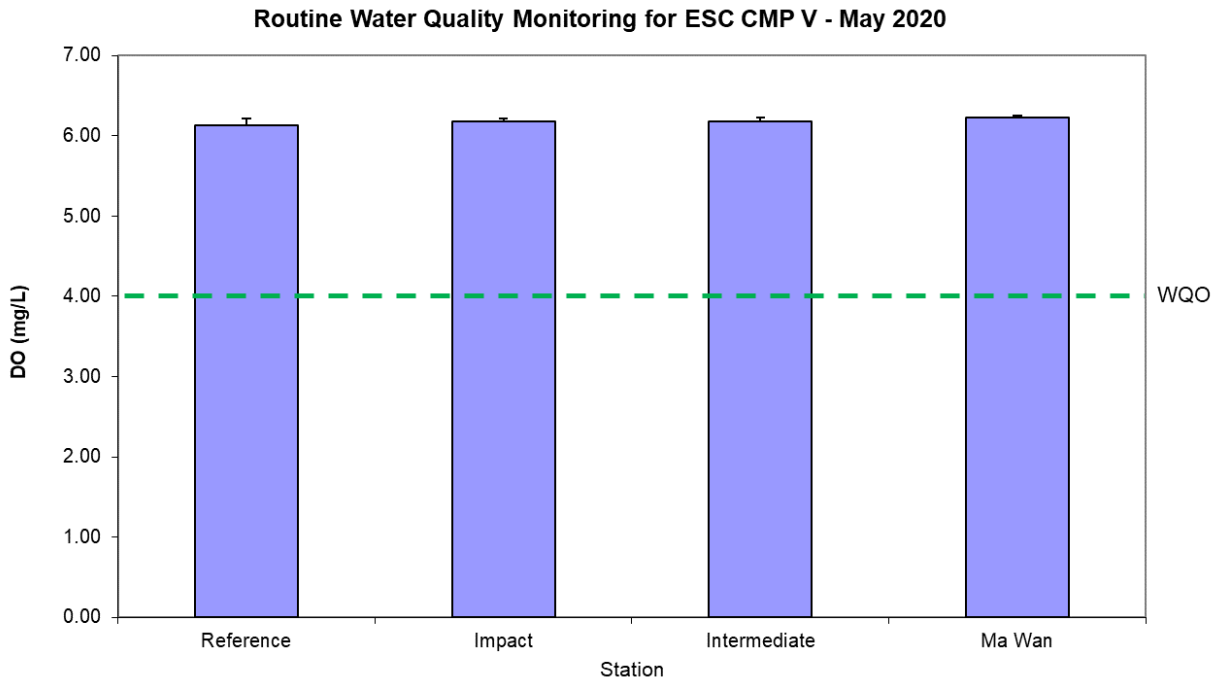


Figure 3: Concentration of Dissolved Oxygen (DO) (mg/L; mean + SD) recorded during Routine Water Quality Monitoring for disposal operations at ESC CMP V in May 2020.

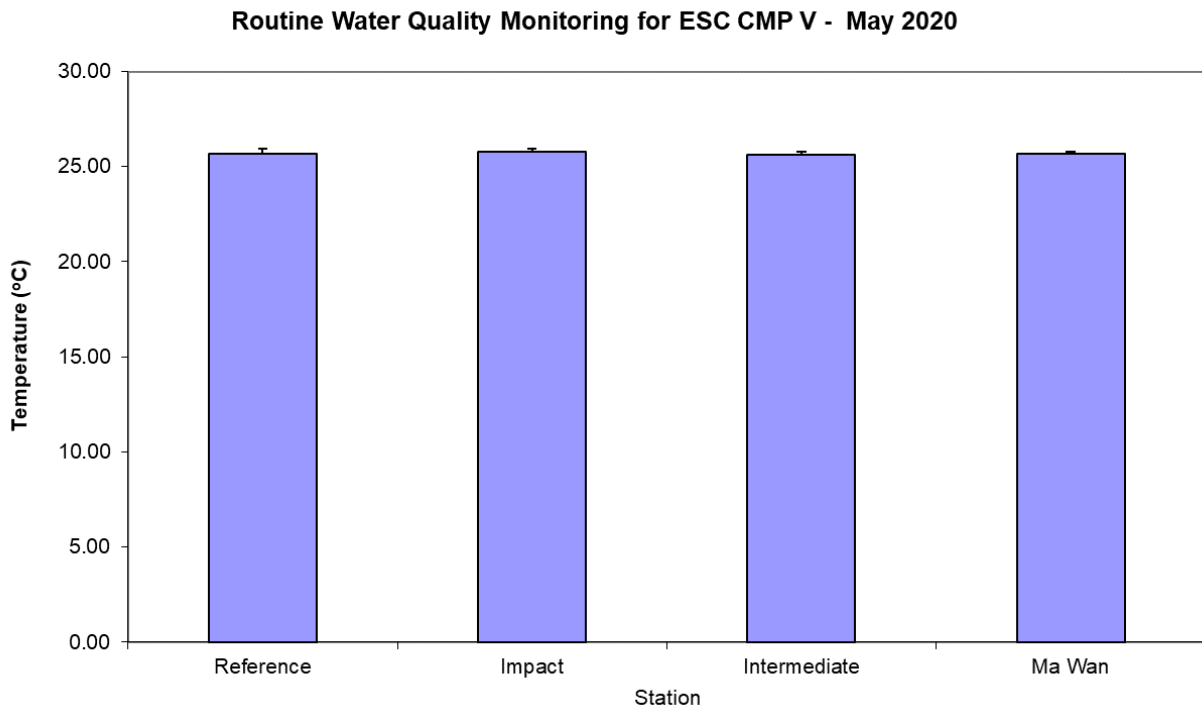


Figure 4: Level of Temperature (°C; mean + SD) recorded during Routine Water Quality Monitoring for disposal operations at ESC CMP V in May 2020.

Routine Water Quality Monitoring for ESC CMP V - May 2020

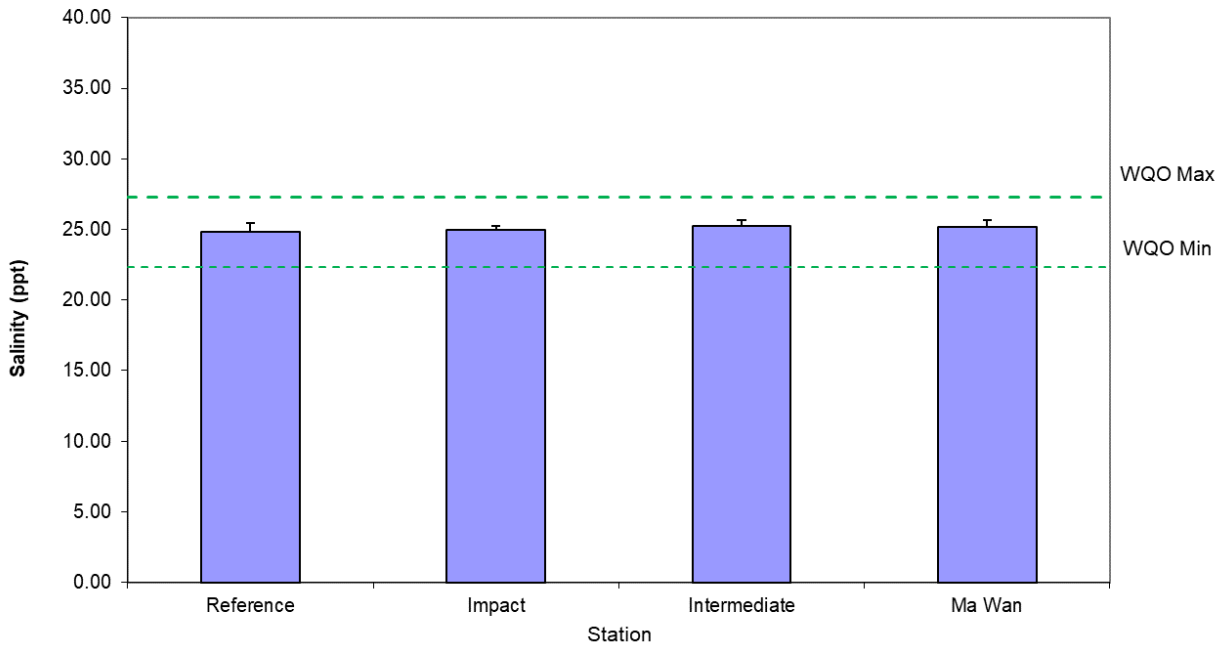


Figure 5: Level of Salinity (ppt; mean + SD) recorded during Routine Water Quality Monitoring for disposal operations at ESC CMP V in May 2020.

Routine Water Quality Monitoring for ESC CMP V - May 2020

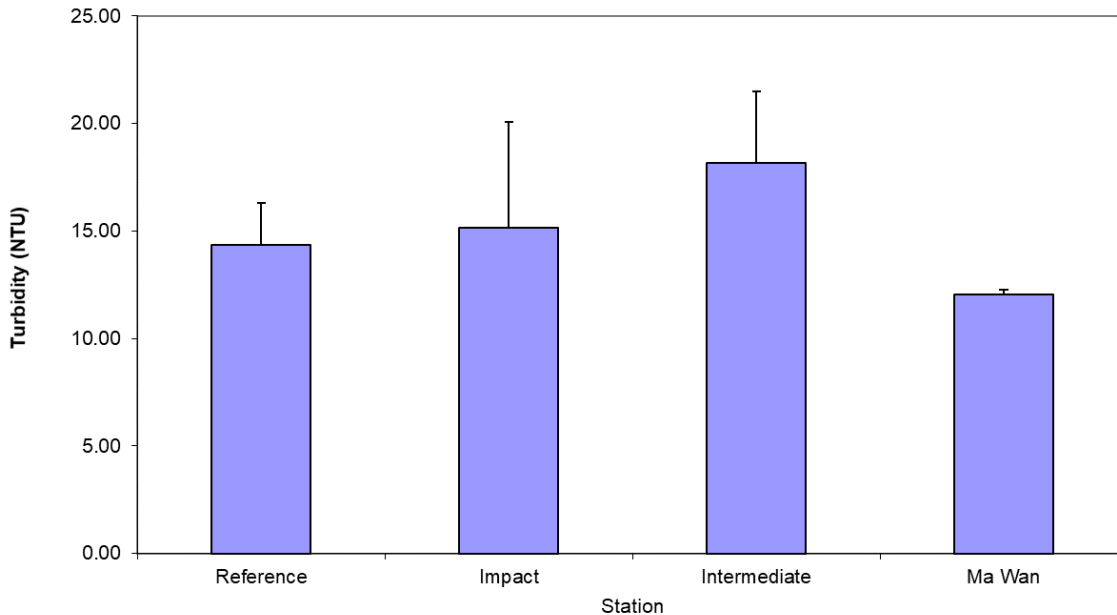


Figure 6: Levels of Turbidity (NTU; mean + SD) recorded during Routine Water Quality Monitoring for disposal operations at ESC CMP V in May 2020.

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**Routine Water Quality Monitoring for ESC CMP V
May 2020**

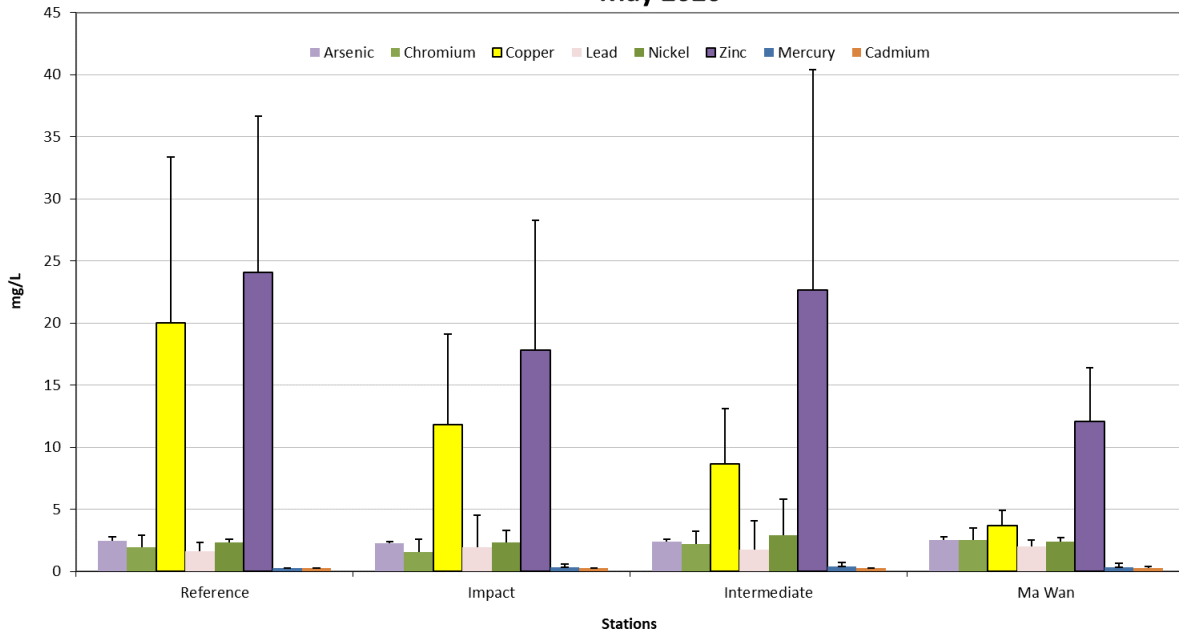


Figure 7: Concentration of Arsenic, Cadmium, Chromium, Copper, Lead, Mercury, Nickel and Zinc ($\mu\text{g/L}$; mean + SD) in water samples collected from Routine Water Quality Monitoring for disposal operations at ESC CMP V in May 2020.

**Routine Water Quality Monitoring Results for Nutrients
May 2020**

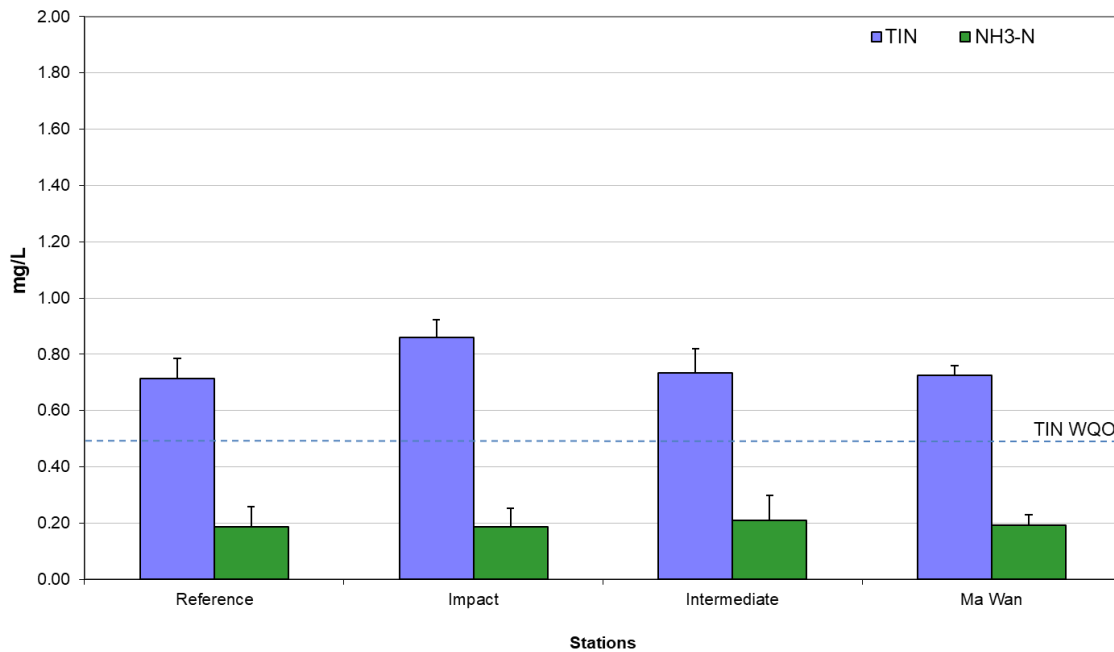


Figure 8: Concentration of Total Inorganic Nitrogen (TIN) and Ammonia Nitrogen (NH₃-N) (mg/L; mean + SD) in water samples collected from Routine Water Quality Monitoring for disposal operations at ESC CMP V in May 2020.

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**Routine Water Quality Monitoring Results for Biochemical Oxygen Demand (BOD₅)
May 2020**

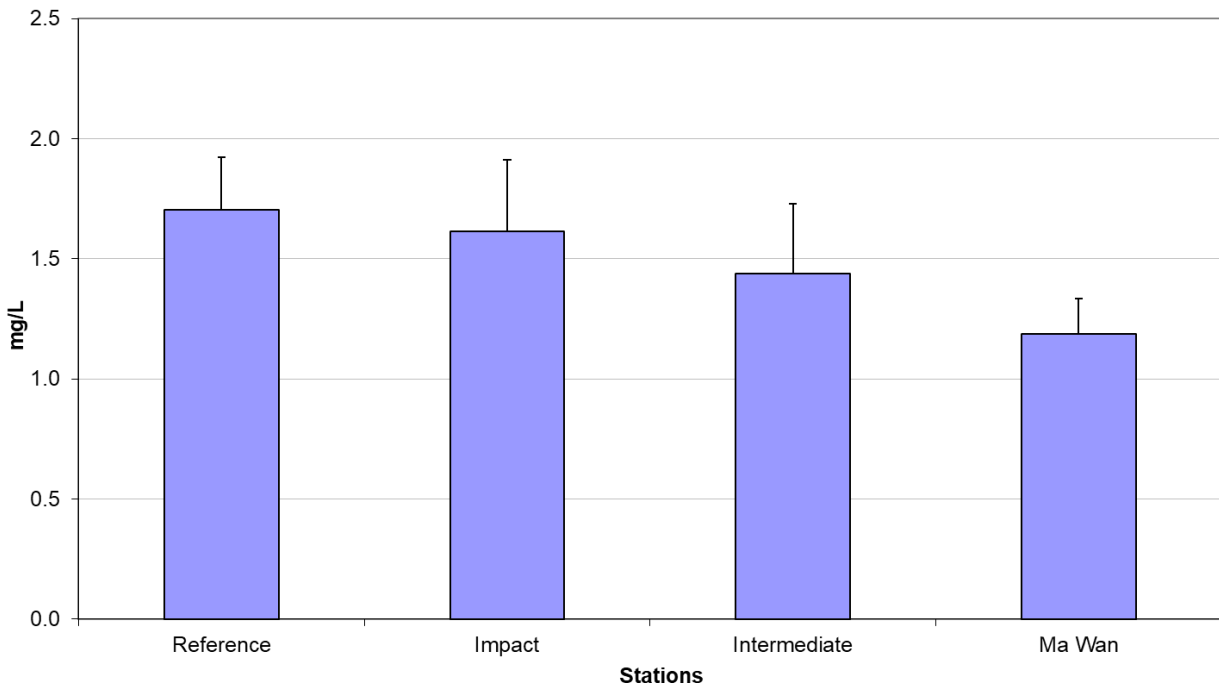


Figure 9: Level of Biochemical Oxygen Demand (BOD₅) (mg/L; mean + SD) in water samples collected from Routine Water Quality Monitoring for disposal operations at ESC CMP V in May 2020.

**Routine Water Quality Monitoring for Suspended Solids
May 2020**

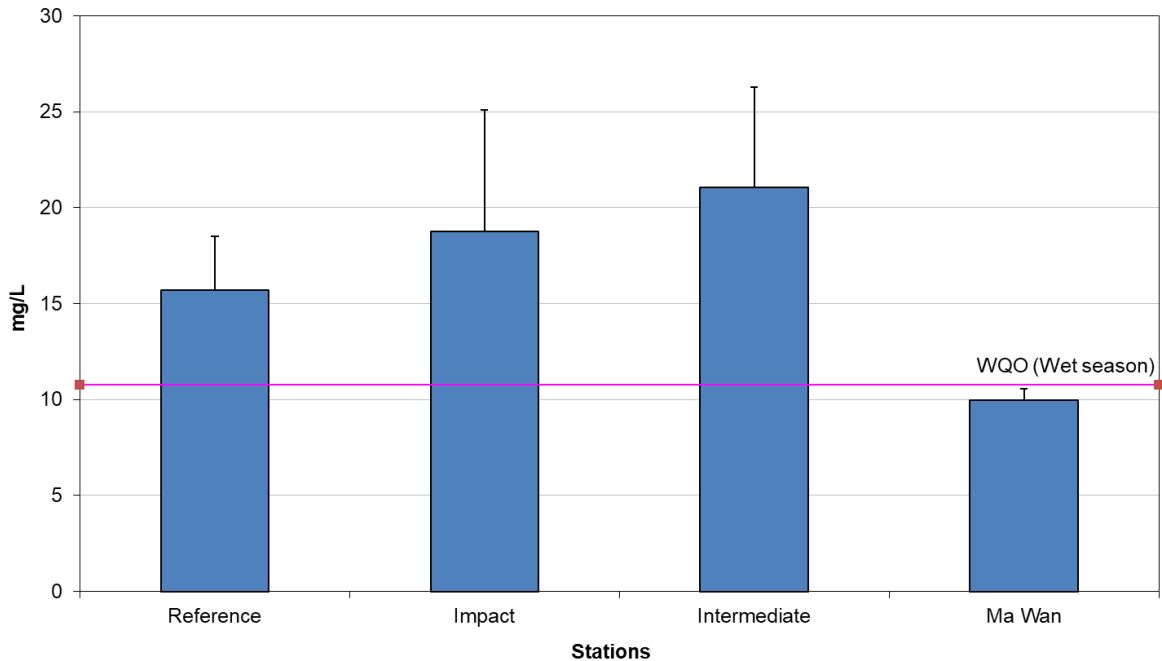


Figure 10: Concentration of Suspended Solids (SS) (mg/L; mean + SD) in water samples collected from Routine Water Quality Monitoring for disposal operations at ESC CMP V in May 2020.

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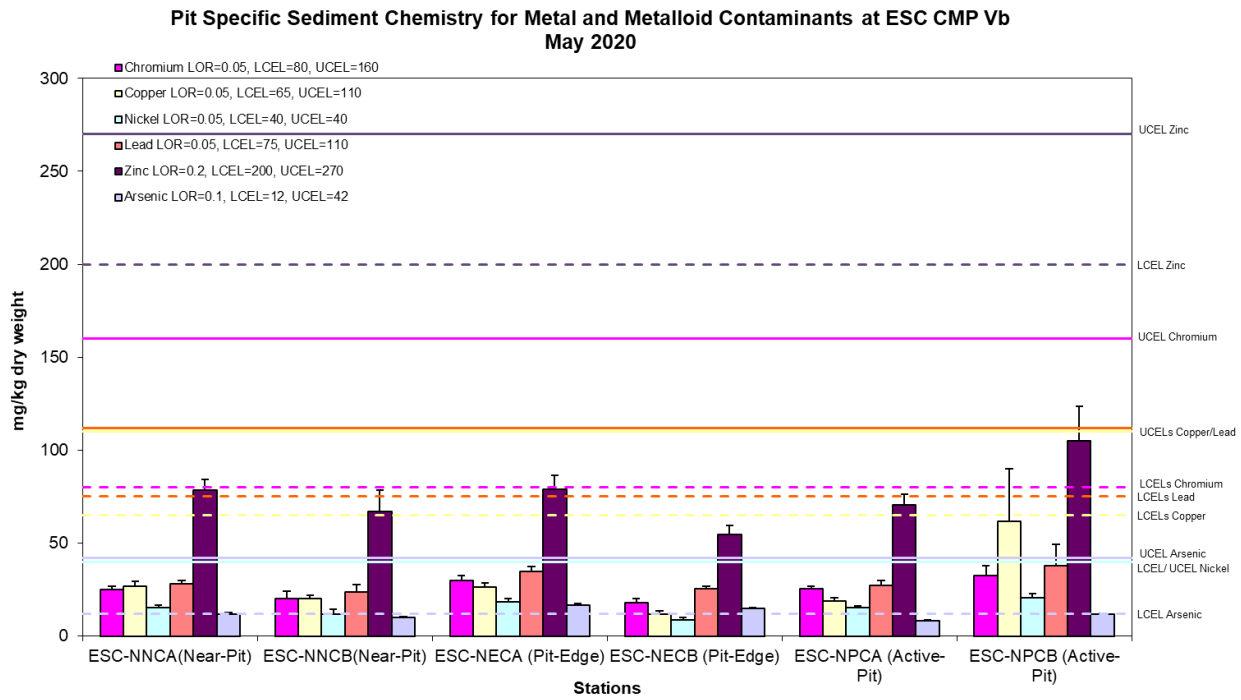


Figure 11: Concentration of Metals and Metalloid (Cr, Cu, Ni, Pb, Zn, As; mg/kg dry weight; mean +SD) in sediment samples collected from Pit Specific Sediment Chemistry Monitoring for ESC CMP Vb in May 2020.

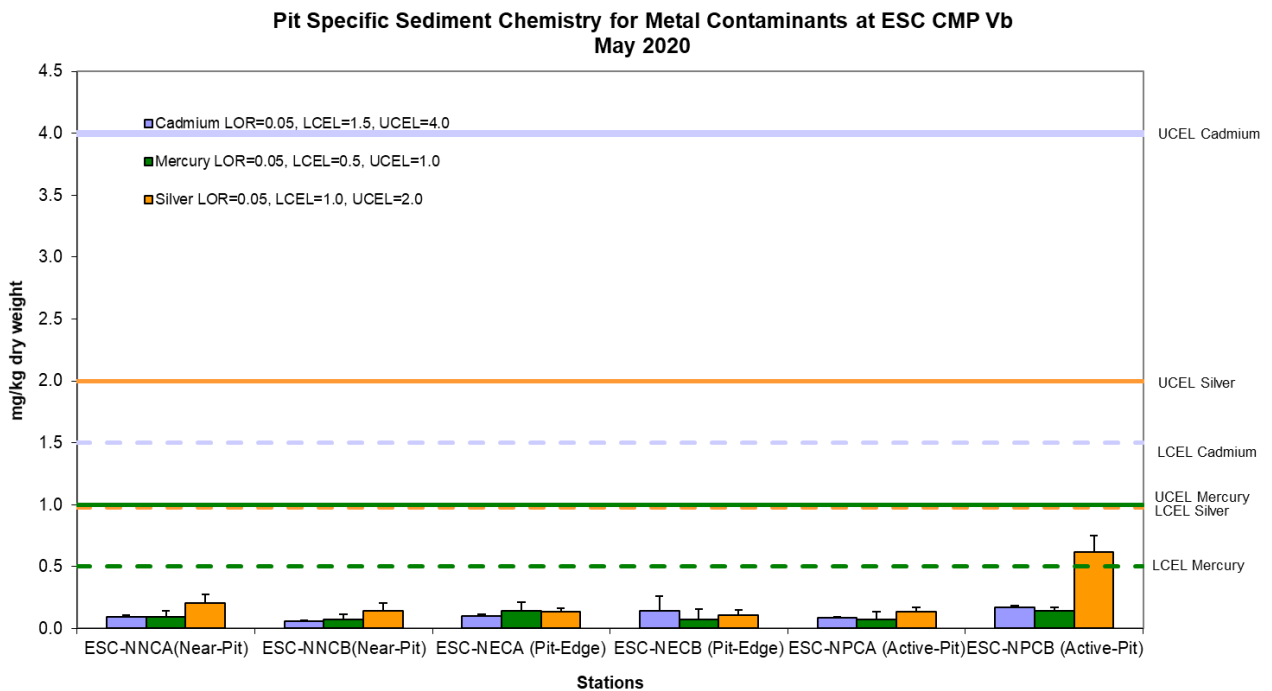


Figure 12: Concentration of Metals (Cd, Hg, Ag; mg/kg dry weight; mean +SD) in sediment samples collected from Pit Specific Sediment Chemistry Monitoring for ESC CMP Vb in May 2020.

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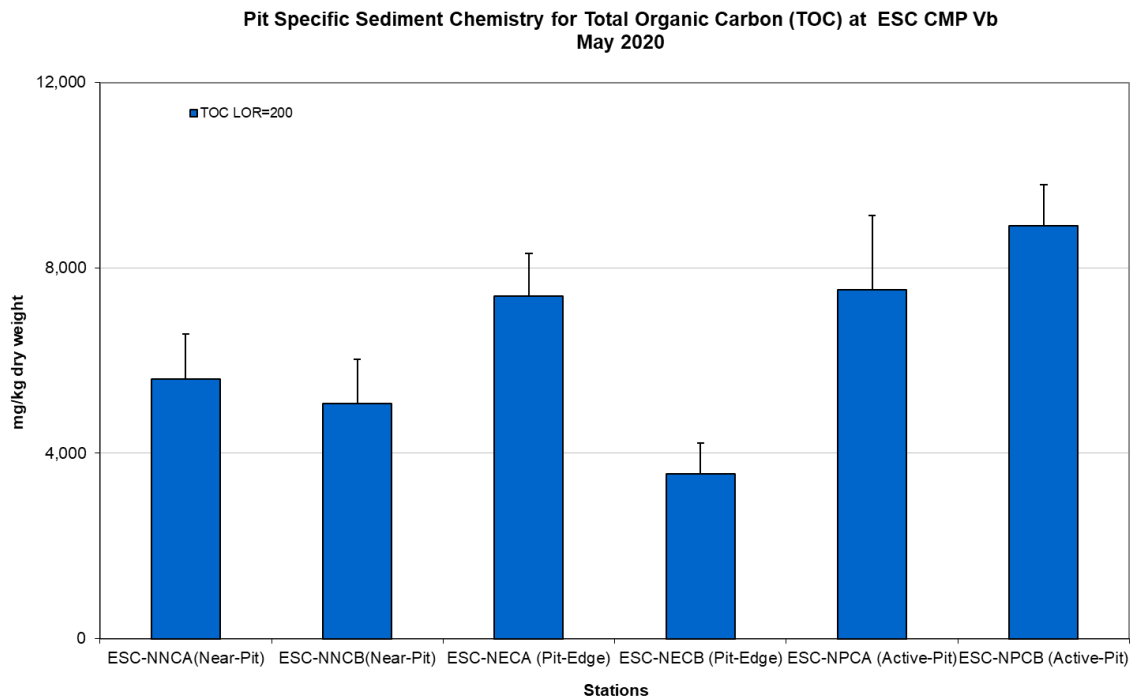


Figure 13: Concentration of Total Organic Carbon (TOC) (mg/kg dry weight; mean +SD) in sediment samples collected from Pit Specific Sediment Chemistry Monitoring for ESC CMP Vb in May 2020.

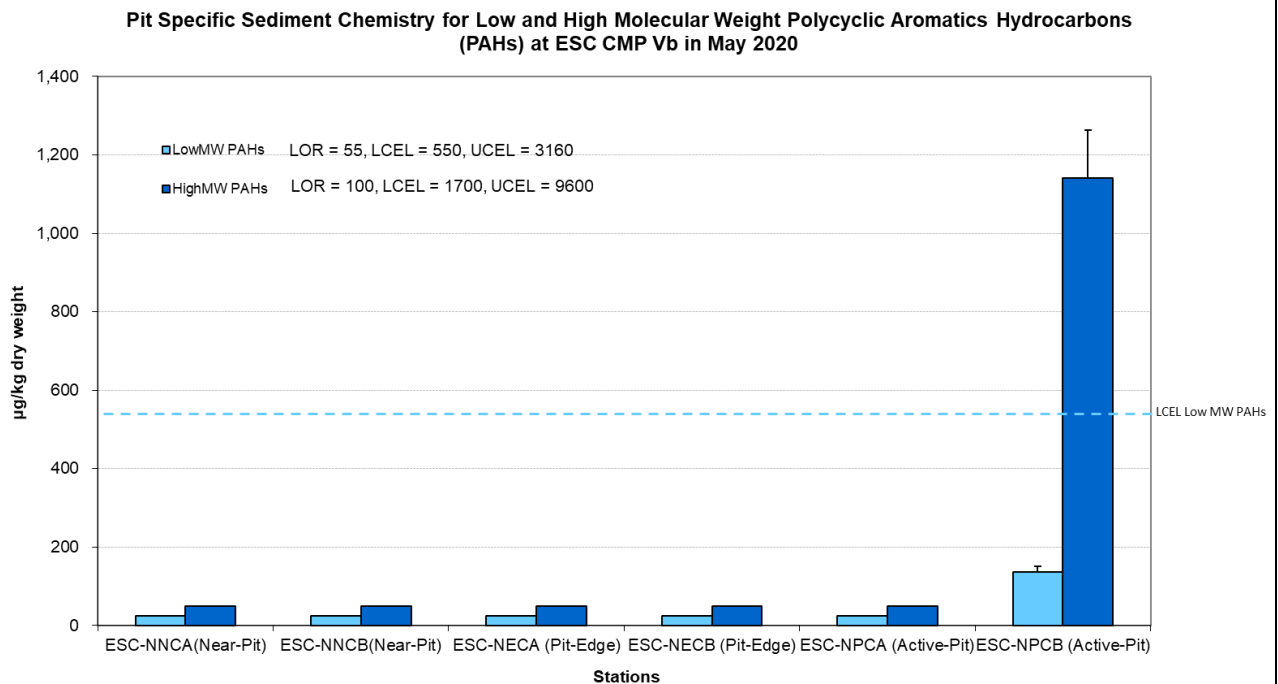


Figure 14: Concentration of Low and High Molecular Weight Polycyclic Aromatics (mg/kg dry weight; mean +SD) in sediment samples collected from Pit Specific Sediment Chemistry Monitoring for ESC CMP Vb in May 2020.

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Date: June 2020

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Annex D

Study Programme

