



Monthly EM&A Report for Contaminated
Mud Pits to the East of Sha Chau –
November 2019

Revision 0

December 2019

Environmental Resources Management

2507, 25/F, One Harbourfront
18 Tak Fung Street
Hungghom, Kowloon
Hong Kong
Telephone (852) 2271 3000
Facsimile (852) 2723 5660

www.erm.com

**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 – November 2019**

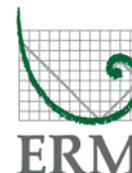
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2507, 25/F, One Harbourfront
18 Tak Fung Street
Hung Hom, Kowloon
Hong Kong
Telephone: (852) 2271 3000
Facsimile: (852) 2723 5660
E-mail: post.hk@erm.com
http://www.erm.com

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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 December 2019			
		Approved by:  Craig A. Reid Partner			
v0	Monthly EM&A Report for ESC CMPs	GS	RC	CAR	12/12/19
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 - November 2019
Date of Report:	12 December 2019
Date prepared by ET:	12 December 2019
Date received by IA:	12 December 2019

Reference EP Condition

Environmental Permit Condition:

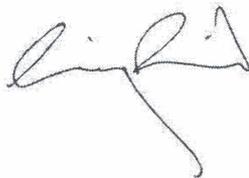
Condition 3.4 of EP-312/2008/A:

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: 12/12/2019

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: 12/12/2019

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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 NOVEMBER 2019

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 November 2019, dredging of accumulated natural deposits at ESC CMP Vb and disposal of contaminated mud at ESC CMP Vd were undertaken.

(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 Vd – November 2019***

1.5.3 *Water Column Profiling* was undertaken at a total of two sampling stations (Upstream and Downstream stations) on 6 November 2019. 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 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 November 2019 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 for November 2019 indicated that the SS levels at both Downstream and Upstream stations were complied with the WQO and 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 Vd did not appear to cause any deterioration in water quality during this reporting period.

1.5.7 ***Routine Water Quality Monitoring of ESC CMPs – November 2019***

1.5.8 *Routine Water Quality Monitoring of ESC CMP V* was undertaken on 7 November 2019. 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 November 2019 as shown in *Figure 1.2*.

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

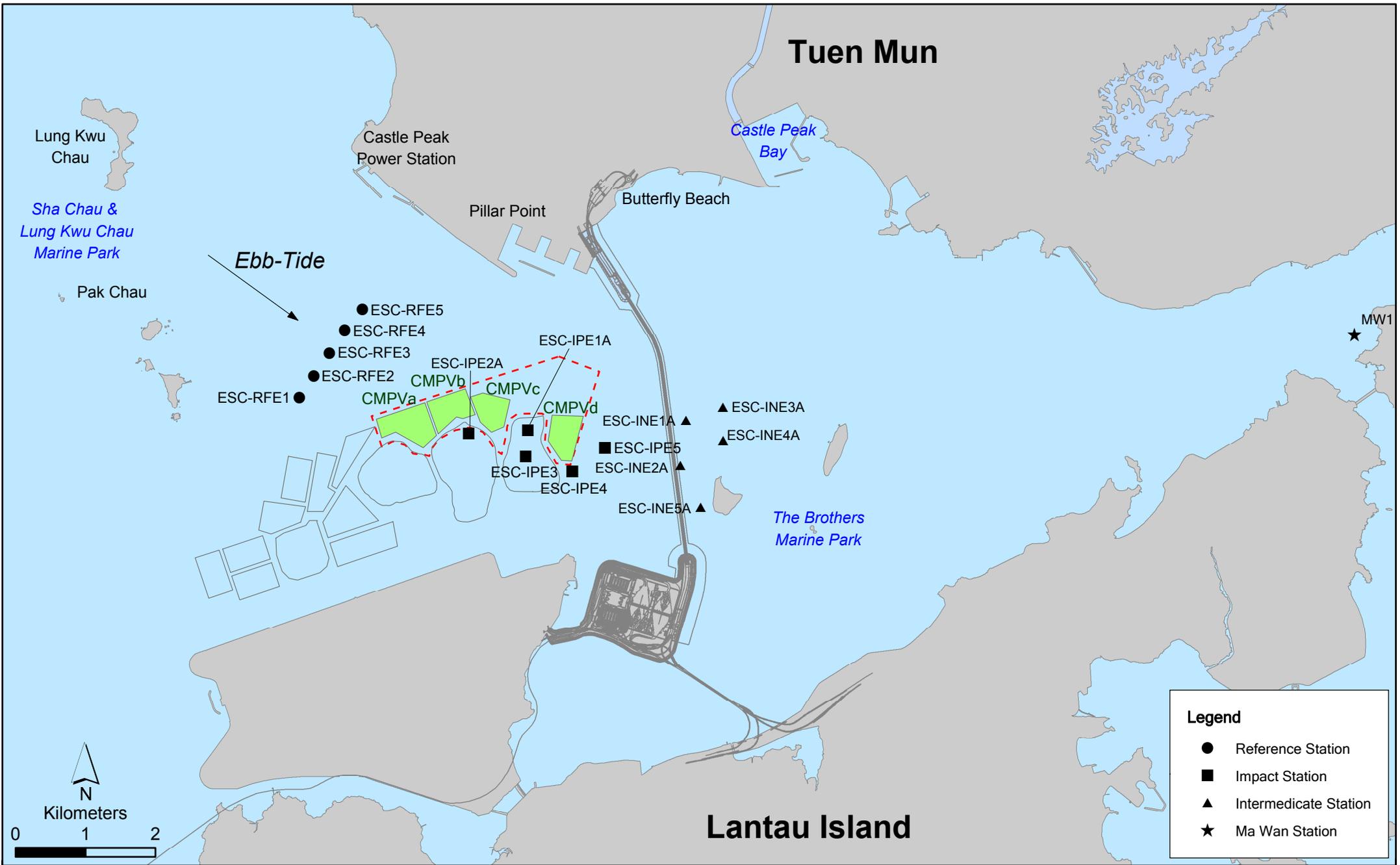


Figure 1.2

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 November 2019 indicated that the levels of pH, Salinity and DO complied with the WQOs at all stations in November 2019.
- 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*).
- 1.5.11 Overall, *in-situ* measurement results of the *Routine Water Quality Monitoring* indicated that the disposal operation at ESC CMP Vd did not appear to cause any unacceptable impacts in water quality in November 2019.

Laboratory Measurements

- 1.5.12 Laboratory analysis of November 2019 results indicated that concentrations of Arsenic, Chromium, Copper, Lead, Nickel and Zinc were detected in November 2019 samples at most stations and the concentrations of these metals and metalloids were similar amongst the stations, except the concentrations of Copper and Zinc were higher at Ma Wan station (*Table B4 of Annex B; Figure 7 of Annex C*).
- 1.5.13 For nutrients, concentrations of Total Inorganic Nitrogen (TIN) at all stations complied with WQO, while the concentrations of Ammonia Nitrogen (NH₃-N) and 5-day Biochemical Oxygen Demand (BOD₅) were generally similar amongst the stations in November 2019 (*Table B4 of Annex B; Figure 8 and 9 of Annex C*).
- 1.5.14 Analyses of results for November 2019 indicated that the SS levels at all stations were lower than the WQO (13.6 mg/L for dry season) and complied with the Action and Limit Levels (*Tables B1 and B4 of Annex B; Figure 10 of Annex C*).
- 1.5.15 Overall, results of the Routine Water Quality Monitoring indicated that the disposal operation at ESC CMP Vd did not appear to cause any unacceptable deterioration in water quality in November 2019. Detailed statistical analysis will be presented in the Quarterly Report to investigate any spatial and temporal trends of potential concern.
- 1.5.16 ***Pit Specific Sediment Chemistry of ESC CMP Vd – November 2019***
- 1.5.17 Monitoring locations for *Pit Specific Sediment Chemistry for ESC CMP Vd* are shown in *Figure 1.3*. A total of six (6) monitoring stations were sampled on 5 November 2019.

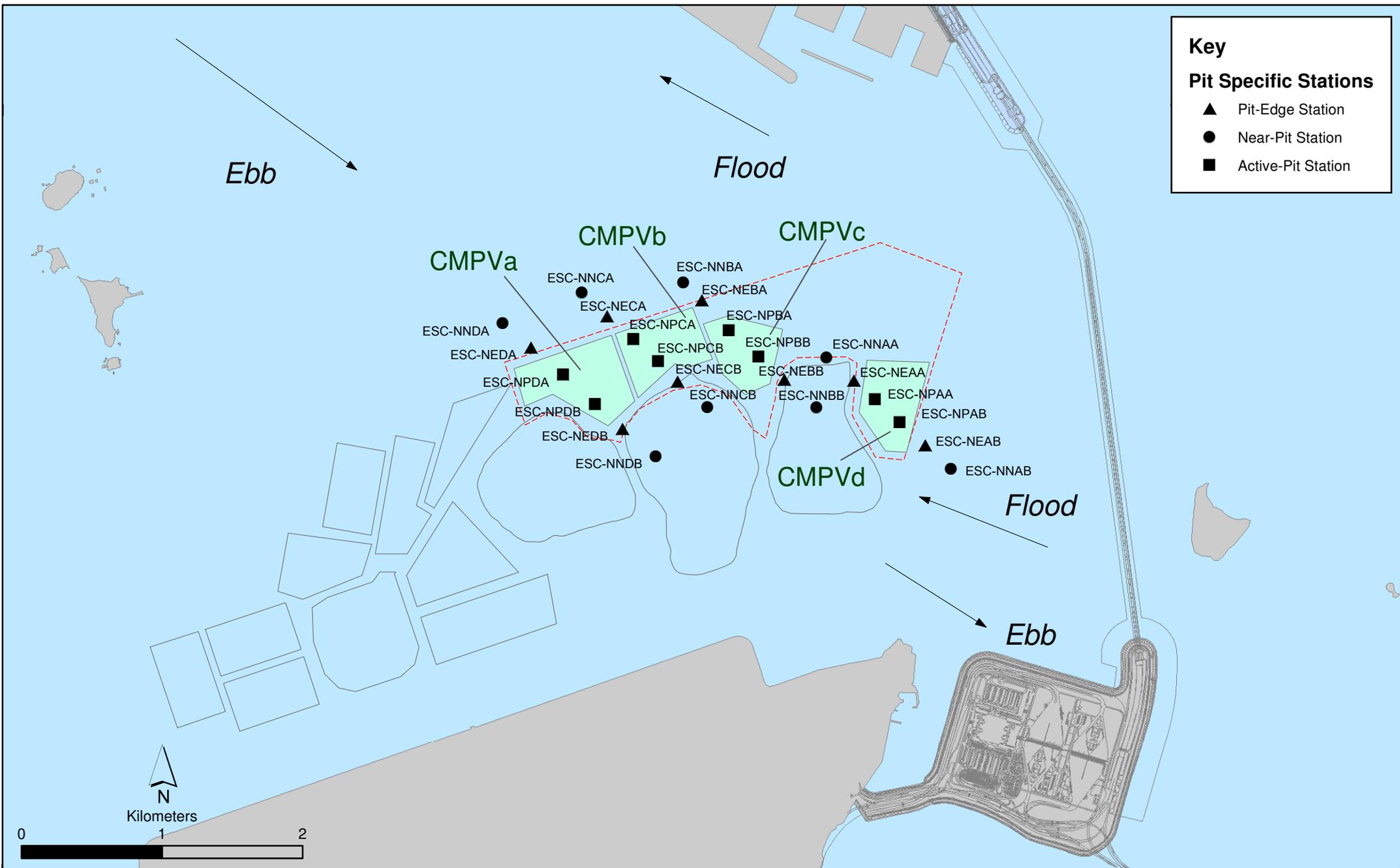


Figure 1.3

Pit Specific Sediment Quality Monitoring Stations for CMPV

- 1.5.18 The concentrations of most inorganic contaminants were lower than the Lower Chemical Exceedance Levels (LCELs) at most stations, except for Copper, Lead, Mercury, Silver and Zinc at Active-Pit stations (*Figures 11 and 12 of Annex C*). The concentrations of Copper were higher than the Upper Chemical Exceedance Level (UCEL) at Active-Pit station ESC-NPAA and were higher than the LCEL at Active-Pit station ESC-NPAB. The concentrations of Lead, Mercury and Zinc were higher than the LCEL at Active-Pit station ESC-NPAA. The concentrations of Silver were higher than the UCEL at Active-Pit station ESC-NPAA.
- 1.5.19 Considering that the higher levels of Copper, Lead, Mercury, Silver and Zinc occurred within Active-Pit stations only but not at the Pit-Edge and Near-Pit stations, 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 November 2019.
- 1.5.20 For organic contaminants, the concentrations of Total Organic Carbon (TOC) were generally similar across Near-Pit and Pit-Edge stations in November 2019, but were higher in Active-Pit stations, especially ESC-NPAA (*Figure 13 of Annex C*). The concentrations of Tributyltin (TBT) were generally similar across all stations, except it was lower at Active-Pit stations ESC-NPAA November 2019 (*Figure 14 of Annex C*). Total Polychlorinated Biphenyls (PCBs), Total dichloro-diphenyl-trichloroethane (DDT) and 4,4'-dichlorodiphenyldichloroethylene (DDE) concentrations were below the limit of reporting at most stations, except the concentration of PCBs was higher than the limit of reporting at Active-Pit stations ESC-NPAA. The concentrations of Low Molecular Weight Polycyclic Aromatic Hydrocarbons (PAHs) and High Molecular Weight PAHs exceeded UCEL at Active-Pit station ESC-NPAA and exceeded LCEL at Active-Pit station ESC-NPAB, and the concentration of High Molecular Weight PAHs exceeded LOR at Near-Pit stations ESC-NPAA and ESC-NPAB (*Figure 15 of Annex C*).
- 1.5.21 Considering that the higher levels of PAHs occurred within Active-Pit stations only, 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 November 2019.
- 1.5.22 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.
- 1.5.23 ***Impact Water Quality Monitoring during Dredging Operations of ESC CMP Vb – November 2019***

1.5.24 Dredging operation at ESC CMP Vb commenced on 11 November 2019. Water quality monitoring was conducted during the reporting period on 11, 13, 15, 18, 20, 22, 25, 27 and 29 November 2019. During each survey day, monitoring was conducted during both mid-ebb and mid-flood tides at two Reference (Upstream) stations and five Impact (Downstream) stations around the dredging operations at ESC CMP Vb. Monitoring was also conducted at one Sensitive Receiver station situated in Ma Wan. A total of eight (8) stations were monitored and locations of the sampling stations are shown in *Figure 1.4*.

1.5.25 Monitoring results are presented in *Table B5 of Annex B*. Daily dredging volume in November 2019 is reported in *Annex D*. Levels of DO, Turbidity and SS complied with the Action and Limit Levels (see *Table B1 of Annex B* for details). The results indicated that the dredging operations at ESC CMP Vb did not appear to cause any unacceptable deterioration in water quality during this reporting period. Therefore, no further action, except for those recommended in the Environmental Permit (EP-312/2008/A), are considered necessary for the dredging operations.

1.6 *ACTIVITIES SCHEDULED FOR THE NEXT MONTH*

1.6.1 The following monitoring activities will be conducted in the next monthly period of December 2019 for ESC CMP V (see *Annex A* for the sampling schedule ⁽¹⁾):

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

1.7 *STUDY PROGRAMME*

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

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

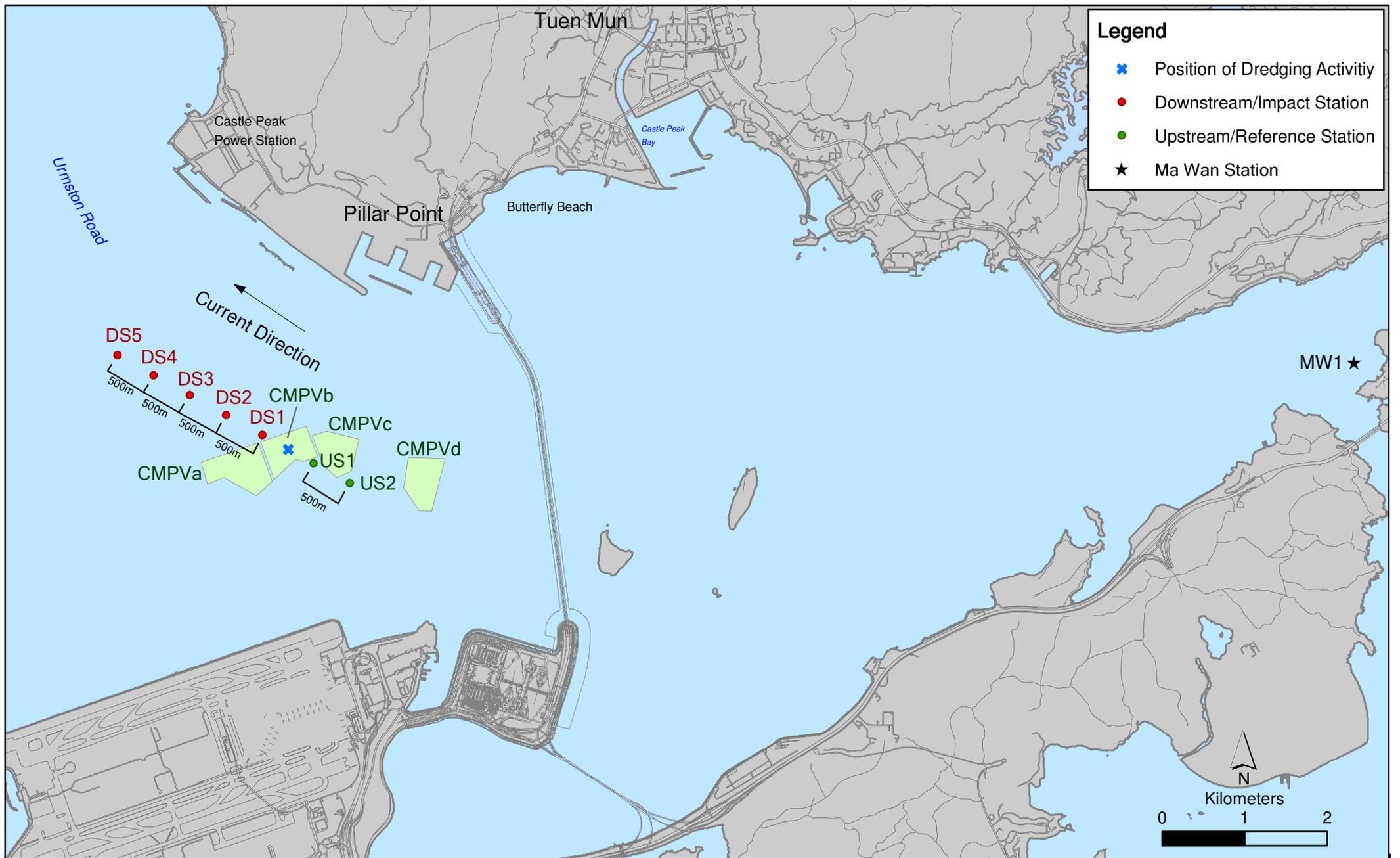


Figure 1.4

Indicative Dredging Impact Sampling Stations for CMPV

Note: The locations of sampling stations will be determined on site based on current direction and position of dredging activities.

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 B5 *Summary Table of DO, Turbidity and SS Levels Recorded in November 2019 for Impact Water Quality Monitoring during Dredging Operations of ESC CMP Vb*

Sampling Date	Tidal Period	Station	Average DO Levels (mg/L)		Average Turbidity Level (NTU)	Average SS Level (mg/L)
			Bottom	Surface and Mid Depth		
11/11/2019	Mid Ebb	US1	7.88	8.20	4.31	5.57
		US2	7.79	8.28	3.23	4.47
		DS1	8.33	8.69	3.31	4.22
		DS2	8.08	8.35	5.55	6.78
		DS3	8.07	8.40	5.34	5.85
		DS4	7.81	8.17	4.72	6.93
		DS5	7.95	8.17	5.09	6.72
		MW1	6.72	6.92	4.49	6.67
	Mid Flood	US1	7.44	7.45	6.72	8.82
		US2	7.50	7.54	7.98	10.00
		DS1	7.52	7.65	6.12	8.67
		DS2	7.49	7.53	6.73	7.80
		DS3	7.52	7.52	6.25	8.28
		DS4	7.45	7.47	6.50	8.85
		DS5	7.44	7.44	6.47	8.23
		MW1	6.70	6.74	4.31	6.47
13/11/2019	Mid Ebb	US1	7.99	9.11	5.97	6.93
		US2	7.99	8.98	5.04	6.62
		DS1	8.04	8.77	6.15	5.03
		DS2	8.25	8.79	4.95	7.93
		DS3	8.28	8.90	5.27	8.83
		DS4	7.99	8.89	8.05	8.85
		DS5	8.15	9.07	5.34	6.47
		MW1	7.39	7.85	3.64	5.55
	Mid Flood	US1	8.23	8.28	12.10	16.88
		US2	8.24	8.28	9.15	13.83
		DS1	8.15	8.20	9.53	12.33
		DS2	8.12	8.19	8.85	10.22
		DS3	8.14	8.19	9.75	11.92
		DS4	8.15	8.21	8.60	10.38
		DS5	8.11	8.22	11.30	12.55
		MW1	7.80	7.97	6.45	7.57
15/11/2019	Mid Ebb	US1	8.26	8.84	3.59	5.05
		US2	8.40	8.90	3.31	4.78
		DS1	8.19	8.63	3.84	3.83
		DS2	8.09	8.58	3.56	6.10
		DS3	8.02	8.49	5.41	6.50
		DS4	7.76	8.40	3.63	4.10
		DS5	7.83	8.62	5.34	5.55
		MW1	7.55	7.72	3.24	5.05
	Mid Flood	US1	8.08	8.18	5.73	6.08
		US2	8.02	8.15	7.35	8.10
		DS1	7.95	8.05	6.54	7.50
		DS2	7.99	8.05	6.05	8.40
		DS3	7.99	8.05	7.35	7.18
		DS4	7.99	8.10	8.20	8.48
		DS5	8.03	8.12	8.60	8.70
		MW1	7.52	7.64	6.12	6.22
18/11/2019	Mid Ebb	US1	8.45	9.13	3.69	5.53

Sampling Date	Tidal Period	Station	Average DO Levels (mg/L)		Average Turbidity Level (NTU)	Average SS Level (mg/L)
			Bottom	Surface and Mid Depth		
	Mid Flood	US2	8.46	8.98	4.01	4.95
		DS1	8.65	9.03	4.24	5.92
		DS2	8.32	8.95	3.91	9.05
		DS3	8.23	9.23	3.89	5.72
		DS4	8.07	9.03	4.06	5.22
		DS5	7.94	8.76	4.16	5.48
		MW1	7.59	7.89	3.94	5.12
		US1	8.03	8.68	7.25	7.72
		US2	8.31	8.96	4.94	6.50
		DS1	8.31	8.74	5.09	4.30
		DS2	8.10	8.49	8.14	10.82
		DS3	8.08	8.66	7.54	6.05
		DS4	8.17	8.69	8.09	7.97
		DS5	8.21	8.56	4.72	6.32
		MW1	7.97	8.19	6.07	6.62
		20/11/2019	Mid Ebb	US1	7.19	7.65
US2	7.15			7.47	6.30	7.13
DS1	7.23			7.46	8.19	7.50
DS2	7.12			7.51	7.09	5.63
DS3	7.29			7.60	7.54	7.65
DS4	7.24			7.55	8.04	7.32
DS5	7.34			7.65	6.69	6.67
MW1	6.72			6.75	3.96	4.35
US1	7.29			7.95	5.21	6.08
US2	6.96			7.54	6.45	6.58
DS1	7.94			7.75	5.87	7.15
DS2	7.71			7.88	4.56	5.08
DS3	7.55			7.85	4.66	4.70
DS4	7.41			7.84	4.32	5.53
DS5	7.68			8.07	5.39	5.52
MW1	6.76			6.86	5.85	5.65
22/11/2019	Mid Ebb	US1	7.40	7.56	5.10	6.75
		US2	7.32	7.55	5.19	5.77
		DS1	7.35	7.47	5.70	6.20
		DS2	7.44	7.48	6.03	7.07
		DS3	7.42	7.45	6.79	6.37
		DS4	7.32	7.40	8.07	7.55
		DS5	7.36	7.40	8.12	7.83
		MW1	6.77	6.81	3.53	4.10
		US1	7.49	7.57	5.06	6.85
		US2	7.41	7.63	6.65	5.52
		DS1	7.49	7.65	3.13	4.23
		DS2	7.42	7.55	4.06	4.13
		DS3	7.32	7.42	4.71	4.45
		DS4	7.43	7.59	3.81	5.10
		DS5	7.41	7.61	3.96	4.90
		MW1	6.56	6.61	4.16	3.92
25/11/2019	Mid Ebb	US1	7.05	7.31	7.12	6.23
		US2	7.02	7.22	8.44	7.68
		DS1	7.05	7.30	10.90	8.80
		DS2	6.97	7.30	12.30	12.28
		DS3	7.11	7.48	8.24	7.85
		DS4	7.08	7.31	7.90	7.28

Sampling Date	Tidal Period	Station	Average DO Levels (mg/L)		Average Turbidity Level (NTU)	Average SS Level (mg/L)		
			Bottom	Surface and Mid Depth				
	Mid Flood	DS5	7.02	7.26	11.55	10.95		
		MW1	6.11	6.22	5.72	6.05		
		US1	7.19	7.34	19.34	12.55		
		US2	6.81	7.00	19.28	13.20		
		DS1	7.24	7.32	19.09	11.55		
		DS2	7.25	7.38	10.20	8.07		
		DS3	7.30	7.39	10.76	10.43		
		DS4	7.25	7.33	15.30	13.92		
		DS5	7.23	7.37	13.90	13.48		
		MW1	6.20	6.19	8.30	7.10		
		27/11/2019	Mid Ebb	US1	6.84	6.85	14.13	9.72
				US2	6.85	6.88	11.57	9.17
				DS1	6.85	6.89	14.50	7.07
				DS2	6.86	6.90	11.75	7.65
	DS3	6.85		6.90	12.35	7.98		
	DS4	6.83		6.89	12.28	8.22		
	DS5	6.88		6.86	11.96	11.03		
	MW1	6.22		6.28	16.91	5.75		
	Mid Flood	US1		6.70	6.97	11.90	12.53	
		US2		6.75	7.00	9.70	10.22	
		DS1		6.75	6.97	7.42	10.03	
		DS2		6.77	6.90	7.53	9.60	
		DS3		6.76	6.90	8.20	10.23	
		DS4		6.72	6.98	9.45	8.85	
		DS5	6.74	6.91	12.50	9.35		
	MW1	6.27	6.55	5.39	12.58			
29/11/2019	Mid Ebb	US1	6.54	6.80	8.37	9.72		
		US2	6.64	6.79	10.42	9.85		
		DS1	6.67	6.85	8.42	8.57		
		DS2	6.46	6.60	8.15	7.20		
		DS3	6.45	6.55	10.90	10.40		
		DS4	6.06	6.46	9.00	7.88		
		DS5	6.04	6.44	7.70	6.98		
		MW1	6.07	6.14	6.55	6.05		
		Mid Flood	US1	6.77	6.81	16.74	13.52	
			US2	6.73	6.74	18.52	16.12	
			DS1	6.70	6.72	12.25	9.70	
			DS2	6.66	6.70	12.93	9.87	
			DS3	6.68	6.71	13.35	9.73	
			DS4	6.65	6.67	11.98	10.03	
	DS5		6.66	6.72	14.46	11.78		
	MW1	6.22	6.25	10.40	9.27			

Notes:

1. Please refer to Table B1 above for the Action and Limit Levels for dredging activities.
2. Cell shaded yellow indicated value exceeding the Action Level criteria.
3. Cell shaded red indicated value exceeding the Limit Level criteria.

Annex C

Graphical Presentations

Routine Water Quality Monitoring for ESC CMP V - November 2019

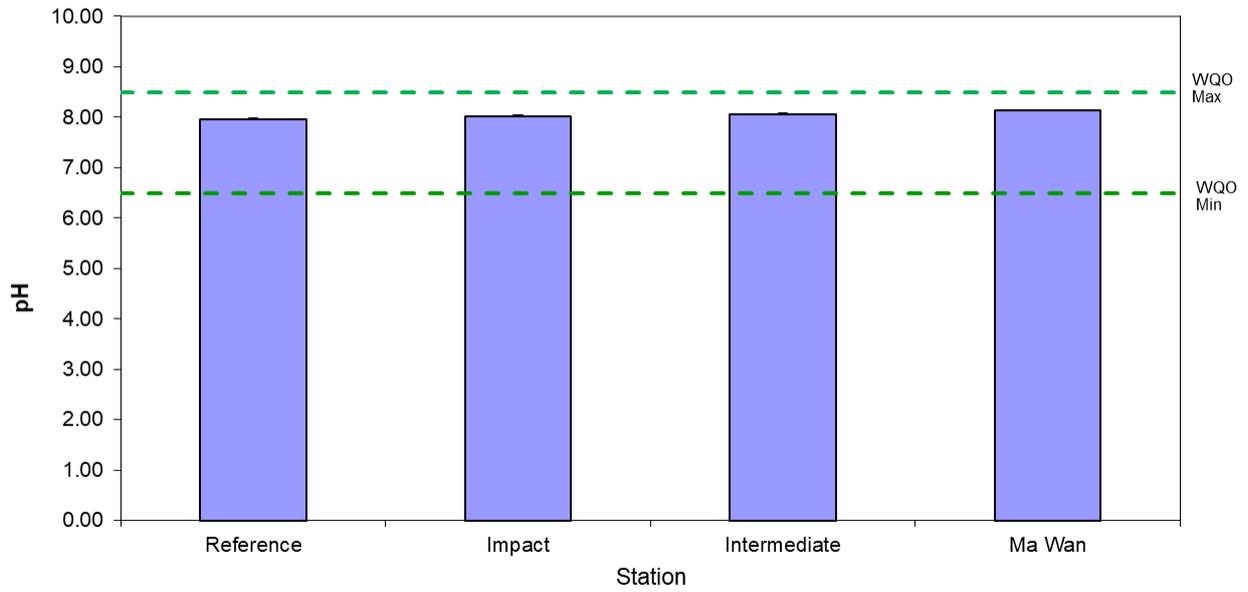


Figure 1: Level of pH recorded during Routine Water Quality Monitoring for disposal operations at ESC CMP V in November 2019.

Routine Water Quality Monitoring ESC CMP V - November 2019

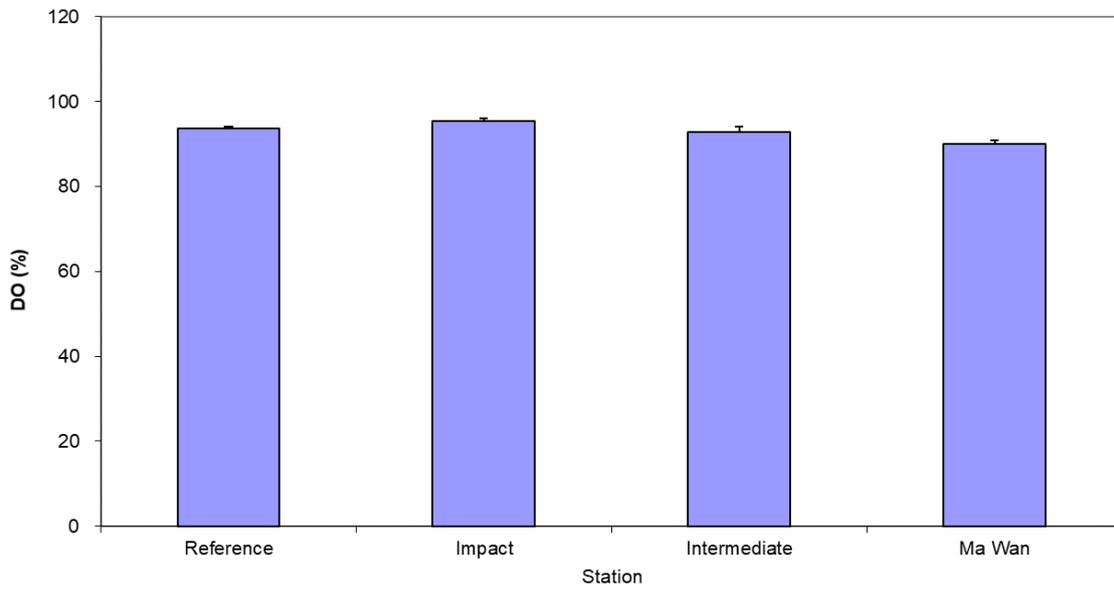


Figure 2: Level of Dissolved Oxygen (DO) (% saturation; mean + SD) recorded during Routine Water Quality Monitoring for disposal operations at ESC CMP V in November 2019.

Source: P:\Projects\0400720 CEDD CMP EM&A 2017-2020\02 Deliverable\05 CMP Monthly Report\32 Monthly November 2019

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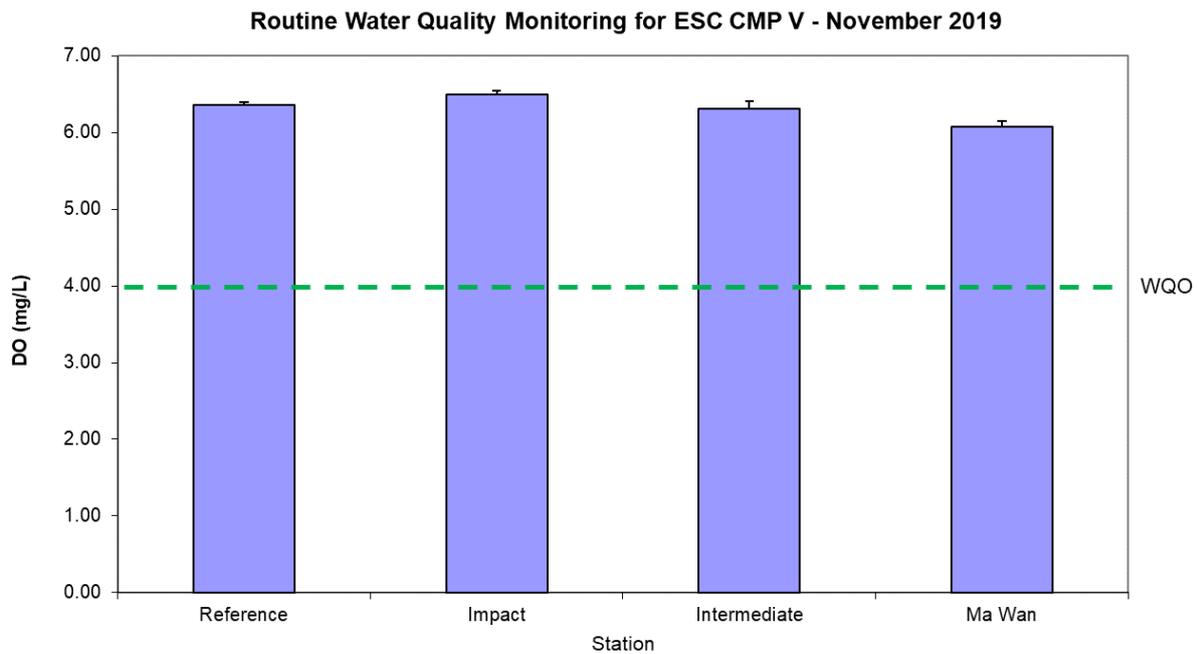


Figure 3: Concentration of Dissolved Oxygen (DO) (mg/L; mean + SD) recorded during Routine Water Quality Monitoring for disposal operations at ESC CMP V in November 2019.

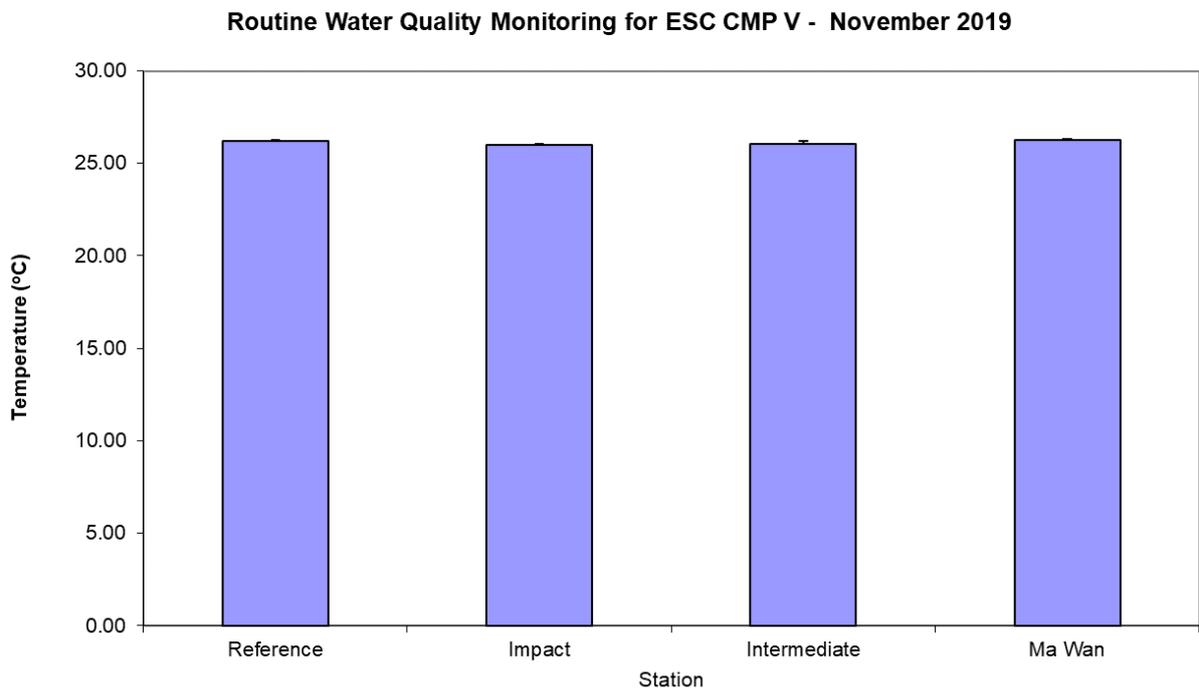


Figure 4: Level of Temperature (°C; mean + SD) recorded during Routine Water Quality Monitoring for disposal operations at ESC CMP V in November 2019.

Routine Water Quality Monitoring for ESC CMP V - November 2019

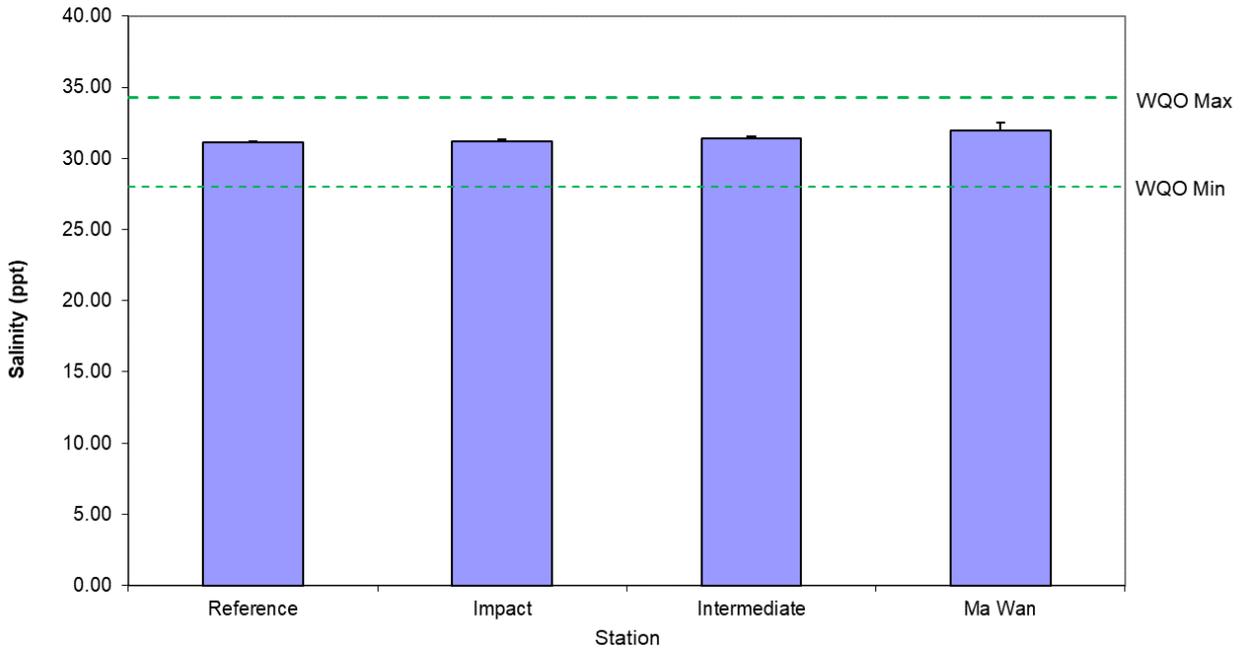


Figure 5: Level of Salinity (ppt; mean + SD) recorded during Routine Water Quality Monitoring for disposal operations at ESC CMP V in November 2019.

Routine Water Quality Monitoring for ESC CMP V - November 2019

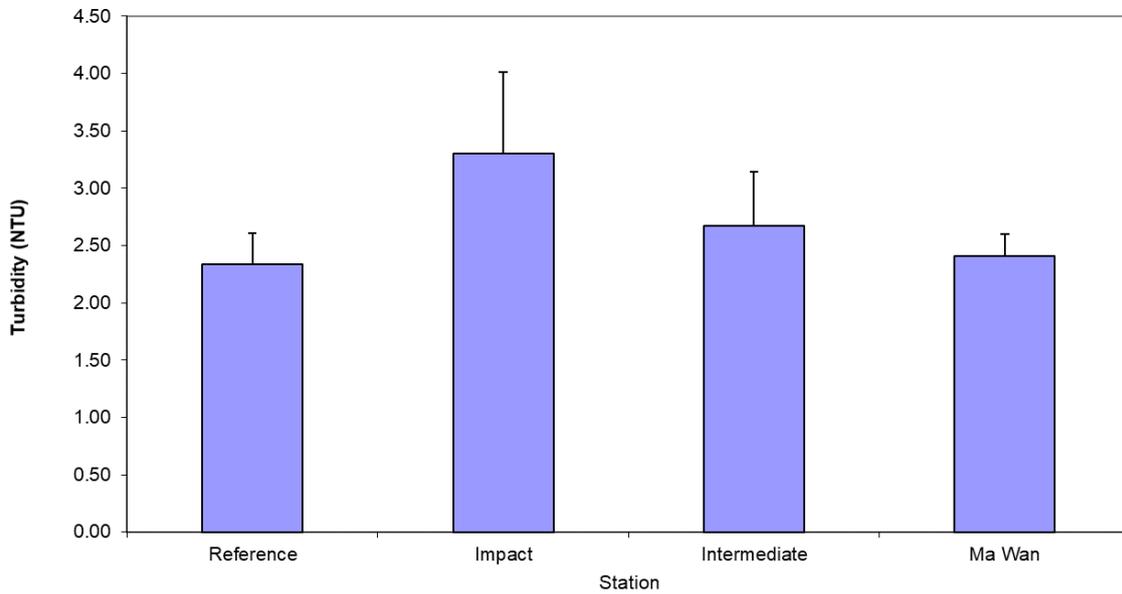


Figure 6: Levels of Turbidity (NTU; mean + SD) recorded during Routine Water Quality Monitoring for disposal operations at ESC CMP V in November 2019.

Source: P:\Projects\0400720 CEDD CMP EM&A 2017-2020\02 Deliverable\05 CMP Monthly Report\32 Monthly November 2019

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**Routine Water Quality Monitoring for ESC CMP V
November 2019**

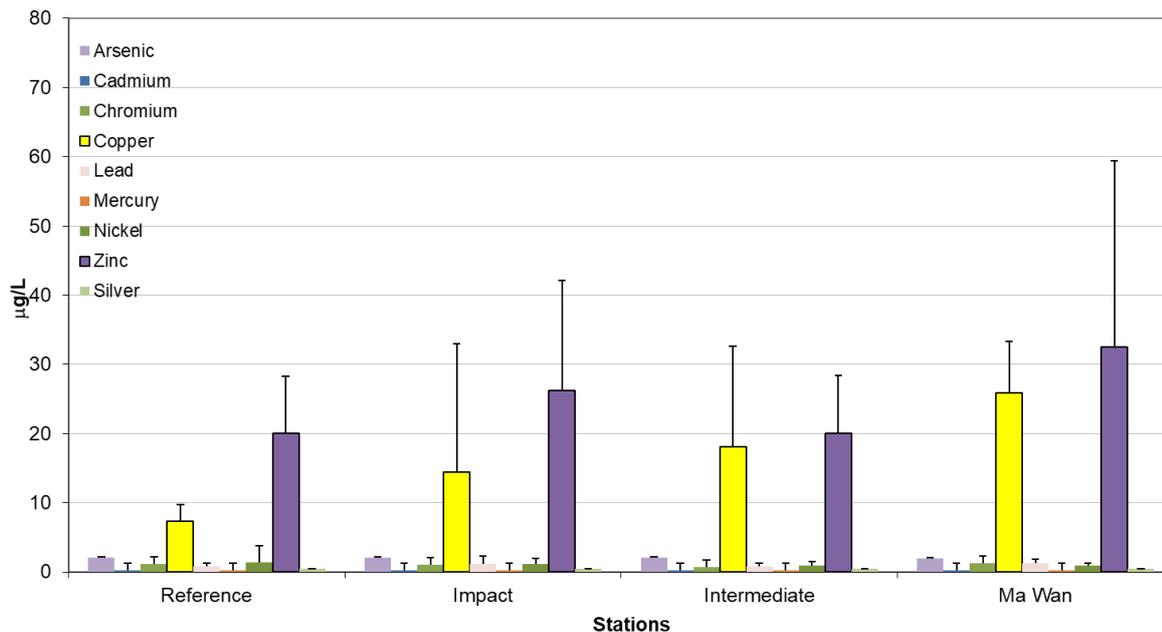


Figure 7: Concentration of Arsenic, Cadmium, Chromium, Copper, Lead, Mercury, Nickel, Zinc and Silver ($\mu\text{g/L}$; mean + SD) in water samples collected from Routine Water Quality Monitoring for disposal operations at ESC CMP V in November 2019.

**Routine Water Quality Monitoring Results for Nutrients
November 2019**

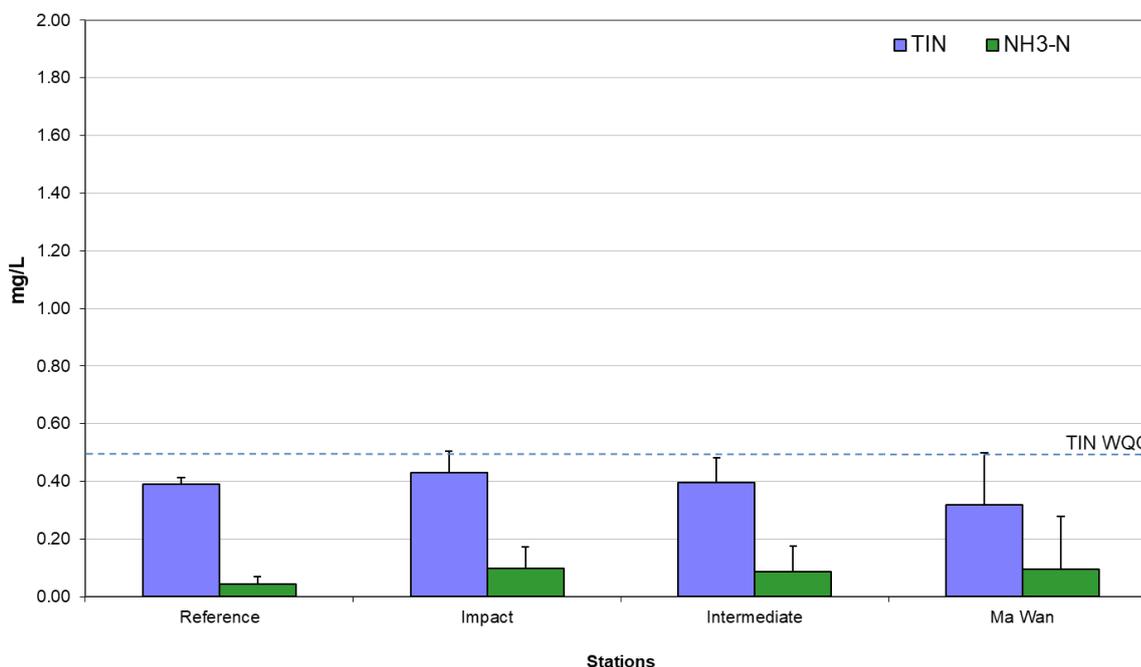


Figure 8: Concentration of Total Inorganic Nitrogen (TIN) and Ammonia Nitrogen ($\text{NH}_3\text{-N}$) ($\mu\text{g/L}$; mean + SD) in water samples collected from Routine Water Quality Monitoring for disposal operations at ESC CMP V in November 2019.

Source: P:\Projects\0400720 CEDD CMP EM&A 2017-2020\02 Deliverable\05 CMP Monthly Report\32 Monthly November 2019

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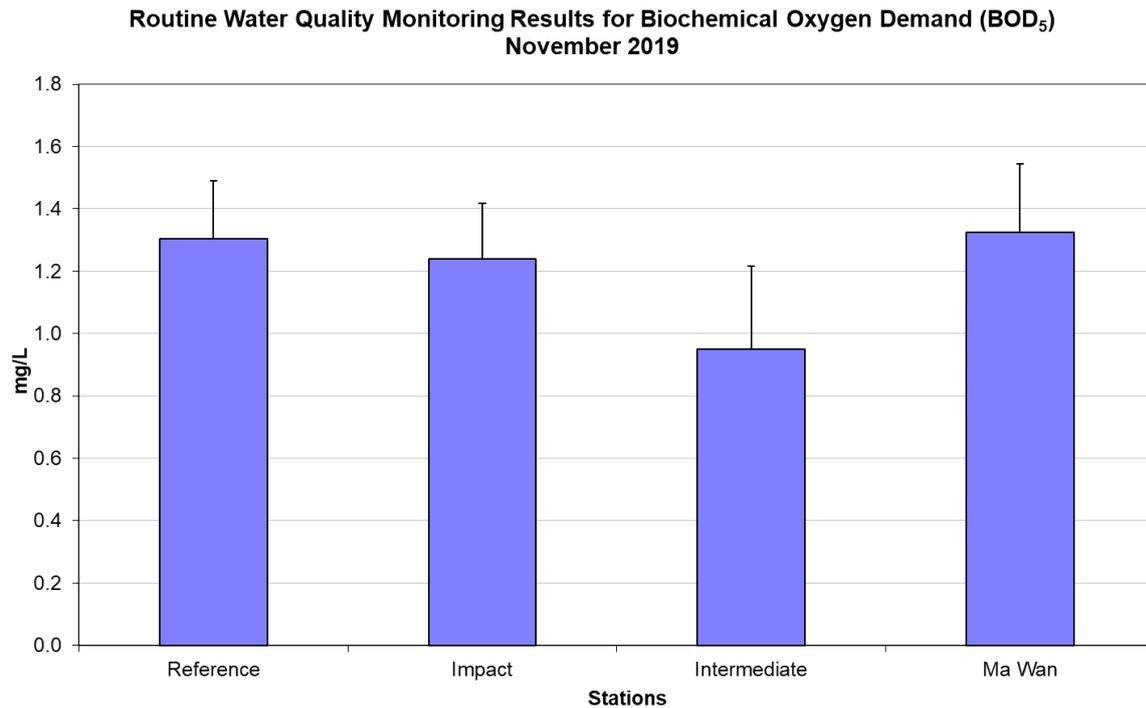


Figure 9: Level of Biochemical Oxygen Demand (BOD₅) (mg/L; mean + SD) in water samples collected from Routine Water Quality Monitoring for disposal operations at ESC CMP V in November 2019.

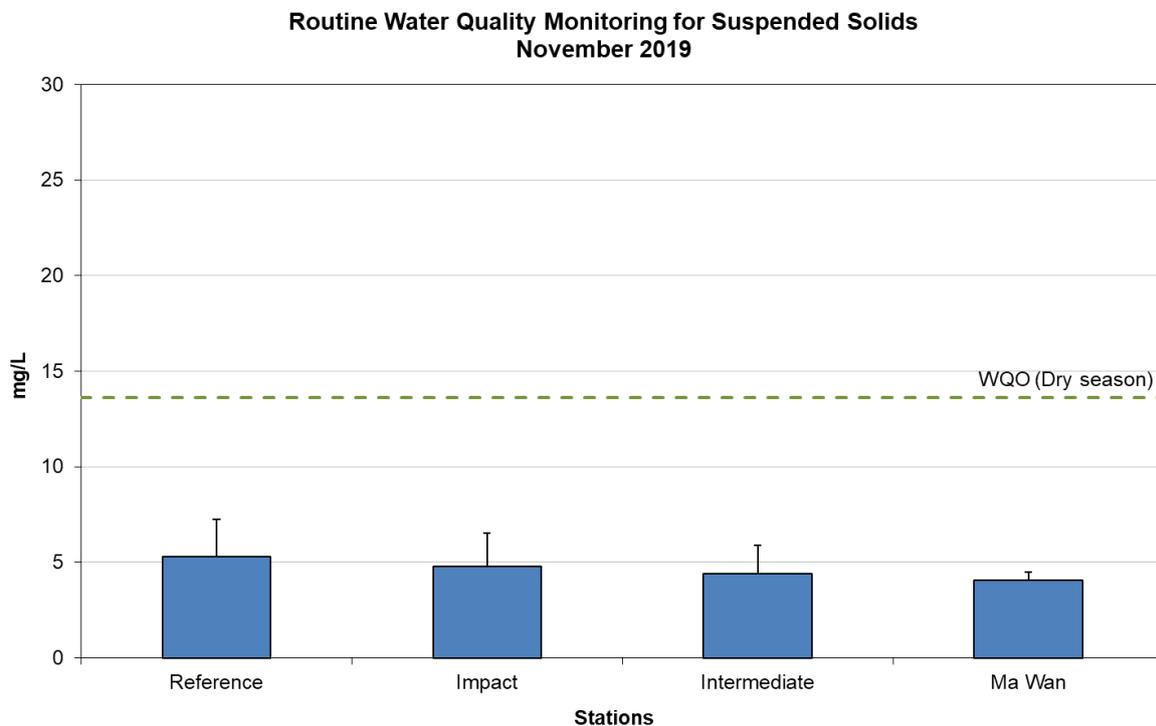


Figure 10: Concentration of Suspended Solids (SS) (mg/L; mean + SD) in water samples collected from Routine Water Quality Monitoring for disposal operations at ESC CMP V in November 2019.

Source: P:\Projects\0400720 CEDD CMP EM&A 2017-2020\02 Deliverable\05 CMP Monthly Report\32 Monthly November 2019

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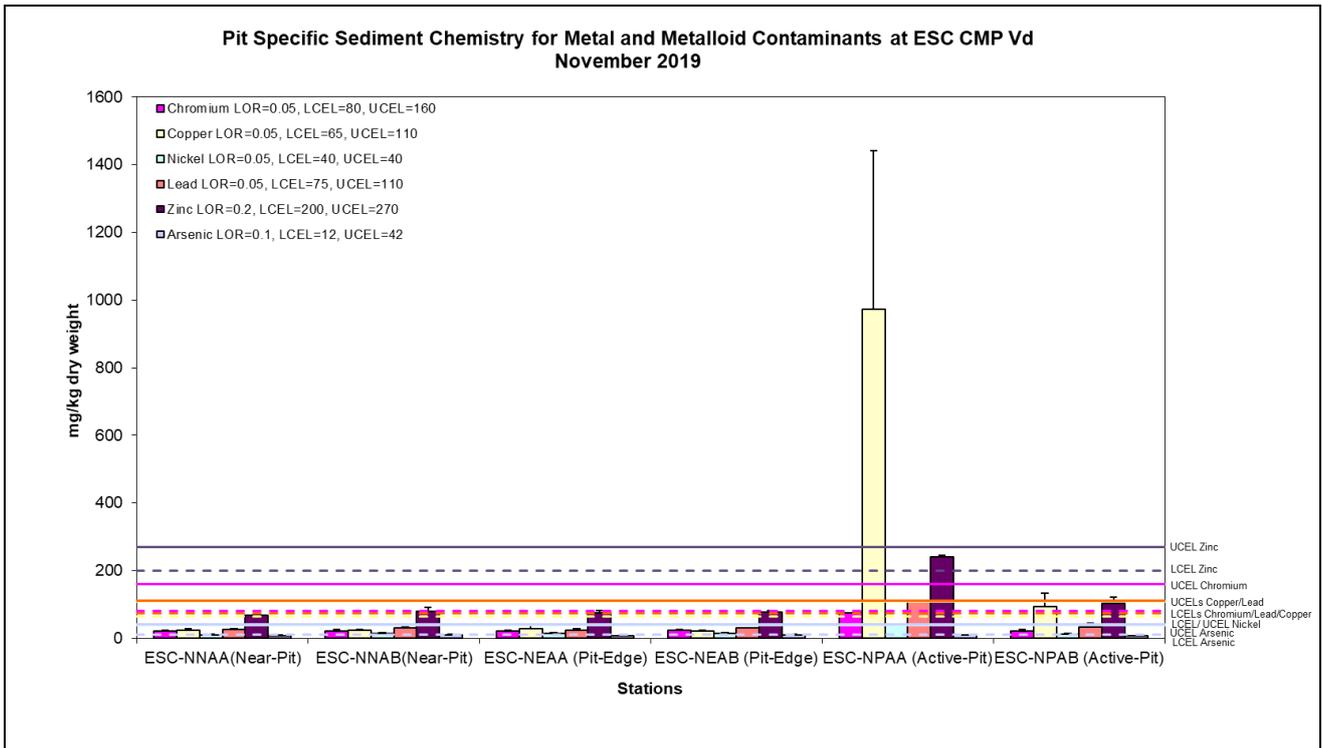


Figure 11: Concentration of Metals and Metalloid (Cr, Cu, Ni, Pb, Zn, As; mg/kg dry weight; mean +SD) in sediment samples collected from Pit Specific Sediment Chemistry Monitoring for ESC CMP Vd in November 2019.

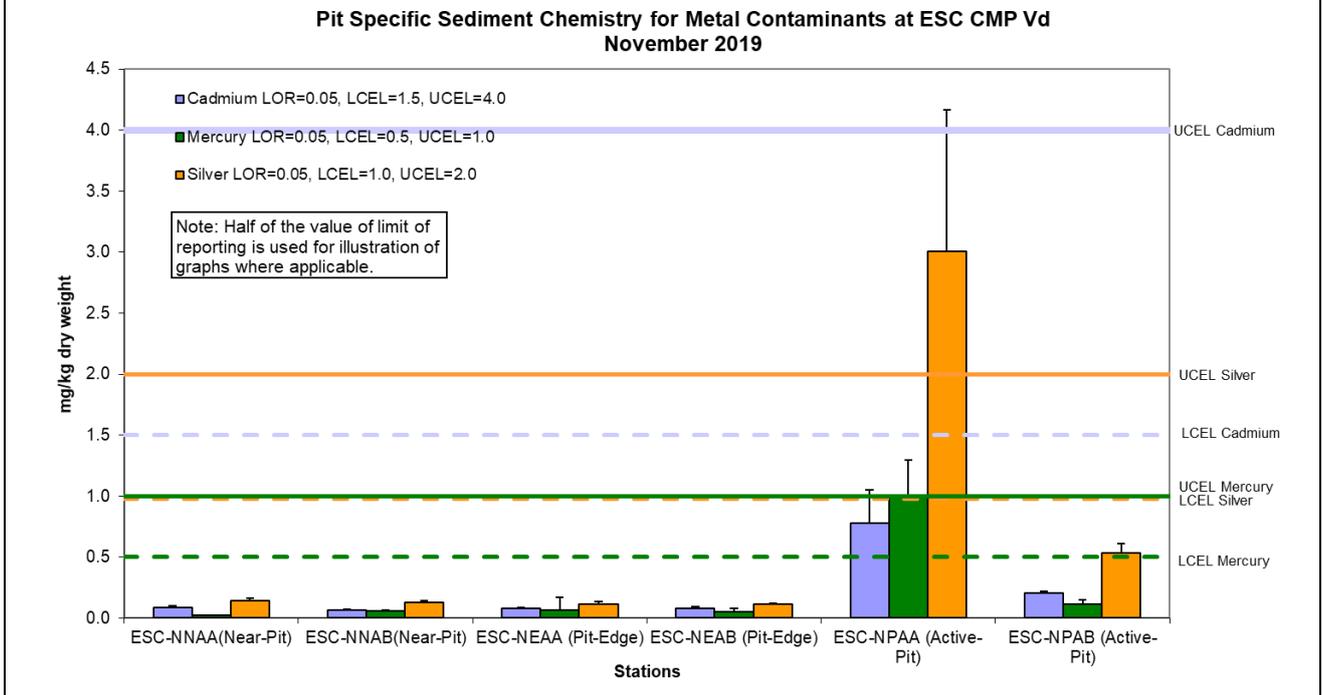


Figure 12: Concentration of Metals (Cd, Hg, Ag; mg/kg dry weight; mean +SD) in sediment samples collected from Pit Specific Sediment Chemistry Monitoring for ESC CMP Vd in November 2019.

Source: P:\Projects\0400720 CEDD CMP EM&A 2017-2020\02 Deliverable\05 CMP Monthly Report\32 Monthly November 2019

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**Pit Specific Sediment Chemistry for Total Organic Carbon (TOC) at ESC CMP Vd
November 2019**

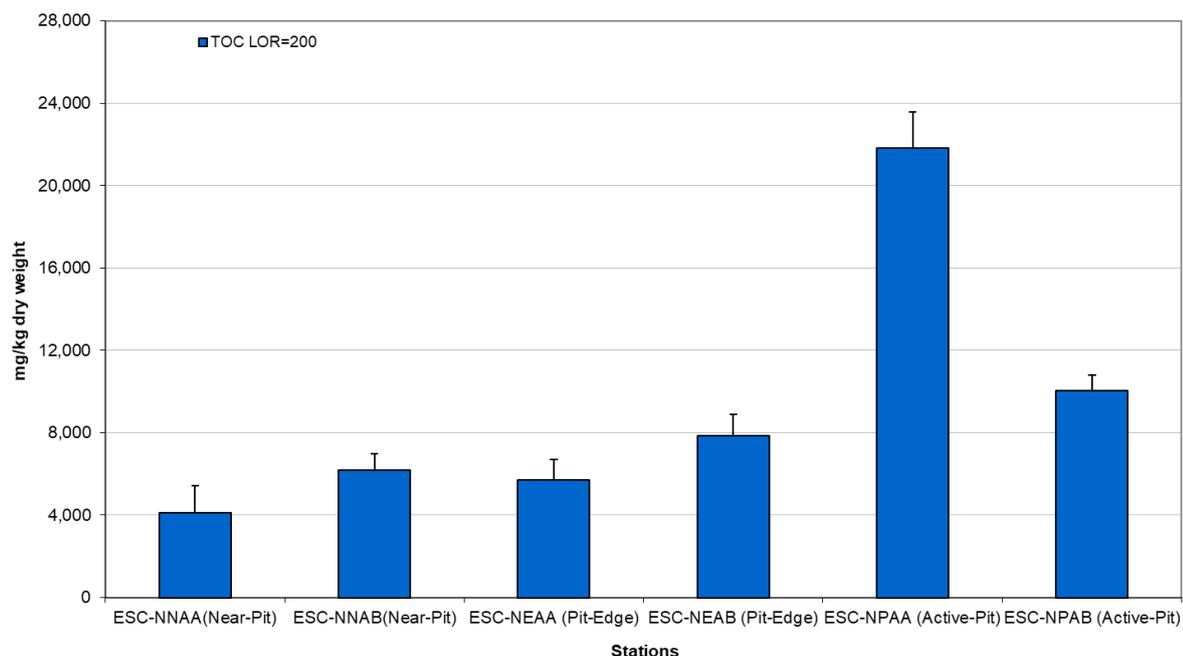


Figure 13: Concentration of Total Organic Carbon (TOC) (mg/kg dry weight; mean +SD) in sediment samples collected from Pit Specific Sediment Chemistry Monitoring for ESC CMP Vd in November 2019.

**Pit Specific Sediment Chemistry for Tributyltin (TBT) at ESC CMP Vd
November 2019**

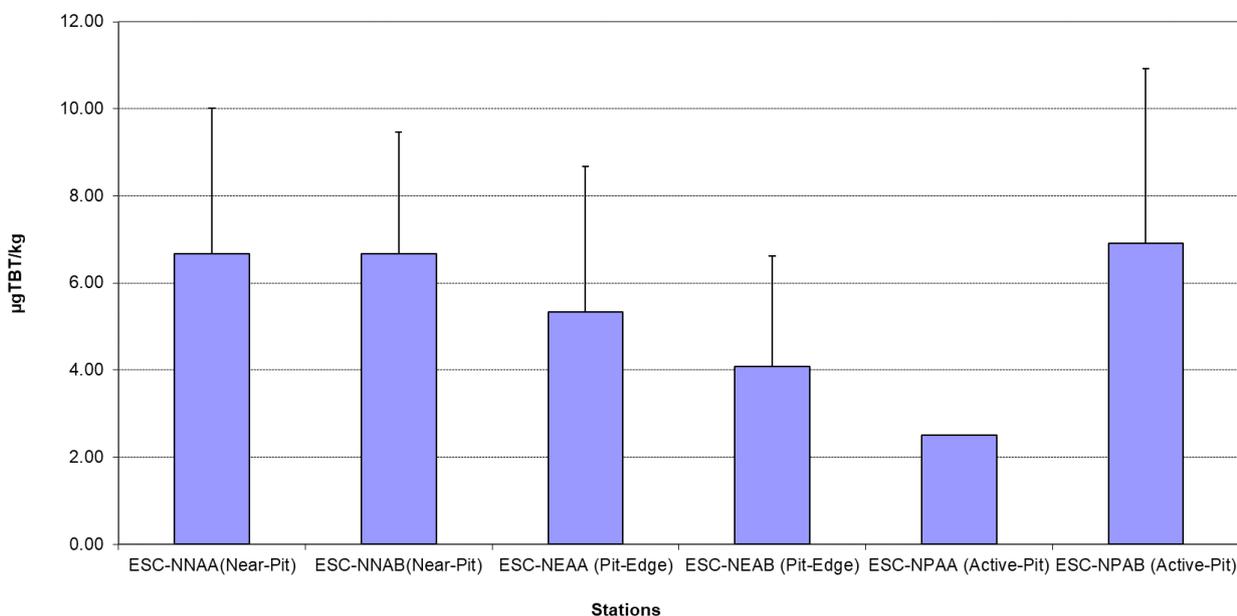


Figure 14: Concentration of Tributyltin (TBT) (µg TBT/kg; mean +SD) in sediment samples collected from Pit Specific Sediment Chemistry Monitoring for ESC CMP Vd in November 2019.

Source: P:\Projects\0400720 CEDD CMP EM&A 2017-2020\02 Deliverable\05 CMP Monthly Report\31 Monthly November 2019

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Pit Specific Sediment Chemistry for Low and High Molecular Weight Polycyclic Aromatics Hydrocarbons (PAHs) at ESC CMP Vd in November 2019

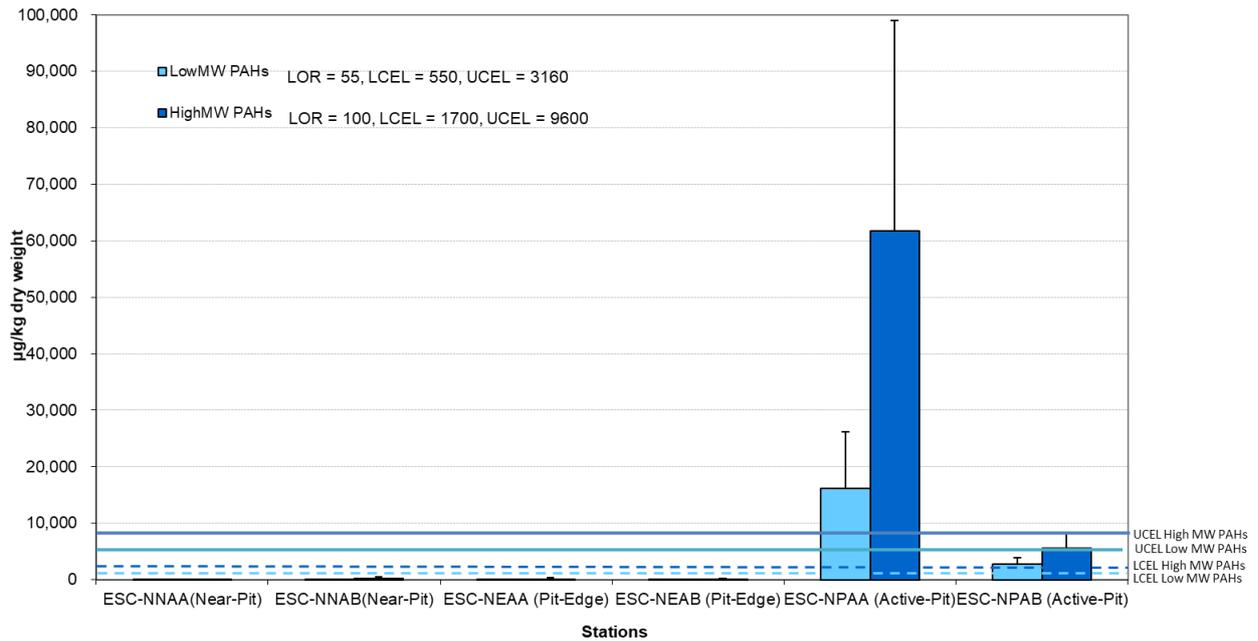


Figure 15: Concentration of Total Organic Carbon (TOC) ($\mu\text{g}/\text{kg}$ dry weight; mean +SD) in sediment samples collected from Pit Specific Sediment Chemistry Monitoring for ESC CMP Vd in November 2019.

Source: P:\Projects\0400720 CEDD CMP EM&A 2017-2020\02 Deliverable\05 CMP Monthly Report\32 Monthly November 2019

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Annex D

Dredging Record

Table D1 Dredging Record at ESC CMP Vb

Date	Daily Dredging Volume (m ³)	Weekly Dredging Volume (m ³) (From Sunday to Saturday)
10-Nov-2019	0	8,500
11-Nov-2019	1,000	
12-Nov-2019	1,500	
13-Nov-2019	500	
14-Nov-2019	1,500	
15-Nov-2019	1,500	
16-Nov-2019	2,500	
17-Nov-2019	1,000	12,000
18-Nov-2019	3,000	
19-Nov-2019	3,000	
20-Nov-2019	2,500	
21-Nov-2019	500	
22-Nov-2019	1,000	
23-Nov-2019	1,000	
24-Nov-2019	1,500	12,500
25-Nov-2019	2,500	
26-Nov-2019	1,500	
27-Nov-2019	500	
28-Nov-2019	2,000	
29-Nov-2019	2,500	
30-Nov-2019	2,000	

Annex E

Study Programme

