MOTT MACDONALD

Agreement No. CE 59/2020 (EP) Environmental Monitoring and Audit for Disposal Facility to the East of Sha Chau (2021-2026) – Investigation

Quarterly EM&A Report for
Contaminated Mud Pits to the East of Sha Chau
– April to June 2021

July 2021

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Mott MacDonald Hong Kong Limited
registered in Hong Kong no. 236497

土木工程拓展署
Civil Engineering and Development Department

MOTT MACDONALD

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

Environmental Certification Sheet

Environmental Permit No. EP-312/2008/A

Reference Document /Plan

Document/~~Plan~~ to be ~~Certified~~/ Verified:	Quarterly EM&A Report for Contaminated Mud Pits to the East of Sha Chau – April to June 2021
Date of Report:	28 July 2021
Date prepared by ET:	28 July 2021
Date received by IA:	28 July 2021

Reference EP Condition

Environmental Permit Condition:

Condition 3.1 of EP-312/2008/A:
The EM&A programme shall be implemented in accordance with the procedures and requirements as set out in the EM&A Manual. Any changes to the programme shall be justified by the ET leader and verified by the Independent Auditor as conforming to the information and requirements contained in the EM&A Manual before submission to the Director for approval.

ET Certification

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

Ir Thomas Chan,
Environmental Team Leader (ETL): Thomas Chan Date: 28 July 2021

IA Verification

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

Dr Wang Wen Xiong,
Independent Auditor (IA): Wang Wang Date: 28 July 2021

Issue and Revision Record

Revision	Date	Originator	Checker	Approver	Description
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Contents

Executive Summary

Water Column Profiling, Routine Water Quality Monitoring, Pit Specific Sediment Chemistry and Cumulative Impact Sediment Chemistry were carried out for the Contaminated Mud Pits (CMPs) to the East of Sha Chau (ESC) during the quarterly reporting period of April to June 2021. This report presents the results of these monitoring activities to identify whether the disposal and capping operations at ESC CMP V are causing any unacceptable impact(s) to the surrounding aquatic environment or to those marine organisms that utilize these habitats.

Water Quality Monitoring for ESC CMPs

Water Column Profiling of ESC CMP Vb – April to June 2021

Results indicated that levels of Salinity, pH and Dissolved Oxygen (DO) complied with the Water Quality Objectives (WQOs) at both Upstream and Downstream stations. Levels of Suspended Solids (SS) mostly complied with the WQO at the Upstream and Downstream stations. Levels of DO, Turbidity and SS complied with the Action and Limit Levels at all stations.

Overall, the results indicated that the mud disposal operation at ESC CMP Vb did not appear to cause any unacceptable impact in water quality during this reporting period.

Routine Water Quality Monitoring of ESC CMPs – April to June 2021

Results of Routine Water Quality Monitoring conducted in April, May and June 2021 showed that the levels of DO, Turbidity and SS complied with the Action and Limit Levels at most stations. From the monitoring results and statistical analysis, there were no trends indicating any increase in the concentrations of contaminants with proximity to the pit or with time. Thus, it appears that mud disposal operations at ESC CMPs have not caused any unacceptable impact in water quality during the reporting period.

Sediment Quality Monitoring for ESC CMPs

Pit Specific Sediment Chemistry of ESC CMP Vb – April to June 2021

Monitoring results showed that the concentrations of inorganic contaminants were generally below the Lower Chemical Exceedance Levels (LCELs) at most monitoring stations. Statistical analysis indicated that there did not appear any trend of increasing sediment contaminants' concentrations with proximity to the pit or with time. Thus, it appears that mud disposal operation at ESC CMP Vb have not caused any unacceptable impact in sediment quality during the reporting period.

Cumulative Impact Sediment Chemistry of ESC CMPs – June 2021

Monitoring results showed that the concentrations of inorganic contaminants were generally below the LCELs at all monitoring stations. Statistical analysis indicated that there did not appear to be any significant trend of increasing concentrations of contaminants with proximity to the pit or with time. Thus, it appears that mud disposal operation at ESC CMP Vb have not caused any unacceptable impact in sediment quality during the reporting period.

行政摘要

在 2021 年 4 月至 6 月的季度報告期內，環境小組在沙洲以東海泥卸置設施進行了水層質量監察、例行水質監察、指定污泥坑沉積物化學監察及沉積物化學累積性影響監察。本報告詳述以上的環境監察結果，從而分析在沙洲以東海泥卸置設施 CMP V 的卸置及覆蓋作業有否對鄰近水體環境及利用這水體為棲身地的海洋生物造成不可接受的環境影響。

沙洲以東海泥卸置設施 (ESC CMPs)之水質監察

水層質量監察 – 2021 年 4 月至 6 月

監察結果顯示上游及下游監測站的鹽度、酸鹼值及溶解氧含量均符合海水水質指標。另外，大部分上游及下游監測站的溶解氧含量均符合海水水質指標。上游及下游監測站的溶解氧含量、混濁度及懸浮固體含量也符合行動及極限水平。總體而言，水層質量監察結果表明報告期內沙洲以東海泥卸置設施 CMP Vb 的污泥卸置活動沒有引致任何不可接受的水質影響。

例行水質監察 – 2021 年 4 月至 6 月

2021 年 4 月至 6 月的例行水質監察結果顯示，大部分監測站的溶解氧含量、混濁度及懸浮固體含量也符合行動及極限水平。從監察數據和統計結果顯示，海水的污染物濃度沒有因越接近泥坑而趨向增加，亦沒有隨著時間而增加。總體而言，沒有證據顯示在報告期內沙洲以東海泥卸置運作對周邊水體環境產生任何不可接受的水質影響。

沙洲以東海泥卸置設施 (ESC CMPs)之沉積物監察

指定污泥坑沉積物化學監察 – 2021 年 4 月至 6 月

監察結果顯示，大部分監測站的無機污染物含量均大致低於化學物質低量值。從統計結果顯示，沉積物的污染物濃度沒有因越接近泥坑而趨向增加，亦沒有隨著時間而增加。總體而言，沒有證據顯示在報告期內沙洲以東海泥卸置運作對沉積物質素造成任何不可接受的影響。

沉積物化學累積性影響監察 – 2021 年 6 月

監察結果顯示，所有監測站的無機污染物含量均大致低於化學物質低量值。從統計結果顯示，沉積物的污染物濃度沒有因越接近泥坑而趨向增加，亦沒有隨著時間而增加。總體而言，沒有證據顯示在報告期內沙洲以東海泥卸置運作對沉積物質素造成任何不可接受的影響。

1 Introduction

1.1 Project Description

The Civil Engineering and Development Department (CEDD) is managing a number of marine disposal facilities in Hong Kong waters, including the Contaminated Mud Pits (CMPs) to the East of Sha Chau (ESC) for the disposal of contaminated sediment, and various open-sea disposal grounds located to the South of Cheung Chau (SCC), East of Tung Lung Chau (ETLC) and East of Ninepins (ENP) for the disposal of uncontaminated sediment.

Environmental Permits (EPs) (Ref. No. EP-312/2008/A) was issued by the Environmental Protection Department (EPD) to the CEDD, the Permit Holder, on 28 November 2008 for the Project - Disposal of Contaminated Sediment – Dredging, Management and Capping of Sediment Disposal Facility at Sha Chau.

Under the requirements of the EP, EM&A programmes which encompass water and sediment chemistry, fisheries assessment, tissue and whole body analysis, sediment toxicity and benthic recolonisation studies as set out in the EM&A Manuals are required to be implemented. EM&A programmes have been continuously carried out during the operation of the CMPs at ESC. A review of the collection and analysis of such environmental data from the monitoring programme demonstrated that there had not been any adverse environmental impacts resulting from disposal activities.[1,2] The current programme will assess the impacts resulting from dredging, disposal and capping operations of CMP V.

A proposal on the change of number of sample replication of water quality and sediment monitoring as well as combination of routine water quality monitoring and water quality monitoring during capping operation was submitted to EPD and agreed by EPD on 3 December 2020. The proposed changes have been effective for the EM&A activities since December 2020.

The present EM&A programme under Agreement No. CE 59/2020 (EP) ("the Study") covers the dredging, disposal and capping operations of the ESC CMP V (see **Appendix A** for the EM&A programme.)

1.2 Activities Conducted during the Reporting Period

Detailed works schedule for ESC CMP V is shown in **Table 1.1**. During the reporting period of April to June 2021, the following works were undertaken at the CMPs:

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

Table 1.1: Works Schedule for ESC CMP V

Pit	Operation	2021												2022												2023												2024												2025												2026		
		Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
ESC CMP V	Dredging																																																																	
	Disposal																																																																	
	Capping																																																																	

[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.

The record for contaminated mud disposal at ESC CMP Vb during the reporting period are presented in **Appendix B1**, and the record for capping operation at ESC CMP Vd during the reporting period is presented in **Appendix B2**.

1.3 Objectives of the Monitoring and Audit Programme

The objectives of the EM&A programme are as follows:

1. To monitor and report on the environmental impacts of the dredging operations associated with the construction of the disposal pits at CMP V;
2. To monitor and report on the environmental impacts due to capping operations of the exhausted pits at CMP V;
3. To monitor and report on the environmental impacts of the disposal of contaminated marine sediments in the active pits at CMP V and specifically to determine:
   a. changes/trends caused by disposal activities in the concentrations of contaminants in sediments adjacent to the pits;
   b. changes/trends caused by disposal activities in the concentrations of contaminants in tissues of demersal marine life adjacent to and remote from the pits;
   c. impacts on water quality and benthic ecology caused by the disposal activities; and
   d. the risks to human health and dolphin of eating seafood taken in the marine area around the active pits.
4. To monitor and report on the environmental impacts of the disposal operation at CMP V and specifically to determine whether the methods of disposal are effective in minimising the risks of unacceptable environmental impacts.
5. To monitor and report on the benthic recolonisation of the capped pits at CMP V and specifically to determine the difference in infauna between the capped pits and adjacent sites.
6. To assess the impact of a major storm (Typhoon Signal No. 8 or above) on the containment of any uncapped or partially capped pits at CMP V.
7. To design and continually review the operation and monitoring programme and:
   a. to make recommendations for changes to the operation that will rectify any unacceptable environmental impacts; and
   b. to make recommendations for changes to the monitoring programme that will improve the ability to cost effectively detect environmental changes caused by the disposal activities.
8. To establish numerical decision criteria for defining impacts for each monitoring component.
9. To provide supervision on the field works and laboratory works to be carried out by contractors/laboratories.

1.4 Purpose of this Report

The purpose of this *Quarterly EM&A Report for Contaminated Mud Pits to the East of Sha Chau – April to June 2021* is to provide information regarding the findings in the reporting period of April to June 2021 (from 1 April to 30 June 2021) on the environmental impacts resulting from backfilling operation at ESC CMP Vb and capping operation at ESC CMP Vd. Although the EM&A programme has been conducted since 1997, this report presents the analytical and statistical results of the quarterly reporting period. Results from previous monitoring will be presented and discussed in the Annual Review Report. Readers are referred to the Monthly EM&A Reports for this Study for graphical and tabular presentations of the monitoring results.

The objectives of this report are to:

- Confirm that all activities, tests, analyses, assessments etc. have been carried out as stated in the Updated EM&A Manual[3]; and
- Report on any trend resulting from dredging, backfilling and capping operations at the CMPs.

[3] ERM (2017) Updated Environmental Monitoring and Audit (EM&A) Manual. Environmental Monitoring and Audit for Contaminated Mud Pit at Sha Chau (2017-2020) – Investigation. Agreement No. CE 63/2016(EP). Submitted to EPD in July 2017.

2 Summary of EM&A Programme

2.1 EM&A Tasks

Six key elements were designed for the EM&A Programme for assessing whether key environmental parameters are being affected by dredging, backfilling and capping operations at the CMPs. Key tasks are as follows:

- Sediment Quality Monitoring;
- Sediment Toxicity Testing;
- Trawling & Tissue/ Whole Body Contaminant Testing;
- Water Quality Monitoring;
- Human Health and Ecological Risk Assessment; and
- Benthic Recolonisation.

2.2 EM&A Sampling and Analysis

Details regarding the methodologies for the field sampling and laboratory analysis of the monitoring tasks listed in **Section 2.1** are presented in the Updated EM&A Manual as well as in the following sampling and laboratory analysis contracts:

- Contract No. CV/2017/04 Sediment Disposal Facilities to the East of Sha Chau and East of Tung Lung Chau – Sampling (2018-2022); and
- Contract No. CV/2017/05 Sediment Disposal Facilities to the East of Sha Chau and East of Tung Lung Chau – Testing (2018-2022).

Lam Geotechnics Limited and Wellab Limited (hereinafter known as “Contractors”) were responsible for sampling under Contract No. CV/2017/04 and laboratory analysis under Contract No. CV/2017/05, respectively, during the reporting period.

3 Summary of Monitoring and Audit Activities

3.1 Sampling and Laboratory Analysis

Schedules of the EM&A programme are presented in **Appendix A**. The sampling, *in-situ* measurements and analysis of samples were conducted in accordance with the Updated EM&A Manual during this reporting period. The sampling conducted as well as the monitoring results received from the Contractors for this reporting period are shown in **Table 3.1**.

Table 3.1: Samplings Conducted and Monitoring Results Received from the Contractors for the Reporting Period

Key Task	Date of Sampling and *In-Situ* Measurement	Date of Results Received from the Contractors
ESC CMPs		
Water Column Profiling of ESC CMP Vb	13 Apr 2021	30 Apr 2021
	5 May 2021	25 May 2021
	10 Jun 2021	25 Jun 2021
Routine Water Quality Monitoring of ESC CMPs	8 Apr 2021	30 Apr 2021
	6 May 2021	25 May 2021
	8 Jun 2021	25 Jun 2021
Pit Specific Sediment Chemistry of ESC CMP Vb	12 Apr 2021	30 Apr 2021
	4 May 2021	25 May 2021
	1 Jun 2021	25 Jun 2021
Cumulative Impact Sediment Chemistry of ESC CMPs	3 Jun 2021	25 Jun 2021

The monitoring results of the above environmental monitoring components for ESC CMPs have been presented in the respective Monthly EM&A Reports. The statistical analysis of these environmental monitoring components, where applicable, are presented in the following sections to report any trends caused by disposal activities at ESC CMPs during the reporting period. It should be noted that statistical analysis was not conducted for Water Column Profiling for ESC CMP Vb as the monitoring stations were mobile depending on the location of backfilling operation during the monitoring event.

4 Summary of Monitoring Results and Statistical Analysis for ESC CMPs

4.1 Water Column Profiling of ESC CMP Vb

Water Column Profiling for ESC CMP Vb was conducted once every month from April to June 2021 as presented in **Table 3.1**. A total of two (2) stations were sampled, one located 100 m Upstream and one located 100 m Downstream of the disposal area. The monitoring results indicated that levels of Salinity, pH and Dissolved Oxygen (DO) complied with the Water Quality Objectives (WQOs) at both Upstream and Downstream stations in April, May and June 2021. Levels of Suspended Solids (SS) complied with the WQO at both Upstream and Downstream stations during the reporting period, except in June 2021, SS level at the Downstream station was slightly higher than the WQO while the SS level at the Upstream station complied with the WQO. Levels of DO, Turbidity and SS also complied with the Action and Limit Levels at all stations during the reporting period.

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

4.2 Routine Water Quality Monitoring of ESC CMPs

4.2.1 Background

Routine Water Quality Monitoring for ESC CMPs was conducted once every month from April to June 2021 as presented in **Table 3.1**. A total of sixteen (16) stations were sampled in April, May and June 2021 with locations of the monitoring stations presented in **Figure 2.1**. The disposal and capping volumes during the reporting period are detailed in **Appendix B1 and B2**, respectively. The monitoring results showed that levels of DO, Salinity and pH complied with the WQOs at most stations, except for the Salinity in Ma Wan was higher than WQO in April, May and June 2021. The higher Salinities recorded at Ma Wan station are likely to be caused by the larger separation distance to Pearl River Delta, which releases a large amount of freshwater discharge in the area during wet season. The levels of DO, Turbidity and SS complied with the Action and Limit Levels at all stations during the reporting period.

4.2.2 Summary of Statistical Analysis

The aim of the statistical analysis is to reveal any trends of increasing concentration of contaminants with proximity to the pit or with time. Data obtained during this reporting period were statistically compared with data obtained since monitoring began at CMP V in February 2012. For most parameters, only low concentrations were measured from February 2012 to June 2021 and some parameters have majority of their recorded values below the limit of reporting. Statistical analysis was performed on parameters for which at least 60% of data were above the limit of reporting since monitoring of CMP V began in February 2012. Improvements have been made to the statistical analysis whereby the spatio-temporal differences in in-situ parameters, dissolved metal, inorganic and organic contaminant contents were tested by two-factor Analysis of Variance (ANOVA) separately for ebb tide and flood tide. Area and Period were treated as fixed factors under investigation.

Should spatial trend of potential concern (i.e. increasing contaminant concentration with proximity to the pit) be detected by ANOVA and subsequent SNK post-hoc tests, further evaluation would be conducted to evaluate if the mud disposal activities were causing consistent and adverse impact to the water body. If potential concern was detected by SNK

results for consecutive reporting months, linear regression analyses would be performed to examine the temporal change of contaminant levels in each area over the concerned months in consideration of tidal effects. Further analysis may also include assessing the concentration variation between stations. Details regarding the statistical analysis results are presented in **Appendix C**.

4.2.3 In-Situ Measurements

Dissolved Oxygen (DO)

DO levels varied significantly with sampling periods and areas during ebb tide and flood tide. There was no consistent spatial trend of decreasing concentrations of DO with proximity to the pit. DO levels were generally the highest at Intermediate and Impact stations, thus there was no significant project related impact.

Turbidity

Turbidity levels varied significantly with sampling periods and areas during ebb tide and flood tide. During ebb tide, the relationship between turbidity levels and proximity to the pit (i.e. Area) indicated a significant overall spatial trend due to historic data from past reporting quarters, but no potential project related spatial trend was detected for the reporting months in this quarter. During flood tide, there was no consistent spatial trend of increasing concentrations of turbidity with proximity to the pit, where the turbidity levels were generally the highest at Reference stations.

4.2.4 Metals and Metalloid

The majority of dissolved metals had high percentage of their values below the limit of reporting (i.e. > 60% of values were below the limit of reporting during February 2012 to June 2021). Copper, Nickel and Zinc were the exceptions, and all varied significantly over sampling periods and area as indicated by results of the ANOVA tests (**Appendix C**), but without any consistent project related spatial trends for both ebb and flood tide. The concentrations of Copper and Nickel were generally the highest at Reference stations. The concentrations of Zinc were generally the highest at Ma Wan station.

4.2.5 Inorganic Contaminants

Ammonia Nitrogen (NH_3-N)

NH_3-N concentrations varied significantly with sampling periods and areas during ebb tide and flood tide. There was no consistent spatial trend of increasing concentrations of NH_3-N with proximity to the pit. Concentrations of NH_3-N were generally the highest at Ma Wan station, thus there was no significant project related impact.

Total Inorganic Nitrogen (TIN)

TIN concentrations varied significantly with sampling periods and areas during ebb tide and flood tide. There was no consistent spatial trend of increasing concentrations of TIN with proximity to the pit. Concentrations of TIN were generally the highest at Reference stations, thus there was no significant project related impact.

5-Day Biochemical Oxygen Demand (BOD_5)

Levels of BOD_5 varied significantly with sampling periods and areas during ebb tide and flood tide. There was no consistent spatial trend of increasing concentrations of BOD_5 with proximity to the pit. Levels of BOD_5 were generally the highest at Reference and Ma Wan stations.

Suspended Solids (SS)

SS levels varied significantly with sampling periods and areas during ebb tide and flood tide. During ebb tide, the relationship between SS levels and proximity to the pit (i.e. Area) indicated a significant overall spatial trend, but no potential project related spatial trend was detected for consecutive reporting months, thus there was no evidence showing consistent project related impact. During flood tide, there was no consistent spatial trend of increasing SS levels with proximity to the pit, where SS levels were generally the highest at Reference stations.

4.2.6 Conclusions

Overall, results of statistical analyses for the water quality data did not appear to provide any evidence of unacceptable water quality impacts caused by the mud disposal and capping operations at CMP V of the ESC area.

4.3 Pit Specific Sediment Chemistry of ESC CMP Vb

4.3.1 Background

Pit Specific Sediment Chemistry of ESC CMP Vb was conducted once every month from April to June 2021 as presented in **Table 3.1**. A total of six (6) monitoring stations for ESC CMP Vb were sampled in each monitoring event and the monitoring locations are shown in **Figure 2.2**. The monitoring results showed that the concentrations of most inorganic contaminants were below the Lower Chemical Exceedance Levels (LCELs) at most stations from April to June 2021, except the concentrations of Arsenic which were higher than LCEL at Pit-Edge stations ESC-NECA (in April and May 2021) and ESC-NECB (in May 2021), as well as Active-Pit station ESC-NPCA (in April and May 2021).

4.3.2 Summary of Statistical Analysis

Statistical analysis was performed for data obtained from Pit Specific Sediment Chemistry of ESC CMP Vb since February 2020. Improved statistical tests were run to examine the difference in contaminant concentrations between Active-Pit, Pit-Edge and Near-Pit stations and between sampling periods. ANOVA was employed as the statistical test, with Period, Area, and Direction as fixed factors.

Should temporal trend of potential concern (i.e. increasing contaminant concentration with proximity to the pit) be detected by ANOVA and subsequent SNK post-hoc tests for consecutive reporting months, further evaluation would be conducted to evaluate if the mud disposal activities were causing consistent and adverse impact to the sediment quality. Linear regression analyses would be performed to examine the temporal change of contaminant levels in each area over the concerned months. Detailed results of statistical analysis are presented in **Appendix C**.

Metals and Metalloids

There were significant spatial and temporal variations in the concentrations of all metal and metalloid contaminants (Arsenic, Cadmium, Chromium, Copper, Lead, Mercury, Nickel, Silver and Zinc). The relationship between contaminant levels and proximity to the pit (i.e. Area) was not significant for Arsenic, Cadmium, Copper, Mercury, and Silver. Subsequent linear regression analysis was conducted for Chromium (flood tide direction), Lead, Nickel (flood tide direction), and Zinc. The overall contaminant concentrations had returned to a lower level in June compared to April and May, such that there was no consistent or increasing project related impact over time. Therefore, there was no unacceptable project-related impact to the sediment quality.

Organic Contaminants

Concentrations of majority of organic contaminants were below their limits of reporting. Statistical analyses were only performed for contaminants for which 60% of data were over their limits of reporting.

In this reporting period, only Total Organic Carbon (TOC) concentrations were statistically analysed. Levels of TOC varied significantly with sampling periods and areas, but the overall project related spatial trend was not significant. In detailed analysis, potential project related spatial trend were detected for two consecutive reporting months in May and June 2021 for both flood and ebb tide directions. Subsequent linear regression analyses show that although the overall TOC levels in June was higher than that in May, the TOC levels returned to a similar level as that of May with the increase of proximity to the pit. This implies the dispersion of contaminant was well-contained. With only two consecutive months showing such spatial trend, there is no evidence indicating unacceptable project-related impact over time, while the TOC levels shall be closely examined during next reporting period.

4.3.3 Conclusions

From the results of the above statistical analyses, there did not appear to be any significant trend of increasing sediment contaminants' concentrations with proximity to the pit or with time. Therefore, 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.

4.4 Cumulative Impact Sediment Chemistry of ESC CMPs

4.4.1 Background

Cumulative Impact Sediment Chemistry of ESC CMPs was conducted in June 2021 as presented in **Table 3.1**. A total of nine (9) monitoring stations were sampled and the monitoring locations are shown in **Figure 2.3**. The monitoring results showed that the concentrations of all inorganic contaminants were generally below the LCELs at all monitoring stations in June 2021.

4.4.2 Summary of Statistical Analysis

Data obtained during this reporting period were statistically compared with previous data obtained since monitoring began for ESC CMPs in June 2016. Improved statistical tests were run to examine the difference in contaminant concentrations amongst Near-Field, Mid-Field, Far-Field stations. ANOVA was employed as the statistical test, with Area and Station as fixed factors.

Should spatial trend of potential concern (i.e. increasing contaminant concentration with proximity to the pit) be detected by ANOVA and subsequent SNK post-hoc tests for a considerable period over the whole sampling period, further evaluation would be conducted to evaluate if the mud disposal activities were causing consistent and adverse cumulative impact to the sediment quality. Regression analysis would be performed to examine the potential increase on the sediment contaminant concentration over time. Detailed results of statistical analysis are presented in **Appendix C**.

Metals and Metalloid

There were significant spatial variations in the concentrations of all metal and metalloid contaminants (Arsenic, Cadmium, Chromium, Copper, Lead, Mercury, Nickel, Silver and Zinc), but no consistent spatial trend (i.e. Capped-pit > Near-Field > Mid-Field > Far-Field) was observed. In most cases, metal concentrations were the highest at Ma Wan or Mid-Field stations, thus there was no significant project related impact.

Organic Contaminants

Concentrations of the majority of organic contaminants were below their limits of reporting. Statistical analyses were only performed for contaminants for which 60% of data were over their limits of reporting.

In this reporting period, only TOC concentrations were statistically analysed. Levels of TOC varied significantly with sampling area and time, with generally higher concentrations recorded at Mid-field stations ESC-RMA and ESC-RMB, Capped station ESC-RCA1 and Ma Wan station. There was no consistent spatial trend of increasing concentrations of TOC with proximity to the pit.

4.4.3 Conclusions

From the results of the above statistical analysis, there did not appear to be any significant trend of increasing sediment contaminants' concentrations with proximity to the pit or over time. Therefore, 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 during the reporting period.

5 Findings of the Field Events and Laboratory Tests and Analyses by the Independent Auditor

During the reporting period of April to June 2021, there was no scheduled inspection conducted by the Independent Auditor (IA).

6 Future Key Issues

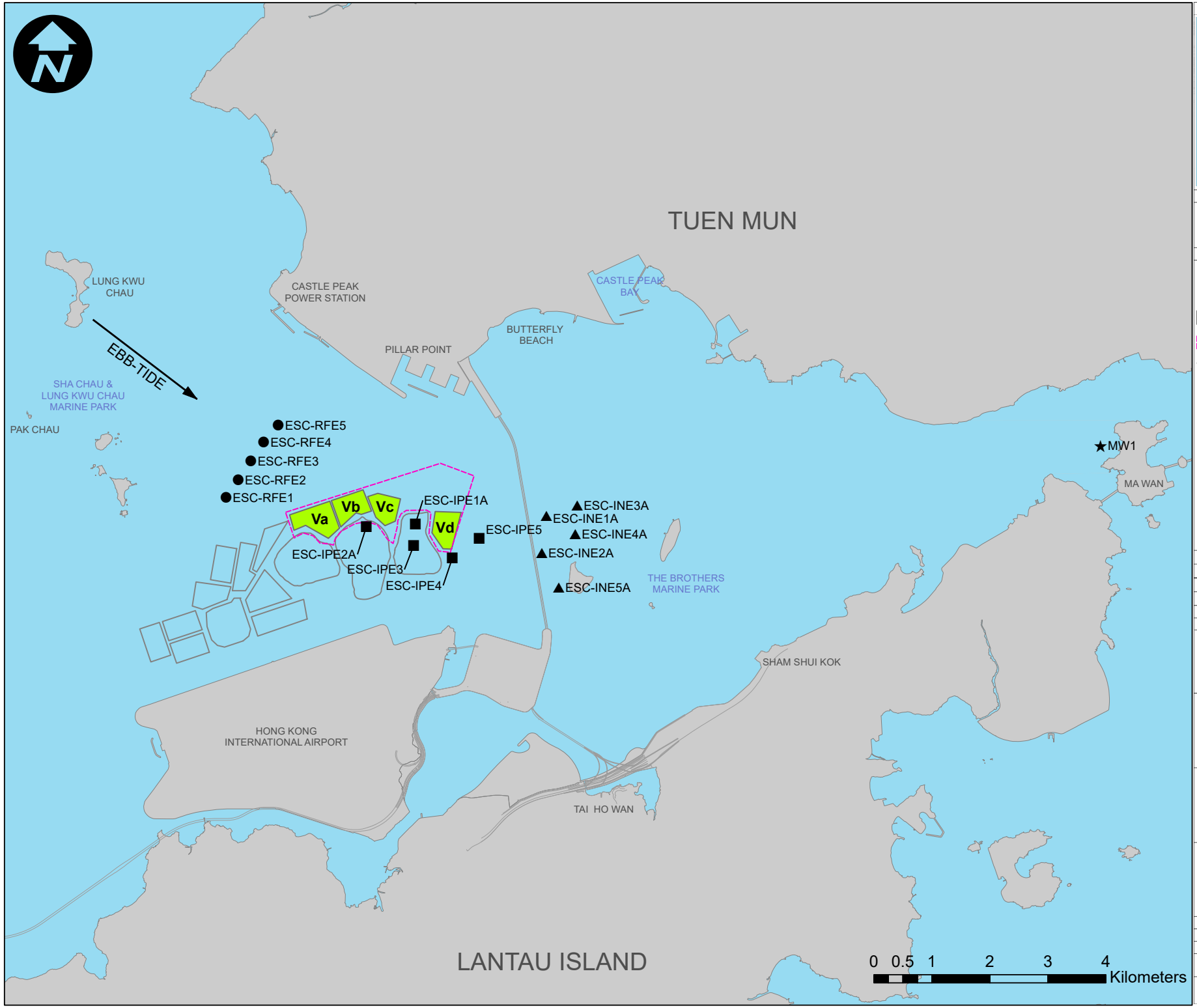
6.1 Activities Scheduled for the Next Reporting Period

The following monitoring activities will be conducted in the next quarterly reporting period of July to September 2021 for ESC CMPs including (see **Appendix A** for the sampling schedule):

- Water Column Profiling of ESC CMP Vb in July, August and September 2021;
- Routine Water Quality Monitoring of ESC CMPs in July, August and September 2021;
- Pit Specific Sediment Chemistry of ESC CMP Vb in July, August and September 2021;
- Cumulative Impact Sediment Chemistry of ESC CMPs in August 2021;
- Sediment Toxicity Test of ESC CMPs in August 2021; and
- Demersal Trawling for ESC CMPs in July and August 2021.

The sampling schedule for ESC CMPs is presented in **Appendix A**.

Figures



Key Plan:

Notes:

Key to symbols:

LEGEND

- ESC CMP V
- ESC USABLE AREA 1

WATER QUALITY SAMPLING STATIONS

- ■ IMPACT STATION
- ▲ INTERMEDIATE STATION
- ● REFERENCE STATION
- ★ MA WAN STATION

Rev	Date	Drawn	Description	Ch'k'd	App'd
P1	APR 2021	KN			

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Client

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

Project

AGREEMENT NO. CE 59/2020 (EP) ENVIRONMENTAL MONITORING AND AUDIT FOR DISPOSAL FACILITY TO THE EAST OF SHA CHAU (2021-2026) – INVESTIGATION

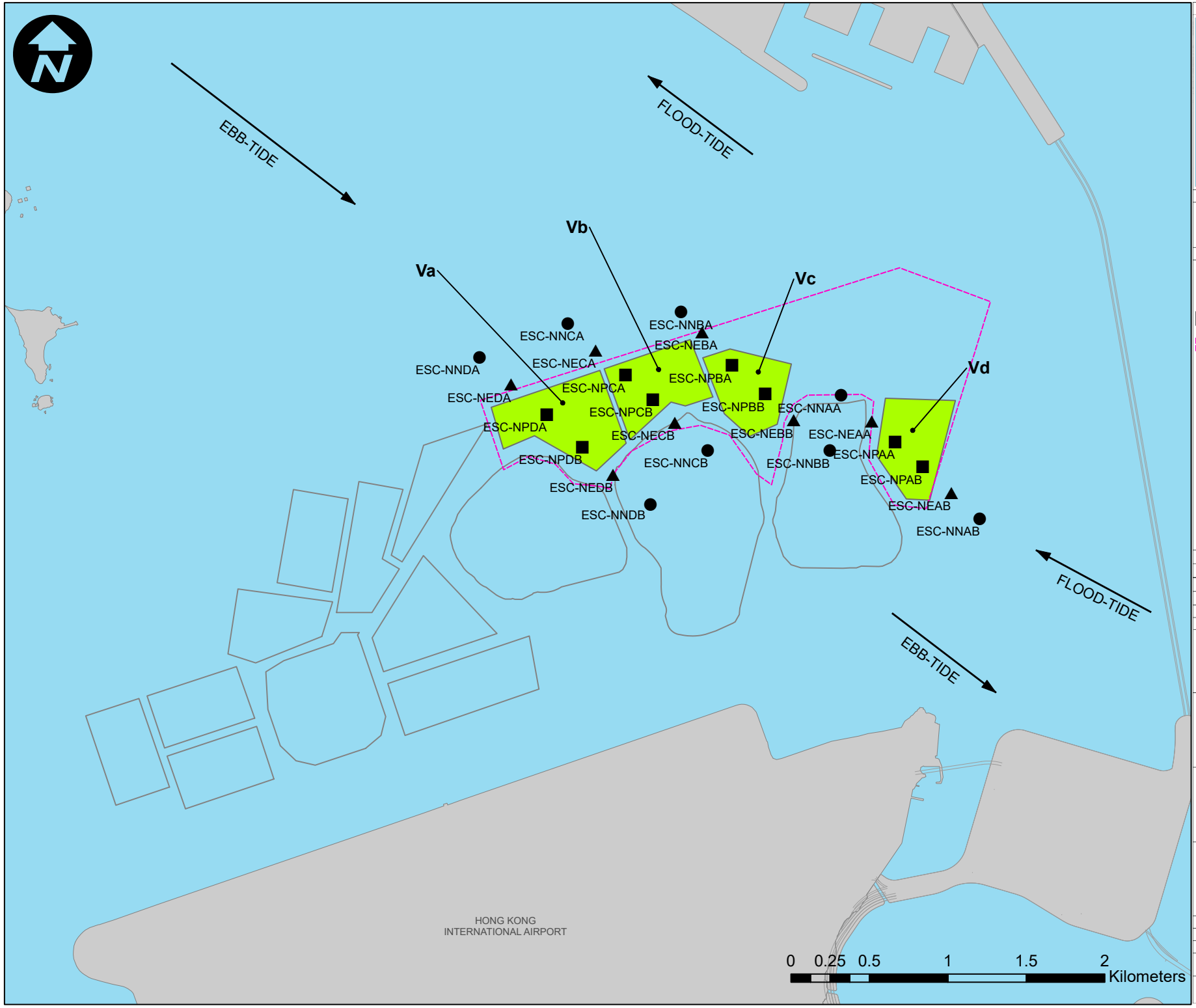
Title

ROUTINE & CAPPING WATER QUALITY SAMPLING STATIONS (EBB-TIDE) FOR ESC CMPS

Designed			Eng check		
Drawn			Coordination		
Dwg check			Approved		
Scale at A3		Status		Rev	

Drawing Number

FIGURE 2.1



Key Plan:

Notes:

Key to symbols:

LEGEND

ESC CMP V

ESC USABLE AREA 1

PIT SPECIFIC SEDIMENT MONITORING STATIONS

ACTIVE-PIT STATION

PIT-EDGE STATION

NEAR-PIT STATION

Rev	Date	Drawn	Description	Ch'k'd	App'd
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AGREEMENT NO. CE 59/2020 (EP) ENVIRONMENTAL MONITORING AND AUDIT FOR DISPOSAL FACILITY TO THE EAST OF SHA CHAU (2021-2026) – INVESTIGATION

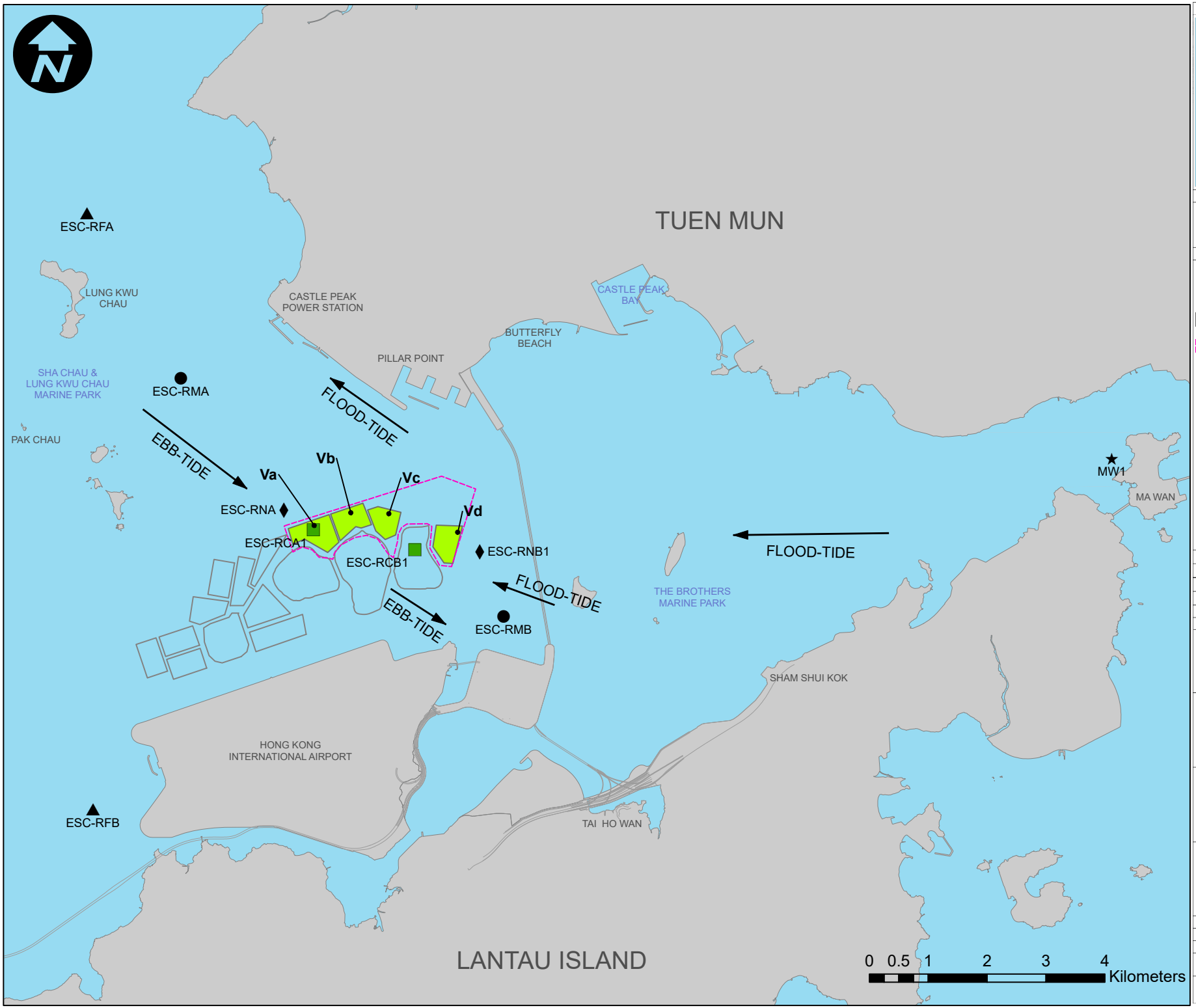
Title

PIT SPECIFIC SEDIMENT QUALITY MONITORING STATIONS FOR CMP V

Designed			Eng check		
Drawn			Coordination		
Dwg check			Approved		
Scale at A3		Status		Rev	

Drawing Number

FIGURE 2.2



Key Plan:

Notes:

Key to symbols:

LEGEND

- ESC CMP V
- ESC USABLE AREA 1

CUMULATIVE IMPACT SEDIMENT MONITORING STATIONS

- CAPPED PIT STATION
- NEAR-FIELD STATION
- MID-FIELD STATION
- FAR-FIELD STATION
- MA WAN STATION

Rev	Date	Drawn	Description	Ch'k'd	App'd
P1	APR 2021	KN			

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AGREEMENT NO. CE 59/2020 (EP) ENVIRONMENTAL MONITORING AND AUDIT FOR DISPOSAL FACILITY TO THE EAST OF SHA CHAU (2021-2026) – INVESTIGATION

Title

CUMULATIVE IMPACTS SEDIMENT QUALITY MONITORING STATIONS FOR ESC CMPS

Designed			Eng check		
Drawn			Coordination		
Dwg check			Approved		
Scale at A3		Status		Rev	

Drawing Number

FIGURE 2.3

Appendices

A. Sampling Schedule
B. Disposal and Capping Records
C. Statistical Analysis

A. Sampling Schedule

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

Parameter / Station Type	Station ID	Frequency	Jan 2021	Feb 2021	Mar 2021	Apr 2021	May 2021	Jun 2021	Jul 2021	Aug 2021	Sep 2021	Oct 2021	Nov 2021	Dec 2021	Jan 2022	Feb 2022	Mar 2022	Apr 2022	May 2022	Jun 2022	Jul 2022	Aug 2022	Sep 2022	Oct 2022	Nov 2022	Dec 2022	Jan 2023	Feb 2023	Mar 2023	Apr 2023	May 2023	Jun 2023	Jul 2023	Aug 2023	Sep 2023	Oct 2023	Nov 2023	Dec 2023	Jan 2024	Feb 2024	Mar 2024	Apr 2024	May 2024	Jun 2024	Jul 2024	Aug 2024	Sep 2024	Oct 2024	Nov 2024	Dec 2024	Jan 2025	Feb 2025	Mar 2025	Apr 2025	May 2025	Jun 2025	Jul 2025	Aug 2025	Sep 2025	Oct 2025	Nov 2025	Dec 2025	Jan 2026	Feb 2026	Mar 2026
Pit Specific Sediment Chemistry *		
Active-Pit		
	ESC-NPAA	Monthly	**6**	**6**	**6**	**6**	**6**	**6**	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
	ESC-NPAB	Monthly	**6**	**6**	**6**	**6**	**6**	**6**	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
Pit-Edge		
	ESC-NEAA	Monthly	**6**	**6**	**6**	**6**	**6**	**6**	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
	ESC-NEAB	Monthly	**6**	**6**	**6**	**6**	**6**	**6**	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
Near-Pit		
	ESC-NNAA	Monthly	**6**	**6**	**6**	**6**	**6**	**6**	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
	ESC-NNAB	Monthly	**6**	**6**	**6**	**6**	**6**	**6**	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
Cumulative Impact Sediment Chemistry *		
Near-field Stations		
	ESC-RNA	4 times per year		**6**				**6**		6				6		6				6		6				6		6				6		6				6		6				6		6				6		6				6		6				6		6	
	ESC-RNB1	4 times per year		**6**				**6**		6				6		6				6		6				6		6				6		6				6		6				6		6				6		6				6		6				6		6	
Mid-field Stations		
	ESC-RMA	4 times per year		**6**				**6**		6				6		6				6		6				6		6				6		6				6		6				6		6				6		6				6		6				6		6	
	ESC-RMB	4 times per year		**6**				**6**		6				6		6				6		6				6		6				6		6				6		6				6		6				6		6				6		6				6		6	
Capped Pit Stations		
	ESC-RCA1	4 times per year		**6**				**6**		6				6		6				6		6				6		6				6		6				6		6				6		6				6		6				6		6				6		6	
	ESC-RCA2	4 times per year		**6**				**6**		6				6		6				6		6				6		6				6		6				6		6				6		6				6		6				6		6				6		6	
Far-field Stations		
	ESC-RFA	4 times per year		**6**				**6**		6				6		6				6		6				6		6				6		6				6		6				6		6				6		6				6		6				6		6	
	ESC-RFB	4 times per year		**6**				**6**		6				6		6				6		6				6		6				6		6				6		6				6		6				6		6				6		6				6		6	
Ma Wan Station		
	MW1	4 times per year		**6**				**6**		6				6		6				6		6				6		6				6		6				6		6				6		6				6		6				6		6				6		6	
Sediment Toxicity Tests		
Near-pit Stations		
	ESC-TDA	2 times per year		**5**						5						5						5						5						5						5						5						5						5						5	
	ESC-TDB1	2 times per year		**5**						5						5						5						5						5						5						5						5						5						5	
Reference Stations		
	ESC-TRA	2 times per year		**5**						5						5						5						5						5						5						5						5						5						5	
	ESC-TRB	2 times per year		**5**						5						5						5						5						5						5						5						5						5						5	
Ma Wan Station		
	MW1	2 times per year		**5**						5						5						5						5						5						5						5						5						5						5	
Tissue / Whole Body Sampling		
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		
Near-pit Stations		
	ESC-INA	4 times per year	**5**	**5**					5	5					5	5					5	5					5	5					5	5					5	5					5	5					5	5					5	5					5	5	
	ESC-INB	4 times per year	**5**	**5**					5	5					5	5					5	5					5	5					5	5					5	5					5	5					5	5					5	5					5	5	
Reference North		
	TNA	4 times per year	**5**	**5**					5	5					5	5					5	5					5	5					5	5					5	5					5	5					5	5					5	5					5	5	
	TNB	4 times per year	**5**	**5**					5	5					5	5					5	5					5	5					5	5					5	5					5	5					5	5					5	5					5	5	
Reference South		
	TSA	4 times per year	**5**	**5**					5	5					5	5					5	5					5	5					5	5					5	5					5	5					5	5					5	5					5	5	
	TSB	4 times per year	**5**	**5**					5	5					5	5					5	5					5	5					5	5					5	5					5	5					5	5					5	5					5	5	
Capping *		
Ebb Tide		
Impact Station Downcurrent		
	ESC-IPE1A	4 times per year *																																																																
	ESC-IPE2A	4 times per year *																																																															
	ESC-IPE3	4 times per year *																																																															
	ESC-IPE4	4 times per year *																																																															
	ESC-IPE5	4 times per year *																																																															
Intermediate Station Downcurrent		
	ESC-INE1A	4 times per year *																																																														
	ESC-INE2A	4 times per year *																																																															
	ESC-INE3A	4 times per year *																																																															
	ESC-INE4A	4 times per year *																																																															
	ESC-INE5A	4 times per year *																																																															
Reference Station Upcurrent		
	ESC-RFE1	4 times per year *																																																															
	ESC-RFE2	4 times per year *																																																															
	ESC-RFE3	4 times per year *																																																															
	ESC-RFE4	4 times per year *																																																															
	ESC-RFE5	4 times per year *																																																															
Ma Wan Station		
	MW1	4 times per year *																																																														
Flood Tide		
Impact Station Downcurrent		
	ESC-IPF1	4 times per year *																																																														
	ESC-IPF2	4 times per year *																																																															
	ESC-IPF3	4 times per year *																																																															
Intermediate Station Downcurrent		
	ESC-INF1	4 times per year *																																																														
	ESC-INF2	4 times per year *																																																															
	ESC-INF3	4 times per year *																																																															
Reference Station Upcurrent		
	ESC-RFF1A	4 times per year *																																																														
	ESC-RFF2A	4 times per year *																																																														
	ESC-RFF3	4 times per year *																																																														
Ma Wan Station		
	MW1	4 times per year *																																																													
Routine Water Quality Monitoring *		
Ebb Tide		
Impact Station Downcurrent		
	ESC-IPE1A	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	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	ESC-IPE2A	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	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	ESC-IPE3	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	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	ESC-IPE4	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	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	ESC-IPE5	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	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Intermediate Station Downcurrent		
	ESC-INE1A	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	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	ESC-INE2A	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	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	ESC-INE3A	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	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	ESC-INE4A	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	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	ESC-INE5A	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	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Reference Station Upcurrent		
	ESC-RFE1	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	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	ESC-RFE2	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	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	ESC-RFE3	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	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	ESC-RFE4	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	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	ESC-RFE5	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	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Ma Wan Station		
	MW1	Monthly*				**4**	**4**	**4**	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Flood Tide		
Impact Station Downcurrent		
	ESC-IPF1	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	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	ESC-IPF2	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	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	ESC-IPF3	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	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Intermediate Station Downcurrent		
	ESC-INF1	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	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	ESC-INF2	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	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	ESC-INF3	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	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Reference Station Upcurrent		
	ESC-RFF1A	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	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	ESC-RFF2A	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	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	ESC-RFF3	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	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Ma Wan Station		
	MW1	Monthly*	**4**	**4**	**4**				4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Water Column Profiling *		
Plume Stations		
	WCP1	Monthly*	**2**	**2**	**2**	**2**	**2**	**2**	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	WCP2	Monthly*	**2**	**2**	**2**	**2**	**2**	**2**	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Benthic Recolonisation Studies		
Capped Stations at CMP V		
	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		
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:

(1) The number shown in each cell represents the numbers of replicates per monitoring station. The number shown in **green bolded text** represented monitoring works have been conducted before/ during the reporting period of this EM&A Report, while the number shown in black represent planned monitoring works after the reporting period of this EM&A Report.

(2) For the planned Routine Water Quality Monitoring (i.e. the numbers of replicates per monitoring station shown in black), the monitoring will be conducted at mid-ebb OR mid-flood tide. The yearly tidal selection of this monitoring will be based on a principle to obtain 6 months monitoring data at mid-ebb, and 6 months monitoring data at mid-flood.

(3) Impact Monitoring for Dredging will be scheduled when dredging operations commence.

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

Remarks:

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

B. Disposal and Capping Records

B1. Disposal Record at ESC CMP Vb

Date	Daily Disposal Volume (m^3)	Accumulative Disposal Volume (m^3)
1 Apr 2021	800	438,796
2 Apr 2021	1,200	439,996
3 Apr 2021	0	439,996
4 Apr 2021	0	439,996
5 Apr 2021	0	439,996
6 Apr 2021	0	439,996
7 Apr 2021	0	439,996
8 Apr 2021	500	440,496
9 Apr 2021	500	440,996
10 Apr 2021	500	441,496
11 Apr 2021	400	441,896
12 Apr 2021	400	442,296
13 Apr 2021	900	443,196
14 Apr 2021	400	443,596
15 Apr 2021	500	444,096
16 Apr 2021	500	444,596
17 Apr 2021	500	445,096
18 Apr 2021	0	445,096
19 Apr 2021	500	445,596
20 Apr 2021	300	445,896
21 Apr 2021	0	445,896
22 Apr 2021	0	445,896
23 Apr 2021	500	446,396
24 Apr 2021	2,200	448,596
25 Apr 2021	1,300	449,896
26 Apr 2021	900	450,796
27 Apr 2021	500	451,296
28 Apr 2021	500	451,796
29 Apr 2021	0	451,796
30 Apr 2021	500	452,296
1 May 2021	500	452,796
2 May 2021	0	452,796
3 May 2021	0	452,796
4 May 2021	1,770	454,566
5 May 2021	1,960	456,526
6 May 2021	500	457,026
7 May 2021	0	457,026
8 May 2021	0	457,026
9 May 2021	1,919	458,945
10 May 2021	0	458,945
11 May 2021	2,487	461,432
12 May 2021	400	461,832
13 May 2021	2,429	464,261
14 May 2021	3,780	468,041
15 May 2021	4,369	472,410
16 May 2021	1,200	473,610
17 May 2021	0	473,610
18 May 2021	1,050	474,660
19 May 2021	1,096	475,756

Date	Daily Disposal Volume (m^3)	Accumulative Disposal Volume (m^3)
20 May 2021	0	475,756
21 May 2021	0	475,756
22 May 2021	1,223	476,979
23 May 2021	0	476,979
24 May 2021	0	476,979
25 May 2021	1,027	478,006
26 May 2021	1,139	479,145
27 May 2021	0	479,145
28 May 2021	0	479,145
29 May 2021	0	479,145
30 May 2021	0	479,145
31 May 2021	2,520	481,665
1 Jun 2021	3,827	485,492
2 Jun 2021	3,913	489,405
3 Jun 2021	1,838	491,243
4 Jun 2021	3,093	494,336
5 Jun 2021	4,983	499,319
6 Jun 2021	3,739	503,058
7 Jun 2021	2,754	505,812
8 Jun 2021	2,948	508,760
9 Jun 2021	3,804	512,564
10 Jun 2021	3,853	516,417
11 Jun 2021	2,593	519,010
12 Jun 2021	2,226	521,236
13 Jun 2021	0	521,236
14 Jun 2021	0	521,236
15 Jun 2021	500	521,736
16 Jun 2021	0	521,736
17 Jun 2021	500	522,236
18 Jun 2021	0	522,236
19 Jun 2021	400	522,636
20 Jun 2021	400	523,036
21 Jun 2021	0	523,036
22 Jun 2021	565	523,601
23 Jun 2021	520	524,121
24 Jun 2021	1,336	525,457
25 Jun 2021	519	525,976
26 Jun 2021	542	526,518
27 Jun 2021	400	526,918
28 Jun 2021	830	527,748
29 Jun 2021	559	528,307
30 Jun 2021	956	529,263

B2. Capping Record at ESC CMP Vd

Date	Daily Disposal Volume (m^3)	Accumulative Disposal Volume (m^3)
1 Apr 2021	0	165,300
2 Apr 2021	0	165,300
3 Apr 2021	0	165,300
4 Apr 2021	0	165,300
5 Apr 2021	0	165,300
6 Apr 2021	0	165,300
7 Apr 2021	0	165,300
8 Apr 2021	0	165,300
9 Apr 2021	0	165,300
10 Apr 2021	0	165,300
11 Apr 2021	0	165,300
12 Apr 2021	0	165,300
13 Apr 2021	0	165,300
14 Apr 2021	0	165,300
15 Apr 2021	0	165,300
16 Apr 2021	0	165,300
17 Apr 2021	0	165,300
18 Apr 2021	0	165,300
19 Apr 2021	0	165,300
20 Apr 2021	0	165,300
21 Apr 2021	0	165,300
22 Apr 2021	0	165,300
23 Apr 2021	0	165,300
24 Apr 2021	0	165,300
25 Apr 2021	0	165,300
26 Apr 2021	0	165,300
27 Apr 2021	0	165,300
28 Apr 2021	0	165,300
29 Apr 2021	1,440	166,740
30 Apr 2021	1,960	168,700
1 May 2021	6,008	174,708
2 May 2021	1,975	176,683
3 May 2021	3,969	180,652
4 May 2021	1,600	182,252
5 May 2021	0	182,252
6 May 2021	4,880	187,132
7 May 2021	2,556	189,688
8 May 2021	2,559	192,247
9 May 2021	0	192,247
10 May 2021	2,471	194,718
11 May 2021	742	195,460
12 May 2021	2,359	197,819
13 May 2021	1,182	199,001
14 May 2021	0	199,001
15 May 2021	0	199,001
16 May 2021	2,292	201,293
17 May 2021	999	202,292
18 May 2021	2,146	204,438
19 May 2021	1,247	205,685

Date	Daily Disposal Volume (m^3)	Accumulative Disposal Volume (m^3)
20 May 2021	3,408	209,093
21 May 2021	2,086	211,179
22 May 2021	975	212,154
23 May 2021	2,052	214,206
24 May 2021	2,193	216,399
25 May 2021	766	217,165
26 May 2021	315	217,480
27 May 2021	0	217,480
28 May 2021	0	217,480
29 May 2021	0	217,480
30 May 2021	0	217,480
31 May 2021	0	217,480
1 Jun 2021	0	217,480
2 Jun 2021	0	217,480
3 Jun 2021	0	217,480
4 Jun 2021	0	217,480
5 Jun 2021	0	217,480
6 Jun 2021	0	217,480
7 Jun 2021	0	217,480
8 Jun 2021	0	217,480
9 Jun 2021	0	217,480
10 Jun 2021	0	217,480
11 Jun 2021	0	217,480
12 Jun 2021	0	217,480
13 Jun 2021	0	217,480
14 Jun 2021	0	217,480
15 Jun 2021	0	217,480
16 Jun 2021	0	217,480
17 Jun 2021	0	217,480
18 Jun 2021	0	217,480
19 Jun 2021	0	217,480
20 Jun 2021	0	217,480
21 Jun 2021	0	217,480
22 Jun 2021	0	217,480
23 Jun 2021	0	217,480
24 Jun 2021	0	217,480
25 Jun 2021	0	217,480
26 Jun 2021	0	217,480
27 Jun 2021	0	217,480
28 Jun 2021	0	217,480
29 Jun 2021	0	217,480
30 Jun 2021	0	217,480

C. Statistical Analysis

Routine Water Quality Monitoring for ESC CMPs – Statistical Analysis up to June 2021

Dissolved Oxygen

Ebb Tide

Source	Type II Sum of Square	Df	F value	Significance Level
Period	2164.84	27	435.24	**
Area	19.03	3	34.43	**
Period:Area	179.33	81	12.02	**
Residuals	561.87	3050		

Note:
1. Assume Gaussian distribution
2. N.S.: No significant difference; **: Significant difference (P-value < 0.05)

SNK Results:
- Overall result[1]:

$$\left.\begin{array}{l}\text{Impact} = \text{Intermediate} \\ \text{Impact} > \text{Reference} > \text{Ma Wan} \\ \text{Intermediate} > \text{Reference} > \text{Ma Wan}\end{array}\right\} \therefore \text{no overall significant project related impact.}$$

- No potential project related spatial trend (i.e. Impact < Intermediate < Reference) were detected for all months over the study period.

Flood Tide

Source	Type II Sum of Square	Df	F value	Significance Level
Period	3446.02	29	1612.42	**
Area	40.90	3	184.99	**
Period:Area	43.89	87	6.85	**
Residuals	144.52	1961		

Note:
1. Assume Gaussian distribution
2. N.S.: No significant difference; **: Significant difference (P-value < 0.05)

SNK Results:
- Overall result:

$$\left.\begin{array}{l}\text{Intermediate} = \text{Impact} = \text{Reference} \\ \text{Intermediate, Impact, Reference} > \text{Ma Wan}\end{array}\right\} \therefore \text{no overall significant project related impact.}$$

- No potential project related spatial trend (i.e. Impact < Intermediate < Reference) were detected for all months over the study period.

[1] The overall result represents the SNK tests on fixed factor Area.

Turbidity

Ebb Tide

Source	Type II Sum of Square	Df	F value	Significance Level
Period	1070.74	27	262.74	**
Area	61.62	3	136.07	**
Period:Area	187.27	81	15.32	**
Residuals	460.36	3050		

Note:
1. Assume Gamma distribution
2. N.S.: No significant difference; **: Significant difference (P-value < 0.05)

SNK Results:
- Overall result:
  Impact > Intermediate > Reference > Ma Wan } ∴ potential overall significant project related impact.
- Months showing potential project related spatial trend (i.e. Impact > Intermediate > Reference):
  - Apr 2012, Aug 2012, Apr 2013, May 2016, Apr 2017, Apr 2020
- No potential project related spatial trend were detected for the reporting months.

Flood Tide

Source	Type II Sum of Square	Df	F value	Significance Level
Period	36915.30	29	181.38	**
Area	1902.67	3	90.37	**
Period:Area	5087.09	87	8.33	**
Residuals	13762.29	1961		

Note:
1. Assume Gaussian distribution
2. N.S.: No significant difference; **: Significant difference (P-value < 0.05)

SNK Results:
- Overall result:
  Reference > Impact > Intermediate > Ma Wan } ∴ no overall significant project related impact.
- No potential project related spatial trend (i.e. Impact > Intermediate > Reference) were detected for all months over the study period.

Copper

Ebb Tide

Source	Type II Sum of Square	Df	F value	Significance Level
Period	2649.27	27	110.54	**
Area	38.12	3	14.32	**
Period:Area	462.01	81	6.43	**
Residuals	2911.45	3280		

Note:
1. Assume Gamma distribution
2. N.S.: No significant difference; **: Significant difference (P-value < 0.05)

SNK Results:
- Overall result:
  Reference > Impact > Intermediate > Ma Wan } ∴ no overall significant project related impact.
- Months showing potential project related spatial trend (i.e. Impact > Intermediate > Reference):
  - Aug 2020
- No potential project related spatial trend detected for the reporting months.

Flood Tide

Source	Type II Sum of Square	Df	F value	Significance Level
Period	1912.07	29	186.67	**
Area	21.86	3	20.63	**
Period:Area	346.29	87	11.27	**
Residuals	777.05	2200		

Note:
1. Assume Gaussian distribution
2. N.S.: No significant difference; **: Significant difference (P-value < 0.05)

SNK Results:
- Overall result:
  Reference > Ma Wan > Impact > Intermediate} ∴ no overall significant project related impact.
- Months showing potential project related spatial trend (i.e. Impact > Intermediate > Reference):
  - Feb 2012
- No potential project related spatial trend detected for the reporting months.

Nickel

Ebb Tide

Source	Type II Sum of Square	Df	F value	Significance Level
Period	939.02	27	150.56	**
Area	20.03	3	28.90	**
Period:Area	154.45	81	8.25	**
Residuals	757.65	3280		

Note:
1. Assume Gamma distribution
2. N.S.: No significant difference; **: Significant difference (P-value < 0.05)

SNK Results:
- Overall result:

$$\left.\begin{array}{l}\text{Impact} = \text{Ma Wan} \\ \text{Reference} > \text{Impact, Ma Wan} > \text{Intermediate}\end{array}\right\} \therefore \text{no overall significant project related impact.}$$

- No potential project related spatial trend (i.e. Impact > Intermediate > Reference) were detected for all months over the study period.

Flood Tide

Source	Type II Sum of Square	Df	F value	Significance Level
Period	763.31	29	182.93	**
Area	5.09	3	11.78	**
Period:Area	122.90	87	9.82	**
Residuals	316.55	2200		

Note:
1. Assume Gaussian distribution
2. N.S.: No significant difference; **: Significant difference (P-value < 0.05)

SNK Results:
- Overall result:

$$\text{Reference} > \text{Impact} > \text{Intermediate} > \text{Ma Wan}\} \quad \therefore \text{no overall significant project related impact.}$$

- No potential project related spatial trend (i.e. Impact > Intermediate > Reference) were detected for all months over the study period.

Zinc

Ebb Tide

Source	Type II Sum of Square	Df	F value	Significance Level
Period	1481.34	27	160.14	**
Area	39.84	3	38.77	**
Period:Area	230.89	81	8.32	**
Residuals	1123.75	3280		

Note:
1. Assume Gamma distribution
2. N.S.: No significant difference; **: Significant difference (P-value < 0.05)

SNK Results:
- Overall result:
  Ma Wan > Reference > Impact > Intermediate } ∴ no overall significant project related impact.
- Months showing potential project related spatial trend (i.e. Impact > Intermediate > Reference):
  - Apr 2013, Jul 2016
- No potential project related spatial trend were detected for the reporting months.

Flood Tide

Source	Type II Sum of Square	Df	F value	Significance Level
Period	1200.63	29	144.07	**
Area	38.46	3	44.61	**
Period:Area	159.21	87	6.37	**
Residuals	632.23	2200		

Note:
1. Assume Gaussian distribution
2. N.S.: No significant difference; **: Significant difference (P-value < 0.05)

SNK Results:
- Overall result:
  Ma Wan > Reference > Intermediate > Impact } ∴ no overall significant project related impact.
- Months showing potential project related spatial trend (i.e. Impact > Intermediate > Reference):
  - Apr 2016, Jan 2019
- No potential project related spatial trend were detected for the reporting months.

Ammonia Nitrogen

Ebb Tide

Source	Type II Sum of Square	Df	F value	Significance Level
Period	884.58	27	405.22	**
Area	18.28	3	75.35	**
Period:Area	82.28	81	12.56	**
Residuals	265.19	3280		

Note:
1. Assume Gamma distribution
2. N.S.: No significant difference; **: Significant difference (P-value < 0.05)

SNK Results:
- Overall result:
  Ma Wa = Reference = Impact = Intermediate } ∴ no overall significant project related impact.
- No potential project related spatial trend (i.e. Impact > Intermediate > Reference) were detected for all months over the study period.

Flood Tide

Source	Type II Sum of Square	Df	F value	Significance Level
Period	766.15	29	130.72	**
Area	6.19	3	10.20	**
Period:Area	58.46	87	3.32	**
Residuals	444.63	2200		

Note:
1. Assume Gaussian distribution
2. N.S.: No significant difference; **: Significant difference (P-value < 0.05)

SNK Results:
- Overall result:
  Ma Wan = Reference = Intermediate = Impact } ∴ no overall significant project related impact.
- No potential project related spatial trend (i.e. Impact > Intermediate > Reference) were detected for all months over the study period.

Total Inorganic Nitrogen

Ebb Tide

Source	Type II Sum of Square	Df	F value	Significance Level
Period	352.90	26	446.64	**
Area	23.72	3	260.19	**
Period:Area	31.18	78	13.16	**
Residuals	95.91	3156		

Note:
1. Assume Gamma distribution
2. N.S.: No significant difference; **: Significant difference (P-value < 0.05)

SNK Results:
- Overall result:

$$\left.\begin{array}{l}\text{Reference} = \text{Impact} \\ \text{Reference, Impact} > \text{Intermediate} > \text{Ma Wan}\end{array}\right\} \therefore \text{no overall significant project related impact.}$$

- No potential project related spatial trend (i.e. Impact > Intermediate > Reference) were detected for all months over the study period.

Flood Tide

Source	Type II Sum of Square	Df	F value	Significance Level
Period	588.42	29	367.44	**
Area	11.57	3	69.86	**
Period:Area	36.69	87	7.64	**
Residuals	121.49	2200		

Note:
1. Assume Gamma distribution
2. N.S.: No significant difference; **: Significant difference (P-value < 0.05)

SNK Results:
- Overall result:

$$\left.\begin{array}{l}\text{Reference} = \text{Intermediate} \\ \text{Intermediate} = \text{Impact} \\ \text{Reference} > \text{Impact} > \text{Ma Wan}\end{array}\right\} \therefore \text{no overall significant project related impact.}$$

- No potential project related spatial trend (i.e. Impact > Intermediate > Reference) were detected for all months over the study period.

BOD_5

Ebb Tide

Source	Type II Sum of Square	Df	F value	Significance Level
Period	413.48	27	103.93	**
Area	17.74	3	40.14	**
Period:Area	182.32	81	15.27	**
Residuals	483.33	3280		

Note:
1. Assume Gamma distribution
2. N.S.: No significant difference; **: Significant difference (P-value < 0.05)

SNK Results:
- Overall result:

$$\left.\begin{array}{c}\text{Reference} = \text{Ma Wan} \\ \text{Impact} = \text{Intermediate} \\ \text{Reference, Ma Wan} > \text{Impact, Imtermediate}\end{array}\right\} \therefore \text{no overall significant project related impact.}$$

- No potential project related spatial trend (i.e. Impact > Intermediate > Reference) were detected for all months over the study period.

Flood Tide

Source	Type II Sum of Square	Df	F value	Significance Level
Period	558.85	29	184.94	**
Area	21.34	3	68.27	**
Period:Area	142.35	87	15.70	**
Residuals	229.24	2200		

Note:
1. Assume Gamma distribution
2. N.S.: No significant difference; **: Significant difference (P-value < 0.05)

SNK Results:
- Overall result:

$$\left.\begin{array}{c}\text{Intermediate} = \text{Impact} \\ \text{Ma Wan} > \text{Reference} > \text{Intermediate, Impact}\end{array}\right\} \therefore \text{no overall significant project related impact.}$$

- Months showing potential project related spatial trend (i.e. Impact > Intermediate > Reference):
  - Jan 2017
- No potential project related spatial trend were detected for the reporting months.

Suspended Solids

Ebb Tide

Source	Type II Sum of Square	Df	F value	Significance Level
Period	724.35	27	283.13	**
Area	40.64	3	142.98	**
Period:Area	122.61	81	15.97	**
Residuals	310.79	3280		

Note:
1. Assume Gamma distribution
2. N.S.: No significant difference; **: Significant difference (P-value < 0.05)

SNK Results:
- Overall result:
  $\text{Impact} > \text{Intermediate} > \text{Reference} > \text{Ma Wan}\ \}$ ∴ potential overall significant project related impact.
- Months showing potential project related spatial trend (i.e. Impact > Intermediate > Reference):
  - Apr 2012, Aug 2012, May 2016, Jul 2017, Jul 2018, Apr 2020, May 2021
- Project related spatial trend was detected in one month during the reporting period.

Flood Tide

Source	Type II Sum of Square	Df	F value	Significance Level
Period	516.90	29	180.32	**
Area	12.51	3	42.20	**
Period:Area	109.36	87	12.72	**
Residuals	217.46	2200		

Note:
1. Assume Gamma distribution
2. N.S.: No significant difference; **: Significant difference (P-value < 0.05)

SNK Results:
- Overall result:
  $\left.\begin{array}{l}\text{Impact} = \text{Intermediate} \\ \text{Reference} > \text{Impact}, \text{Intermediate} > \text{Ma Wan}\end{array}\right\}$ ∴ no overall significant project related impact.
- Months showing potential project related spatial trend (i.e. Impact > Intermediate > Reference):
  - Nov 2012, Jul 2013, Nov 2017, Aug 2018, Dec 2020
- No potential project related spatial trend detected for the reporting months.

Pit Specific Sediment Chemistry for ESC CMPs – Statistical Analysis up to June 2021

Arsenic

Source	Type II Sum of Square	Df	F value	Significance Level
Period	11.58	16	39.422	**
Area	8.19	2	223.268	**
Direction	2.22	1	121.064	**
Period:Area	11.49	32	19.566	**
Period:Direction	1.46	16	4.982	**
Area:Direction	7.81	2	212.873	**
Period:Area:Direction	10.93	32	18.617	**
Residuals	15.97	870		

Note:
1. Assume Gamma distribution
2. N.S.: No significant difference; **: Significant difference (P-value < 0.05)

SNK Results:
- Overall result:

$$\left.\begin{array}{l}\text{Pit Edge} > \text{Active Pit}\\ \text{Pit Edge} > \text{Near Pit}\\ \text{Active Pit} > \text{Near Pit}\end{array}\right\} \therefore \text{no overall significant project related impact.}$$

- Months showing potential project related spatial trend (i.e. Active Pit > Pit Edge > Near Pit): Direction[2]
  - Flood Tide: Jun 2021
  - Ebb Tide: Sep 2020, Nov 2020
- Project related spatial trend was detected in one month during the reporting period.

Cadmium

Source	Type II Sum of Square	Df	F value	Significance Level
Period	41.59	16	23.230	**
Area	68.15	2	304.517	**
Direction	0.26	1	2.284	N.S.
Period:Area	28.31	32	7.907	**
Period:Direction	16.31	16	9.110	**
Area:Direction	22.88	2	102.253	**
Period:Area:Direction	19.91	32	5.561	**
Residuals	97.36	870		

Note:
1. Assume Gamma distribution
2. N.S.: No significant difference; **: Significant difference (P-value < 0.05)

SNK Results:
- Overall result:

$$\left.\begin{array}{l}\text{Active Pit} = \text{Pit Edge}\\ \text{Pit Edge} = \text{Near Pit}\\ \text{Active Pit} > \text{Near Pit}\end{array}\right\} \therefore \text{no overall significant project related impact.}$$

- No potential project related spatial trend (i.e. Active Pit > Pit Edge > Near Pit) were detected for all months over the study period.

Chromium

Source	Type II Sum of Square	Df	F value	Significance Level

[2] Direction: Stations located at downstream of the active pit during corresponding tide.

Period	5.59	16	19.270	**
Area	12.84	2	354.264	**
Direction	2.53	1	139.369	**
Period:Area	4.26	32	7.352	**
Period:Direction	1.89	16	6.516	**
Area:Direction	12.59	2	347.300	**
Period:Area:Direction	2.26	32	3.889	**
Residuals	15.77	870		

Note:

1. Assume Gamma distribution
2. N.S.: No significant difference; **: Significant difference (P-value < 0.05)

SNK Results:

- Overall result:

  $$\left.\begin{array}{l}\text{Active Pit} > \text{Pit Edge} \\ \text{Pit Edge} > \text{Near Pit} \\ \text{Active Pit} > \text{Near Pit}\end{array}\right\} \therefore \text{potential overall significant project related impact.}$$

- Months showing potential project related spatial trend (i.e. Active Pit > Pit Edge > Near Pit): Direction
  - Flood Tide: Feb 2020, Mar 2020, Oct 2020, Nov 2020, Dec 2020, Apr 2021, May 2021, Jun 2021[3]
  - Ebb Tide: Apr 2020, Oct 2020, Nov 2020, May 2021
- Potential project related spatial trend were detected for consecutive three months over the reporting period for flood tide direction.

Regression Analysis Results:

Period	R Square	Adjusted R Square	Y-intercept	Slope	Significance Level
Apr-21	0.72	0.71	30.38	-1.50	**
May-21	0.82	0.81	30.55	-1.28	**
Jun-21	0.56	0.53	24.41	-0.76	**

Note: Linear regression analysis on spatial changes of contaminant concentrations in flood tide direction for the reporting months.

[3] Circled months represents consecutive months with significant spatial trend.

Copper

Source	Type II Sum of Square	Df	F value	Significance Level
Period	17.33	16	26.909	**
Area	128.27	2	1593.375	**
Direction	9.35	1	232.381	**
Period:Area	14.08	32	10.931	**
Period:Direction	9.76	16	15.150	**
Area:Direction	42.03	2	522.162	**
Period:Area:Direction	19.63	32	15.241	**
Residuals	35.02	870		

Note:

1. Assume Gamma distribution
2. N.S.: No significant difference; **: Significant difference (P-value < 0.05)

SNK Results:

- Overall result:

$$\left.\begin{array}{l}\text{Active Pit} > \text{Near Pit} \\ \text{Near Pit} > \text{Pit Edge} \\ \text{Active Pit} > \text{Pit Edge}\end{array}\right\} \therefore \text{no overall significant project related impact.}$$

- Months showing potential project related spatial trend (i.e. Active Pit > Pit Edge > Near Pit): Direction
  - Flood Tide: Jul 2020, Oct 2020, May 2021
  - Ebb Tide: Jul 2020, Oct 2020
- Project related spatial trend was detected in one month during the reporting period.

Lead

Source	Type II Sum of Square	Df	F value	Significance Level
Period	4.77	16	7.016	**
Area	20.98	2	247.033	**
Direction	2.99	1	70.488	**
Period:Area	9.51	32	6.999	**
Period:Direction	2.41	16	3.544	**
Area:Direction	4.52	2	53.216	**
Period:Area:Direction	3.48	32	2.561	**
Residuals	36.94	870		

Note:
1. Assume Gamma distribution
2. N.S.: No significant difference; **: Significant difference (P-value < 0.05)

SNK Results:

- Overall result:

$$\left.\begin{array}{l}\text{Active Pit} > \text{Pit Edge} \\ \text{Pit Edge} > \text{Near Pit} \\ \text{Active Pit} > \text{Near Pit}\end{array}\right\} \therefore \text{Potential overall significant project related impact.}$$

- Months showing potential project related spatial trend (i.e. Active Pit > Pit Edge > Near Pit): Direction
  - Flood Tide: Jun 2020, Jul 2020, Aug 2020, Sep 2020, Oct 2020, Nov 2020, Dec 2020, Apr 2021, May 2021, Jun 2021
  - Ebb Tide: May 2020, Jul 2020, Mar 2021, May 2021, Jun 2021
- Potential project related spatial trend was detected for consecutive three months over the reporting period in flood tide direction, and consecutive two months in ebb tide direction.

Regression Analysis Results:

Period	R Square	Adjusted R Square	Y-intercept	Slope	Significance Level
Apr-21	0.74	0.73	37.58	-1.95	**
May-21	0.85	0.84	37.71	-1.69	**
Jun-21	0.52	0.49	31.39	-0.69	**

Note: Linear regression analysis on spatial changes of contaminant concentrations in flood tide direction for the reporting months.

Period	R Square	Adjusted R Square	Y-intercept	Slope	Significance Level
May-21	0.37	0.33	32.79	-1.51	**
Jun-21	0.45	0.41	32.09	-2.60	**

Note: Linear regression analysis on spatial changes of contaminant concentrations in ebb tide direction for the two concerned reporting months.

Mercury

Source	Type II Sum of Square	Df	F value	Significance Level
Period	108.40	16	22.640	**
Area	103.69	2	173.246	**
Direction	44.66	1	149.225	**
Period:Area	50.48	32	5.272	**
Period:Direction	29.65	16	6.193	**
Area:Direction	70.55	2	117.871	**
Period:Area:Direction	16.50	32	1.723	**
Residuals	260.35	870		

Note:

1. Assume Gamma distribution
2. N.S.: No significant difference; **: Significant difference (P-value < 0.05)

SNK Results:

- Overall result:

$$\left.\begin{array}{l}\text{Active Pit} > \text{Pit Edge} \\ \text{Active Pit} > \text{Near Pit} \\ \text{Pit Edge} = \text{Near Pit}\end{array}\right\} \therefore \text{no overall significant project related impact.}$$

- No potential project related spatial trend (i.e. Active Pit > Pit Edge > Near Pit) were detected for all months over the study period.

Nickel

Source	Type II Sum of Square	Df	F value	Significance Level
Period	8.69	16	48.645	**
Area	13.89	2	622.395	**
Direction	6.36	1	570.115	**
Period:Area	4.54	32	12.706	**
Period:Direction	3.51	16	19.662	**
Area:Direction	16.39	2	734.428	**
Period:Area:Direction	2.49	32	6.973	**
Residuals	9.71	870		

Note:

1. Assume Gamma distribution
2. N.S.: No significant difference; **: Significant difference (P-value < 0.05)

SNK Results:

- Overall result:

$$\left.\begin{array}{l}\text{Active Pit} > \text{Near Pit}\\ \text{Active Pit} > \text{Pit Edge}\\ \text{Near Pit} = \text{Pit Edge}\end{array}\right\} \therefore \text{no overall significant project related impact.}$$

- Months showing potential project related spatial trend (i.e. Active Pit > Pit Edge > Near Pit): Direction
  - Flood Tide: Feb 2020, Mar 2020, Oct 2020, Nov 2020, Dec 2020, Apr 2021, May 2021, Jun 2021
  - Ebb Tide: Jun 2020, Jul 2020, Oct 2020
- Potential project related spatial trend was detected for consecutive three months over the reporting period in flood tide direction.

Regression Analysis Results:

Period	R Square	Adjusted R Square	Y-intercept	Slope	Significance Level
Apr-21	0.62	0.60	18.44	-0.84	**
May-21	0.75	0.73	18.70	-0.72	**
Jun-21	0.46	0.42	15.44	-0.40	**

Note: Linear regression analysis on spatial changes of contaminant concentrations in flood tide direction for the reporting months.

Silver

Source	Type II Sum of Square	Df	F value	Significance Level
Period	33.63	16	20.339	**
Area	215.50	2	1042.636	**
Direction	2.22	1	21.474	**
Period:Area	39.03	32	11.801	**
Period:Direction	21.16	16	12.799	**
Area:Direction	33.66	2	162.828	**
Period:Area:Direction	23.61	32	7.141	**
Residuals	89.91	870		

Note:

1. Assume Gamma distribution
2. N.S.: No significant difference; **: Significant difference (P-value < 0.05)

SNK Results:

- Overall result:

$$\left.\begin{array}{l}\text{Active Pit} > \text{Near Pit} \\ \text{Active Pit} > \text{Pit Edge} \\ \text{Near Pit} = \text{Pit Edge}\end{array}\right\} \therefore \text{no overall significant project related impact.}$$

- No potential project related spatial trend (i.e. Active Pit > Pit Edge > Near Pit) were detected for all months over the study period.

Zinc

Source	Type II Sum of Square	Df	F value	Significance Level
Period	8.26	16	37.240	**
Area	31.79	2	1147.045	**
Direction	1.60	1	115.717	**
Period:Area	8.99	32	20.272	**
Period:Direction	3.38	16	15.243	**
Area:Direction	7.11	2	256.560	**
Period:Area:Direction	2.34	32	5.280	**
Residuals	12.06	870		

Note:

1. Assume Gamma distribution
2. N.S.: No significant difference; **: Significant difference (P-value < 0.05)

SNK Results:

- Overall result:

  $$\left.\begin{array}{l}\text{Active Pit} > \text{Near Pit}\\ \text{Active Pit} > \text{Pit Edge}\\ \text{Near Pit} > \text{Pit Edge}\end{array}\right\} \therefore \text{no overall significant project related impact.}$$

- Months showing potential project related spatial trend (i.e. Active Pit > Pit Edge > Near Pit): Direction
  - Flood Tide: Jun 2020, Jul 2020, Oct 2020, Nov 2020, Apr 2021, May 2021
  - Ebb Tide: Apr 2020, Jun 2020, Jul 2020, Oct 2020, Mar 2021, May 2021, Jun 2021
- Potential project related spatial trend was detected for consecutive two months over the reporting period in both flood and ebb tide directions.

Regression Analysis Results:

Period	R Square	Adjusted R Square	Y-intercept	Slope	Significance Level
Apr-21	0.72	0.71	97.55	-5.21	**
May-21	0.81	0.79	100.19	-4.25	**
Jun-21	0.27	0.23	82.00	-1.92	**

Note: Linear regression analysis on spatial changes of contaminant concentrations in flood tide direction for the reporting months. Potential project related spatial trend was not detected in June 2021 and June 201 was included in the regression analysis for comparison purpose only.

Period	R Square	Adjusted R Square	Y-intercept	Slope	Significance Level
May-21	0.71	0.69	100.12	-8.85	**
Jun-21	0.59	0.56	80.52	-6.33	**

Note: Linear regression analysis on spatial changes of contaminant concentrations in ebb tide direction for the two concerned reporting months.

Total Organic Carbon

Source	Type II Sum of Square	Df	F value	Significance Level
Period	59.54	16	171.343	**
Area	44.70	2	1029.042	**
Direction	6.39	1	294.289	**
Period:Area	13.64	32	19.633	**
Period:Direction	6.97	16	20.052	**
Area:Direction	12.11	2	278.753	**
Period:Area:Direction	12.96	32	18.647	**
Residuals	18.89	870		

Note:
1. Assume Gamma distribution
2. N.S.: No significant difference; **: Significant difference (P-value < 0.05)

SNK Results:

- Overall result:
  $\left.\begin{array}{l}\text{Active Pit} > \text{Near Pit}\\ \text{Active Pit} > \text{Pit Edge}\\ \text{Near Pit} > \text{Pit Edge}\end{array}\right\}$ ∴ no overall significant project related impact.
- Months showing potential project related spatial trend (i.e. Active Pit > Pit Edge > Near Pit): Direction
  - Flood Tide: Feb 2020, Apr 2020, May 2020, Aug 2020, Oct 2020, May 2021, Jun 2021
  - Ebb Tide: Jul 2020, Oct 2020, May 2021, Jun 2021
- Potential project related spatial trend was detected for consecutive two months over the reporting period in both flood and ebb tide directions.

Regression Analysis Results:

Period	R Square	Adjusted R Square	Y-intercept	Slope	Significance Level
May-21	0.60	0.57	7186	-470	**
Jun-21	0.93	0.93	14767	-1587	**

Note: Linear regression analysis on spatial changes of contaminant concentrations in flood tide direction for the two concerned reporting months.

Period	R Square	Adjusted R Square	Y-intercept	Slope	Significance Level
May-21	0.34	0.30	4997	-330	**
Jun-21	0.85	0.84	15928	-2180	**

Note: Linear regression analysis on spatial changes of contaminant concentrations in ebb tide direction for the two concerned reporting months.

Cumulative Sediment Chemistry for ESC CMPs – Statistical Analysis up to June 2021

Arsenic

Source	Type II Sum of Square	Df	F value	Significance Level
Period	6534.65	20	162.37	**
Area	8932.58	4	1109.79	**
Period:Area	4726.13	80	29.36	**
Residuals	4026.46	2001		

Note:

1. Assume Gaussian distribution
2. N.S.: No significant difference; **: Significant difference (P-value < 0.05)

SNK Results:

- Overall result:
  - Mid-Field = Far-Field > Ma Wan > Near-Field > Capped-pit, ∴no overall significant project related impact.
- No potential project related spatial trend (i.e. Capped-pit > Near-Field > Mid-Field > Far-Field) were detected for all months over the study period.

Cadmium

Source	Type II Sum of Square	Df	F value	Significance Level
Period	50.70	20	21.24	**
Area	52.01	4	108.96	**
Period:Area	42.90	80	4.49	**
Residuals	238.79	2001		

Note:

1. Assume Gamma distribution
2. N.S.: No significant difference; **: Significant difference (P-value < 0.05)

SNK Results:

- Overall result:
  - Mid-Field = Far-Field = Ma Wan = Near-Field = Capped-pit, ∴no overall significant project related impact.
- No potential project related spatial trend (i.e. Capped-pit > Near-Field > Mid-Field > Far-Field) were detected for all months over the study period.

Chromium

Source	Type II Sum of Square	Df	F value	Significance Level
Period	4807.76	20	26.44	**
Area	64355.54	4	1769.91	**
Period:Area	15822.15	80	21.76	**
Residuals	18189.55	2001		

Note:
1. Assume Gaussian distribution
2. N.S.: No significant difference; **: Significant difference (P-value < 0.05)

SNK Results:
- Overall result:
  - Ma Wan > Mid-Field > Far-Field > Near-Field > Capped-pit, ∴ no overall significant project related impact.
- No potential project related spatial trend (i.e. Capped-pit > Near-Field > Mid-Field > Far-Field) were detected for all months over the study period.

Copper

Source	Type II Sum of Square	Df	F value	Significance Level
Period	11415.09	20	18.76	**
Area	241226.12	4	1982.72	**
Period:Area	23837.63	80	9.80	**
Residuals	60862.54	2001		

Note:
1. Assume Gaussian distribution
2. N.S.: No significant difference; **: Significant difference (P-value < 0.05)

SNK Results:
- Overall result:
  - Ma Wan > Mid-Field > Far-Field > Near-Field > Capped-pit, ∴ no overall significant project related impact.
- No potential project related spatial trend (i.e. Capped-pit > Near-Field > Mid-Field > Far-Field) were detected for all months over the study period.

Lead

Source	Type II Sum of Square	Df	F value	Significance Level
Period	29278.94	20	107.95	**
Area	65485.06	4	1207.20	**
Period:Area	18584.28	80	17.13	**
Residuals	27136.28	2001		

Note:
1. Assume Gaussian distribution
2. N.S.: No significant difference; **: Significant difference (P-value < 0.05)

SNK Results:
- Overall result:
  - Ma Wan > Mid-Field > Far-Field > Near-Field > Capped-pit, ∴ no overall significant project related impact.
- No potential project related spatial trend (i.e. Capped-pit > Near-Field > Mid-Field > Far-Field) were detected for all months over the study period.

Mercury

Source	Type II Sum of Square	Df	F value	Significance Level
Period	392.19	20	40.31	**
Area	66.11	4	33.97	**
Period:Area	184.74	80	4.75	**
Residuals	973.54	2001		

Note:
1. Assume Gamma distribution
2. N.S.: No significant difference; **: Significant difference (P-value < 0.05)

SNK Results:
- Overall result:
  - Ma Wan = Capped-pit = Mid-Field = Far-Field = Near-Field, ∴ no overall significant project related impact.
- No potential project related spatial trend (i.e. Capped-pit > Near-Field > Mid-Field > Far-Field) were detected for all months over the study period.

Nickel

Source	Type II Sum of Square	Df	F value	Significance Level
Period	2191.63	20	25.61	**
Area	23211.42	4	1355.94	**
Period:Area	8203.54	80	23.96	**
Residuals	8563.42	2001		

Note:
1. Assume Gaussian distribution
2. N.S.: No significant difference; **: Significant difference (P-value < 0.05)

SNK Results:
- Overall result:
  - Ma Wan > Mid-Field > Far-Field > Near-Field > Capped-pit, ∴ no overall significant project related impact.
- No potential project related spatial trend (i.e. Capped-pit > Near-Field > Mid-Field > Far-Field) were detected for all months over the study period.

Silver

Source	Type II Sum of Square	Df	F value	Significance Level
Period	101.15	20	29.94	**
Area	716.09	4	1059.75	**
Period:Area	71.76	80	5.31	**
Residuals	338.03	2001		

Note:
1. Assume Gamma distribution
2. N.S.: No significant difference; **: Significant difference (P-value < 0.05)

SNK Results:
- Overall result:
  - Ma Wan > Mid-Field = Far-Field = Near-Field = Capped-pit, ∴ no overall significant project related impact.
- No potential project related spatial trend (i.e. Capped-pit > Near-Field > Mid-Field > Far-Field) were detected for all months over the study period.

Zinc

Source	Type II Sum of Square	Df	F value	Significance Level
Period	15.73	20	33.67	**
Area	127.38	4	1363.22	**
Period:Area	45.27	80	24.22	**
Residuals	46.74	2001		

Note:
1. Assume Gamma distribution
2. N.S.: No significant difference; **: Significant difference (P-value < 0.05)

SNK Results:
- Overall result:
  - Ma Wan > Far-Field > Mid-Field > Near-Field > Capped-pit, ∴ no overall significant project related impact.
- No potential project related spatial trend (i.e. Capped-pit > Near-Field > Mid-Field > Far-Field) were detected for all months over the study period.

Total Organic Carbon

Source	Type II Sum of Square	Df	F value	Significance Level
Period	1778146099	20	56.93	**
Area	3124285836	4	500.12	**
Period:Area	3416849756	80	27.35	**
Residuals	3125122129	2001		

Note:
1. Assume Gaussian distribution
2. N.S.: No significant difference; **: Significant difference (P-value < 0.05)

SNK Results:
- Overall result:
  - Ma Wan > Mid-Field > Far-Field > Near-Field > Capped-pit, ∴ no overall significant project related impact.
- No potential project related spatial trend (i.e. Capped-pit > Near-Field > Mid-Field > Far-Field) were detected for all months over the study period.