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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

Quarterly EM&A Report for
Contaminated Mud Pits to the East of Sha Chau
– October to December 2022 (Rev. A)

January 2022

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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 – October to December 2021
Date of Report:	27 January 2022
Date prepared by ET:	27 January 2022
Date received by IA:	27 January 2022

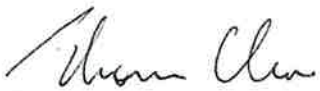
Reference EP Condition

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):  Date: 27 January 2022

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):  Date: 27 January 2022

Issue and Revision Record

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Executive summary

Water Column Profiling, Routine Water Quality Monitoring, Pit Specific Sediment Chemistry, Cumulative Impact Sediment Chemistry and Sediment Chemistry after a Major Storm were carried out for the Contaminated Mud Pits (CMPs) to the East of Sha Chau (ESC) during the quarterly reporting period of October to December 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 – October to December 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 – October to December 2021

Results of Routine Water Quality Monitoring conducted in October, November and December 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 – October to December 2021

Monitoring results showed that the concentrations of all inorganic contaminants were below the Lower Chemical Exceedance Levels (LCELs) at all 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 – December 2021

Monitoring results showed that the concentrations of all inorganic contaminants were 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.

Sediment Chemistry after a Major Storm of ESC CMPs – October 2021

Sampling for Sediment Chemistry after a Major Storm Event was conducted for ESC CMPs on 18 October 2021 after the visit of tropical cyclones Lionrock and Kompasu, which led to the issue of No. 8 Gale or Storm Signal on 9 to 10 October 2021 and 12 to 13 October 2021 respectively.

Monitoring results showed that the concentrations of all inorganic contaminants were 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. Overall, there appeared to be no evidence showing the failure of CMPs in retaining disposed mud or causing contamination of sediments after the major storm event in October 2021.

行政摘要

在 2021 年 10 月至 12 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、沉積物化學累積性影響監察及強颱風後的沉積物質素監察。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 10 月至 12 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 10 月至 12 月

2021 年 10 月至 12 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 10 月至 12 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。

沉積物化學累積性影響監察 – 2021 年 12 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。

強颱風後的沉積物質素監察 – 2021 年 10 月

熱帶氣旋獅子山在 2021 年 10 月 9 日至 10 日吹襲香港，並在同日發出八號暴風信號。熱帶氣旋圓規亦在 2021 年 10 月 12 日至 13 日吹襲香港，並在同日發出八號暴風信號。在熱帶氣旋過後，環境小組在 2021 年 10 月 18 日在沙洲以東海泥卸置設施附近範圍採集沉積物樣本作分析。監察結果顯示大部分的無機污染物含量在所有監測站均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。總體而言，沒有證據顯示 2021 年 10 月的強颱風導致污泥從泥坑擴散或引起沉積物污染。

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 October to December 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																																																													

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] 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.

1.3 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 – October to December 2021* is to provide information regarding the findings in the reporting period of October to December 2021 (from 1 October to 31 December 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	7 Oct 2021	8 Nov 2021
	3 Nov 2021	23 Nov 2021
	6 Dec 2021	18 Jan 2022
Routine Water Quality Monitoring of ESC CMPs	5 Oct 2021	8 Nov 2021
	4 Nov 2021	23 Nov 2021
	7 Dec 2021	18 Jan 2022
Pit Specific Sediment Chemistry of ESC CMP Vb	5 Oct 2021	8 Nov 2021
	2 Nov 2021	23 Nov 2021
	2 Dec 2021	18 Jan 2022
Cumulative Impact Sediment Chemistry of ESC CMPs	2 Dec 2021	18 Jan 2022
Sediment Chemistry after a Major Storm	18 Oct 2021	8 Nov 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 October to December 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 October, November and December 2021. Levels of Suspended Solids (SS) complied with the WQO at both Upstream and Downstream stations during the reporting period, except during October 2021 when the SS level at the Upstream station was higher than 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 October to December 2021 as presented in **Table 3.1**. A total of ten (10) stations were sampled during flood tide in December 2021 with locations of the monitoring stations presented in **Figure 2.1**, while a total of sixteen (16) stations were sampled during ebb tide in October and November 2021 with locations of the monitoring stations presented in **Figure 2.2**. 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 all stations. The levels of DO, Turbidity and SS complied with the Action and Limit Levels at all stations during the reporting period, but it is noted that some SS levels which were above the wet (i.e. October 2021) and dry (i.e. November and December 2021) season WQOs but in compliance with the Action and Limit Levels.

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 December 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, with potential project related spatial trend detected for one month within this reporting 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 Impact 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 December 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 the highest at Reference stations; while the concentrations of Zinc were 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 similar at all stations and slightly higher 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, Impact and Intermediate 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 similar across all stations and higher 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 October to December 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 2.3**. The monitoring results showed that the concentrations of all inorganic contaminants were below the Lower Chemical Exceedance Levels (LCELs) at all stations from October to December 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, Silver and Zinc. Subsequent linear regression analysis was conducted for Chromium (flood tide direction), Lead (ebb tide and flood tide directions) and Nickel (flood tide direction). For Chromium (flood tide direction) and Nickel (flood tide direction), the overall contaminant concentrations had returned to a lower level in November compared to October 2021; although a slight increase was experienced in the concentrations in December 2021, the dispersion of contaminant is well maintained and the concentration levels were still well below the respective Lower Chemical Exceedance Levels (LCELs). For Lead (flood tide direction), the overall concentration is in similar level from October 2021 to November 2021, despite a slight increase was experienced in the concentration in December 2021, the dispersion of contaminant is still well maintained and the concentration levels were still well below the LCEL.

For Lead (ebb tide direction), the dispersion of contaminant was well maintained and the potential project related spatial trend was not detected in November and December 2021, 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 reporting months, one in November 2021 for flood tide direction and one in October 2021 for ebb tide direction, but such trend was not detected in other reporting months. Therefore, there is no evidence indicating unacceptable project-related impact over time.

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 December 2021 as presented in **Table 3.1**. A total of nine (9) monitoring stations were sampled and the monitoring locations are shown in **Figure 2.4**. The monitoring results showed that the concentrations of all inorganic contaminants were below the LCELs at all monitoring stations in December 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 Ma Wan station and Mid-field stations. 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.

4.5 Sediment Chemistry after a Major Storm of ESC CMPs

4.5.1 Background

Samplings for Sediment Chemistry after a Major Storm of ESC CMPs were conducted at nine (9) monitoring stations (see **Figure 2.5** for the monitoring locations) on 18 October 2021 after the visit of tropical cyclones Lionrock and Kompasu, which led to the issue of No. 8 Gale or Storm Signal on 9 to 10 October 2021 and 12 to 13 October 2021 respectively. The tracks of Lionrock and Kompasu are shown in **Figure 2.6** and **2.7** respectively. The monitoring results showed that the concentrations of all inorganic contaminants were below the LCEL at all monitoring stations in October 2021.

Figure 2.6: Track of Tropical Cyclone Lionrock (Source: Hong Kong Observatory)

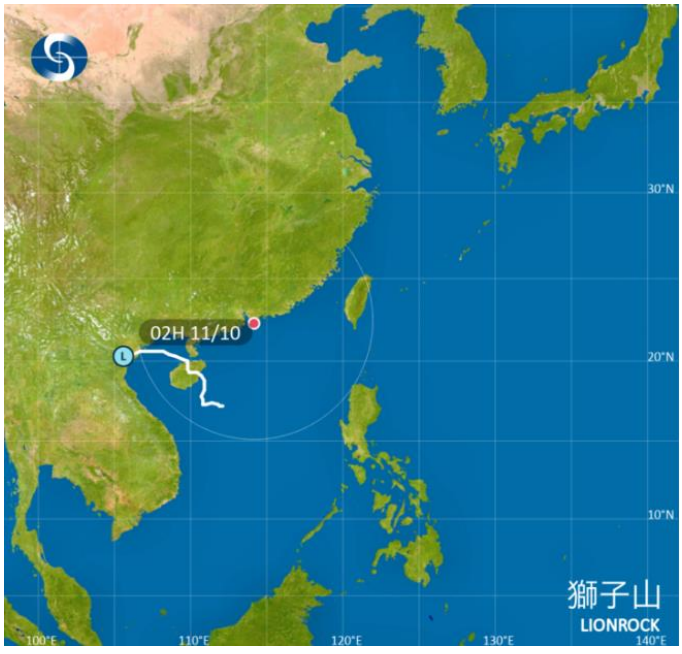


Figure 2.7: Track of Tropical Cyclone Kompasu (Source: Hong Kong Observatory)

4.5.2 Summary of Statistical Analyses

The data obtained were examined using statistical analyses. Statistical tests were run on inorganic contaminants, including Arsenic, Cadmium, Chromium, Copper, Nickel, Lead, Mercury, Silver and Zinc to examine differences in their sediment concentrations between Near-Field, Mid-Field, Far-Field, Capped-Pit and Ma Wan stations. A single-factor Analyses of Variance was employed as the statistical test, with Area as fixed factor.

Should spatial trend of potential concern (i.e. increasing contaminant concentration with proximity to the pit) be detected by ANOVA and subsequent post-hoc tests, further evaluation such as linear regression would be performed to examine the significance of the trend. Detailed results of statistical analyses are presented in **Appendix C**.

4.5.3 Conclusions

Results of the statistical analyses indicated that concentrations of all contaminants showed significant differences amongst sampling areas except for Lead. However, there did not appear to be any trend of increasing contaminant's concentrations with proximity to the pit (i.e. Capped-pit > Near-field > Mid-field > Far-field). Therefore, results of statistical analyses do not provide any evidence of the failure of ESC CMP Vd in retaining disposed mud or causing contamination of sediments after the major storm event in October 2021.

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

During the reporting period, the Independent Auditor (IA) conducted an inspection at the laboratory facility on 21 October 2021. The procedures of laboratory testing and measurement of metals in water samples were inspected. The IA was generally satisfied with the laboratory facilities and the whole procedures of sample analysis and measurements. The IA suggested that the laboratory should soak sample bottles with acids for 1-2 days followed by water rinsing before water sample collection. Overall, the IA satisfied with the monitoring procedures and confirmed that the requirements as stated in the EM&A Manual were implemented accordingly.

6 Future Key Issues

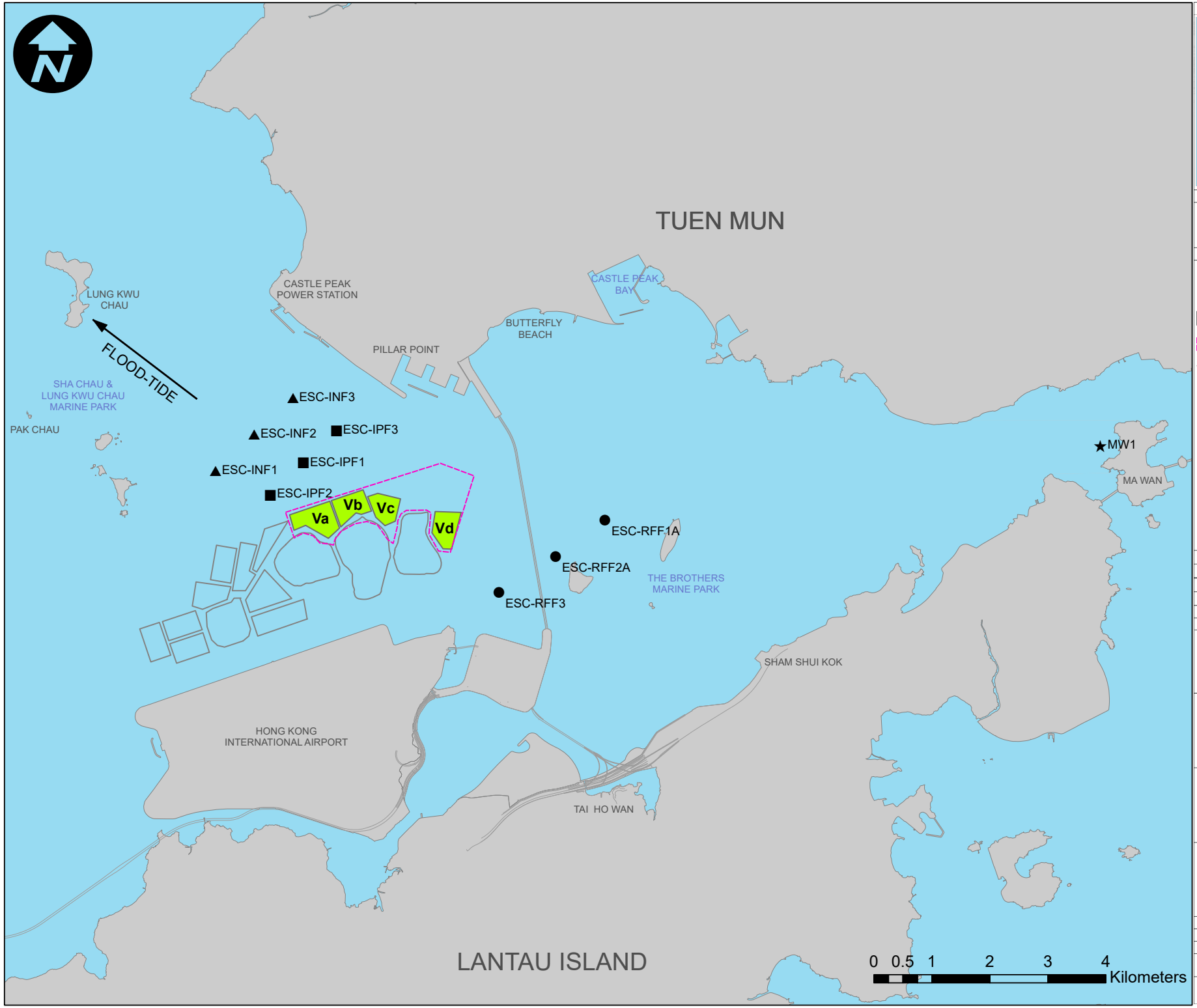
6.1 Activities Scheduled for the Next Reporting Period

The following monitoring activities will be conducted in the next quarterly reporting period of January to March 2022 for ESC CMPs including:

- Water Column Profiling of ESC CMP Vb in January, February and March 2022;
- Routine Water Quality Monitoring of ESC CMPs in January, February and March 2022;
- Pit Specific Sediment Chemistry of ESC CMP Vb in January, February and March 2022;
- Cumulative Impact Sediment Chemistry of ESC CMPs in February 2022;
- Sediment Toxicity Test of ESC CMPs in February 2022; and
- Demersal Trawling for ESC CMPs in January and February 2022.

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

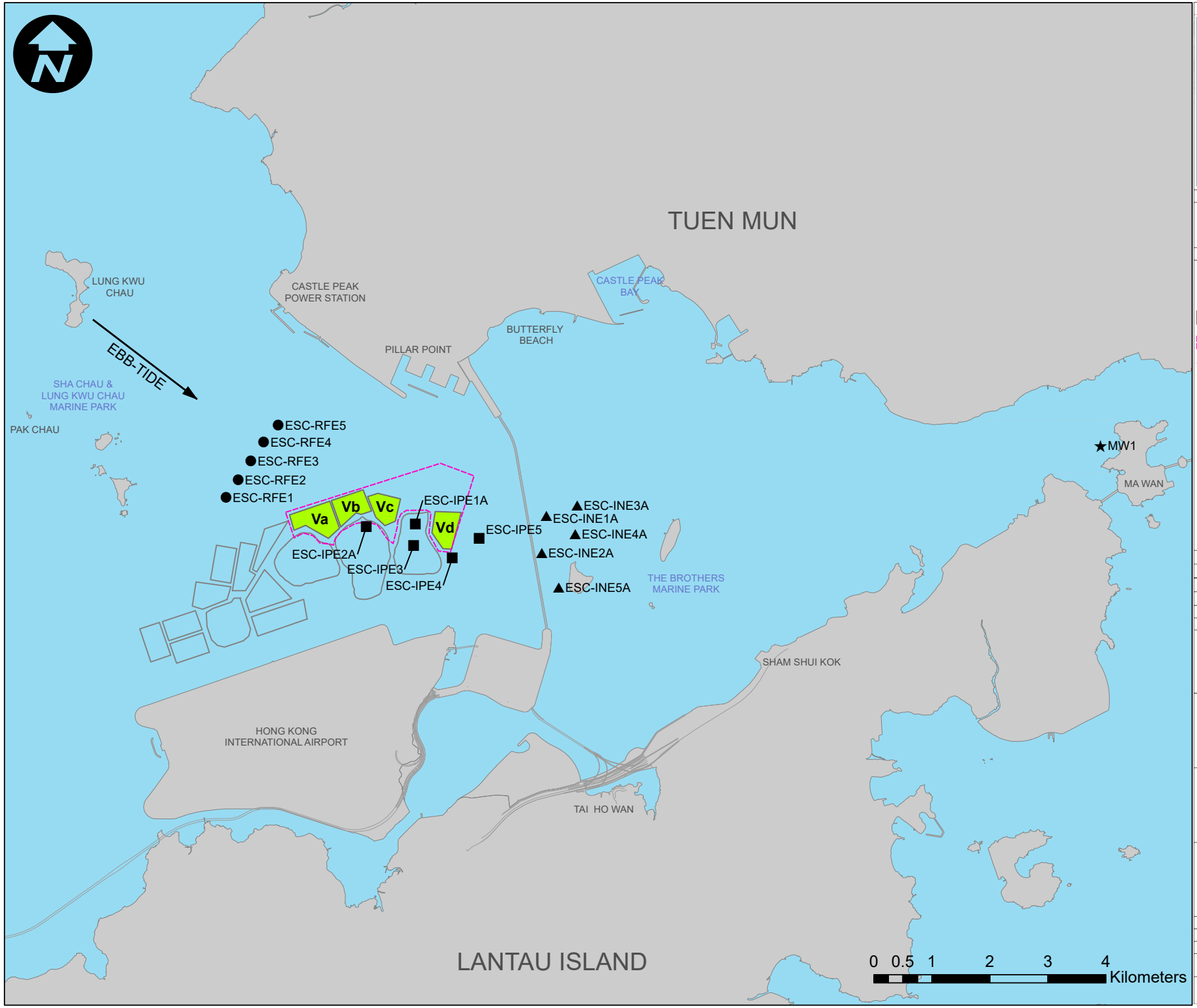
Title

ROUTINE & CAPPING WATER QUALITY SAMPLING STATIONS (FLOOD-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

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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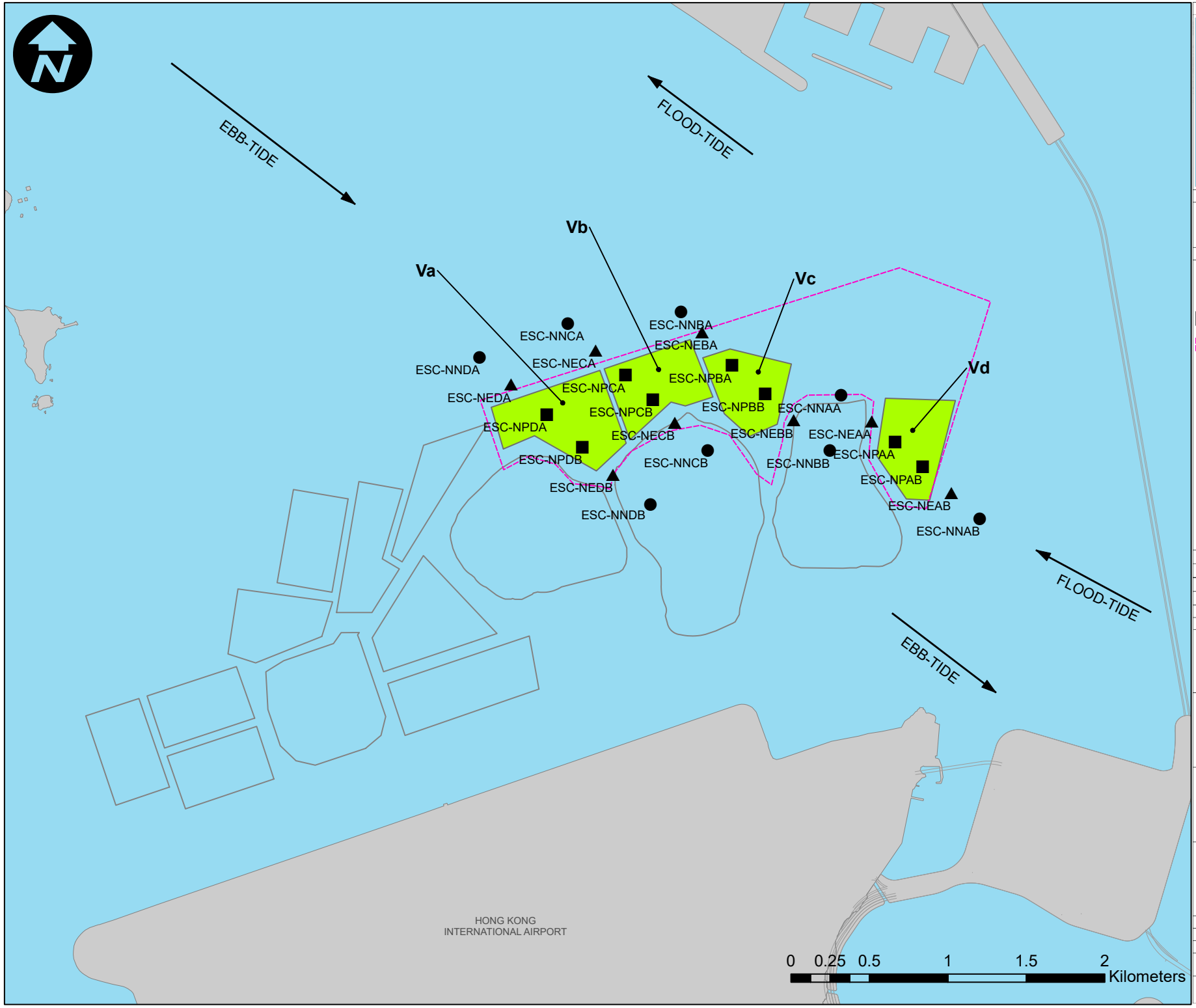
Title

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 2.2



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

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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**

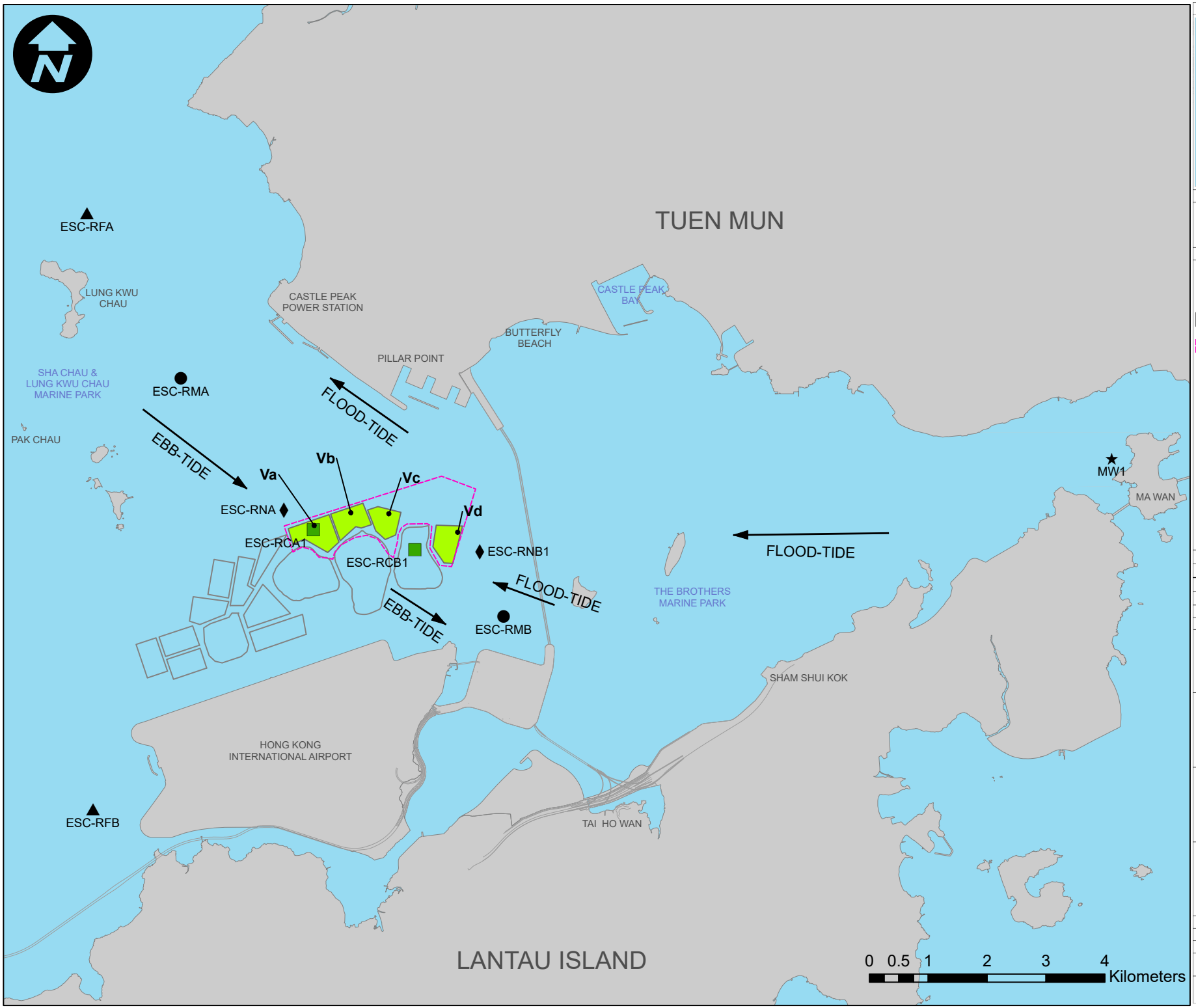
Title

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 2.3



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

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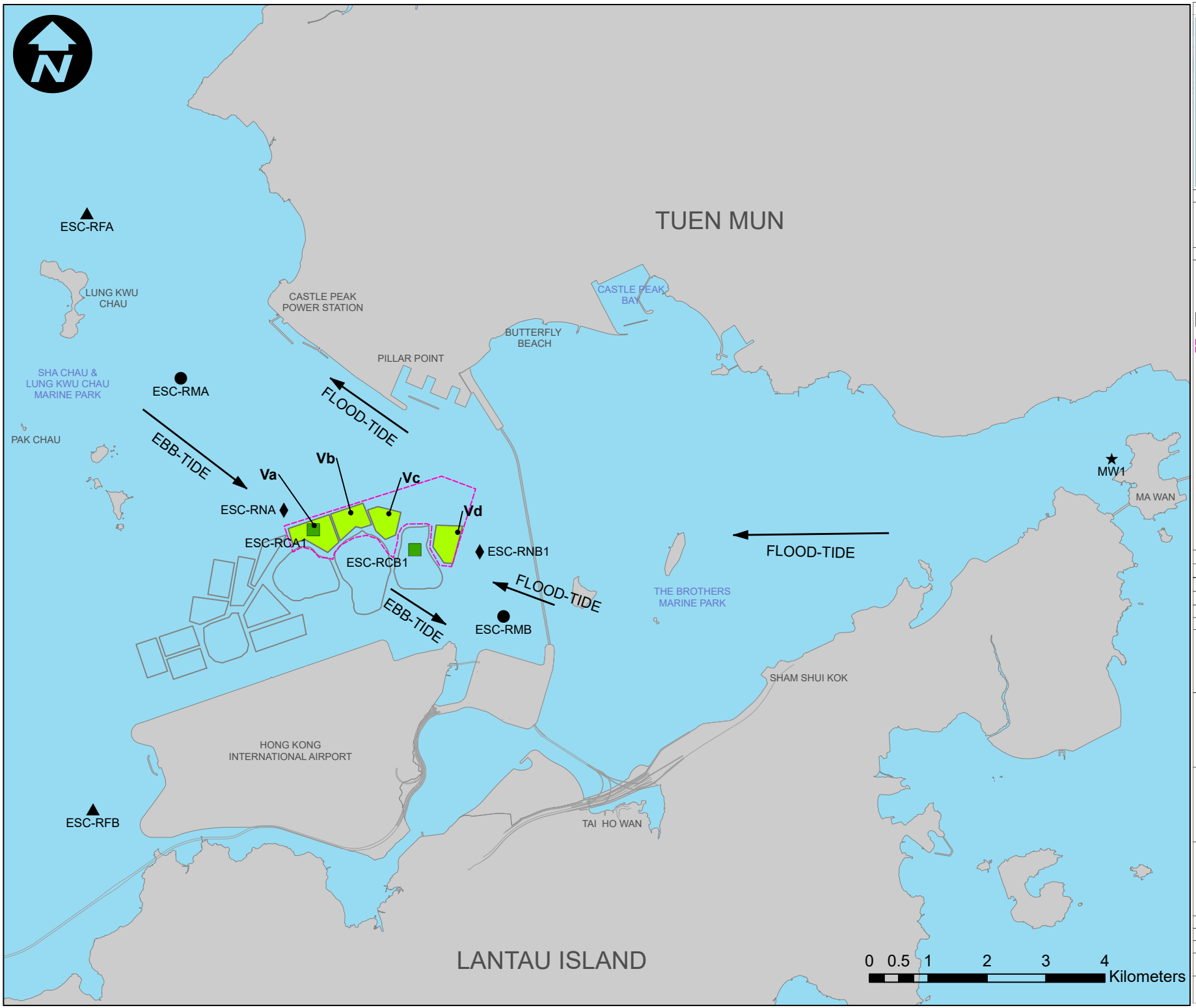
Title

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 2.4



Key Plan:

Notes:

Key to symbols:

LEGEND

- ESC CMP V
- ESC USABLE AREA 1

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

SEDIMENT CHEMISTRY AFTER A MAJOR STORM MONITORING STATIONS FOR ESC CMPS

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

Drawing Number

FIGURE 2.5

Appendices

Appendix A. Sampling Schedule

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

Parameter / Station Type	Station ID	Frequency	2021												2022												2023												2024												2025												2026		
Pit Specific Sediment Chemistry *			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	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
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 *			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	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
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-RCB1	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			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	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
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			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	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
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			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	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
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 *			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	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
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 *			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	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
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
	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
	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
	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
	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
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
	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
	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
	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
	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
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
	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
	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
	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
	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
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
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
	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
	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
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
	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
	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
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
	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
	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
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

Water Column Profiling *			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	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
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 Recoloinisation Studies			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	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
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			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	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
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 Monthly EM&A Report, while the number shown in black represent planned monitoring works after the reporting period of this Monthly EM&A Report.

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

(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.

Appendix B. Disposal and Capping Records

B1. Disposal Record at ESC CMP Vb

Date	Daily Disposal Volume (m^3)	Accumulative Disposal Volume (m^3)
1 Oct 2021	0	572,930
2 Oct 2021	748	573,678
3 Oct 2021	377	574,055
4 Oct 2021	371	574,426
5 Oct 2021	368	574,794
6 Oct 2021	669	575,463
7 Oct 2021	2,628	578,091
8 Oct 2021	0	578,091
9 Oct 2021	0	578,091
10 Oct 2021	0	578,091
11 Oct 2021	0	578,091
12 Oct 2021	0	578,091
13 Oct 2021	0	578,091
14 Oct 2021	0	578,091
15 Oct 2021	1,500	579,591
16 Oct 2021	2,500	582,091
17 Oct 2021	2,000	584,091
18 Oct 2021	2,500	586,591
19 Oct 2021	2,576	589,167
20 Oct 2021	2,500	591,667
21 Oct 2021	2,666	594,333
22 Oct 2021	2,500	596,833
23 Oct 2021	3,000	599,833
24 Oct 2021	1,000	600,833
25 Oct 2021	500	601,333
26 Oct 2021	500	601,833
27 Oct 2021	3,000	604,833
28 Oct 2021	1,500	606,333
29 Oct 2021	2,500	608,833
30 Oct 2021	2,500	611,333
31 Oct 2021	2,000	613,333
1 Nov 2021	2,000	615,333
2 Nov 2021	2,000	617,333
3 Nov 2021	2,000	619,333
4 Nov 2021	1,500	620,833
5 Nov 2021	1,000	621,833
6 Nov 2021	1,500	623,333
7 Nov 2021	1,500	624,833
8 Nov 2021	1,500	626,333
9 Nov 2021	1,500	627,833
10 Nov 2021	2,000	629,833
11 Nov 2021	600	630,433
12 Nov 2021	0	630,433
13 Nov 2021	0	630,433
14 Nov 2021	1,000	631,433
15 Nov 2021	2,500	633,933
16 Nov 2021	1,500	635,433
17 Nov 2021	1,500	636,933
18 Nov 2021	1,500	638,433

Date	Daily Disposal Volume (m^3)	Accumulative Disposal Volume (m^3)
19 Nov 2021	1,000	639,433
20 Nov 2021	1,500	640,933
21 Nov 2021	1,500	642,433
22 Nov 2021	2,000	644,433
23 Nov 2021	2,000	646,433
24 Nov 2021	2,500	648,933
25 Nov 2021	2,500	651,433
26 Nov 2021	1,500	652,933
27 Nov 2021	0	652,933
28 Nov 2021	0	652,933
29 Nov 2021	0	652,933
30 Nov 2021	0	652,933
1 Dec 2021	0	652,933
2 Dec 2021	0	652,933
3 Dec 2021	0	652,933
4 Dec 2021	0	652,933
5 Dec 2021	0	652,933
6 Dec 2021	0	652,933
7 Dec 2021	0	652,933
8 Dec 2021	0	652,933
9 Dec 2021	0	652,933
10 Dec 2021	0	652,933
11 Dec 2021	527	653,460
12 Dec 2021	0	653,460
13 Dec 2021	0	653,460
14 Dec 2021	0	653,460
15 Dec 2021	0	653,460
16 Dec 2021	0	653,460
17 Dec 2021	0	653,460
18 Dec 2021	0	653,460
19 Dec 2021	0	653,460
20 Dec 2021	0	653,460
21 Dec 2021	0	653,460
22 Dec 2021	0	653,460
23 Dec 2021	0	653,460
24 Dec 2021	0	653,460
25 Dec 2021	0	653,460
26 Dec 2021	0	653,460
27 Dec 2021	0	653,460
28 Dec 2021	0	653,460
29 Dec 2021	0	653,460
30 Dec 2021	0	653,460
31 Dec 2021	0	653,460

B2. Capping Record at ESC CMP Vd

Date	Daily Disposal Volume (m^3)	Accumulative Disposal Volume (m^3)
1 Oct 2021	0	217,480
2 Oct 2021	0	217,480
3 Oct 2021	0	217,480
4 Oct 2021	0	217,480
5 Oct 2021	0	217,480
6 Oct 2021	0	217,480
7 Oct 2021	0	217,480
8 Oct 2021	0	217,480
9 Oct 2021	0	217,480
10 Oct 2021	0	217,480
11 Oct 2021	0	217,480
12 Oct 2021	0	217,480
13 Oct 2021	0	217,480
14 Oct 2021	0	217,480
15 Oct 2021	0	217,480
16 Oct 2021	0	217,480
17 Oct 2021	0	217,480
18 Oct 2021	0	217,480
19 Oct 2021	0	217,480
20 Oct 2021	0	217,480
21 Oct 2021	0	217,480
22 Oct 2021	0	217,480
23 Oct 2021	0	217,480
24 Oct 2021	0	217,480
25 Oct 2021	0	217,480
26 Oct 2021	0	217,480
27 Oct 2021	0	217,480
28 Oct 2021	0	217,480
29 Oct 2021	0	217,480
30 Oct 2021	0	217,480
31 Oct 2021	0	217,480
1 Nov 2021	0	217,480
2 Nov 2021	0	217,480
3 Nov 2021	0	217,480
4 Nov 2021	0	217,480
5 Nov 2021	0	217,480
6 Nov 2021	0	217,480
7 Nov 2021	0	217,480
8 Nov 2021	0	217,480
9 Nov 2021	0	217,480
10 Nov 2021	0	217,480
11 Nov 2021	0	217,480
12 Nov 2021	0	217,480
13 Nov 2021	0	217,480
14 Nov 2021	0	217,480
15 Nov 2021	0	217,480
16 Nov 2021	0	217,480
17 Nov 2021	0	217,480
18 Nov 2021	0	217,480

Date	Daily Disposal Volume (m^3)	Accumulative Disposal Volume (m^3)
19 Nov 2021	0	217,480
20 Nov 2021	0	217,480
21 Nov 2021	0	217,480
22 Nov 2021	0	217,480
23 Nov 2021	0	217,480
24 Nov 2021	0	217,480
25 Nov 2021	0	217,480
26 Nov 2021	0	217,480
27 Nov 2021	0	217,480
28 Nov 2021	0	217,480
29 Nov 2021	0	217,480
30 Nov 2021	0	217,480
1 Dec 2021	0	217,480
2 Dec 2021	0	217,480
3 Dec 2021	0	217,480
4 Dec 2021	0	217,480
5 Dec 2021	0	217,480
6 Dec 2021	0	217,480
7 Dec 2021	0	217,480
8 Dec 2021	0	217,480
9 Dec 2021	0	217,480
10 Dec 2021	0	217,480
11 Dec 2021	0	217,480
12 Dec 2021	0	217,480
13 Dec 2021	0	217,480
14 Dec 2021	0	217,480
15 Dec 2021	0	217,480
16 Dec 2021	0	217,480
17 Dec 2021	0	217,480
18 Dec 2021	0	217,480
19 Dec 2021	0	217,480
20 Dec 2021	0	217,480
21 Dec 2021	0	217,480
22 Dec 2021	0	217,480
23 Dec 2021	0	217,480
24 Dec 2021	0	217,480
25 Dec 2021	0	217,480
26 Dec 2021	0	217,480
27 Dec 2021	0	217,480
28 Dec 2021	0	217,480
29 Dec 2021	0	217,480
30 Dec 2021	0	217,480
31 Dec 2021	0	217,480

Appendix C. Statistical Analysis

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

Dissolved Oxygen

Ebb Tide

Source	Type II Sum of Square	Df	F value	Significance Level
Period	2253.73	30	283.51	**
Area	37.97	3	47.76	**
Period:Area	206.02	90	8.64	**
Residuals	916.30	3458		

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

SNK Results:
- Overall result[1]:

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

- 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	4011.76	32	1176.03	**
Area	49.34	3	154.28	**
Period:Area	49.34	96	4.82	**
Residuals	244.65	2295		

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

SNK Results:
- Overall result:

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

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

[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	1161.77	30	221.25	**
Area	90.36	3	172.08	**
Period:Area	204.70	90	12.99	**
Residuals	605.27	3458		

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, Apr 2013, May 2016, Apr 2017, Apr 2020, Nov 2021
- Potential 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	57565.48	32	87.88	**
Area	3092.58	3	50.36	**
Period:Area	9904.80	96	5.04	**
Residuals	46981.68	2295		

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

SNK Results:
- Overall result:
  $$\left.\begin{array}{r}\text{Impact} = \text{Reference}\\ \text{Reference} = \text{Intermediate}\\ \text{Impact} = \text{Intermediate}\\ \text{Impact, Reference, Intermediate} > \text{Ma Wan}\end{array}\right\}$$ ∴ 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	2973.90	30	116.69	**
Area	35.15	3	13.79	**
Period:Area	466.22	90	6.10	**
Residuals	2939.24	3460		

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	2106.91	32	192.48	**
Area	20.20	3	19.68	**
Period:Area	350.73	96	10.68	**
Residuals	789.49	2308		

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

SNK Results:
- Overall result:
  Reference > Impact > Ma Wan > 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	1041.50	30	154.55	**
Area	20.81	3	30.88	**
Period:Area	157.21	90	7.78	**
Residuals	777.24	3460		

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

SNK Results:
- Overall result:

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

- 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	834.78	32	184.43	**
Area	3.71	3	8.73	**
Period:Area	146.84	96	10.81	**
Residuals	326.46	2308		

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

SNK Results:
- Overall result:

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

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

Zinc

Ebb Tide

Source	Type II Sum of Square	Df	F value	Significance Level
Period	1577.25	30	160.43	**
Area	38.51	3	39.17	**
Period:Area	234.42	90	7.95	**
Residuals	1133.86	3460		

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, Nov 2021
- Potential 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	1264.72	32	142.47	**
Area	39.63	3	47.62	**
Period:Area	166.53	96	6.25	**
Residuals	640.24	2308		

Note:
1. Assume Gamma 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	896.21	30	369.36	**
Area	17.31	3	71.33	**
Period:Area	85.03	90	11.68	**
Residuals	279.84	3460		

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	771.62	32	124.04	**
Area	6.25	3	10.72	**
Period:Area	59.98	96	3.21	**
Residuals	448.68	2308		

Note:
1. Assume Gamma 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	415.25	29	464.97	**
Area	23.79	3	257.46	**
Period:Area	32.96	87	12.30	**
Residuals	102.73	3336		

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

SNK Results:
- Overall result:

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

- 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	627.67	32	360.83	**
Area	11.31	3	69.35	**
Period:Area	40.37	96	7.74	**
Residuals	125.46	2308		

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

SNK Results:
- Overall result:

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

- 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	432.26	30	101.39	**
Area	15.33	3	35.95	**
Period:Area	185.96	90	14.54	**
Residuals	491.71	3460		

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	562.50	32	175.10	**
Area	22.06	3	73.24	**
Period:Area	143.26	96	14.87	**
Residuals	231.69	2308		

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	758.04	30	270.23	**
Area	43.93	3	156.61	**
Period:Area	127.64	90	15.17	**
Residuals	323.53	3460		

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, May 2016, Jul 2017, Jul 2018, Apr 2020, May 2021
- 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	541.50	32	170.10	**
Area	14.12	3	47.31	**
Period:Area	115.11	96	12.05	**
Residuals	229.60	2308		

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):
  - Nov 2012, Jul 2013, Nov 2017, Aug 2018, Dec 2020, Sep 2021
- No potential project related spatial trend were detected for the reporting months.

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

Arsenic

Source	Type II Sum of Square	Df	F value	Significance Level
Period	56.44	22	141.91	**
Area	8.49	2	234.78	**
Direction	4.45	1	246.04	**
Period:Area	14.81	44	18.62	**
Period:Direction	4.11	22	10.33	**
Area:Direction	6.55	2	181.16	**
Period:Area:Direction	13.44	44	16.90	**
Residuals	18.98	1050		

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, Aug 2021
  - Ebb Tide: Feb 2020, Sep 2020, Nov 2020, July 2021
- No potential project related spatial trend (i.e. Active Pit > Pit Edge > Near Pit) were detected for the reporting months.

Cadmium

Source	Type II Sum of Square	Df	F value	Significance Level
Period	49.95	22	21.38	**
Area	83.60	2	393.53	**
Direction	0.81	1	7.59	N.S.
Period:Area	36.06	44	7.72	**
Period:Direction	23.30	22	9.97	**
Area:Direction	27.76	2	130.66	**
Period:Area:Direction	26.04	44	5.57	**
Residuals	111.52	1050		

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.

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

Chromium

Source	Type II Sum of Square	Df	F value	Significance Level
Period	10.73	22	29.97	**
Area	15.12	2	464.59	**
Direction	4.34	1	266.65	**
Period:Area	5.41	44	7.56	**
Period:Direction	2.84	22	7.93	**
Area:Direction	12.04	2	369.92	**
Period:Area:Direction	4.11	44	5.74	**
Residuals	17.08	1050		

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, July 2021, Aug 2021, Oct 2021, Nov 2021, Dec 2021[3]
  - Ebb Tide: Apr 2020, Oct 2020, Nov 2020, May 2021, Oct 2021
- Potential project related spatial trend were detected for consecutive three months over the reporting period for flood tide direction and and was detected in one month for ebb tide direction.

Regression Analysis Results:

Period	R Square	Adjusted R Square	Y-intercept	Slope	Significance Level
Oct-21	0.62	0.60	26.34	-1.28	**
Nov-21	0.80	0.79	23.72	-0.91	**
Dec-21	0.56	0.54	26.66	-0.88	**

Note: Linear regression analysis on spatial changes of contaminant concentrations in flood tide direction for the three concerned 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	23.77	22	30.33	**
Area	146.72	2	2060.02	**
Direction	13.82	1	387.94	**
Period:Area	17.05	44	10.88	**
Period:Direction	12.06	22	15.39	**
Area:Direction	43.22	2	606.78	**
Period:Area:Direction	24.30	44	15.51	**
Residuals	37.39	1050		

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, Sep 2021
- No potential project related spatial trend (i.e. Active Pit > Pit Edge > Near Pit) were detected for the reporting months.

Lead

Source	Type II Sum of Square	Df	F value	Significance Level
Period	12.44	22	15.52	**
Area	24.11	2	330.81	**
Direction	5.30	1	145.37	**
Period:Area	10.31	44	6.43	**
Period:Direction	3.75	22	4.67	**
Area:Direction	5.39	2	74.01	**
Period:Area:Direction	4.04	44	2.52	**
Residuals	38.26	1050		

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, Aug 2021, Oct 2021, Nov 2021, Dec 2021
  - Ebb Tide: May 2020, Jul 2020, Mar 2021, May 2021, Jun 2021, Sep 2021, Oct 2021
- Potential project related spatial trend was detected for consecutive three months over the reporting period in flood tide direction and was detected in one month for ebb tide direction.

Regression Analysis Results:

Flood Tide:

Period	R Square	Adjusted R Square	Y-intercept	Slope	Significance Level
Oct-21	0.71	0.69	35.16	-2.03	**
Nov-21	0.89	0.88	35.35	-1.94	**
Dec-21	0.60	0.57	40.78	-2.09	**

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

Ebb Tide:

Period	R Square	Adjusted R Square	Y-intercept	Slope	Significance Level
Sep-21	0.74	0.73	22.01	-1.35	**
Oct-21	0.59	0.56	36.24	-3.23	**

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

Mercury

Source	Type II Sum of Square	Df	F value	Significance Level
Period	114.10	22	20.09	**
Area	102.67	2	198.87	**
Direction	58.31	1	225.87	**
Period:Area	61.14	44	5.38	**
Period:Direction	34.57	22	6.09	**
Area:Direction	77.68	2	150.47	**
Period:Area:Direction	27.42	44	2.41	**
Residuals	271.04	1050		

Note:

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

SNK Results:

- Overall result:

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

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

Nickel

Source	Type II Sum of Square	Df	F value	Significance Level
Period	11.36	22	50.00	**
Area	15.44	2	747.46	**
Direction	9.76	1	944.92	**
Period:Area	6.22	44	13.68	**
Period:Direction	4.49	22	19.78	**
Area:Direction	14.98	2	725.39	**
Period:Area:Direction	5.15	44	11.33	**
Residuals	10.84	1050		

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

SNK Results:

- Overall result:

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

- 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, Jul 2021, Aug 2021, Oct 2021, Nov 2021, Dec 2021
  - Ebb Tide: Jun 2020, Jul 2020, Oct 2020, Jul 2021, Oct 2021
- Potential project related spatial trend was detected for consecutive three months over the reporting period in flood tide direction and was detected in one month for ebb tide direction.

Regression Analysis Results:

Period	R Square	Adjusted R Square	Y-intercept	Slope	Significance Level
Oct-21	0.55	0.52	16.90	-0.71	**
Nov-21	0.81	0.80	16.12	-0.62	**
Dec-21	0.51	0.48	17.13	-0.53	**

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

Silver

Source	Type II Sum of Square	Df	F value	Significance Level
Period	50.35	22	24.64	**
Area	259.37	2	1396.28	**
Direction	3.92	1	42.23	**
Period:Area	50.15	44	12.27	**
Period:Direction	28.24	22	13.82	**
Area:Direction	36.00	2	193.79	**
Period:Area:Direction	36.12	44	8.84	**
Residuals	97.52	1050		

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

SNK Results:
- Overall result:
  Active Pit > Near Pit
  Active Pit > Pit Edge
  Near Pit > Pit Edge
  ∴ 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	11.13	22	40.45	**
Area	37.55	2	1500.66	**
Direction	2.52	1	201.71	**
Period:Area	10.18	44	18.50	**
Period:Direction	4.91	22	17.85	**
Area:Direction	7.04	2	281.51	**
Period:Area:Direction	4.42	44	8.04	**
Residuals	13.14	1050		

Note:

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

SNK Results:
- Overall result:
  Active Pit > Near Pit
  Active Pit > Pit Edge
  Near Pit > Pit Edge
  ∴ 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, Sep 2021
- No potential project related spatial trend (i.e. Active Pit > Pit Edge > Near Pit) were detected for the reporting months.

Total Organic Carbon

Source	Type II Sum of Square	Df	F value	Significance Level
Period	65.31	22	153.79	**
Area	47.35	2	1226.62	**
Direction	8.80	1	456.06	**
Period:Area	18.51	44	21.79	**
Period:Direction	8.17	22	19.24	**
Area:Direction	12.37	2	320.34	**
Period:Area:Direction	16.90	44	19.90	**
Residuals	20.27	1050		

Note:

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

SNK Results:

- Overall result:

  Active Pit > Near Pit
  Active Pit > Pit Edge
  Near Pit > Pit Edge
  } ∴ 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, Jul 2021, Sep 2021, Nov 2021
  - Ebb Tide: Jul 2020, Oct 2020, May 2021, Jun 2021, Oct 2021
- Potential project related spatial trend was detected in one month during the reporting period in both flood tide and ebb tide directions.

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

Arsenic

Source	Type II Sum of Square	Df	F value	Significance Level
Period	68.41	22	160.62	**
Area	90.78	4	1172.20	**
Period:Area	63.83	88	37.47	**
Residuals	40.64	2099		

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.

Cadmium

Source	Type II Sum of Square	Df	F value	Significance Level
Period	55.04	22	21.11	**
Area	57.79	4	121.93	**
Period:Area	47.19	88	4.53	**
Residuals	248.71	2099		

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	5109.69	22	26.10	**
Area	69067.34	4	1940.69	**
Period:Area	16432.95	88	20.99	**
Residuals	18675.33	2099		

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	12079.40	22	18.32	**
Area	248825.40	4	2075.53	**
Period:Area	25626.87	88	9.72	**
Residuals	62909.70	2099		

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	29972.36	22	100.25	**
Area	69418.21	4	1277.04	**
Period:Area	19004.60	88	15.89	**
Residuals	28524.72	2099		

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	398.73	22	38.69	**
Area	60.76	4	32.43	**
Period:Area	201.87	88	4.90	**
Residuals	983.20	2099		

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	2235.35	22	23.93	**
Area	25139.54	4	1480.41	**
Period:Area	8601.54	88	23.02	**
Residuals	8911.00	2099		

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	106.41	22	29.23	**
Area	768.81	4	1161.64	**
Period:Area	74.46	88	5.11	**
Residuals	347.30	2099		

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	16.29	22	31.81	**
Area	134.15	4	1440.81	**
Period:Area	46.69	88	22.79	**
Residuals	48.86	2099		

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	1831974556	22	53.98	**
Area	3452037676	4	559.47	**
Period:Area	3758303379	88	27.69	**
Residuals	3237812963	2099		

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.

Sediment Chemistry of ESC CMPs after a Major Storm Event (on 18 October 2021)

Arsenic

Source	Type II Sum of Square	Df	F value	Significance Level
Area	105.45	4	54.92	**
Residuals	23.52	49		

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

SNK Results:
- Ma Wan = Capped-pit = Mid-Field > Far-Field > Near-Field

Cadmium

Source	Type II Sum of Square	Df	F value	Significance Level
Area	0.022	4	18.96	**
Residuals	0.014	49		

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

SNK Results:
- Ma Wan = Mid-Field > Capped-pit > Near-Field = Far-Field

Chromium

Source	Type II Sum of Square	Df	F value	Significance Level
Area	1256.62	4	87.28	**
Residuals	176.36	49		

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

SNK Results:
- Ma Wan > Capped-pit > Mid-Field > Near-Field = Far-Field

Copper

Source	Type II Sum of Square	Df	F value	Significance Level
Area	5588.91	4	62.32	**
Residuals	1098.59	49		

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

SNK Results:
- Ma Wan > Capped-pit = Mid-Field > Near-Field = Far-Field

Lead

Source	Type II Sum of Square	Df	F value	Significance Level
Area	0.38	4	1.01	N.S.
Residuals	4.59	49		

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

Mercury

Source	Type II Sum of Square	Df	F value	Significance Level
Area	0.046	4	36.87	**
Residuals	0.015	49		

Note:

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

SNK Results:

- Ma Wan > Capped-pit > Mid-Field = Near-Field > Far-Field

Nickel

Source	Type II Sum of Square	Df	F value	Significance Level
Area	542.41	4	64.81	**
Residuals	102.53	49		

Note:

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

SNK Results:

- Ma Wan > Capped-pit > Mid-Field > Near-Field = Far-Field

Silver

Source	Type II Sum of Square	Df	F value	Significance Level
Area	19.08	4	48.00	**
Residuals	4.87	49		

Note:

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

SNK Results:

- Ma Wan > Mid-Field = Capped-pit = Near-Field = Far-Field

Zinc

Source	Type II Sum of Square	Df	F value	Significance Level
Area	13002.83	4	65.93	**
Residuals	2415.90	49		

Note:

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

SNK Results:

- Ma Wan > Capped-pit > Near-Field = Mid-Field > Far-Field