MOTT MACDONALD

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

Quarterly EM&A Report for
Contaminated Mud Pits to the East of Sha Chau
– July to September 2022

November 2022

Mott MacDonald
3/F Manulife Place
348 Kwun Tong Road
Kwun Tong
Kowloon
Hong Kong

T +852 2828 5757
mottmac.hk

Civil Engineering and
Development Department
Fill Management Division
5/F, Civil Engineering and
Development Building
101 Princess Margaret
Road
Homantin, Kowloon

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 – July to September 2022

November 2022

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 – July to September 2022
Date of Report:	17 November 2022
Date prepared by ET:	17 November 2022
Date received by IA:	17 November 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: 17 November 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: 17 November 2022

Issue and Revision Record

Revision	Date	Originator	Checker	Approver	Description
A	November 2022	Various	Thomas Chan	Eric Ching	Revision A of Submission

Document reference: 423134 | 06/06/04 | A

Information class: Standard

Contents

Tables

Figures

Appendices

Executive summary

Water Column Profiling, Routine Water Quality Monitoring, Pit Specific Sediment Chemistry, Cumulative Impact Sediment Chemistry, Sediment Chemistry after a Major Storm, Sediment Toxicity Tests and Demersal Trawling were carried out for the Contaminated Mud Pits (CMPs) to the East of Sha Chau (ESC) during the quarterly reporting period of July to September 2022. 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 – July to September 2022

Results indicated that levels of Salinity, pH, DO and SS complied with the Water Quality Objectives (WQOs) at both Upstream and Downstream stations. Levels of DO, Turbidity and SS also 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 – July to September 2022

Results of Routine Water Quality Monitoring conducted in July, August and September 2022 showed that the levels of SS and pH complied with the WQOs at all stations. Levels of DO and Salinity also complied with the WQOs at most stations. Levels of DO, Turbidity and SS complied with the Action and Limit Levels at all 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 – July to September 2022

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

Cumulative Impact Sediment Chemistry of ESC CMPs – August 2022

Monitoring results showed that the concentrations of most inorganic contaminants were below the LCELs at most 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 CMP V – July and August 2022

Samplings for Sediment Chemistry after a Major Storm Event were conducted for ESC CMPs on 6 July and 29 August 2022 after the visit of tropical cyclones Chaba and Ma-on, respectively, which led to the issue of No. 8 Gale or Storm Signal on 1 July and 24 August 2022 respectively.

Monitoring results showed that the concentrations of most inorganic contaminants were below the LCELs at most 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 July and August 2022.

Sediment Toxicity Tests of ESC CMPs – August 2022

Statistical analysis showed either no significant differences between Impact and Reference stations, or no project related trend in the toxicity tests of all the tested marine benthos. There did not appear to be any evidence of unacceptable impacts to sediment toxicity due to the mud disposal operations at ESC CMPs.

Demersal Trawling for ESC CMPs – August and September 2022

During the sampling period in August and September 2022, the mean number of faunal species caught was generally lower at Impact stations. Biotic abundance, Biomass, Catch per Unit Effort (CPUE) and Yield per Unit Effort (YPUE) were also generally lower at Impact stations ESC-INA and ESC-INB.

行政摘要

在 2022 年 7 月至 9 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、強颱風後的沉積物質素監察、沉積物毒性測試及底棲漁業資源監察。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 – 2022 年 7 月至 9 月

監察結果顯示上游及下游監測站的鹽度、酸鹼值、溶解氧及懸浮固體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 – 2022 年 7 月至 9 月

2022 年 7 月至 9 月的例行水質監察結果顯示，所有監測站的懸浮固體含量及酸鹼值均符合海水水質指標。另外，大部分監測站的溶解氧濃度及鹽度均符合海水水質指標。所有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 – 2022 年 7 月至 9 月

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

沉積物化學累積性影響監察 – 2022 年 8 月

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

強颱風後的沉積物質素監察 – 2022 年 7 月及 8 月

颱風暹芭於 2022 年 6 月 29 日吹襲香港，並在 2022 年 7 月 1 日發出 8 號烈風或暴風信號；而強烈熱帶風暴馬鞍於 2022 年 8 月 23 日吹襲香港，並在 2022 年 8 月 24 日發出 8 號烈風或暴風信號。在強颱風過後，環境小組分別在 2022 年 7 月 6 日及 8 月 29 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 2022 年 7 月及 8 月強颱風導致污泥從泥坑擴散或引起沉積物污染。

沙洲以東污泥坑之沉積物毒性測試 – 2022 年 8 月

統計結果顯示，所有已測試的海洋底棲生物在受影響監測站及參考監測站的沉積物毒性測試沒有明顯分別，且在沉積物毒性測試中亦沒有偵測到與項目相關的趨勢。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毒性造成任何不可接受的影響。

沙洲以東污泥坑之底棲漁業資源監察 – 2022 年 8 月及 9 月

監察結果顯示，2022 年 8 月和 9 月的底棲漁業資源在受影響監測站普遍錄得較低的品種數量。而在 2022 年 8 月及 9 月受影響監測站 ESC-INA 及 ESC-INB 的生物量、生物重量、單位努力漁獲量及單位努力生產量普遍錄得較低的數值。

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. In early 2022, after implementing the Phase 1 optimisation for at least one year, a further data review was conducted. The monitoring data has been reviewed and demonstrated that the data robustness and representativeness are maintained. Therefore, a technical note presenting the data review results served as a supplementary information was submitted to EPD and presented that Phase 2 optimization of sample replication of water quality and sediment monitoring for the Project will be implemented in 2022. EPD expressed no comment on the review and note the implementation of Phase 2 optimization of sample replication on 18 May 2022, and thus this optimization has been effective for the EM&A activities since July 2022.

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 July to September 2022, the following works were undertaken at the CMPs:

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

[1] ERM (2013) Final Report. Submitted under Agreement No. CE 4/2009 (EP) Environmental Monitoring and Audit for Contaminated Mud Pit at East Sha Chau. For CEDD.

[2] ERM (2017) Final Report. Submitted under Agreement No. CE 23/2012 (EP) Environmental Monitoring and Audit for Contaminated Mud Pits to the South of The Brothers and at East Sha Chau (2012 – 2017). For CEDD.

Table 1.1: Works Schedule for ESC CMP V

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

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 – July to September 2022* is to provide information regarding the findings in the reporting period of July to September 2022 (from 1 July to 30 September 2022) 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/2022/05 Sediment Disposal Facilities to the East of Sha Chau and East of Tung Lung Chau – Sampling (2022-2027); and
- Contract No. CV/2022/06 Sediment Disposal Facilities to the East of Sha Chau and East of Tung Lung Chau – Sample Testing (2022-2027).

Lam Geotechnics Limited and ALS Technichem (HK) Pty Limited (hereinafter known as “Contractors”) were responsible for sampling under Contract No. CV/2022/05 and laboratory analysis under Contract No. CV/2022/06, 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	19 Jul 2022	3 Aug 2022
	17 Aug 2022	29 Aug 2022
	5 Sep 2022	14 Sep 2022
Routine Water Quality Monitoring of ESC CMPs	20 Jul 2022	3 Aug 2022
	22 Aug 2022	13 Sep 2022
	2 Sep 2022	19 Sep 2022
Pit Specific Sediment Chemistry of ESC CMP Vb	18 Jul 2022	19 Aug 2022
	19 Aug 2022	9 Sep 2022
	7 Sep 2022	22 Sep 2022
Cumulative Impact Sediment Chemistry of ESC CMPs	18 Aug 2022	9 Sep 2022
Sediment Chemistry after a Major Storm	6 Jul 2022	19 Aug 2022
	29 Aug 2022	13 Sep 2022
Sediment Toxicity Test of ESC CMPs	18 Aug 2022	4 Nov 2022
Demersal Trawling of ESC CMPs	18 & 19 Aug 2022	7 Nov 2022
	5 & 6 Sep 2022	7 Nov 2022

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 July to September 2022 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, DO and SS complied with the WQOs at both Upstream and Downstream stations in July, August and September 2022. 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 July to September 2022 as presented in **Table 3.1**. A total of sixteen (16) stations were sampled during ebb tide in August 2022 with locations of the monitoring stations presented in **Figure 4.1**; while a total of ten (10) stations were sampled during flood tide in July and September 2022 with locations of the monitoring stations presented in **Figure 4.2**. The disposal and capping volumes during the reporting period are detailed in **Appendix B1** and **B2**, respectively. The monitoring results showed that levels of SS and pH complied with the WQOs at all stations, except for higher levels of Salinity recorded at Ma Wan station in July 2022 and slightly lower levels of DO recorded at Ma Wan station in September 2022 but in compliance with the Action and Limit Levels. The higher Salinities recorded at Ma Wan station are likely to be caused by the larger separation distance to Pearl River Delta mouth, which releases a large amount of freshwater runoff in the area during wet season, when compared to the Reference stations. The levels of DO, Turbidity and SS complied with the Action and Limit Levels at all stations during the reporting period.

4.2.2 Summary of Statistical Analysis

The aim of the statistical analysis is to reveal any trends of increasing concentration of contaminants with proximity to the pit or with time. Data obtained during this reporting period were statistically compared with data obtained since monitoring began at CMP V in February 2012 except for metals and metalloid of which data prior to July 2022 collected under a more conservative method were excluded, where those metals and metalloid data demonstrated no consistent project related spatial trends.

For most parameters, only low concentrations were measured throughout the study period 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. For metals and metalloid, starting from July 2022, dissolved metal and metalloid concentrations for which at least 60% of data were detectable were taken into account in the statistical analysis to review if any trends of increasing concentration of contaminants with proximity to the pit or with time.

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 Impact stations for ebb tide and at Reference stations for flood tide, 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. No potential project related spatial trend were detected 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 Reference stations.

4.2.4 Metals and Metalloid

Statistical analysis was performed for flood tide data of all dissolved metal and metalloid contaminants except Lead and Silver which had high percentage of their values were not detected (i.e. > 60% of values were not detected from July 2022 to September 2022). No significant difference was observed for Cadmium, while Arsenic concentration varied significantly over sampling periods and area. Other dissolved metal and metalloid varied significantly over either sampling periods or area as indicated by results of the ANOVA tests (**Appendix C**). There were no consistent project related spatial trends detected for all dissolved metals and metalloid, and the concentrations of were generally the highest at Intermediate stations. Statistical analysis will be conducted for cumulative flood tide data in the next reporting period as a sufficient data size being obtained.

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 at Reference and Impact stations were generally similar, thus there was no significant project related impact.

5-Day Biochemical Oxygen Demand (BOD_5)

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

Suspended Solids (SS)

SS levels varied significantly with sampling periods and areas during ebb tide and flood tide. During ebb tide, the relationship between SS levels and proximity to the pit (i.e. Area) indicated a significant overall spatial trend, but no potential project related spatial trend was detected in this reporting period, 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 July to September 2022 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 4.3**. The monitoring results showed that the concentrations of most inorganic contaminants were below the Lower Chemical Exceedance Levels (LCELs) at most stations from July to September 2022, except for Arsenic. The concentrations of Arsenic were higher than the LCEL at Near-Pit station ESC-NNCA, Pit-Edge stations ESC-NECA, ESC-NECB and Active-Pit stations ESC-NPCA, ESC-NPCB in July 2022; at Pit-Edge station ESC-NECA and Active-Pit stations ESC-NPCA, ESC-NPCB in August 2022; and at Near-Pit station ESC-NNCA, Pit-Edge stations ESC-NECA, ESC-NECB and Active-Pit stations ESC-NPCA, ESC-NPCB in September 2022.

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 Cadmium, Chromium, Copper, Mercury, Nickel and Silver. Subsequent linear regression analysis was conducted for Arsenic (ebb tide direction), Lead (ebb tide direction) and

Zinc (ebb tide direction). For Arsenic (ebb tide direction), the contaminant concentration returned to a lower level in August 2022 especially for Near-Pit stations, and the potential project related spatial trend was not detected in September 2022. Therefore, there is no evidence indicating consistent project related impact over time. For Lead (ebb tide direction), although the overall contaminant concentration in July 2022 were higher than June 2022, it returned to a lower level in subsequent months. The potential project related spatial trend was also not detected in August 2022, thus there was no consistent spatial trend of increasing contaminant concentrations with proximity to the pit over time. For Zinc (ebb tide direction), contaminant concentrations for the two concerned months in June and July 2022 were in similar level, but the spatial trend was not detected anymore in August 2022. Therefore, there was no evidence of consistent spatial trend of increasing contaminant concentrations with proximity to the pit over time.

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. Potential project related spatial trends were detected in flood tide direction for July and August 2022, but it was not observed in September 2022. Therefore, there is no evidence indicating consistent or increasing 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 August 2022 as presented in **Table 3.1**. A total of nine (9) monitoring stations were sampled and the monitoring locations are shown in **Figure 4.4**. The monitoring results showed that the concentrations of most inorganic contaminants were below the LCELs at most monitoring stations in August 2022, except the concentrations of Arsenic which were higher than the LCEL at Near-field station ESC-RNB1, Mid-field stations ESC-RMA, ESC-RMB, Far-field station ESC-RFB and Capped Pits station ESC-RCA1, as well as concentrations of Silver were higher than the LCEL at Ma Wan station MW1.

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. 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 4.5** for the monitoring locations) on 6 July 2022 after the visit of tropical cyclone Chaba and 29 August 2022 after the visit of tropical cyclone Ma-on, which led to the issue of No. 8 Gale or Storm Signal on 1 July and 24 August 2022 respectively. The track of Chaba is shown in **Figure 4.6** and the track of Ma-on is shown in **Figure 4.7**.

For July 2022, the monitoring results showed that the concentrations of most inorganic contaminants were below the LCEL at most monitoring stations, except for Arsenic. The concentrations of Arsenic were higher than the LCEL at Near-field station ESC-RNA, ESC-RNB1, Mid-field stations ESC-RMA, ESC-RMB, Far-field stations ESC-RFA and Capped Pit stations ESC-RCA1, ESC-RCB1. For August 2022, the monitoring results showed that the concentrations of most inorganic contaminants were below the LCEL at most monitoring stations, except for Arsenic and Silver. The concentrations of Arsenic were higher than the LCEL at Near-field station ESC-RNB1, Mid-field station ESC-RMA, Far-field stations ESC-RFB and Capped Pit stations ESC-RCB1. The concentrations of Silver were higher than the LCEL at Ma Wan station MW1.

Figure 4.6: Track of Tropical Cyclone Chaba (Source: Hong Kong Observatory)

Figure 4.7: Track of Tropical Cyclone Ma-on (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

In July 2022, results of the statistical analyses indicated that concentrations of all contaminants did not show significant differences amongst sampling areas, except for Chromium, Copper, Nickel, Silver and Zinc. In August 2022, results of the statistical analyses indicated that concentrations of all contaminants did not show significant differences amongst sampling areas, except for Chromium, Copper, Nickel and Silver. 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 July and August 2022.

4.6 Sediment Toxicity Tests – August 2022

Sediment Toxicity Tests were undertaken for sediments collected from the Impact (Near Pit), Reference and Ma Wan stations (see **Figure 4.8** for the sampling locations) in August 2022.

Appropriate statistical test, i.e. ANOVA, was applied for comparing and determining the level of significance in the results of August 2022 between Impact and Reference Stations. When significant difference was detected then multiple comparison procedures would be used (e.g. Turkey's Test) to isolate where the differences is occurring.

Results of the Sediment Toxicity Tests in August 2022 showed that there were no significant differences between Impact and Reference stations in the toxicity tests for all tested marine benthos. Therefore, there did not appear to be any evidence of unacceptable impacts to sediment toxicity due to the mud disposal operations at ESC CMP Vb. Detailed results of statistical analyses are presented in **Appendix C.**

4.7 Demersal Trawling – August and September 2022

Fishery resources monitoring by demersal trawling was carried out at two (2) impact and four (4) reference stations (see **Figure 4.9** for locations) in August and September 2022. Monitoring results are presented in the following sections.

Abundance and Biomass

The average number of species collected in the period of August and September 2022 is presented in **Table 4.1**. Mean number of faunal species caught at Impact stations was generally lower than at Reference stations in August and September 2022.

Biotic abundance, Biomass, Catch per Unit Effort (CPUE) and Yield per Unit Effort (YPUE) were generally lower at Impact stations ESC-INA and ESC-INB in August and September 2022 (**Table 4.2**). Annual trend and statistical analyses will be conducted in the Annual EM&A Review Report to determine whether there is any significant difference that shows a considerable impact to fishery resources caused by the mud disposal operations at ESC CMP Vb.

Table 4.1: Summary of the Mean Number of Faunal Species Caught during Monitoring in August and September 2022

Mean Number of Faunal Species	Impact Stations		Reference Stations			
	ESC-INA	ESC-INB	TNA	TNB	TSA	TSB
Aug 2022	11.6	10.8	24.2	26.6	40.8	36.2
Sep 2022	15.8	14.6	26.2	26.2	41.2	43.8

Table 4.2: Summary of CPUE and YPUE during Monitoring in August and September 2022

Date	Station	Type of Station	No. of Individuals per Station	Total Biomass per Station (g)	Mean CPUE(1) per Tow (no./hr/net)	Mean YPUE(2) per Tow (g/hr/net)
Aug 2022	ESC-INA	Impact	525	4107.5	105	821.5
Aug 2022	ESC-INB	Impact	248	1330.4	49.6	266.08
Aug 2022	TNA	Reference	10622	116272.7	2124.4	23254.54
Aug 2022	TNB	Reference	3680	51072.4	736	10214.48
Aug 2022	TSA	Reference	2657	54964.7	531.4	10992.94
Aug 2022	TSB	Reference	2596	48336	519.2	9667.20
Sep 2022	ESC-INA	Impact	554	15739.3	110.8	3147.86
Sep 2022	ESC-INB	Impact	764	12378.7	152.8	2475.74
Sep 2022	TNA	Reference	21126	227929.4	4225.2	45585.88
Sep 2022	TNB	Reference	20718	191274	4143.6	38254.80
Sep 2022	TSA	Reference	4975	147316.2	995	29463.24
Sep 2022	TSB	Reference	5109	128153.9	1021.8	25630.78

Notes:
(1) CPUE is calculated by dividing the number of individuals with the trawling time and number of nets (in hour and number of nets).
(2) YPUE is calculated by dividing the weight (g) of fish with trawling effort (in hour and number of nets).

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 for Pit Specific Sediment Chemistry on 18 July 2022 and a total of 6 stations were sampled. *In-situ* and laboratory measurements were conducted. The IA was generally satisfied with the sample collection and confirmed that the requirements as stated in the EM&A Manual were implemented accordingly.

6 Future Key Issues

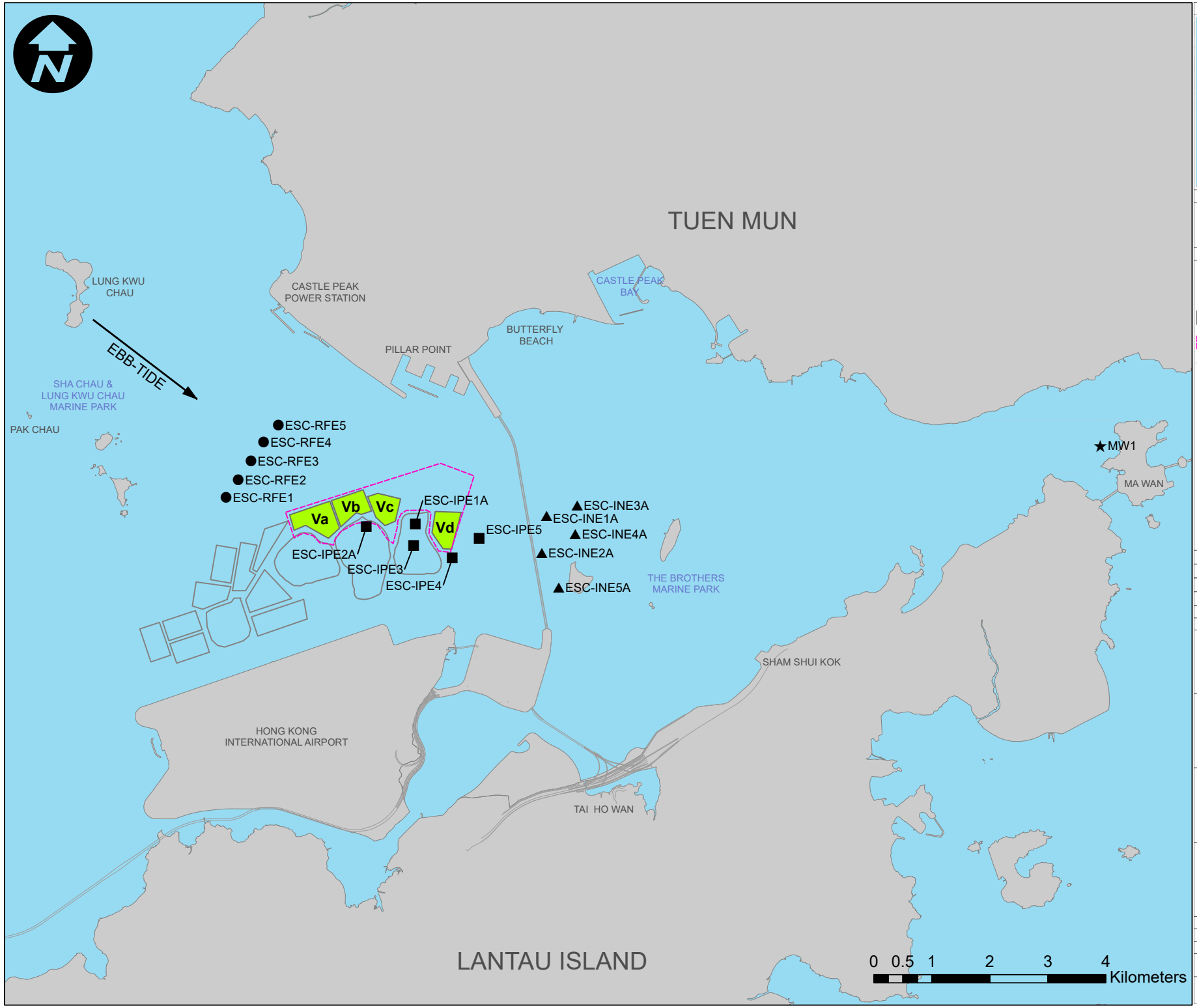
6.1 Activities Scheduled for the Next Reporting Period

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

- Water Column Profiling of ESC CMP Vb in October, November and December 2022;
- Routine Water Quality Monitoring of ESC CMPs in October, November and December 2022;
- Pit Specific Sediment Chemistry of ESC CMP Vb in October, November and December 2022; and
- Cumulative Impact Sediment Chemistry of ESC CMPs in December 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			

MOTT MACDONALD
3/F International Trade Tower
348 Kwun Tong Road
Kwun Tong, Kowloon
Hong Kong
T +852 2828 5757
F +852 2821823
W mottmac.com

Client

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

Project

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

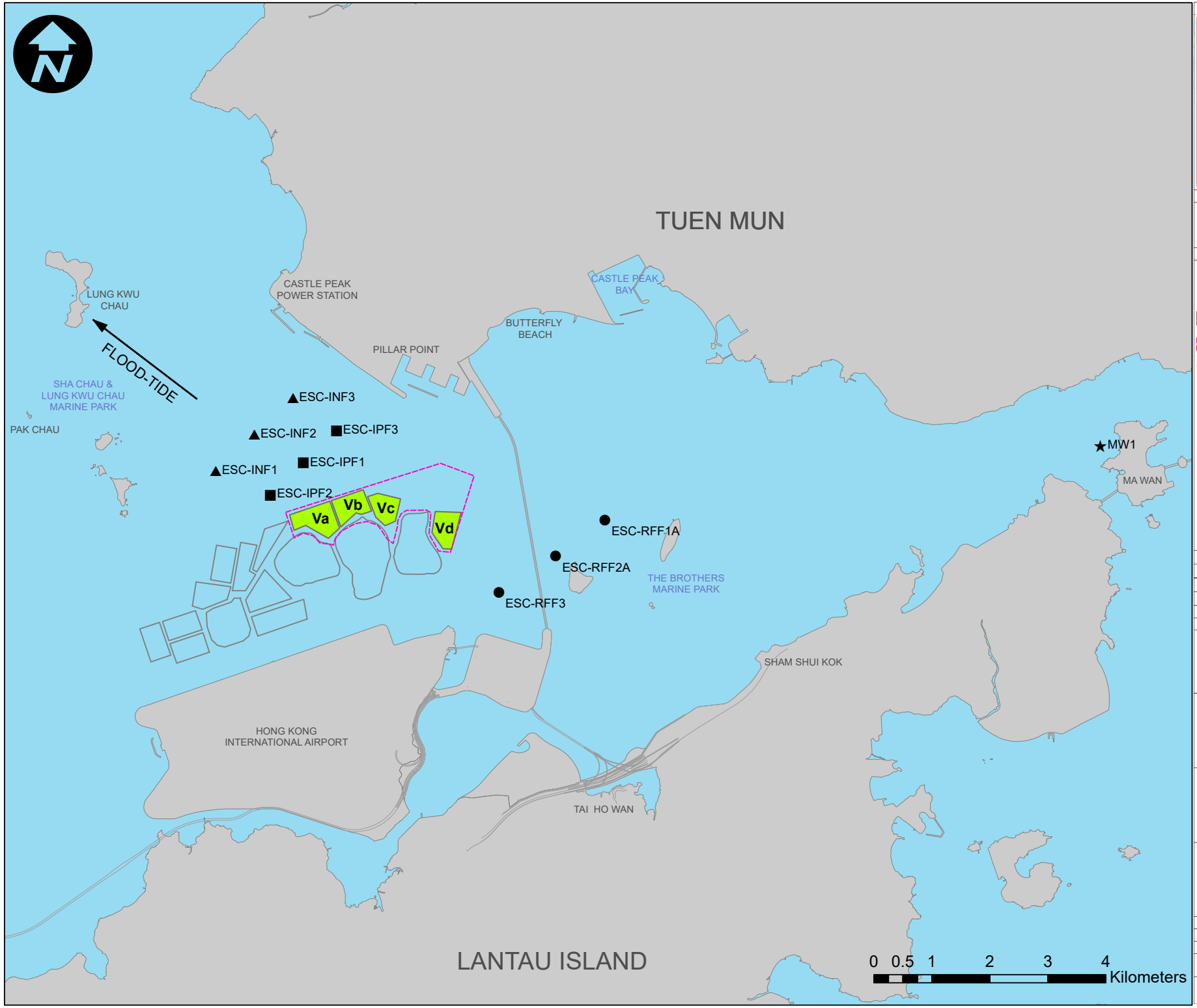
Title

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

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

Drawing Number

FIGURE 4.1



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			

MOTT MACDONALD
3/F International Trade Tower
348 Kwun Tong Road
Kwun Tong, Kowloon
Hong Kong
T +852 2828 5757
F +852 2821823
W mottmac.com

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

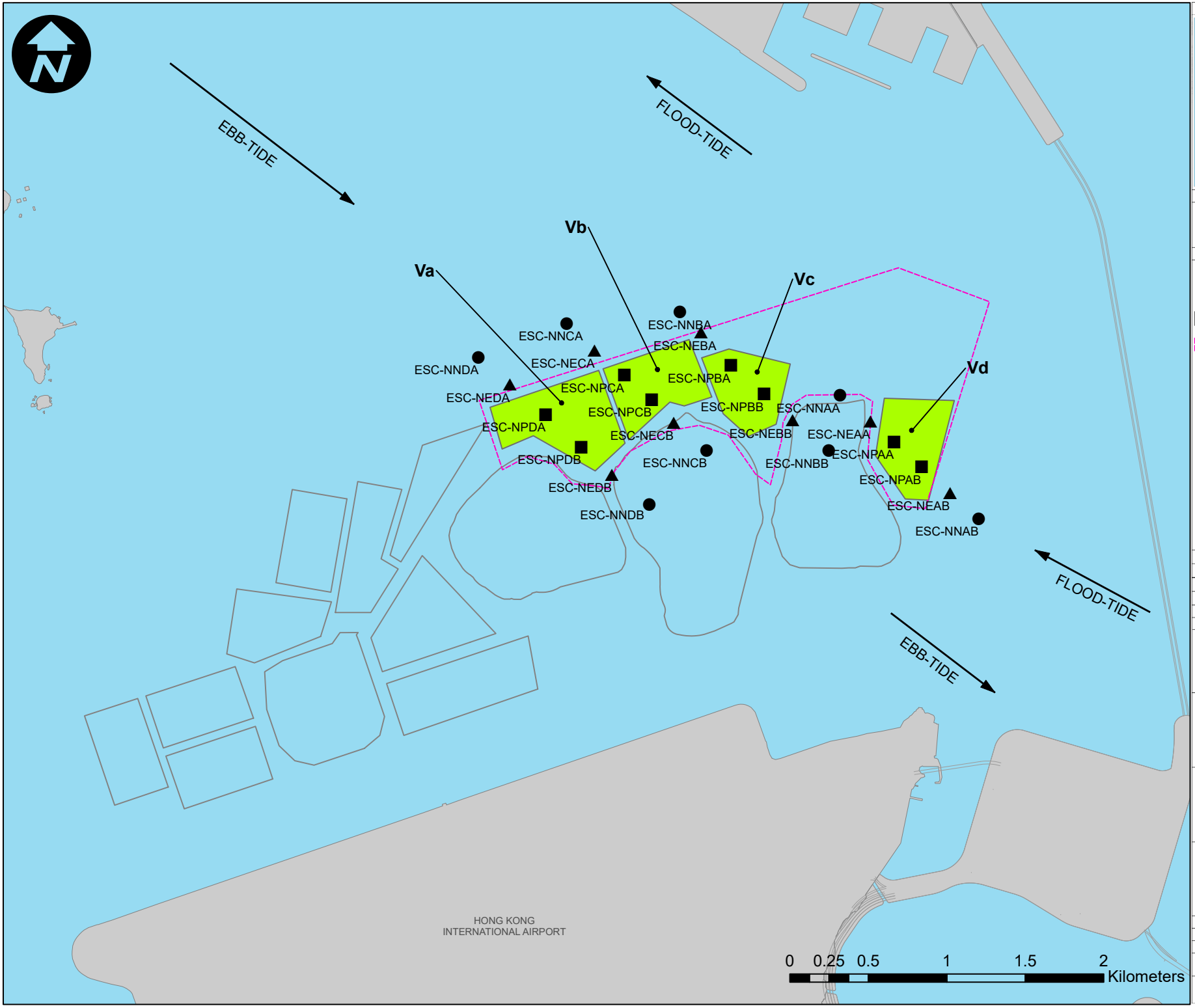
Title

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 4.2



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

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

MOTT MACDONALD

3/F International Trade Tower
348 Kwun Tong Road
Kwun Tong, Kowloon
Hong Kong
T +852 2828 5757
F +852 2821823
W mottmac.com

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

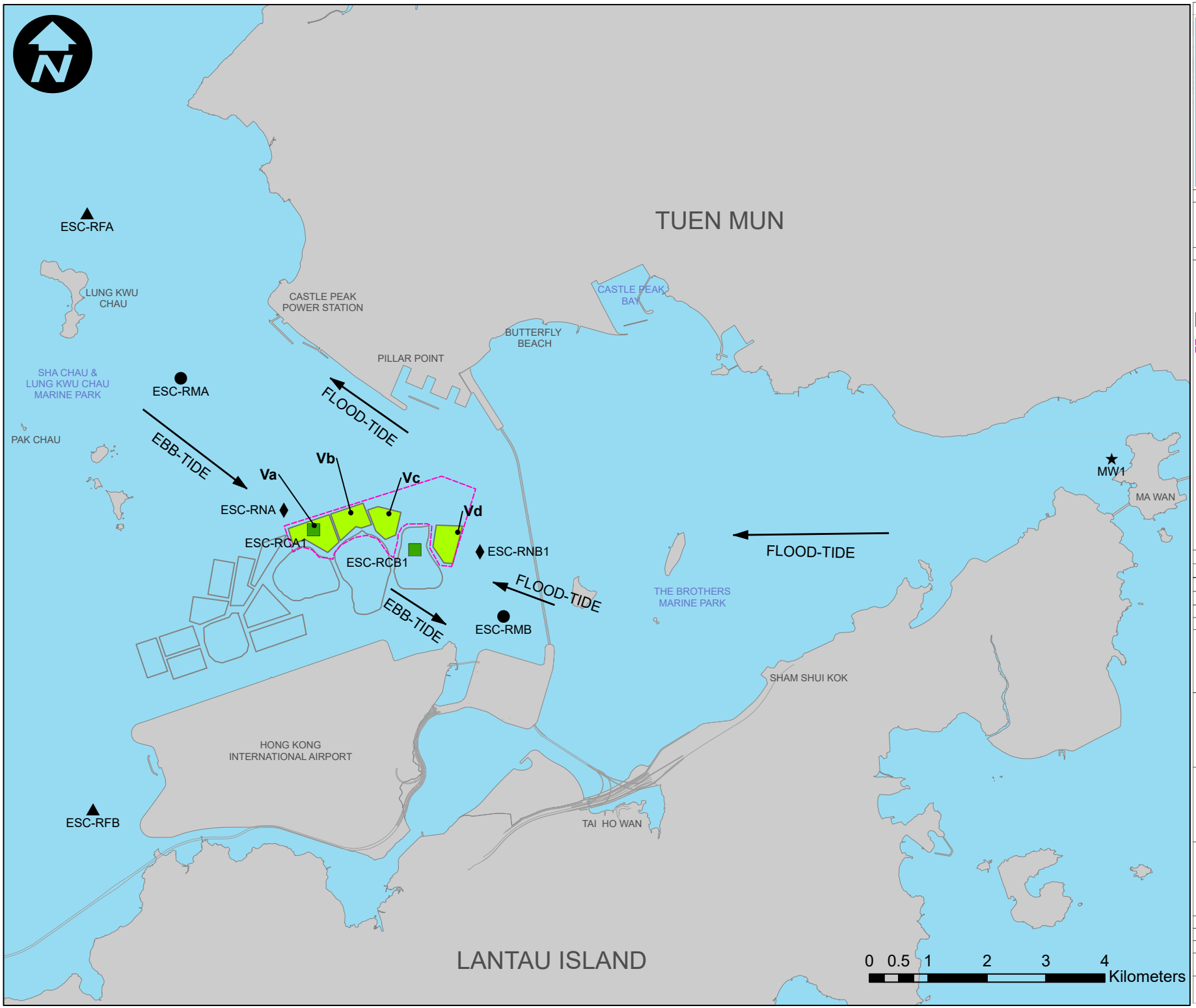
Title

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 4.3



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

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

MOTT MACDONALD
3/F International Trade Tower
348 Kwun Tong Road
Kwun Tong, Kowloon
Hong Kong
T +852 2828 5757
F +852 2821823
W mottmac.com

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

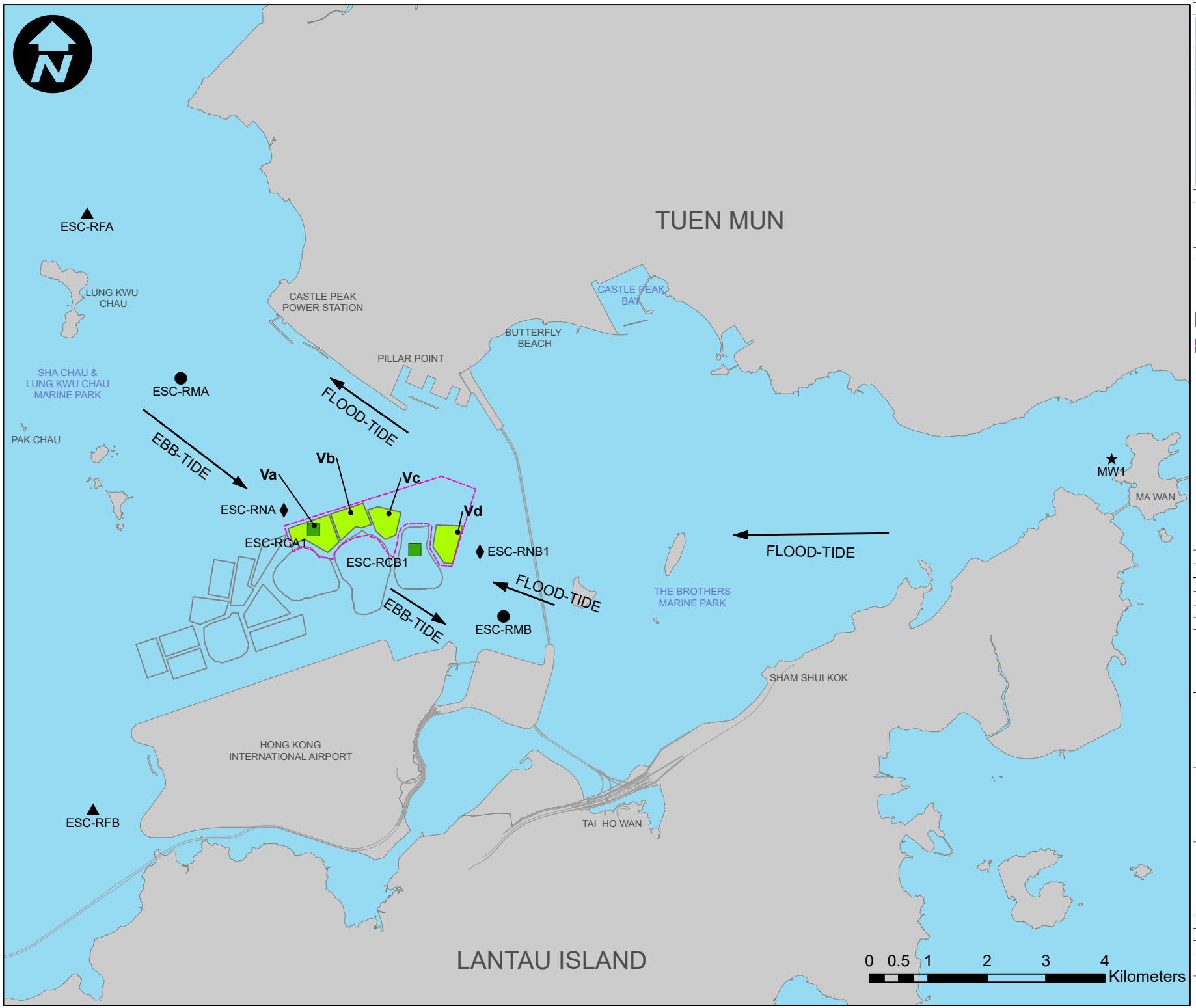
Title

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 4.4



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			

MOTT MACDONALD

3/F International Trade Tower
348 Kwun Tong Road
Kwun Tong, Kowloon
Hong Kong
T +852 2828 5757
F +852 2821823
W mottmac.com

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**

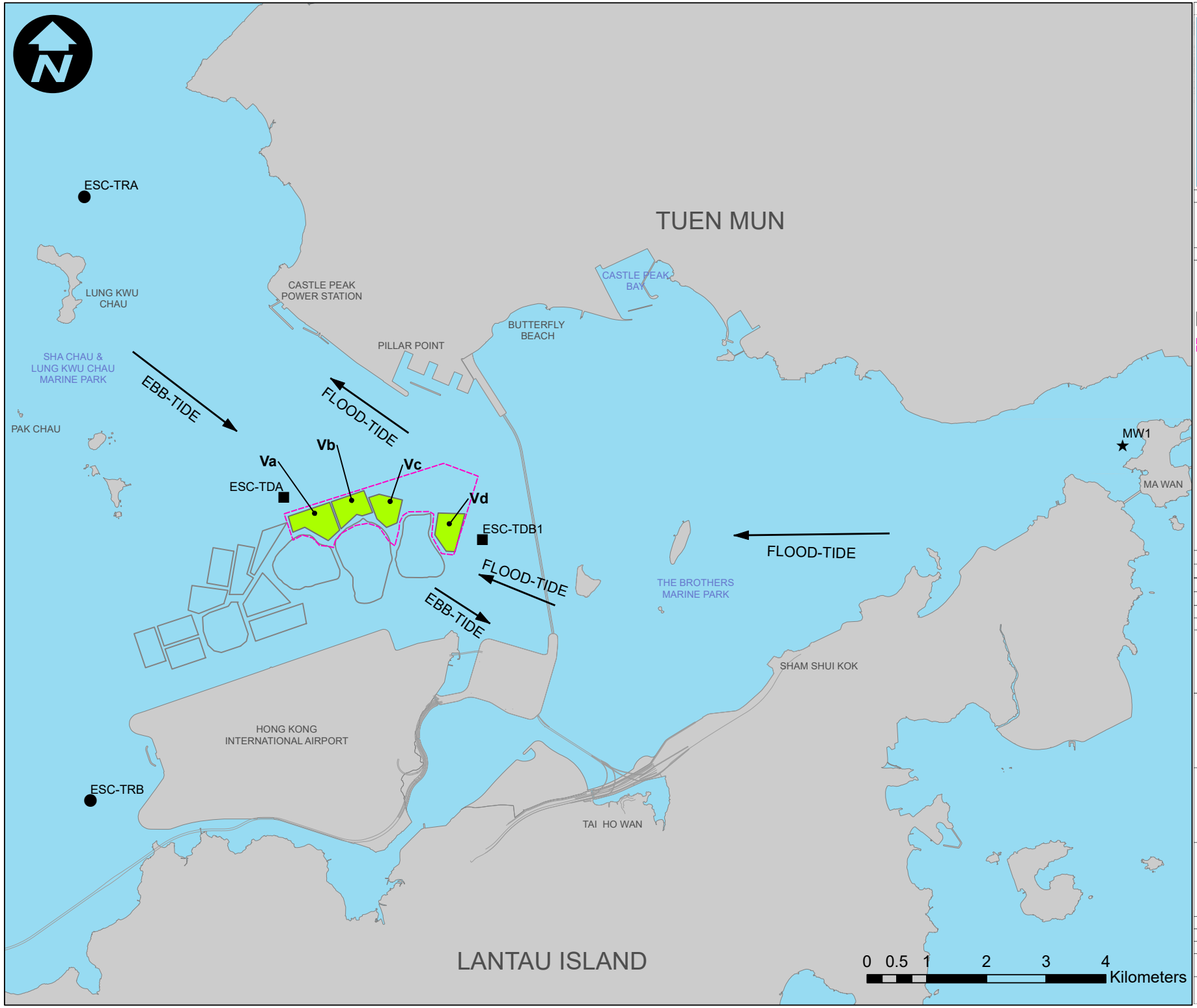
Title

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 4.5



Key Plan:

Notes:

Key to symbols:

LEGEND

- ESC CMP V
- ESC USABLE AREA 1

SEDIMENT TOXICITY MONITORING STATIONS

- NEAR-FIELD STATION
- REFERENCE STATION
- MA WAN STATION

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

MOTT MACDONALD
3/F International Trade Tower
348 Kwun Tong Road
Kwun Tong, Kowloon
Hong Kong
T +852 2828 5757
F +852 2821823
W mottmac.com

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

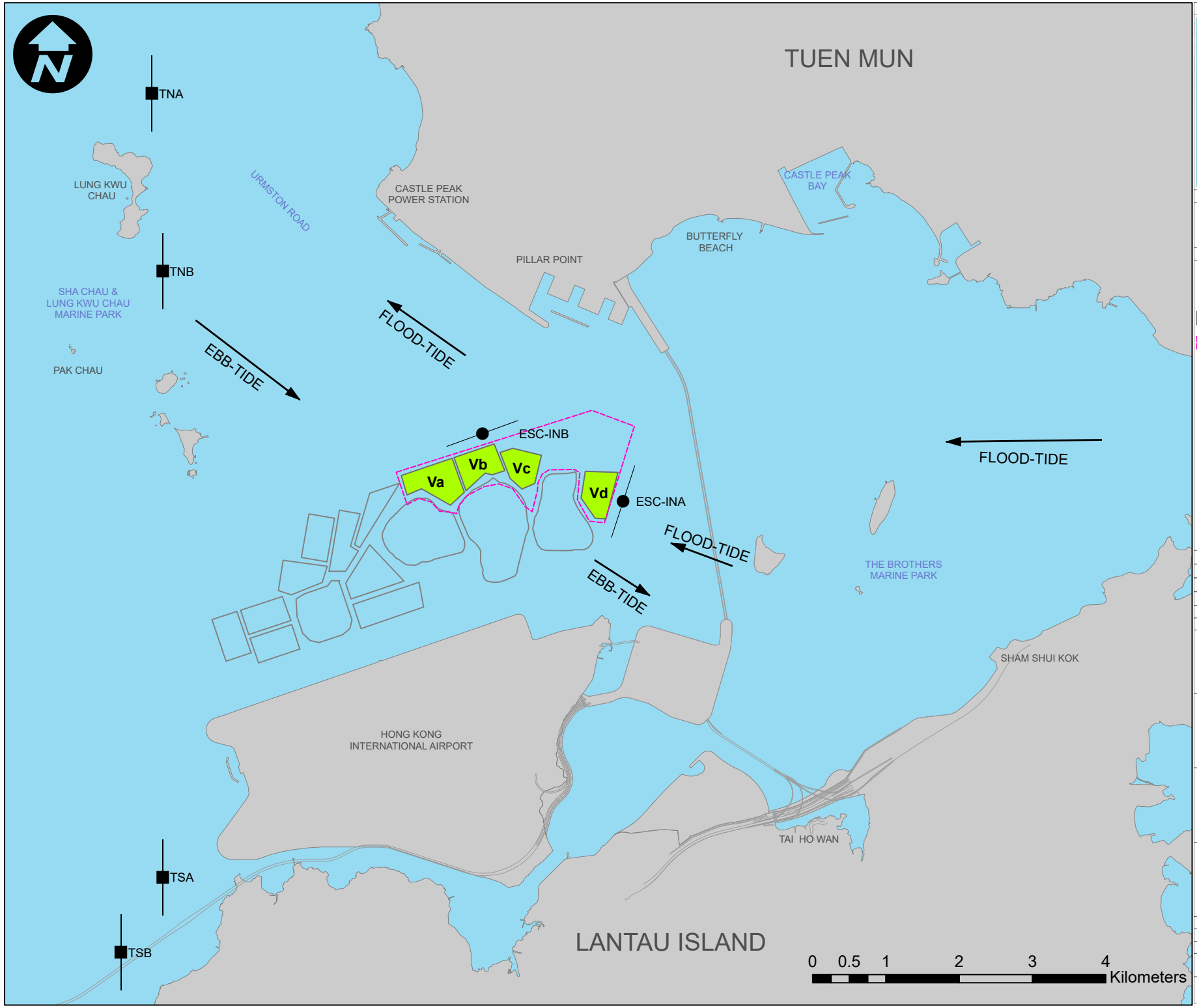
Title

SEDIMENT TOXICITY MONITORING STATIONS FOR ESC CMPS

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

Drawing Number

FIGURE 4.8



Key Plan:

Notes:

Key to symbols:

LEGEND

ESC CMP V

ESC USABLE AREA 1

DEMERSAL TRAWL SAMPLING STATIONS

IMPACT TRAWL STATION

REFERENCE TRAWL STATION

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

MOTT MACDONALD

3/F International Trade Tower
348 Kwun Tong Road
Kwun Tong, Kowloon
Hong Kong
T +852 2828 5757
F +852 2821823
W mottmac.com

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

MARINE BIOTA MONITORING STATIONS FOR ESC CMPS

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

Drawing Number

FIGURE 4.9

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	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
	ESC-NPAB	Monthly	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	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
Pit-Edge																																																																	
	ESC-NEAA	Monthly	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	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
	ESC-NEAB	Monthly	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	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
Near-Pit																																																																	
	ESC-NNAA	Monthly	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	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
	ESC-NNAB	Monthly	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	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
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		2				2		2				2		2				2		2				2		2				2		2				2		2				2		2	
	ESC-RNB1	4 times per year		6				6		6				6		6				6		2				2		2				2		2				2		2				2		2				2		2				2		2				2		2	
Mid-field Stations																																																																	
	ESC-RMA	4 times per year		6				6		6				6		6				6		2				2		2				2		2				2		2				2		2				2		2				2		2				2		2	
	ESC-RMB	4 times per year		6				6		6				6		6				6		2				2		2				2		2				2		2				2		2				2		2				2		2				2		2	
Capped Pit Stations																																																																	
	ESC-RCA1	4 times per year		6				6		6				6		6				6		2				2		2				2		2				2		2				2		2				2		2				2		2				2		2	
	ESC-RCB1	4 times per year		6				6		6				6		6				6		2				2		2				2		2				2		2				2		2				2		2				2		2				2		2	
Far-field Stations																																																																	
	ESC-RFA	4 times per year		6				6		6				6		6				6		2				2		2				2		2				2		2				2		2				2		2				2		2				2		2	
	ESC-RFB	4 times per year		6				6		6				6		6				6		2				2		2				2		2				2		2				2		2				2		2				2		2				2		2	
Ma Wan Station																																																																	
	MW1	4 times per year		6				6		6				6		6				6		2				2		2				2		2				2		2				2		2				2		2				2		2				2		2	
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		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
	ESC-IPE2A	Monthly*				4	4	4		4		4	4			4		4	4	4		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
	ESC-IPE3	Monthly*				4	4	4		4		4	4			4		4	4	4		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
	ESC-IPE4	Monthly*				4	4	4		4		4	4			4		4	4	4		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
	ESC-IPE5	Monthly*				4	4	4		4		4	4			4		4	4	4		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
Intermediate Station Downcurrent																																																																	
	ESC-INE1A	Monthly*				4	4	4		4		4	4			4		4	4	4		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
	ESC-INE2A	Monthly*				4	4	4		4		4	4			4		4	4	4		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
	ESC-INE3A	Monthly*				4	4	4		4		4	4			4		4	4	4		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
	ESC-INE4A	Monthly*				4	4	4		4		4	4			4		4	4	4		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
	ESC-INE5A	Monthly*				4	4	4		4		4	4			4		4	4	4		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
Reference Station Upcurrent																																																																	
	ESC-RFE1	Monthly*				4	4	4		4		4	4			4		4	4	4		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
	ESC-RFE2	Monthly*				4	4	4		4		4	4			4		4	4	4		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
	ESC-RFE3	Monthly*				4	4	4		4		4	4			4		4	4	4		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
	ESC-RFE4	Monthly*				4	4	4		4		4	4			4		4	4	4		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
	ESC-RFE5	Monthly*				4	4	4		4		4	4			4		4	4	4		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
Ma Wan Station																																																																	
	MW1	Monthly*				4	4	4		4		4	4			4		4	4	4		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
Flood Tide																																																																	
Impact Station Downcurrent																																																																	
	ESC-IPF1	Monthly*	4	4	4				4		4			4	4		4				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
	ESC-IPF2	Monthly*	4	4	4				4		4			4	4		4				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
	ESC-IPF3	Monthly*	4	4	4				4		4			4	4		4				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
Intermediate Station Downcurrent																																																																	
	ESC-INF1	Monthly*	4	4	4				4		4			4	4		4				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
	ESC-INF2	Monthly*	4	4	4				4		4			4	4		4				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
	ESC-INF3	Monthly*	4	4	4				4		4			4	4		4				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
Reference Station Upcurrent																																																																	
	ESC-RFF1A	Monthly*	4	4	4				4		4			4	4		4				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
	ESC-RFF2A	Monthly*	4	4	4				4		4			4	4		4				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
	ESC-RFF3	Monthly*	4	4	4				4		4			4	4		4				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
Ma Wan Station																																																																	
	MW1	Monthly*	4	4	4				4		4			4	4		4				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
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														2	2	2	2	2																																															
	US2	3 times per week														2	2	2	2	2																																															
Downstream Stations																																																																	
	DS1	3 times per week														2	2	2	2	2																																															
	DS2	3 times per week														2	2	2	2	2																																															
	DS3	3 times per week														2	2	2	2	2																																															
	DS4	3 times per week														2	2	2	2	2																																															
	DS5	3 times per week														2	2	2	2	2																																															
Ma Wan Station																																																																	
	MW1	3 times per week														2	2	2	2	2																																															

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 been conducted monthly starting in December 2020. A technical note presenting the data review results served as a supplementary information was submitted to EPD and presented that Phase 2 optimization of sample replication of water quality and sediment monitoring for the Project will be implemented in 2022 was provided to EPD in April 2022. Phase 2 optimization of sample replication has been effective for the EM&A activities since July 2022.

Due to the logistic problem induced by the pandemic which adversely affecting the supply of international species adopted in testing programme of Sediment Toxicity Tests, as such, Sediment Toxicity Tests of ESC CMPs originally scheduled in February 2022 were postponed to March 2022.

^ To enable the required Research Fishing Permit could be granted by the time undertaking the Demersal Trawling, trawling originally scheduled in July and August 2022 will be tentatively postponed to August and September 2022.

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 Jul 2022	0	765,975
2 Jul 2022	0	765,975
3 Jul 2022	0	765,975
4 Jul 2022	0	765,975
5 Jul 2022	1,033	767,008
6 Jul 2022	1,086	768,094
7 Jul 2022	1,054	769,148
8 Jul 2022	995	770,143
9 Jul 2022	979	771,122
10 Jul 2022	0	771,122
11 Jul 2022	666	771,788
12 Jul 2022	682	772,470
13 Jul 2022	376	772,846
14 Jul 2022	0	772,846
15 Jul 2022	551	773,397
16 Jul 2022	0	773,397
17 Jul 2022	0	773,397
18 Jul 2022	619	774,016
19 Jul 2022	629	774,645
20 Jul 2022	295	774,940
21 Jul 2022	0	774,940
22 Jul 2022	467	775,407
23 Jul 2022	0	775,407
24 Jul 2022	0	775,407
25 Jul 2022	506	775,913
26 Jul 2022	0	775,913
27 Jul 2022	0	775,913
28 Jul 2022	0	775,913
29 Jul 2022	0	775,913
30 Jul 2022	0	775,913
31 Jul 2022	0	775,913
1 Aug 2022	595	776,508
2 Aug 2022	0	776,508
3 Aug 2022	0	776,508
4 Aug 2022	0	776,508
5 Aug 2022	626	777,134
6 Aug 2022	627	777,761
7 Aug 2022	0	777,761
8 Aug 2022	630	778,391
9 Aug 2022	0	778,391
10 Aug 2022	519	778,910
11 Aug 2022	0	778,910
12 Aug 2022	601	779,511
13 Aug 2022	0	779,511
14 Aug 2022	0	779,511
15 Aug 2022	601	780,112
16 Aug 2022	622	780,734
17 Aug 2022	614	781,348
18 Aug 2022	0	781,348

Date	Daily Disposal Volume (m^3)	Accumulative Disposal Volume (m^3)
19 Aug 2022	0	781,348
20 Aug 2022	552	781,900
21 Aug 2022	0	781,900
22 Aug 2022	600	782,500
23 Aug 2022	600	783,100
24 Aug 2022	0	783,100
25 Aug 2022	0	783,100
26 Aug 2022	475	783,575
27 Aug 2022	599	784,174
28 Aug 2022	0	784,174
29 Aug 2022	522	784,696
30 Aug 2022	633	785,329
31 Aug 2022	306	785,635
1 Sep 2022	0	785,635
2 Sep 2022	676	786,311
3 Sep 2022	580	786,891
4 Sep 2022	0	786,891
5 Sep 2022	1,003	787,894
6 Sep 2022	460	788,354
7 Sep 2022	467	788,821
8 Sep 2022	0	788,821
9 Sep 2022	0	788,821
10 Sep 2022	0	788,821
11 Sep 2022	0	788,821
12 Sep 2022	0	788,821
13 Sep 2022	0	788,821
14 Sep 2022	467	789,288
15 Sep 2022	465	789,753
16 Sep 2022	462	790,215
17 Sep 2022	960	791,175
18 Sep 2022	0	791,175
19 Sep 2022	0	791,175
20 Sep 2022	1,086	792,261
21 Sep 2022	192	792,453
22 Sep 2022	207	792,660
23 Sep 2022	0	792,660
24 Sep 2022	343	793,003
25 Sep 2022	0	793,003
26 Sep 2022	456	793,459
27 Sep 2022	0	793,459
28 Sep 2022	359	793,818
29 Sep 2022	579	794,397
30 Sep 2022	0	794,397

B2. Capping Record at ESC CMP Vd

Date	Daily Disposal Volume (m^3)	Accumulative Disposal Volume (m^3)
1 Jul 2022	0	285,080
2 Jul 2022	0	285,080
3 Jul 2022	0	285,080
4 Jul 2022	0	285,080
5 Jul 2022	0	285,080
6 Jul 2022	0	285,080
7 Jul 2022	0	285,080
8 Jul 2022	0	285,080
9 Jul 2022	0	285,080
10 Jul 2022	0	285,080
11 Jul 2022	0	285,080
12 Jul 2022	0	285,080
13 Jul 2022	0	285,080
14 Jul 2022	0	285,080
15 Jul 2022	0	285,080
16 Jul 2022	0	285,080
17 Jul 2022	0	285,080
18 Jul 2022	0	285,080
19 Jul 2022	0	285,080
20 Jul 2022	0	285,080
21 Jul 2022	0	285,080
22 Jul 2022	0	285,080
23 Jul 2022	0	285,080
24 Jul 2022	0	285,080
25 Jul 2022	0	285,080
26 Jul 2022	0	285,080
27 Jul 2022	0	285,080
28 Jul 2022	0	285,080
29 Jul 2022	0	285,080
30 Jul 2022	0	285,080
31 Jul 2022	0	285,080
1 Aug 2022	0	285,080
2 Aug 2022	0	285,080
3 Aug 2022	0	285,080
4 Aug 2022	0	285,080
5 Aug 2022	0	285,080
6 Aug 2022	0	285,080
7 Aug 2022	0	285,080
8 Aug 2022	0	285,080
9 Aug 2022	0	285,080
10 Aug 2022	0	285,080
11 Aug 2022	0	285,080
12 Aug 2022	0	285,080
13 Aug 2022	0	285,080
14 Aug 2022	0	285,080
15 Aug 2022	0	285,080
16 Aug 2022	0	285,080
17 Aug 2022	0	285,080
18 Aug 2022	0	285,080

Date	Daily Disposal Volume (m^3)	Accumulative Disposal Volume (m^3)
19 Aug 2022	0	285,080
20 Aug 2022	0	285,080
21 Aug 2022	0	285,080
22 Aug 2022	0	285,080
23 Aug 2022	0	285,080
24 Aug 2022	0	285,080
25 Aug 2022	0	285,080
26 Aug 2022	0	285,080
27 Aug 2022	0	285,080
28 Aug 2022	0	285,080
29 Aug 2022	0	285,080
30 Aug 2022	0	285,080
31 Aug 2022	0	285,080
1 Sep 2022	0	285,080
2 Sep 2022	0	285,080
3 Sep 2022	0	285,080
4 Sep 2022	0	285,080
5 Sep 2022	0	285,080
6 Sep 2022	0	285,080
7 Sep 2022	0	285,080
8 Sep 2022	0	285,080
9 Sep 2022	0	285,080
10 Sep 2022	0	285,080
11 Sep 2022	0	285,080
12 Sep 2022	0	285,080
13 Sep 2022	0	285,080
14 Sep 2022	0	285,080
15 Sep 2022	0	285,080
16 Sep 2022	0	285,080
17 Sep 2022	0	285,080
18 Sep 2022	0	285,080
19 Sep 2022	0	285,080
20 Sep 2022	0	285,080
21 Sep 2022	0	285,080
22 Sep 2022	0	285,080
23 Sep 2022	0	285,080
24 Sep 2022	0	285,080
25 Sep 2022	0	285,080
26 Sep 2022	0	285,080
27 Sep 2022	0	285,080
28 Sep 2022	0	285,080
29 Sep 2022	0	285,080
30 Sep 2022	0	285,080

Appendix C. Statistical Analysis

Routine Water Quality Monitoring for ESC CMPs – Statistical Analysis up to September 2022

Dissolved Oxygen

Ebb Tide

Source	Type II Sum of Square	Df	F value	Significance Level
Period	93.69	35	227.46	**
Area	0.74	3	21.01	**
Period:Area	7.55	105	6.11	**
Residuals	49.01	4164		

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

SNK Results:
- Overall result[1]:
  $\text{Impact} > \text{Intermediate} > \text{Reference} > \text{Ma Wan}\}$ ∴ no overall significant project related impact.
- No potential project related spatial trend (i.e. Impact < Intermediate < Reference) were detected for all months over the study period.

Flood Tide

Source	Type II Sum of Square	Df	F value	Significance Level
Period	5705.32	36	1119.74	**
Area	64.96	3	152.98	**
Period:Area	55.90	108	3.66	**
Residuals	387.52	2738		

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

SNK Results:
- Overall result:
  $\left.\begin{matrix}\text{Reference} = \text{Intermediate} \\ \text{Reference, Intermediate} > \text{Impact} > \text{Ma Wan}\end{matrix}\right\}$ ∴ 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.

[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	1911.94	35	270.50	**
Area	139.19	3	229.75	**
Period:Area	231.80	105	10.93	**
Residuals	840.91	4164		

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
- 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	88206.26	36	123.96	**
Area	2499.08	3	42.14	**
Period:Area	12073.35	108	5.66	**
Residuals	54121.05	2738		

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

SNK Results:
- Overall result:
  $\left.\begin{array}{l}\text{Reference} = \text{Impact} = \text{Intermediate} \\ \text{Reference, Impact, Intermediate} > \text{Ma Wan}\end{array}\right\}$ ∴ 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.

Arsenic

Flood Tide

Source	Type II Sum of Square	Df	F value	Significance Level
Period	0.185	1	27.742	**
Area	0.068	3	3.402	**
Period:Area	0.013	3	0.635	N.S.
Residuals	0.214	32		

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

SNK Results:
- Overall result:

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

- No potential project related spatial trend (i.e. Impact > Intermediate > Reference) were detected for all months since July 2022.

Cadmium

Flood Tide

Source	Type II Sum of Square	Df	F value	Significance Level
Period	0.116	1	0.416	N.S.
Area	0.823	3	0.988	N.S.
Period:Area	0.211	3	0.254	N.S.
Residuals	8.880	32		

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

Chromium

Flood Tide

Source	Type II Sum of Square	Df	F value	Significance Level
Period	0.772	1	12.298	**
Area	0.358	3	1.900	N.S.
Period:Area	0.121	3	0.645	N.S.
Residuals	2.008	32		

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

SNK Results:
- Overall result:

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

- No potential project related spatial trend (i.e. Impact > Intermediate > Reference) were detected for all months since July 2022.

Copper

Flood Tide

Source	Type II Sum of Square	Df	F value	Significance Level
Period	0.00007	1	0.00096	N.S.
Area	1.25033	3	5.73212	**
Period:Area	0.58585	3	2.68580	N.S.
Residuals	2.32669	32		

Note:

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

SNK Results:

- Overall result:
  Intermediate = Impact = Reference = Ma Wan} ∴ no overall significant project related impact.
- No potential project related spatial trend (i.e. Impact > Intermediate > Reference) were detected for all months since July 2022.

Mercury

Flood Tide

Source	Type II Sum of Square	Df	F value	Significance Level
Period	8.36 $x10^{-06}$	1	33.650	**
Area	6.04 $x10^{-08}$	3	0.081	N.S.
Period:Area	9.17 $x10^{-08}$	3	0.123	N.S.
Residuals	7.95 $x10^{-06}$	32		

Note:

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

SNK Results:

- Overall result:
  Reference = Impact = Intermediate = Ma Wan} ∴ no overall significant project related impact.
- No potential project related spatial trend (i.e. Impact > Intermediate > Reference) were detected for all months since July 2022.

Nickel

Flood Tide

Source	Type II Sum of Square	Df	F value	Significance Level
Period	0.0002	1	0.0096	N.S.
Area	0.3874	3	5.9385	**
Period:Area	0.0030	3	0.0457	N.S.
Residuals	0.6959	32		

Note:

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

SNK Results:

- Overall result:
  $\text{Intermediate} = \text{Impact} = \text{Reference} = \text{Ma Wan}\}$ ∴ no overall significant project related impact.
- No potential project related spatial trend (i.e. Impact > Intermediate > Reference) were detected for all months since July 2022.

Zinc

Flood Tide

Source	Type II Sum of Square	Df	F value	Significance Level
Period	0.013	1	0.030	N.S.
Area	5.257	3	4.010	**
Period:Area	0.054	3	0.041	N.S.
Residuals	13.982	32		

Note:

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

SNK Results:

- Overall result:
  $$\left.\begin{array}{c}\text{Ma Wan} = \text{Reference} \\ \text{Reference} = \text{Impact} = \text{Intermediate} \\ \text{Ma Wan} > \text{Impact, Intermediate}\end{array}\right\}$$ ∴ no overall significant project related impact.
- No potential project related spatial trend (i.e. Impact > Intermediate > Reference) were detected for all months since July 2022.

Ammonia Nitrogen

Ebb Tide

Source	Type II Sum of Square	Df	F value	Significance Level
Period	923.77	35	330.37	**
Area	16.57	3	69.13	**
Period:Area	92.21	105	10.99	**
Residuals	297.83	3728		

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	838.61	36	124.09	**
Area	6.29	3	11.17	**
Period:Area	61.76	108	3.05	**
Residuals	452.81	2412		

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	451.46	35	423.32	**
Area	22.39	3	244.95	**
Period:Area	38.14	105	11.92	**
Residuals	113.60	3728		

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

SNK Results:
- Overall result:

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

- 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	645.21	36	341.57	**
Area	11.92	3	75.71	**
Period:Area	40.86	108	7.21	**
Residuals	126.56	2412		

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

SNK Results:
- Overall result:

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

- 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	495.83	35	105.48	**
Area	14.92	3	37.03	**
Period:Area	189.68	105	13.45	**
Residuals	500.67	3728		

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	579.58	36	163.62	**
Area	23.59	3	79.90	**
Period:Area	147.98	108	13.92	**
Residuals	237.34	2412		

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

SNK Results:
- Overall result:

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

- 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	857.15	35	267.07	**
Area	42.88	3	155.88	**
Period:Area	131.33	105	13.64	**
Residuals	341.85	3728		

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

SNK Results:
- Overall result:
  $\text{Impact} > \text{Intermediate} > \text{Reference} > \text{Ma Wan}\ \}\ \therefore$ 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	633.35	36	179.17	**
Area	14.59	3	49.53	**
Period:Area	120.60	108	11.37	**
Residuals	236.84	2412		

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

SNK Results:
- Overall result:
  $\left.\begin{array}{l}\text{Intermediate} = \text{Impact} \\ \text{Reference} > \text{Intermediate, Impact} > \text{Ma Wa}\end{array}\right\}\ \therefore$ 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 September 2022

Arsenic

Source	Type II Sum of Square	Df	F value	Significance Level
Period	79.32	31	152.04	**
Area	8.67	2	257.47	**
Direction	6.67	1	396.32	**
Period:Area	16.21	62	15.54	**
Period:Direction	5.12	31	9.82	**
Area:Direction	6.75	2	200.61	**
Period:Area:Direction	15.61	62	14.96	**
Residuals	21.00	1248		

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, Jul 2021, Mar 2022, Apr 2022[3], Jun 2022, Jul 2022, Aug 2022
- Potential project related spatial trend was detected in consecutive two months for ebb tide direction over the reporting period.

Regression Analysis Results:

Period	R Square	Adjusted R Square	Y-intercept	Slope	Significance Level
Jun-22	0.17	0.12	13.94	-0.47	N.S.
Jul-22	0.89	0.86	14.31	-0.77	**
Aug-22	0.79	0.74	13.18	-0.71	**

Note: Linear regression analysis on spatial changes of contaminant concentrations in ebb tide direction for the three consecutive months with significant spatial trend.

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

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

Cadmium

Source	Type II Sum of Square	Df	F value	Significance Level
Period	77.05	31	22.86	**
Area	99.22	2	456.37	**
Direction	0.65	1	5.94	**
Period:Area	46.22	62	6.86	**
Period:Direction	25.72	31	7.63	**
Area:Direction	35.00	2	160.96	**
Period:Area:Direction	35.95	62	5.33	**
Residuals	135.67	1248		

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.

Chromium

Source	Type II Sum of Square	Df	F value	Significance Level
Period	15.93	31	34.79	**
Area	21.56	2	729.78	**
Direction	5.54	1	375.30	**
Period:Area	7.14	62	7.79	**
Period:Direction	3.41	31	7.44	**
Area:Direction	14.65	2	495.78	**
Period:Area:Direction	5.85	62	6.39	**
Residuals	18.43	1248		

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, Apr 2022, May 2022, July 2022
  - Ebb Tide: Apr 2020, Oct 2020, Nov 2020, May 2021, Oct 2021, Jan 2022, Feb 2022, Sep 2022
- Potential project related spatial trend was detected in one month for flood tide direction and one month in ebb tide direction over the reporting period.

Copper

Source	Type II Sum of Square	Df	F value	Significance Level
Period	32.29	31	29.24	**
Area	179.30	2	2516.25	**
Direction	16.60	1	465.91	**
Period:Area	25.85	62	11.70	**
Period:Direction	15.14	31	13.71	**
Area:Direction	46.74	2	655.90	**
Period:Area:Direction	31.84	62	14.42	**
Residuals	44.46	1248		

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, Jan 2022, Feb 2022
- No potential project related spatial trend were detected for the reporting months.

Lead

Source	Type II Sum of Square	Df	F value	Significance Level
Period	14.90	31	14.04	**
Area	28.34	2	413.80	**
Direction	7.19	1	209.92	**
Period:Area	11.47	62	5.40	**
Period:Direction	4.46	31	4.20	**
Area:Direction	7.05	2	102.85	**
Period:Area:Direction	4.71	62	2.22	**
Residuals	42.74	1248		

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, Jan 2022, Feb 2022, Mar 2022, Jul 2022
  - Ebb Tide: May 2020, Jul 2020, Mar 2021, May 2021, Jun 2021, Sep 2021, Oct 2021, Jan 2022, Feb 2022, Jun 2022, Jul 2022, Sep 2022
- Potential project related spatial trend was detected for one month in ebb tide direction and two months in flood tide direction over the reporting period.

Regression Analysis Results:

Period	R Square	Adjusted R Square	Y-intercept	Slope	Significance Level
Jun-22	0.33	0.29	33.46	-1.88	**
Jul-22	0.88	0.85	39.09	-2.25	**

Note: Linear regression analysis on spatial changes of contaminant concentrations in ebb tide direction for the two consecutive months with significant spatial trend.

Mercury

Source	Type II Sum of Square	Df	F value	Significance Level
Period	133.70	31	19.32	**
Area	111.47	2	249.73	**
Direction	67.49	1	302.41	**
Period:Area	67.38	62	4.87	**
Period:Direction	35.75	31	5.17	**
Area:Direction	92.24	2	206.65	**
Period:Area:Direction	32.67	62	2.36	**
Residuals	278.53	1248		

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	15.87	31	52.28	**
Area	22.11	2	1129.27	**
Direction	11.89	1	1213.94	**
Period:Area	8.26	62	13.60	**
Period:Direction	5.06	31	16.67	**
Area:Direction	18.47	2	943.18	**
Period:Area:Direction	6.96	62	11.46	**
Residuals	12.22	1248		

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, Apr 2022, May 2022, Jul 2022
  - Ebb Tide: Jun 2020, Jul 2020, Oct 2020, Jul 2021, Oct 2021, Jan 2022, Feb 2022, Sep 2022
- Potential project related spatial trend was detected in one month for flood tide direction and one month for ebb tide direction over the reporting period.

Silver

Source	Type II Sum of Square	Df	F value	Significance Level
Period	185.34	31	66.66	**
Area	310.97	2	1733.69	**
Direction	3.81	1	42.49	**
Period:Area	65.94	62	11.86	**
Period:Direction	33.72	31	12.13	**
Area:Direction	35.52	2	198.01	**
Period:Area:Direction	50.63	62	9.11	**
Residuals	111.93	1248		

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	15.98	31	44.65	**
Area	48.52	2	2101.78	**
Direction	3.18	1	275.19	**
Period:Area	13.03	62	18.21	**
Period:Direction	6.30	31	17.60	**
Area:Direction	7.95	2	344.55	**
Period:Area:Direction	7.27	62	10.16	**
Residuals	14.40	1248		

Note:

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

SNK Results:

- Overall result:

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

- Months showing potential project related spatial trend (i.e. Active Pit > Pit Edge > Near Pit): Direction
  - Flood Tide: Jun 2020, Jul 2020, Oct 2020, Nov 2020, Apr 2021, May 2021, Feb 2022
  - Ebb Tide: Apr 2020, Jun 2020, Jul 2020, Oct 2020, Mar 2021, May 2021, Jun 2021, Sep 2021, Feb 2022, Jun 2022, Jul 2022
- Potential project related spatial trend was detected for one month in ebb tide direction over the reporting period.

Regression Analysis Results:

Period	R Square	Adjusted R Square	Y-intercept	Slope	Significance Level
Jun-22	0.56	0.54	88.13	-6.07	**
Jul-22	0.73	0.66	89.69	-6.53	**

Note: Linear regression analysis on spatial changes of contaminant concentrations in ebb tide direction for the two consecutive months with significant spatial trend.

Total Organic Carbon

Source	Type II Sum of Square	Df	F value	Significance Level
Period	111.98	31	180.29	**
Area	67.58	2	1686.51	**
Direction	7.89	1	393.73	**
Period:Area	41.17	62	33.14	**
Period:Direction	14.23	31	22.90	**
Area:Direction	10.16	2	253.53	**
Period:Area:Direction	27.81	62	22.39	**
Residuals	25.01	1248		

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, Feb 2022, Mar 2022, Jul 2022, Aug 2022
  - Ebb Tide: Jul 2020, Oct 2020, May 2021, Jun 2021, Oct 2021, Jul 2022
- Potential project related spatial trend was detected for consecutive two months in flood tide direction and one month in ebb tide direction over the reporting period.

Regression Analysis Results:

Period	R Square	Adjusted R Square	Y-intercept	Slope	Significance Level
Jul-22	0.79	0.74	8641.67	-510.00	**
Aug-22	0.42	0.28	5866.67	-200.00	N.S.

Note: Linear regression analysis on spatial changes of contaminant concentrations in flood tide direction for the two consecutive months with significant spatial trend.

Cumulative Sediment Chemistry for ESC CMPs – Statistical Analysis up to September 2022

Arsenic

Source	Type II Sum of Square	Df	F value	Significance Level
Period	69.53	25	142.26	**
Area	98.48	4	1259.45	**
Period:Area	66.20	100	33.87	**
Residuals	43.20	2210		

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	70.78	25	24.37	**
Area	64.10	4	137.95	**
Period:Area	50.43	100	4.34	**
Residuals	256.73	2210		

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	5178.90	25	23.29	**
Area	75306.56	4	2116.51	**
Period:Area	17124.65	100	19.25	**
Residuals	19658.25	2210		

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	12375.47	25	16.50	**
Area	260565.37	4	2171.03	**
Period:Area	26913.79	100	8.97	**
Residuals	66310.53	2210		

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	31325.60	25	91.15	**
Area	73624.87	4	1338.95	**
Period:Area	19498.54	100	14.18	**
Residuals	30380.29	2210		

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	418.48	25	37.22	**
Area	54.20	4	30.13	**
Period:Area	217.52	100	4.84	**
Residuals	993.85	2210		

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	2266.91	25	21.26	**
Area	27613.24	4	1618.92	**
Period:Area	8960.15	100	21.01	**
Residuals	9423.77	2210		

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	174.06	25	42.99	**
Area	795.06	4	1227.25	**
Period:Area	84.47	100	5.22	**
Residuals	357.93	2210		

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	17.06	25	29.61	**
Area	142.85	4	1549.82	**
Period:Area	48.29	100	20.95	**
Residuals	50.93	2210		

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	1979158662	25	53.01	**
Area	3639331082	4	609.24	**
Period:Area	3815280621	100	25.55	**
Residuals	3300398796	2210		

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 6 July 2022)

Arsenic

Source	Type II Sum of Square	Df	F value	Significance Level
Area	31.07	4	1.19	N.S.
Residuals	85.05	13		

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

Cadmium

Source	Type II Sum of Square	Df	F value	Significance Level
Area	0.010	4	2.56	N.S.
Residuals	0.013	13		

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

Chromium

Source	Type II Sum of Square	Df	F value	Significance Level
Area	490.91	4	4.13	**
Residuals	386.29	13		

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

SNK Results:

- $\begin{cases} \text{Ma Wan} = \text{Mid-Field} = \text{Capped-pit} = \text{Near-Field} \\ \text{Mid-Field} = \text{Capped-pit} = \text{Near-Field} = \text{Far-Field} \\ \text{Ma Wan} > \text{Far-Field} \end{cases}$

Copper

Source	Type II Sum of Square	Df	F value	Significance Level
Area	926.35	4	5.27	**
Residuals	570.79	13		

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

Lead

Source	Type II Sum of Square	Df	F value	Significance Level
Area	428.13	4	2.00	N.S.
Residuals	697.03	13		

Note:

1. Assume Gaussian 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	0.004	4	1.10	N.S.
Residuals	0.012	13		

Note:

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

Nickel

Source	Type II Sum of Square	Df	F value	Significance Level
Area	207.53	4	4.31	**
Residuals	156.56	13		

Note:

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

SNK Results:

- $\begin{cases} \text{Ma Wan} = \text{Mid-Field} = \text{Capped-pit} = \text{Near-Field} \\ \text{Mid-Field} = \text{Capped-pit} = \text{Near-Field} = \text{Far-Field} \\ \text{Ma Wan} > \text{Far-Field} \end{cases}$

Silver

Source	Type II Sum of Square	Df	F value	Significance Level
Area	0.55	4	68.90	**
Residuals	0.03	13		

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

Zinc

Source	Type II Sum of Square	Df	F value	Significance Level
Area	3329.99	4	3.88	**
Residuals	2792.22	13		

Note:

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

SNK Results:

- $\begin{cases} \text{Ma Wan} = \text{Capped-pit} = \text{Mid-Field} = \text{Near-Field} \\ \text{Capped-pit} = \text{Mid-Field} = \text{Near-Field} = \text{Far-Field} \\ \text{Ma Wan} > \text{Far-Field} \end{cases}$

Sediment Chemistry of ESC CMPs after a Major Storm Event (on 29 August 2022)

Arsenic

Source	Type II Sum of Square	Df	F value	Significance Level
Area	39.74	4	1.44	N.S.
Residuals	89.39	13		

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

Cadmium

Source	Type II Sum of Square	Df	F value	Significance Level
Area	0.00061	4	0.67	N.S.
Residuals	0.00295	13		

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

Chromium

Source	Type II Sum of Square	Df	F value	Significance Level
Area	313.88	4	3.93	**
Residuals	259.29	13		

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

SNK Results:

- $\begin{cases} \text{Ma Wan} = \text{Far-Field} = \text{Mid-Field} = \text{Near-Field} \\ \text{Mid-Field} = \text{Near-Field} = \text{Capped-pit} \\ \text{Ma Wan, Far-Field} > \text{Capped-pit} \end{cases}$

Copper

Source	Type II Sum of Square	Df	F value	Significance Level
Area	902.08	4	6.73	**
Residuals	435.90	13		

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

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

Lead

Source	Type II Sum of Square	Df	F value	Significance Level
Area	468.65	4	2.74	N.S.
Residuals	556.65	13		

Note:

1. Assume Gaussian 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	0.0042	4	1.80	N.S.
Residuals	0.0076	13		

Note:

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

Nickel

Source	Type II Sum of Square	Df	F value	Significance Level
Area	126.99	4	3.60	**
Residuals	114.50	13		

Note:

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

SNK Results:

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

Silver

Source	Type II Sum of Square	Df	F value	Significance Level
Area	1.48	4	184.41	**
Residuals	0.03	13		

Note:

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

SNK Results:

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

Zinc

Source	Type II Sum of Square	Df	F value	Significance Level
Area	1850.85	4	2.03	N.S.
Residuals	2962.08	13		

Note:

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

Sediment Toxicity for ESC CMPs – August 2022

Survival rate for burrowing amphipod *Leptochirus plumulosus*

Source	Type II Sum of Square	Df	F value	Significance Level
Area	0.0025	2	2.3872	N.S.
Residuals	0.0116	22		

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

Growth rate for benthic polychaete *Neanthes arenaceodentata*

Source	Type II Sum of Square	Df	F value	Significance Level
Area	0.0003	2	0.6623	N.S.
Residuals	0.0057	22		

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

Survival rate for marine bivalve *Crassostrea gigas*

Source	Type II Sum of Square	Df	F value	Significance Level
Area	0.0006	2	0.9165	N.S.
Residuals	0.0072	22		

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

Mortality rate for barnacles *Balanus Amphitrite*

Source	Df	F value	Significance Level
Area	2	0.0530	N.S.
Residuals	21		

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

Mortality rate for shrimp *Penaeus vannaamei*

Source	Df	F value	Significance Level
Area	2	0.0228	N.S.
Residuals	21		

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