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

Annual EM&A Report for
Contaminated Mud Pits to the East of Sha Chau
– January to December 2023 (Rev. A)

September 2024

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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:	Annual EM&A Report for Contaminated Mud Pits to the East of Sha Chau – January to December 2023
Date of Report:	20 September 2024
Date prepared by ET:	20 September 2024
Date received by IA:	20 September 2024

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): [signature]

Date: 20 September 2024

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): [signature]

Date: 20 September 2024

Issue and Revision Record

Revision	Date	Originator	Checker	Approver	Description
A	Sep 2024	Various	Thomas Chan	Eric Ching	Revision A of Submission

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Contents

Appendices

Executive Summary

During the environmental monitoring from January to December 2023 ("the reporting period"), null hypotheses for each monitoring components of dredging and disposal operations have not been rejected. This demonstrated that the dredging and disposal operations at the contaminated mud pits (CMPs) to the East of Sha Chau (ESC) is not adversely affecting the marine environment in the vicinity of the pits or in the ESC area as a whole.

Disposal Operations

Sediment Quality Monitoring

The majority of contaminants' concentrations recorded in sediments outside of ESC CMPs were below levels of concern as defined by the Lower Chemical Exceedance Level (LCEL) and Upper Chemical Exceedance Level (UCEL) throughout the reporting period. Statistical analysis for most contaminants' concentrations did not reveal any spatial or temporal trends, or significant increasing in contaminant concentration with proximity to the mud pit or over time. Therefore, there did not appear to be any evidence of unacceptable impacts to sediment quality due to the mud disposal operations at ESC CMPs.

Sediment Toxicity Monitoring

There were no significant differences in sediment toxicity between Impact and Reference stations for consecutive monitoring period for most of the toxicity tests using different marine benthos in March and August 2023. Therefore, there did not appear to be any evidence of unacceptable impacts to sediment toxicity due to the mud disposal operations at ESC CMPs.

Routine Water Quality Monitoring

Significant spatio-temporal variations were observed in metal and inorganic contaminants' concentrations and *in situ* parameters of ESC CMPs, but there were no clear, consistent trends indicating any significant increase in contaminant concentrations with proximity to the pit or with time. Therefore, there did not appear to be any unacceptable water quality impacts caused by the disposal operations at ESC CMP Vb.

Biomonitoring for Contaminants

During the reporting period from January to December 2023, all concentrations measured in tissue and whole body samples remained below the relevant Maximum Permitted Concentrations (MPCs) during the reporting period. Therefore, there did not appear to be any unacceptable ecological impacts caused by the disposal operations at ESC CMPs.

Sediment Chemistry after a Major Storm for ESC CMPs

Samplings for Sediment Chemistry after a Major Storm Event were conducted for ESC CMPs on three (3) days during the reporting period, including: on 23 July 2023 after the visit of tropical cyclone Talim on 15 July 2023, which led to the issue of No. 8 Gale or Storm Signal on 17 July 2023; on 5 September 2023 after the visit of Super Typhoon Saola on 30 August 2023, which led to the issue of No. 8 Gale or Storm Signal on 1 September 2023; and on 11 October 2023 after the visit of Severe Typhoon Koinu on 4 October 2024, which led to the issue of No. 8 Storm Signal on 9 October 2023. Monitoring results showed that the concentrations of most inorganic contaminants were below the LCELs at most monitoring stations in July 2023, September 2023 and October 2023. 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 events in July, September and October 2023.

Conclusions

The conclusion of the Annual EM&A Report for January to December 2023 is that the monitoring programme has successfully met the objectives of the Study. The statistically robust monitoring programme has demonstrated that unacceptable environmental impacts have not occurred as a result of the disposal operations at ESC CMPs during the reporting period. This finding is consistent with previous years of monitoring at ESC CMP areas.

行政摘要

2023 年 1 月至 12 月間的環境監察結果顯示，每一監察項目的虛假設均被接納，表示沙洲以東污泥坑的挖掘活動和卸泥運作過程整體上沒有對污泥坑或沙洲以東附近的海域造成不良的影響。

卸泥運作

沉積物監察

在監察期內，污泥坑外圍的沉積物中大部份的污染物含量均錄得低於化學物質低量值(LCEL) 和化學物質高量值 (UCEL)的水平。從統計結果顯示，沉積物中大部份的污染物濃度沒有因越接近泥坑而顯著增加，大部份的污染物濃度亦沒有隨著時間而持續地顯著增加。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。

沉積物毒性測試

在 2023 年 3 月及 8 月，大部份受影響監測站及參考監測站的沉積物毒性測試結果均沒有在連續監測活動中呈現顯著的分別。因此，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。

例行水質監察

在沙洲以東污泥坑量度的金屬、無機污染物及其他即時量度的水質參數跟隨著時間及空間有顯著的分別，但從統計結果顯示，污染物濃度沒有因越接近污泥坑而趨向增加，亦沒有隨著時間而增加。因此，沒有証據顯示在沙洲以東污泥坑 Vb 的卸泥運作引起任何不可接受的水質影響。

生物污染物監察

在監察期內，所有動物組織樣本及全體樣本均錄得低於香港食物攙雜(金屬雜質含量)規例訂定的最高准許濃度的含量。因此，沒有証據顯示在沙洲以東污泥坑的卸泥運作引起任何不可接受的生態影響。

強颱風後的沙洲以東污泥坑沉積物質素

颱風泰利於 2023 年 7 月 15 日吹襲香港，並在 2023 年 7 月 17 日發出 8 號烈風或暴風信號；超強颱風蘇拉於 2023 年 8 月 30 日吹襲香港，並在 2023 年 9 月 1 日發出 8 號烈風或暴風信號；而強颱風小犬於 2023 年 10 月 4 日吹襲香港，並在 2023 年 10 月 9 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 2023 年 7 月 23 日，9 月 5 日及 10 月 11 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。監察結果顯示大部份的無機污染物含量在大部份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 2023 年 7，9 及 10 月的熱帶風暴導致污泥從泥坑擴散或引起沉積物污染。

總結

年度環境監察及審核報告(2023 年 1 月至 12 月)總結出監察項目能夠成功達到研究的目的。監察項目全面的統計結果展示出於報告期內沙洲以東污泥坑卸泥活動並未有造成不可接受的環境影響。這些結果與過去的污泥坑年度監察結果一致。

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 Permit (EP) (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. Details please refer to **Section 3**.

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 Objectives of the EM&A Programme

The objectives of the EM&A programme for ESC CMPs 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;

[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.

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.

1.3 Overview of Activities Conducted during the Reporting Period

During the reporting period of January to December 2023 (hereafter referred to as “the reporting period’), the following activities were carried out and monitoring as part of the EM&A Programme at the CMPs:

- Disposal of contaminated mud at ESC CMP Vb commenced on 15 January 2020 after the completion of CMP Vd disposal operation. Approximately 202,844 m^3 of contaminated mud was disposed into CMP Vb during the reporting period (**Chart 1.1**); and
- Capping operations at ESC CMP Vd commenced on 16 January 2020. Approximately 345,940 m^3 of uncontaminated mud was disposed into CMP Vd during the reporting period (**Chart 1.2**).

Chart 1.1: Cumulative Dredging Volume (m^3) of Contaminated Mud at ESC CMP Vb (from January to December 2023)

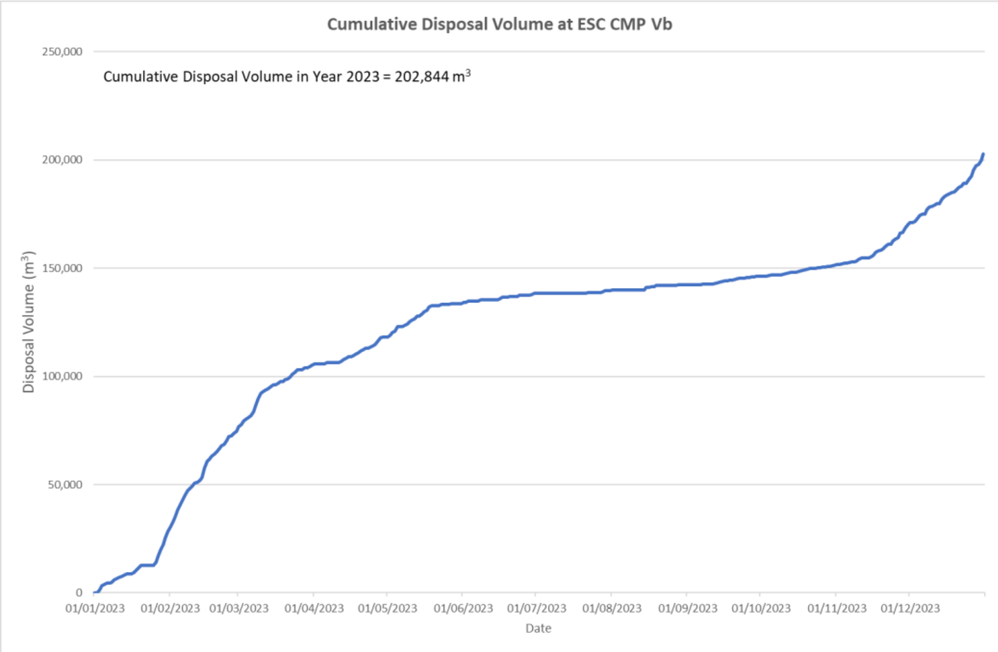
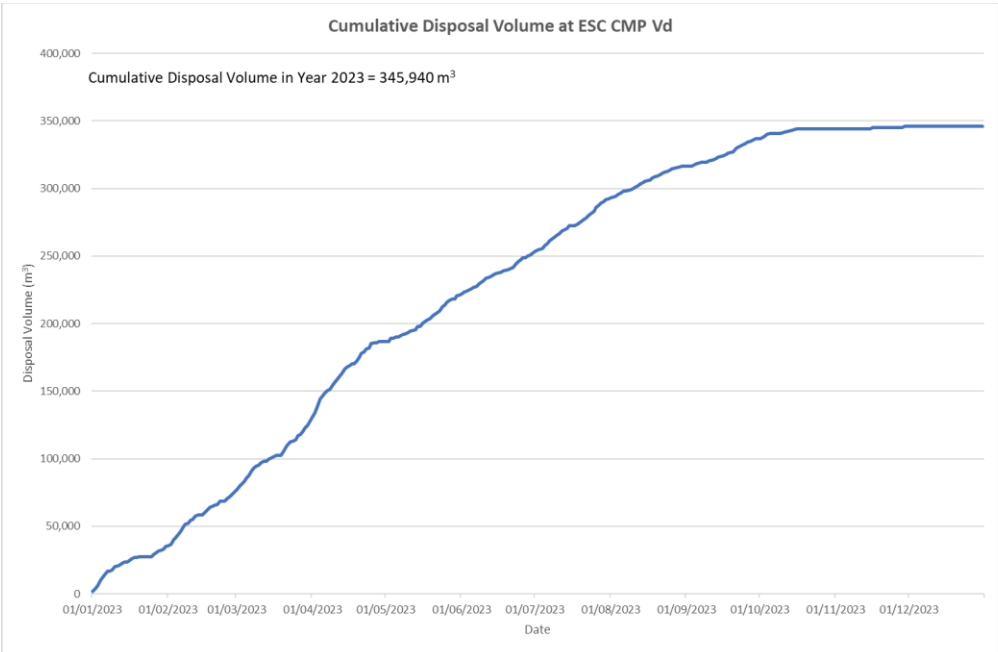


Chart 1.2: Cumulative Disposal Volume (m^3) of Uncontaminated Mud at ESC CMP Vd (from January to December 2023)



1.4 Purpose of this Report

The purpose of this “Annual EM&A Report for Contaminated Mud Pits to the East of Sha Chau – January to December 2023” is to provide a review of the EM&A findings for the Project’s activities undertaken during the annual monitoring period from January to December 2023. This review will supplement findings of the Quarterly EM&A Reports compiled by the Environmental Team by discussing the overall environmental acceptability of disposal operations at the ESC CMPs and identifying any trends which require continual tracking as the monitoring proceeds. This Annual

EM&A Report will also discuss the technical performance and cost-effectiveness of the monitoring programme design and make recommendations for revisions, if appropriate.

The objectives of this report are to:

- Make a clear statement on the acceptability of environmental impacts with reference to the impact hypotheses;
- State how successful the monitoring programme has been in addressing the objectives of the Study; and
- Make recommendations for revisions to the monitoring programme and disposal operations, as necessary, to ensure that the objectives are fully met in as cost-effective manner as possible.

NOTE

Readers are referred to the Monthly and Quarterly EM&A Reports for this Study for detailed presentations and statistical analysis of the monitoring results. The Quarterly EM&A Reports contain analysis and discussion of all data collected during the 12 months (January to December 2023) of the monitoring programme for the Project. Only data relevant to the specific discussions to address the objectives of the annual review are presented in this Annual EM&A Report.

1.5 Structure of the Annual EM&A Report

The structure of this Annual EM&A Report is as follows:

- **Section 2 – Acceptability of Environmental Impacts:** This section briefly discusses the main findings of each of the monitoring components highlighting the acceptability of any detected impacts. Details of any issues that warrant further investigation (such as trends in increasing contaminant concentration) will be presented and discussed.
- **Section 3 – Review of the Monitoring Programme:** This section discusses the degree of success of the programme in addressing the Study's objectives. Information will be presented concerning the adequacy of the field sampling programmes. Revision of the monitoring programme such as sampling frequency or sample sizes would be discussed, if applicable.
- **Section 4 – Summary and Conclusion**: This section summarises the main findings of this Annual EM&A Report, highlighting the acceptability of environmental impacts and providing recommendations for revisions to the monitoring programme, if appropriate.

2 Acceptability of Environmental Impacts

2.1 Introduction

The EIA for ESC CMP V concluded that there are unlikely to be any unacceptable environmental impacts associated with dredging, disposal and capping operations provided that the proposed operations plans are implemented.[3,4] The operations plans included restrictions on the maximum dredging rate, maximum backfilling level and backfilling rates and specified thickness of the cap, which are specified in the Environmental Permit of the Project (EP No. EP-312/2008/A). The following impact hypothesis is proposed for verification under the EM&A Programme:

EIA IMPACT HYPOTHESIS
Impacts associated with dredging operations to construct CMPs and as well as disposal and capping operations at CMPs are not expected to result in exceedances of water quality objectives at sensitive receivers nor cause exceedances of applicable water quality standards. The operational design has been specified such that disposal of sediments shall not cause a detectable deterioration in sediment quality outside the CMPs during their disposal operations. Physical impacts to fisheries and marine ecological sensitive receivers (e.g. *Sousa chinensis*) are not expected and no change in contaminant levels in marine organism tissue is predicted to arise from this Project. Air and noise impacts are expected to be undetectable.

In accordance with this hypothesis and the specific objectives for the EM&A programme of ESC CMPs, the EM&A methodology incorporates both specific data collection and analysis components and broader, holistic reviews of the monitoring programme as well as the dredging, disposal and capping operations. This methodology involves the assessment of the acceptability of environmental impacts with reference to specific Impact Hypotheses established for each of the five (5) monitoring components detailed below:

- Sediment Quality
- Sediment Toxicity
- Trawling & Tissue/Whole Body Contaminant Testing
- Water Quality
- Impacts of Major Storms

Human Health and Ecological Risk Assessment as a part of EM&A Programme is discussed in a separate report, Annual Risk Assessment Report, and would not be discussed further in this Annual EM&A Report.

Each of the monitoring components is discussed in turn in the following sub-sections by re-stating the specific Impact Hypotheses and discussing whether they are accepted or rejected based on the monitoring results from January to December 2023. Where appropriate, monitoring data collected from February 2006 to December 2023 under the previous and current Agreement Nos. CE 19/2004 (EP), CE 4/2009 (EP), CE 23/2012 (EP), CE 63/2016 (EP) and CE 59/2020 (EP) have been incorporated for the analysis. Details of statistical analyses are only presented for contaminants where potential environmental impacts have been detected (e.g. significant increases of contaminant's concentration over time since disposal at a specific CMP commenced or significant increases of contaminant's concentration with proximity to a specific CMP). For

[3] ERM (2005) Detailed Site Selection Study for a Proposed Contaminated Mud Disposal Facility within the Airport East / East of Sha Chau Area. Agreement No. CE 12/2002 (EP).

[4] ERM (2010) Contaminated Sediment Disposal Facility at South of Brothers. Agreement No. FM 2/2009.

detailed statistical results of other contaminants please refer to the respective Quarterly EM&A Reports.

During this reporting period, monitoring has been undertaken for the Project's activities at ESC CMP V CMPs. The monitoring schedules are presented in **Appendix A**.

2.2 Sediment Quality

2.2.1 Background & Objectives

Sediment chemistry has long been an important component of monitoring programmes at ESC. Since 1997, there has been a comprehensive list of Contaminants of Concern (COCs) [5] comprising eight (8) heavy metals and one (1) metalloid, polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), organochlorine pesticides (e.g. Total Dichloro-diphenyl-trichloroethane (DDT) and 4,4'-Dichloro-diphenyl-dichloroethylene (4,4'-DDE)) and Tributyltin (TBT). These contaminants which correspond, with the exception of Total DDT and 4,4'-DDE, to the list of COCs in ETWB TC(W) No. 34/2002 (where this technical circular has been subsumed under Project Administration Handbook for Civil Engineering Works Section 4) in sediments have been measured in the present monitoring programme and changes over time and distance are examined.

The main objective of this task is to determine if there are any changes and/or trends in the concentrations of contaminants in sediments adjacent to the pits caused by disposal activities. This objective is most appropriately addressed through two separate but intrinsically linked sub-tasks:

- **Pit Specific Monitoring of Sediment Quality** – conducted to examine near-field impacts of disposal operations on the spread of contaminants from the active pit ESC CMP Vb and to allow for rapid detection of any potential adverse environmental impacts and, if necessary, changes to the operation plan.
- **Cumulative Impact Monitoring of Sediment Quality** – conducted to analyse the ambient conditions in the wider North Lantau region and to investigate whether any impacts to marine sediments are occurring due to the dispersion of contaminants from ESC CMPs.

2.2.2 Hypothesis

The impact hypothesis for this task is as follows:

There is no increase in sediment contaminants' concentrations over time at individual stations or a trend of increasing concentrations with proximity to the active pit.

As a result of the separation of this programme into two sub-tasks, two sets of null hypotheses were tested for the current monitoring at ESC CMPs:

Pit Specific Monitoring of Sediment Quality

H_0 There is no increase in sediment contaminant's concentration over time in the adjacent area of contaminated mud disposal activity.

H_0 There is no increase in sediment contaminant's concentration in the area adjacent to the pit during the contaminated mud disposal works.

[5] PELB Draft Technical Circular for Management of Dredged / Excavated Sediment.

Cumulative Impact Monitoring of Sediment Quality

H_0 There is no increase in sediment contaminant's concentration over time in the wider area of North Lantau where the contaminated mud disposal activity is undertaken.

H_0 There is no increase in sediment contaminant's concentration with increasing proximity to the pits.

2.2.3 Monitoring Results for ESC CMPs

Pit Specific Monitoring of Sediment Quality

During the reporting period, sampling for ESC CMP Vb has been undertaken from January to December 2023. Samples were obtained at a total of six (6) locations - two (2) Active Pit stations (ESC-NPAA and ESC-NPAB), two (2) Pit Edge stations (ESC-NEAA and ESC-NEAB) and two (2) Near Pit stations (ESC-NNAA and ESC-NNAB) as shown in **Figure 2.1**.

Graphical presentations of the monitoring results are shown in **Figures 1 to 17** of **Appendix B**. Over the monitoring period from January to December 2023 for Pit Specific Sediment Chemistry Monitoring, there were several Lower Chemical Exceedance Level (LCEL) and Upper Chemical Exceedance Level (UCEL) exceedances recorded for inorganic and organic contaminants at Active Pit stations, including Arsenic, Chromium, Copper, Nickel, Lead, Mercury, Silver, Zinc, Low Molecular Weight PAHs and high Molecular Weight PAHs. Since the Active Pit stations are locations within CMP Vb which were receiving contaminated mud during the reporting period, the exceedances of LCEL or UCEL occasionally recorded at the Active Pit stations only are thus not considered as indicating any dispersion of contaminated mud from CMP Vb.

LCEL exceedances for Arsenic were recorded in Active Pit stations, Pit Edge stations and Near Pit stations. **Whilst the average concentration of Arsenic in the Earth's crust is generally ~2 mg/kg, significantly higher Arsenic concentrations (median = 14 mg/kg) have been recorded in Hong Kong's onshore sediments [6]. It is presumed that the natural concentrations of Arsenic are similar in onshore and offshore sediments[7], and relatively high Arsenic levels may thus occur throughout Hong Kong. Therefore, the higher levels of Arsenic are unlikely to be caused by the disposal operations at ESC CMP Vb but rather as a result of naturally occurring deposits.**

Occasional LCEL exceedances were recorded for organic contaminants at Pit-edge (NECA) and Near-Pit (NNCA) station, including Low MW PAHs and high MW PAHs. Considering PAHs are the only testing parameters occasionally slightly exceeding the LCEL at Pit-Edge (ESC-NECA) and Near-Pit (NNCA) station, therefore, this is no not considered as indicating any dispersion of contaminated mud from CMP Vb.

Analysis of Variance was conducted for ESC CMP Vb to examine any difference in contaminant concentrations amongst Active Pit, Pit Edge and Near Pit stations. Monitoring data collected from February 2020 to December 2023 were used for the analysis. Improved statistical tests were performed. Details regarding the statistical analysis are presented in **Appendix C**. Concentrations of the majority of organic contaminants were below their reporting limits. Statistical analyses were only performed for contaminants for which 60% of data were over their reporting limits. In the situation where temporal trends of potential concern were detected by ANOVA and subsequent post-hoc tests for consecutive months, further evaluation including linear regression would be performed.

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[6] Sewell RJ (1999) Geochemical Atlas of Hong Kong. Geotechnical Engineering Office, Government of the Hong Kong Special Administrative Region.

[7] Whiteside PGD (2000) Natural geochemistry and contamination of marine sediments in Hong Kong. In: The Urban Geology of Hong Kong (ed. Page A & Reels SJ). Geological Society of Hong Kong Bulletin No. 6, p109-121.

For most of the metal and organic contaminants with sufficient data for statistical analyses, there were significant spatial and temporal variations in the concentrations of the contaminants. For some of the metal and organic contaminants, there was no significant spatial trend of increasing contaminants' concentrations with proximity to the pit for ESC CMP Vb.

For those contaminants with potential project related spatial trend being detected for consecutive months (i.e. Lead, Nickel and Total Organic Carbon), further evaluation have been conducted and the results showed that the concentrations of these contaminants did not appear to increase over time.

Therefore, it is concluded that the null hypotheses listed in **Section 2.2.2** above were not rejected (i.e. there has been no increase in sediment contaminant's concentration over time and in the area adjacent to the active pit during the monitoring period).

Overall, results collected in the reporting period do not appear to indicate any unacceptable environmental impacts to sediment quality as a result of the contaminated mud disposal operations at ESC CMP Vb.

Cumulative Impact Monitoring of Sediment Quality

During the reporting period, sampling has been undertaken in February, June, August and December 2023 at stations distributed throughout the North Lantau region. The stations were located in five different types of discrete areas as shown in **Figure 2.2**. Three of the areas are located at increasing distances from the disposal operations (i.e. Near Field (ESC-RNA & ESC-RNB1), Mid Field (ESC-RMA & ESC-RMB), Far Field (ESC-RFA & ESC-RFB)) with the fourth area located at the Capped Pit ESC CMPs (ESC-RCA1 & ESC-RCB1) and the fifth area at Ma Wan Station (i.e. sensitive receiver station).

Graphical presentations of monitoring results and their trends (if any) are presented in **Figures 18 to 33** of **Appendix B**. Over the monitoring period from January to December 2023, most contaminants' concentrations were recorded below their respective LCELs at all stations, except Silver which exceeded the LCEL occasionally at Ma Wan station MW1. Analysis of Variance was performed to determine the differences in contaminants' concentrations amongst Capped-pit, Near-Field, Mid-Field, Far-Field stations, and amongst the sampling periods (i.e. between June 2016 and December 2023). Improved statistical tests were performed. In the situation where temporal trends of potential concern were detected by ANOVA and subsequent post-hoc tests for consecutive months, further evaluation including linear regression would be performed. Details of the statistical analysis are presented in **Appendix C**.

Statistical analysis was only performed for contaminants which had 60% of the data over their reporting limits. Significant differences in concentrations of contaminants were detected between the five areas. There were no apparent spatial trends of increasing metal and metalloid contaminants (Arsenic, Cadmium, Chromium, Copper, Nickel, Lead, Mercury, Silver and Zinc) and organic contaminant's (TOC) concentrations with proximity to the pit. The null hypotheses listed in **Section 2.2.2** above was therefore not rejected (i.e. there has been no increase in sediment contaminants' concentration with proximity to the pit in the wider North Lantau area).

Overall, there does not appear to be any evidence of unacceptable environmental impacts to sediment quality in the North Lantau area as a result of the contaminated mud disposal operations at ESC CMP Vb during 2023.

2.2.4 Environmental Impacts

Through the statistical analysis conducted on Pit Specific Monitoring of Sediment Quality data and Cumulative Impact Monitoring of Sediment Quality data there were no trends indicating any significant contamination of sediments with proximity to the pit or with time during the mud disposal operation. Therefore, it can be concluded that there is no evidence that contaminated mud disposal operations at ESC CMP Vb are causing any unacceptable impacts to marine sediment quality in the vicinity of the pit or the North Lantau area as a whole.

2.3 Sediment Toxicity Testing

2.3.1 Background and Objectives

The ecotoxicological testing programme features a suite of tests that include phylogenetically distinct species that interact with sediments in different ways. Unacceptable impacts will have occurred if the levels of contaminants in the sediments collected in the area of the active pits are shown to have toxicity to marine fauna. The findings of the sediment toxicity tests should be compared to the results of the sediment chemistry monitoring.

The objective of this task is to determine if there are any changes and/or trends caused by disposal activities in the toxicity of sediments adjacent to the pits as a result of disposal activities.

2.3.2 Hypothesis

In accordance with the objectives of the Study, the impact hypothesis for this task is as follows:

H_0 There is no increase in sediment toxicity over time at individual stations or a trend of increasing toxicity with proximity to the pit.

The null hypothesis examined during the Quarterly EM&A Reports for this task was as follows:

H_0 There are no differences in the toxicity of sediment adjacent to the pits when compared with reference sediment.

2.3.3 Monitoring Results for ESC CMP V

During the reporting period, sediment samples were collected from the Impact and Reference areas as well as Ma Wan station (**Figure 2.3**) in February and August 2023 for the EM&A programme of ESC CMP V. Sediment toxicity tests were conducted with three (3) international species (the amphipod *Leptocheirus plumulosus*, bivalve larvae *Crassostrea gigas*, and polychaete *Neanthes arenaceodentata*) and two (2) local species (the barnacle *Balanus amphitrite* and shrimp *Penaeus vannamei*) in accordance with the EM&A Manual.

Appropriate statistical test, i.e. ANOVA, was applied for comparing and determining the level of significance in the results between Impact and Reference Stations. Statistical tests were performed for results of March and August 2023.

In March 2023, there were no significant differences between Impact and Reference stations in the toxicity tests for the growth rate for benthic polychaete, survival rate for marine bivalve as well as mortality rates for barnacles and shrimp. In detailed analysis, the potential project related spatial trend was not detected in the survival rate for burrowing amphipod. 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.

In August 2023, there were no significant differences between Impact and Reference stations in the toxicity tests for the survival rate for burrowing amphipod and growth rate for benthic polychaete. In detailed analysis, the potential project related spatial trend was not detected in the survival rate for marine bivalve. Potential project related trends were detected for mortality rates for barnacles and shrimp in August 2023; however, during our further investigation on the analysis results of the Cumulative Impact Monitoring of Sediment Quality, no unacceptable project related impacts to sediment quality was observed. It is also noted that the mortality rate of barnacles and shrimp at the Impact station closer to the disposal operation (i.e. ESC-TDA) was similar as Reference and Ma Wan Stations, implying that there may be external factors contributing to the potential project related trend. 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**.

2.3.4 Environmental Impacts

During the reporting period, there did not appear to be any significant trend of increasing sediment toxicity with proximity to the pit at ESC CMP V. Therefore, the contaminated mud disposal operations at ESC CMP V do not appear to be adversely affecting the toxicity of marine sediment in the vicinity of the pit during the reporting period in an unacceptable manner.

2.4 Trawling and Tissue/Whole Body Contaminant Testing

2.4.1 Background and Objectives

The bioaccumulation of contaminants by prey organisms and the consequent biomagnification of contaminants through the food chain has long been an issue of concern for contaminated dredged material management. Although the public at large may not appreciate the technical details of a biomonitoring programme, especially when mobile marine populations are involved, they are well aware of the potential for contaminated mud disposal to taint seafood products.

As well as examining the influence of contaminated sediment disposal on contaminant levels in demersal fisheries resources, the impact of disposal on the abundance and community structure of the marine fauna has been and will continue to be assessed. Consequently, there are two objectives for this task:

- **Biomonitoring of Contaminants –** To identify any increase in the concentrations of contaminants in demersal marine life adjacent to and remote from the pits.
- **Trawling, Sorting & Analysis –** To assess the impact of contaminated mud disposal at ESC CMP Vb on the fisheries resources of the wider North Lantau area.

2.4.2 Impact Hypothesis

In order to reflect the dual workstreams under this task, two sets of null hypotheses were tested during the monitoring of ESC CMPs:

Bio-monitoring	H_0	The concentrations of contaminants in tissue and whole body samples of demersal marine life adjacent to ESC CMPs are not greater than contaminant concentrations from samples collected at areas remote from ESC CMPs.
	H_0	The concentrations of contaminants in tissue and whole body samples of demersal marine life do not increase over time.
Trawling	H_0	There are no differences in the composition or abundance of demersal fisheries resources near to and remote from the pits.
	H_0	There are no differences in the composition or abundance of demersal fisheries resources over time.

2.4.3 Monitoring Results for ESC CMPs

Biomonitoring of Contaminants

During the reporting period, samples for biota contaminant analysis were collected from ESC CMPs and Reference areas during dry (i.e. January and February) and wet season (i.e. July and August) of 2023. The samples were collected from five (5) replicate trawls made at each of the six (6) monitoring stations. Two (2) stations are located in the Impact areas (ESC-INA and ESC-

INB for ESC CMPs) and four (4) further stations split equally among the two Reference areas (TNA and TNB; TSA and TSB). The locations of the stations are detailed on **Figure 2.4**.

Graphical presentations of annual monitoring results and their trends (if any) are presented in **Figures 34–59** in **Appendix B**. Tissue and whole body contaminants' concentrations were observed to be varied over time at both Impact and Reference areas and there were no observable trends of increasing concentrations with time. Despite some occasional surges in contaminants' concentrations were observed in Impact stations, the surges of contaminants' concentrations were also recorded at Reference stations, this implies that the surge in concentrations may be due to natural background fluctuations rather than indicating any unacceptable environmental impacts from the contaminated mud disposal operations at ESC CMPs.

During the reporting period from January to December 2023, all concentrations measured in tissue and whole body samples remained below the relevant Maximum Permitted Concentrations (MPCs) specified under the Food Adulteration (Metallic Contamination) Regulations (Cap. 132) during the reporting period. Details regarding the statistical analysis of the monitoring data collected in January/February 2023 and July/August 2023 are presented in **Appendix C**.

Tissue and whole body concentrations of the majority of metal and organic contaminants did not vary significantly between Impact and Reference stations except Zine in tissue samples of Swimming Crab and Lead in whole body samples of Demersal/Pelagic Fish. However, they show significantly higher contaminant levels in Reference than Impact stations. It should also be highlighted that there were insufficient or unequal sample size in some of the target groups during the reporting period, thereby reducing the confidence levels of the statistical analysis except Demersal/Pelagic Fish. For lead in whole body samples of Demersal/Pelagic Fish, in view of the result of other inorganic and organic contaminants in whole body samples of Demersal/Pelagic Fish, this occasional spatial trends for lead may be due to natural background fluctuations rather than indicating any unacceptable environmental impacts from the contaminated mud disposal operations at ESC CMPs.

Based on the long term trend of contaminant concentrations since March 2006 as presented in **Figures 34–59** of **Appendix B**, no concentrations of any metal and organic contaminants during the reporting period exceeded the highest concentrations recorded in previous years. Some exhibited decreasing trends or remained low in concentrations, in particular for organic contaminants, with most of them being below detection limits.

Overall, the monitoring results do not appear to indicate any unacceptable environmental impacts to biota contaminants' concentrations as a result of the contaminated mud disposal operations at CMPs of the ESC area.

Trawling, Sorting & Analysis

Graphical presentations of abundance, biomass and species richness are presented in **Figures 60–62** of **Appendix B**. Monitoring data collected from February 2006 to August 2023 under the previous and existing Agreements Nos. CE 19/2004 (EP), CE 4/2009 (EP), CE 23/2012 (EP), CE 63/2016 (EP) and CE 59/2020 (EP) are included in the statistical analysis in order to detect any spatial or temporal trends in demersal fisheries resources. Details of the statistical analysis of the monitoring are presented in **Appendix C**.

There were spatio-temporal variations recorded for abundance, biomass, number of species (**Figures 60–62**) as well as species richness, Pielou's evenness and Shannon Wiener diversity of catches during the survey (**Table 2.1**). Both abundance and biomass of catches were the highest in February 2013. Number of species was the greatest in July 2011 while species richness was the highest in July 2018. The highest diversity was recorded in August 2018, and the highest evenness was recorded in March-R2 2006. As only significant spatial but not temporal variations in abundance, biomass, species richness and number of species between Impact and Reference stations were observed in some survey months during the reporting period, it is concluded that the null hypotheses listed in **Section 2.2.2** above were not rejected (i.e. there are differences in the composition or abundance of demersal fisheries resources near to and remote from the pits as well as no differences over time).

Overall, results collected in the reporting period do not appear to indicate any unacceptable environmental impacts to fisheries resources as a result of the contaminated mud disposal operations at ESC CMP Vb.

Table 2.1: Number of Species, Diversity and Evenness (Average Values) of Fisheries Resources in Trawl Samples from the Impact and Reference Areas from March 2006 to August 2023

Date	Impact			Reference		
	No. of Species	Pielou's Evenness	Shannon Wiener Diversity	No. of Species	Pielou's Evenness	Shannon Wiener Diversity
Mar 2006 R1	42.2	0.76	1.25	34.4	0.60	0.91
Mar 2006 R2	24.4	0.82	1.15	21.8	0.76	1.02
Jul 2006	24.6	0.74	1.07	21.0	0.76	1.12
Aug 2006	33.3	0.82	1.28	32.2	0.77	1.18
Jan 2007	28.7	0.67	0.96	27.3	0.62	0.88
Feb 2007	26.0	0.60	0.85	29.4	0.66	0.96
Jul 2007	36.9	0.59	0.92	34.8	0.56	0.85
Aug 2007	41.1	0.55	0.89	33.3	0.52	0.79
Jan 2008	31.0	0.53	1.79	29.8	0.55	1.84
Feb 2008	34.7	0.55	1.91	35.6	0.56	1.99
Jul 2008	38.3	0.53	1.93	35.8	0.55	1.94
Aug 2008	37.3	0.62	2.26	41.6	0.55	2.06
Jan 2009	37.0	0.46	1.63	37.9	0.61	2.22
Feb 2009	45.1	0.59	2.24	36.2	0.53	1.91
Jul 2009	39.1	0.40	1.45	38.8	0.42	1.52
Aug 2009	38.8	0.41	1.50	37.2	0.46	1.65
Jan 2010	37.4	0.52	1.86	38.1	0.65	2.36
Feb 2010	37.6	0.50	1.78	41.9	0.62	2.30
Jul 2010	45.5	0.42	1.59	44.8	0.69	2.62
Aug 2010	39.7	0.46	1.73	44.4	0.60	2.25
Dec 2010	43.5	0.40	1.50	39.0	0.53	1.93
Jan 2011	33.2	0.44	1.55	34.3	0.51	1.81
Feb 2011	38.3	0.28	1.01	39.4	0.52	1.89
Jul 2011	54.5	0.30	1.21	46.5	0.69	2.64
Aug 2011	44.0	0.46	1.72	47.9	0.69	2.66
Jan 2012	35.7	0.22	0.77	40.5	0.36	1.34
Feb 2012	34.6	0.44	1.56	34.4	0.55	1.92
Jul 2012	46.3	0.30	1.15	46.4	0.46	1.76
Aug 2012	44.2	0.17	0.63	43.6	0.55	2.06
Jan 2013	33.3	0.12	0.43	34.0	0.30	1.07
Feb 2013	32.1	0.22	0.74	31.2	0.52	1.74

Date	Impact			Reference		
	No. of Species	Pielou's Evenness	Shannon Wiener Diversity	No. of Species	Pielou's Evenness	Shannon Wiener Diversity
Jul 2013	50.9	0.36	1.41	43.6	0.32	1.19
Aug 2013	39.3	0.23	0.84	35.8	0.35	1.24
Jan 2014	45.1	0.39	1.50	36.2	0.40	1.44
Feb 2014	36.4	0.51	1.84	34.1	0.45	1.58
Jul 2014	46.2	0.58	2.21	45.8	0.38	1.47
Aug 2014	46.0	0.52	1.97	45.0	0.50	1.89
Jan 2015	29.1	0.52	1.74	30.2	0.45	1.53
Feb 2015	27.5	0.58	1.92	36.6	0.56	2.00
Jul 2015	47.4	0.61	0.78	46.6	0.47	1.92
Aug 2015	50.0	0.63	2.44	46.0	0.50	1.82
Jan 2016	36.6	0.61	2.16	38.9	0.50	2.28
Feb 2016	32.6	0.57	1.96	39.0	0.62	2.04
Jul 2016	48.9	0.62	2.39	54.1	0.51	2.03
Aug 2016	53.5	0.47	1.88	54.5	0.51	1.43
Jan 2017	22.9	0.62	1.93	24.6	0.45	1.85
Feb 2017	34.1	0.62	2.19	35.1	0.52	2.52
Jul 2017	37.4	0.68	2.46	50.3	0.65	2.11
Aug 2017	35.6	0.75	2.64	45.3	0.56	2.24
Jan 2018	22.9	0.74	2.31	30.75	0.66	2.18
Feb 2018	31.7	0.69	2.39	38.3	0.60	1.88
Jul 2018	51.5	0.64	2.50	52.8	0.48	2.15
Aug 2018	40.9	0.73	2.70	45.65	0.57	1.85
Jan 2019	25.0	0.73	2.35	38.8	0.51	2.95
Feb 2019	29.3	0.93	3.12	43.9	0.78	2.31
Jul 2019	32.7	0.65	2.25	55.9	0.57	2.41
Aug 2019	28.3	0.73	2.42	46.0	0.63	2.41
Jan 2020	17.6	0.75	2.14	26.1	0.81	2.63
Feb 2020	20.4	0.67	2.02	33.6	0.77	2.68
Jul 2020	35.1	0.72	2.54	44.7	0.75	2.82
Aug 2020	27.3	0.67	2.16	44.7	0.68	2.55
Jan 2021	20.1	0.53	1.60	26.4	0.44	1.44
Feb 2021	19.7	0.58	1.73	32.6	0.67	2.31
Jul 2021	25.1	0.57	1.83	41.3	0.71	2.63
Aug 2021	24.9	0.74	2.36	39.3	0.70	2.58
Jan 2022	13.2	0.70	1.80	28.1	0.61	2.04
Feb 2022	9.7	0.51	1.12	23.2	0.70	2.12
Aug 2022	11.2	0.72	1.68	32.0	0.55	1.92
Sep 2022	16.2	0.55	1.51	35.4	0.38	1.38
Jan 2023	12.2	0.74	1.83	25.55	0.36	1.17
Feb 2023	12.8	0.74	1.84	22.50	0.62	1.92
Jul 2023	27.4	0.76	2.50	38.95	0.47	1.71
Aug 2023	14.9	0.80	2.12	36.00	0.48	1.72

2.4.4 Environmental Impacts

During the monitoring from March 2006 to August 2023, it was found that abundance, biomass and species richness of demersal fisheries resources did not show any consistent decreasing trends with time. No evidence could be found to support that the contaminated mud disposal operations at ESC CMPs are posing unacceptable impacts to fisheries resources in the vicinity of the pits or the wider North Lantau area as a whole. In addition, the monitoring results of contaminants' levels in biota also do not appear to indicate any unacceptable environmental impacts as a result of the contaminated mud disposal operations at ESC CMP Vb.

2.5 Water Quality Assessment

2.5.1 Background and Objectives

The main objectives of this component of the Study are to determine any unacceptable impacts on water quality caused by the dredging and disposal works at ESC CMPs. Three separate components of water quality monitoring are necessary:

- **Routine Water Quality Monitoring for Dissolved Metals –** conducted to examine the effects of disposal activities at ESC CMPs on the level of inorganic metal contaminants in marine waters;
- **Impact Water Quality Monitoring for Dredging Activities –** conducted to examine the effects of dredging operations at ESC CMP V on water quality parameters;
- **Water Column Profiling –** conducted to examine *in situ* the effects of disposal operations on water quality parameters within the water column at ESC CMP Vb.

2.5.2 Impact Hypothesis

In order to assess the impacts of disposal operations on water quality, two null hypotheses were tested during the monitoring at ESC CMPs during the reporting period. Results of the Impact Water Quality Monitoring for Dredging Activities at ESC CMP Vb were compared against the Action and Limit Levels established from the baseline water quality monitoring data.

Routine Water Quality

H_0 There are no differences in the levels of contaminants in water samples in the plume arising from disposal works and background levels in the vicinity of ESC CMP Vb.

Water Column Profiling

H_0 There is no change in the level of compliance with the appropriate WQOs for the NWWCZ.

2.5.3 Monitoring Results for ESC CMPs

Impact Water Quality Monitoring for Dredging Activities of ESC CMP V

Impact Water Quality Monitoring for Dredging Activities was not performed during the reporting period as no dredging activities were undertaken for the same period.

Routine Water Quality Monitoring

Graphical presentations of monitoring results and their trends (if any) are presented in **Figures 63 to 81** of **Appendix B**. Sampling was undertaken from January to December 2023 during the reporting period at stations distributed throughout the ESC CMP area. Replicate water samples were collected at various stations located in four (4) areas at increasing distances from the active pits: Impact, Intermediate, Reference and Sensitive Receivers stations (**Figures 2.5a and 2.5b**).

Improved statistical tests were performed to reveal any trends of increasing concentrations of contaminants with proximity to the pit or with time. For metals and metalloid, the data collected prior to July 2022 was collected under a more conservative method; while starting from July 2022, dissolved metal and metalloid data was collected and analysed instead. Details regarding the statistical analysis are presented in **Appendix C**.

The results of the ANOVA tests indicated that Copper, Nickel, Zinc, Ammonia Nitrogen, TIN, BOD_5, DO, Turbidity and SS varied significantly with sampling periods and areas though there was no consistent spatial trend of increasing contaminant concentrations with proximity to the pit for both ebb and flood tide.

Water Column Profiling

During the reporting period from January to December 2023, Water Column Profiling was conducted monthly from January to December 2023 at Upstream and Downstream stations of ESC CMP Vb.

The measured DO, pH and Salinity levels at Upstream and Downstream stations complied with the WQOs. The levels of DO, Turbidity and SS at all stations complied with the Action and Limit Levels during the reporting period.

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

2.5.4 Environmental Impacts

Statistical analysis of the Routine Water Quality Monitoring data collected for ESC CMPs revealed that there were no trends of increasing contaminants' concentrations with proximity to the pit or with time. In addition, levels of key water quality parameters (e.g. SS, DO and Turbidity) generally complied with the WQOs and Action and Limit Levels. Overall, results of water quality monitoring in the reporting period appear to indicate that disposal activities at ESC CMPs were being undertaken in an environmentally acceptable manner.

2.6 Major Storms

2.6.1 Background

Based on the previous experience with the development and approval for CMPs at ESC for use as a confined disposal facility for contaminated mud, monitoring the dispersion of contaminated sediments during major storm events, such as typhoons of signal no. 8 or higher, is an important objective of the Study. The purpose of the post-storm monitoring programme is to determine whether the pits retain disposed sediments during storms and whether there are any detectable changes in sediment quality adjacent to the pits.

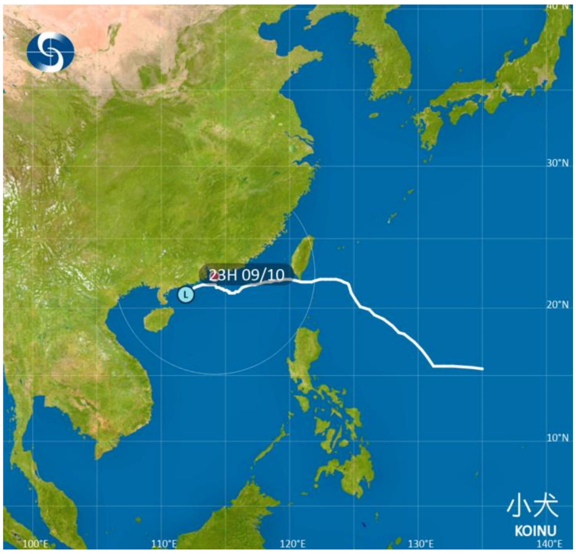
2.6.2 Monitoring Results

Samplings for Sediment Chemistry after a Major Storm of ESC CMPs were conducted at nine (9) monitoring stations (see **Figure 2.2** for the monitoring locations) on three days during the reporting period, including: 23 July 2023 after the visit of tropical cyclone Talim which led to the issue of No. 8 Storm Signal on 17 July 2023; 5 September 2023 after the visit of tropical cyclone Saola which led to the issue of No. 8 Storm Signal on 1 September 2023; and 11 October 2023 after the visit of tropical cyclone Koinu which led to the issue of No. 8 Storm Signal on 9 October 2023. The tracks of Talim, Saola and Koinu are shown in **Map 2.1, Map 2.2** and **Map 2.3** respectively.

Map 2.1: Track of Tropical Cyclone Talim (Source: Hong Kong Observatory)

Map 2.2: Track of Tropical Cyclone Saola (Source: Hong Kong Observatory)

Map 2.3: Track of Tropical Cyclone Koinu (Source: Hong Kong Observatory)



Analyses of monitoring results indicated that the concentrations of most inorganic contaminants, except for Arsenic, were below the LCELs at most monitoring stations in July 2023 (Figures 82 & 83 of **Appendix B**), September 2023 (Figures 84 & 85 of **Appendix B**) and October 2023 (Figures 86 & 87 of **Appendix B**).

For the sampling event on 23 July 2023, statistical analysis indicated that concentrations of all contaminants showed significant differences amongst sampling areas. 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 CMPs in retaining disposed mud or causing contamination of sediments after the major storm event in July 2023.

For the sampling event on 5 September 2023, statistical analysis indicated that concentrations of all contaminants showed significant differences amongst sampling areas. 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 CMPs in retaining disposed mud or causing contamination of sediments after the major storm events in September 2023.

For the sampling event on 11 October 2023, statistical analysis indicated that concentrations of all contaminants showed significant differences amongst sampling areas. 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 CMPs in retaining disposed mud or causing contamination of sediments after the major storm events in October 2023.

2.6.3 Environmental Impacts

Overall, there was no evidence of the failure of ESC CMPs in retaining disposed mud or causing contamination of sediments after the storm events in July, September and October 2023.

3 Recommendations on EM&A Programme

3.1 Background

EM&A optimization has been implemented in 2 phases since 2020, and the Phase 2 optimization has been in place since July 2022. Updated EM&A Manual with incorporation of Phase 2 optimization was submitted on 3 April 2023. EPD expressed no comment on the Updated EM&A Manual on 27 April 2023.

3.2 Recommendations

No further recommendation is being proposed on the current EM&A Programme.

4 Summary and Conclusions

4.1 Findings from the Monitoring Programme

A review of the individual monitoring sub-tasks (**Sections 2.2 – 2.6**) demonstrates that the monitoring programme has been successful in meeting its objectives. The null hypotheses for each of the monitoring components have been tested and conclusions drawn as to the environmental impacts of the dredging, disposal and capping operations at the ESC CMPs. A summary of findings for the monitoring programme for the reporting period between January and December 2023 is provided in **Table 4.1**.

Overall, there appears to be no evidence to indicate that unacceptable environmental impacts are occurring through disposal, capping and dredging operations at the ESC CMPs.

Table 4.1: Summary of Environmental Acceptability of Disposal, Capping and Dredging Operations at the Contaminated Mud Pits of East of Sha Chau during the Reporting Period of January to December 2023

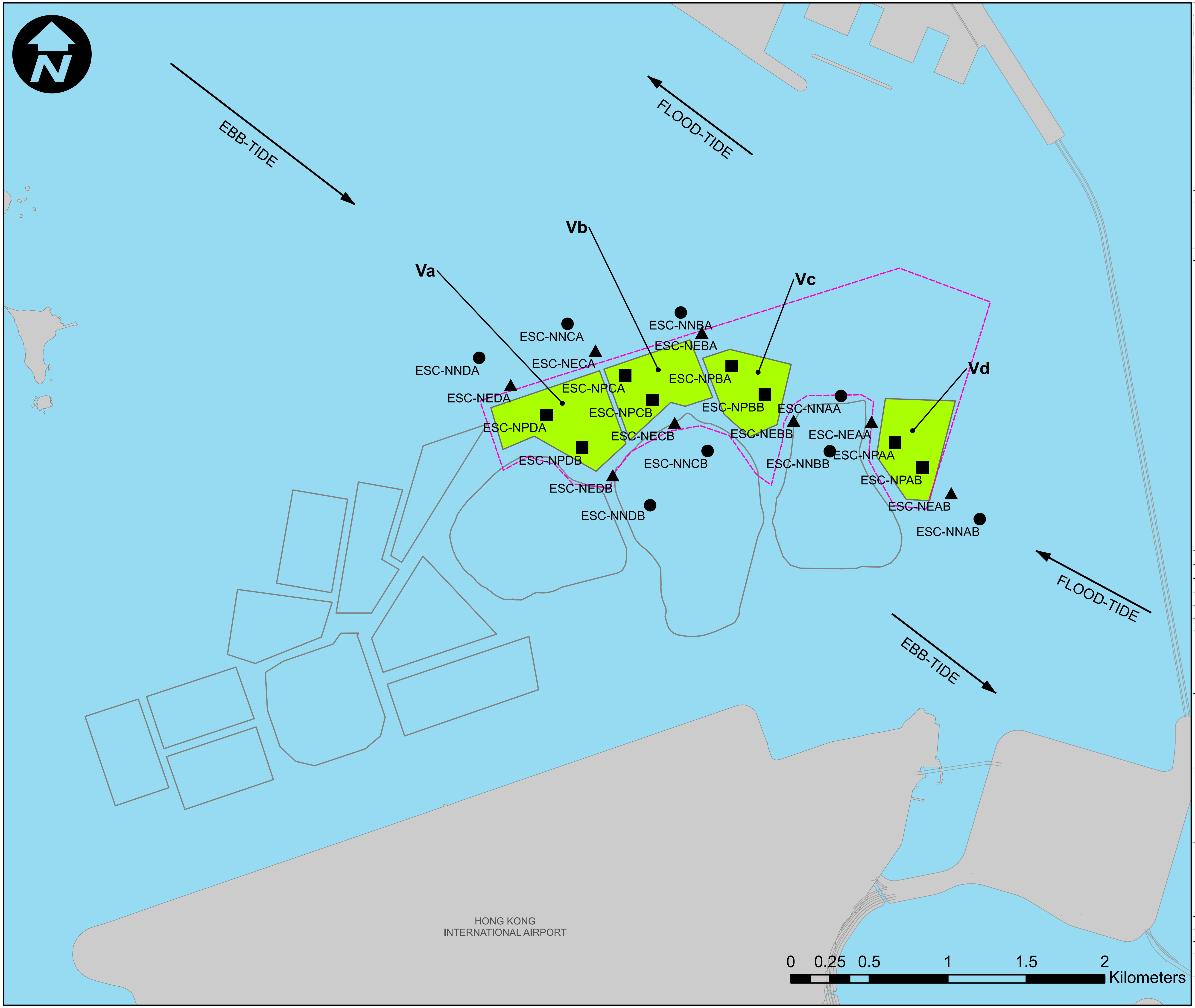
Monitoring Programme	Monitoring Component	Null Hypothesis	Parameters Analysed	Reported Results	Notable Exceedances	Conclusions
Sediment Quality for ESC CMPs	Pit Specific Sediment Chemistry Monitoring	• There is no increase in sediment contaminant's concentration over time in the adjacent area of contaminated mud disposal activity. • There is no increase in sediment contaminants' concentration in the area adjacent to the pits during the contaminated mud disposal works.	Laboratory analysis of 8 heavy metals (Cu, Ni, Pb, Cd, Cr, Zn, Ag and Hg) and 1 metalloid (As), PAHs, PCBs, DDT, DDE, TOC and TBT in sediment samples.	• Several LCEL and UCEL exceedances were recorded for inorganic and organic contaminants (i.e. Arsenic, Chromium, Copper, Nickel, Lead, Mercury, Silver and Zinc) at Active Pit. However, the occasion exceedances of LCEL and UCEL only recorded at the Action Pit, thus not considered as indicating any dispersion of contaminated mud from CMP Vb. • Occasional LCEL exceedances were recorded for organic contaminants at Pit-edge (NECA) and Near-Pit (NNCA) station, including Low MW PAHs and high MW PAHs. However, considering PAHs are the only testing parameters occasionally slightly exceeding the LCEL at Pit-Edge (ESC-NECA) and Near-Pit (NNCA) station, therefore, this is no not considered as indicating any dispersion of contaminated mud from CMP Vb. • Potential project related spatial trend being detected in consecutive months for Lead, Nickel and Total Organic Carbon. However, refer to the further evaluation, the results showed that the concentrations of these contaminants in the proximity to ESC CMP Vb did not appear to increase over time.	Not applicable	The null hypothesis was not rejected. It can be concluded that there is **no evidence that disposal operations at ESC CMP Vb are causing unacceptable impacts to the level of contaminants in marine sediments in the vicinity of the pits.**

Monitoring Programme	Monitoring Component	Null Hypothesis	Parameters Analysed	Reported Results	Notable Exceedances	Conclusions
	Cumulative Impact Sediment Chemistry Monitoring	• There is no increase in sediment contaminant's concentration over time in the wider area of North Lantau where the contaminated mud disposal activity is undertaken. • There is no increase in sediment contaminant's concentration with increasing proximity to the pits.	Laboratory analysis of 8 heavy metals (Cu, Ni, Pb, Cd, Cr, Zn, Ag and Hg) and 1 metalloid (As), PAHs, PCBs, DDT, DDE, TOC and TBT in sediment samples.	Significant differences in concentrations of contaminants were detected between the five areas. There is no consistent spatial or temporal trends of increasing metal and organic contaminant concentration with proximity to the pit and time were recorded.	Not applicable	The null hypotheses were not rejected. It can be concluded that **there is no evidence that disposal operations at ESC CMPs are causing unacceptable impacts to the level of contaminants in marine sediments in the vicinity of the pits or the wider area as a whole.**
Sediment Toxicity for ESC CMPs	Sediment Ecotoxicological Testing	There are no differences in the toxicity of sediments adjacent to the pits when compared with reference sediments.	Laboratory analysis of the survival rates of five (5) selected species in sediments from the Impact and Reference stations	No potential project related spatial trend detected in growth rate for burrowing amphipod, benthic polychaete and marine bivalve. For mortality rates for barnacles and shrimp in August 2023, there was no evidence showing a consistent or increasing project related impact over time.	Not applicable	The null hypothesis was not rejected. **There appears to be no evidence of increasing sediment toxicity towards the active ESC CMPs.**
Trawling for ESC CMPs	Sorting and Analysis of Fisheries Resources	There are no differences in the composition or abundance of demersal fisheries resources near to and remote from the pits. There are no differences in the composition or abundance of demersal fisheries resources over time.	Catch composition, abundance and biomass	Both abundance and biomass of catches were the highest in February 2013. Number of species was the greatest in July 2011 while species richness was the highest in July 2018. Highest diversity was recorded in August 2018, and the highest evenness was recorded in March-R2 2006.	Not applicable	The null hypotheses were not rejected. **There is no evidence of unacceptable impacts to the abundance of fisheries resources at areas near to the pits which may be caused by disposal operations at ESC CMP Vb.**

Monitoring Programme	Monitoring Component	Null Hypothesis	Parameters Analysed	Reported Results	Notable Exceedances	Conclusions
Biomonitoring of Contaminants ESC CMPs	Tissue/Whole-body Contaminant Testing	The concentrations of contaminants in tissue and whole body samples of demersal marine life adjacent to ESC CMPs are not greater than contaminant concentrations from samples collected at areas remote from ESC CMPs. The concentrations of contaminants in tissue and whole body samples of demersal marine life do not increase over time.	Laboratory analysis of eight heavy metals (Cu, Ni, Pb, Cd, Cr, Zn, Ag and Hg), Inorganic Arsenic, PCBs, DDT, DDE and TBT in tissue and whole-body samples of the target species.	• Generally, the tissue and whole-body concentrations of most metal and organic contaminants did not vary significantly between Impact and Reference stations except Zine in tissue samples of Swimming Crab and Lead in whole body samples of Demersal/Pelagic Fish, which show significantly higher contaminant levels in Reference than Impact stations. However, it should be highlighted that there were insufficient or unequal sample size in some of the target groups during the reporting period, thereby reducing the confidence levels of the statistical analysis except Demersal/Pelagic Fish. This occasional spatial trends for lead may be due to natural background fluctuations. • Occasional surges of contaminants' concentrations in Impact stations are more likely to be a result of natural fluctuations rather than adverse impacts from the contaminated mud disposal works.	Not applicable	The null hypotheses were not rejected. **There is no evidence of unacceptable impacts to contaminant concentrations in fisheries resources at areas near to the pits which may be caused by disposal operations at ESC CMP Vb.**

Monitoring Programme	Monitoring Component	Null Hypothesis	Parameters Analysed	Reported Results	Notable Exceedances	Conclusions
Water Quality Monitoring for ESC CMP V	Routine Water Quality Monitoring for Dissolved Metals of ESC CMP V	There are no differences in the levels of contaminants in water samples in the plume arising from disposal works and background levels in the vicinity of ESC CMPs.	Laboratory analysis of eight heavy metals (Cu, Ni, Pb, Cd, Cr, Zn, Ag and Hg) and 1 metalloid (As), Ammonia, NH_3-N, TIN, SS and BOD_5 in water samples.	Significant spatio-temporal variations were observed in metal and inorganic contaminant concentrations and *in-situ* parameters, but no noticeable pattern of variation was recorded.	Not applicable	The null hypothesis was not rejected. It can be concluded that **there is no evidence to indicate that disposal operations at ESC CMPs are causing unacceptable impacts to the level of contaminants in marine waters in the vicinity of the pits or the wider area as a whole.**
	Water Column Profiling of ESC CMP Vb	There is no change in the level of compliance with the appropriate WQOs for the NWWCZ.	*In-situ* measurements of temperature, salinity, turbidity, DO, pH and SS in water samples.	Levels of salinity, DO and pH complied with the WQOs and levels of salinity, turbidity, DO, SS and pH complied with their respective Action and Limit Levels at Upstream and Downstream stations.	Not applicable	The null hypothesis was not rejected. It can be concluded that **there is no evidence to indicate that disposal operations at ESC CMP Vb are causing unacceptable impacts to the level of contaminants in marine waters in the vicinity of the pits.**
Impacts of Major Storms for ESC CMPs	Cumulative Impact Sediment Chemistry Monitoring	There is no increase in sediment contaminant concentration with increasing proximity to the pits.	Laboratory analysis of 8 heavy metals (Cd, Cr, Cu, Ni, Pb, Hg, Ag and Zn) and 1 metalloid (As) in sediment samples.	Statistical analysis indicated that concentrations of all contaminants showed significant differences amongst sampling areas. However, there did not appear to be any trend of increasing contaminant's concentrations with proximity to the pit.	Not applicable	The null hypothesis was not rejected. It can be concluded that there is no evidence of the failure of ESC CMPs in retaining disposed mud or causing contamination of sediments after the major storm event.

Figures



Key Plan:

Notes:

Key to symbols:

LEGEND

ESC CMP V

ESC USABLE AREA 1

PIT SPECIFIC SEDIMENT MONITORING STATIONS

ACTIVE-PIT STATION

PIT-EDGE STATION

NEAR-PIT STATION

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Civil Engineering and Development Department

Project

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

Title

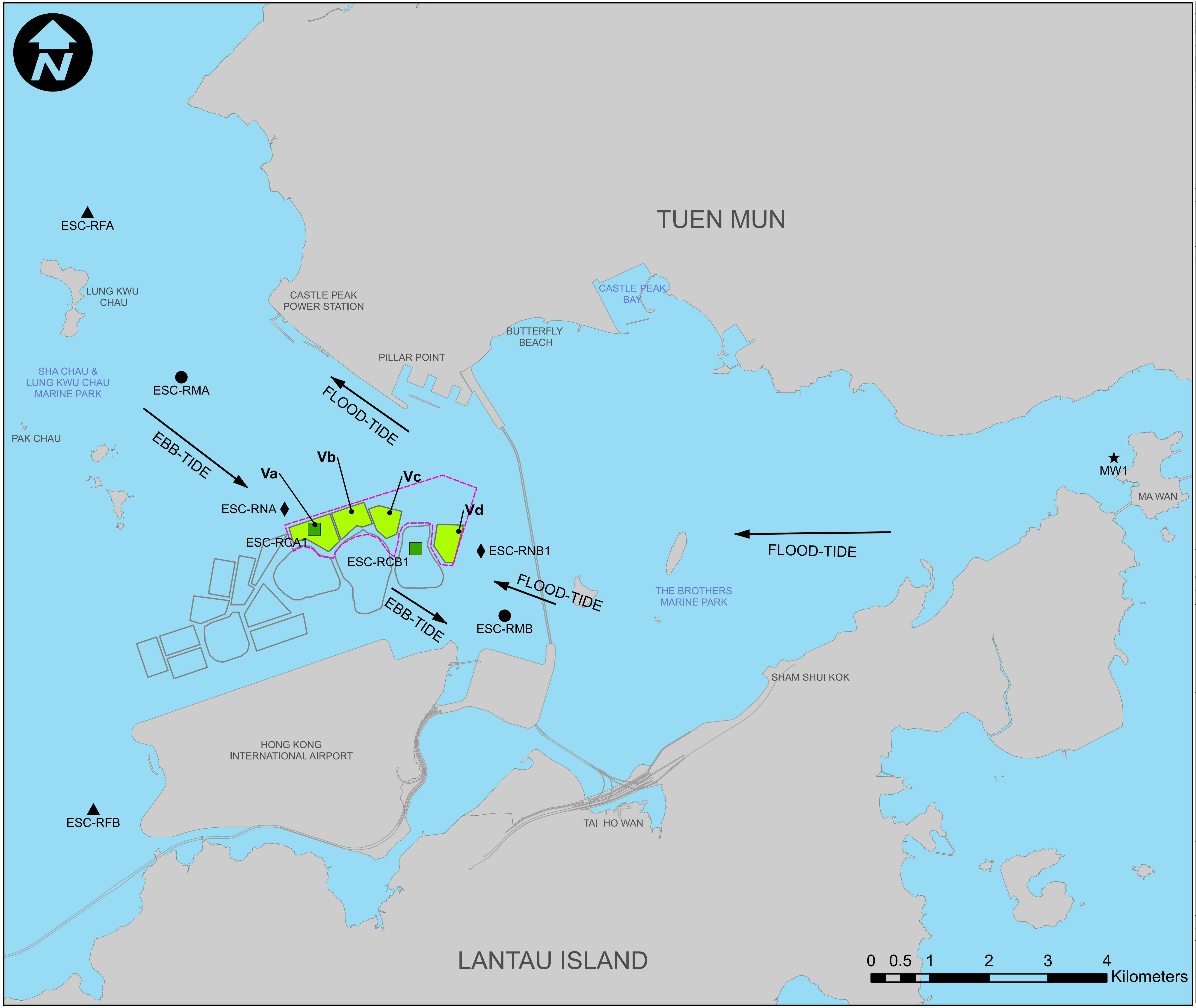
**PIT SPECIFIC SEDIMENT QUALITY
MONITORING STATIONS FOR CMP V**

Designed		Eng check	
Drawn		Coordination	
Dwg check		Approved	

Scale at A3 | Status | Rev

Drawing Number

FIGURE 2.1



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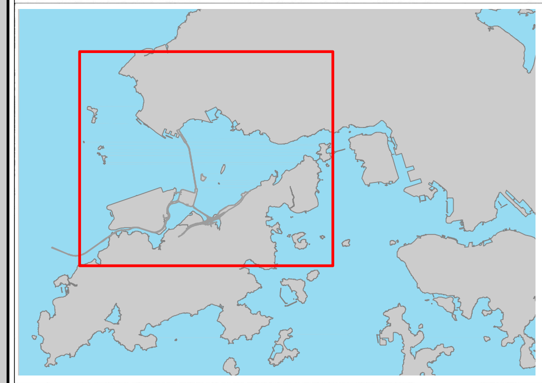

Notes:

Key to symbols:

LEGEND

ESC CMP V

ESC USABLE AREA 1

CUMULATIVE IMPACT SEDIMENT MONITORING STATIONS

CAPPED PIT STATION

NEAR-FIELD STATION

MID-FIELD STATION

FAR-FIELD STATION

MA WAN STATION

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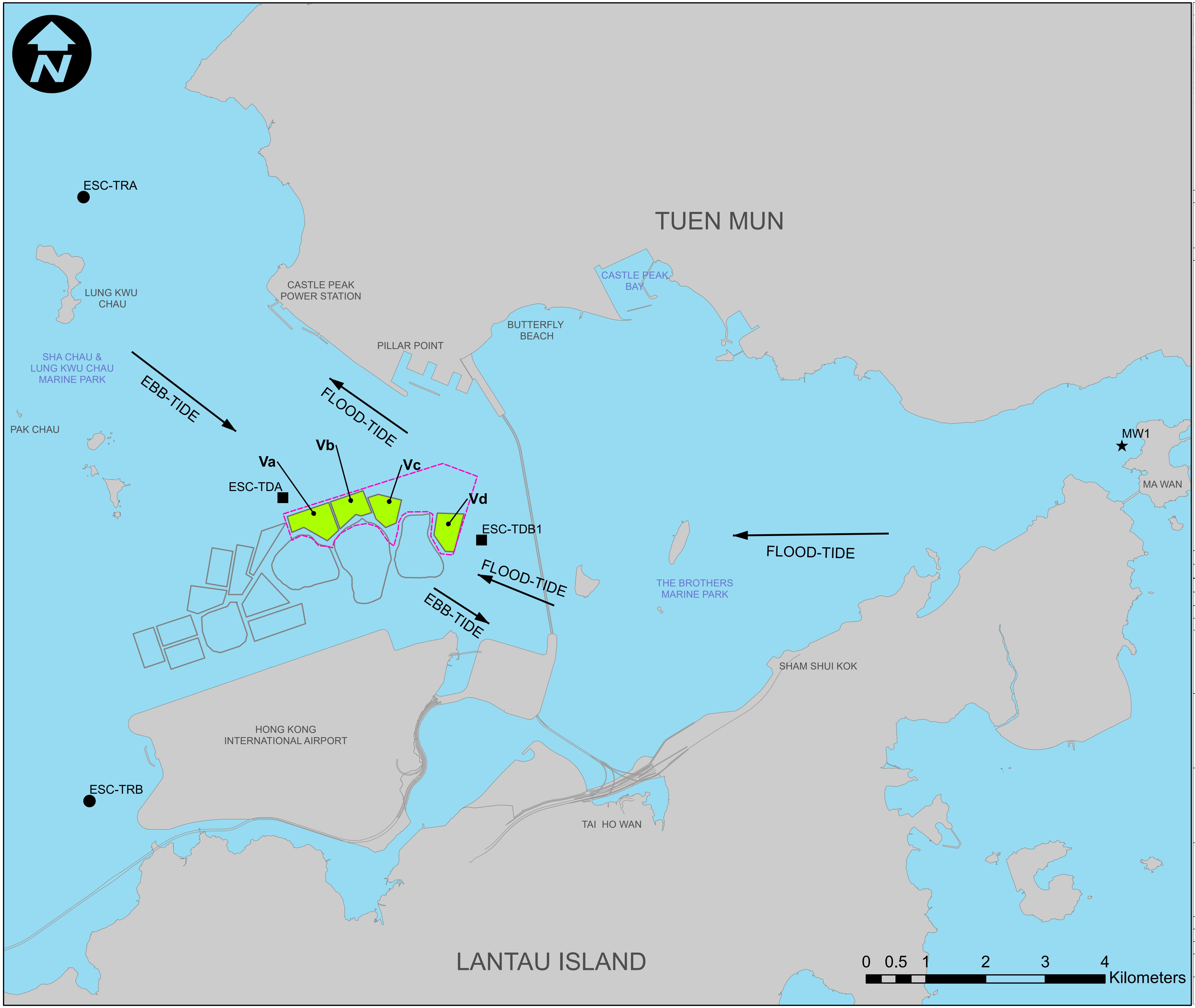
Title

CUMULATIVE IMPACTS SEDIMENT QUALITY MONITORING STATIONS FOR ESC CMPS

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

Drawing Number

FIGURE 2.2



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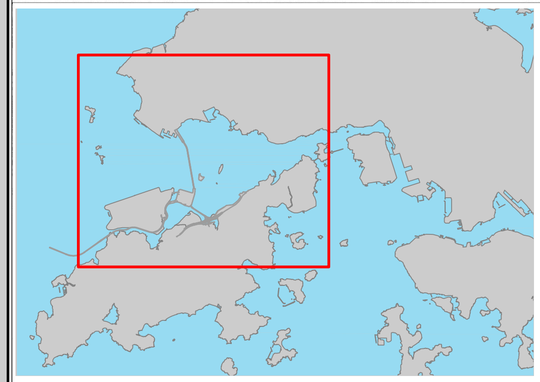

Notes:

Key to symbols:

LEGEND

- ESC CMP V
- ESC USABLE AREA 1

SEDIMENT TOXICITY MONITORING STATIONS

- ■ NEAR-FIELD STATION
- ● REFERENCE STATION
- ★ MA WAN STATION

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ENVIRONMENTAL MONITORING AND AUDIT FOR DISPOSAL FACILITY TO THE EAST OF SHA CHAU (2021-2026) – INVESTIGATION**

Title

SEDIMENT TOXICITY MONITORING STATIONS FOR ESC CMPS

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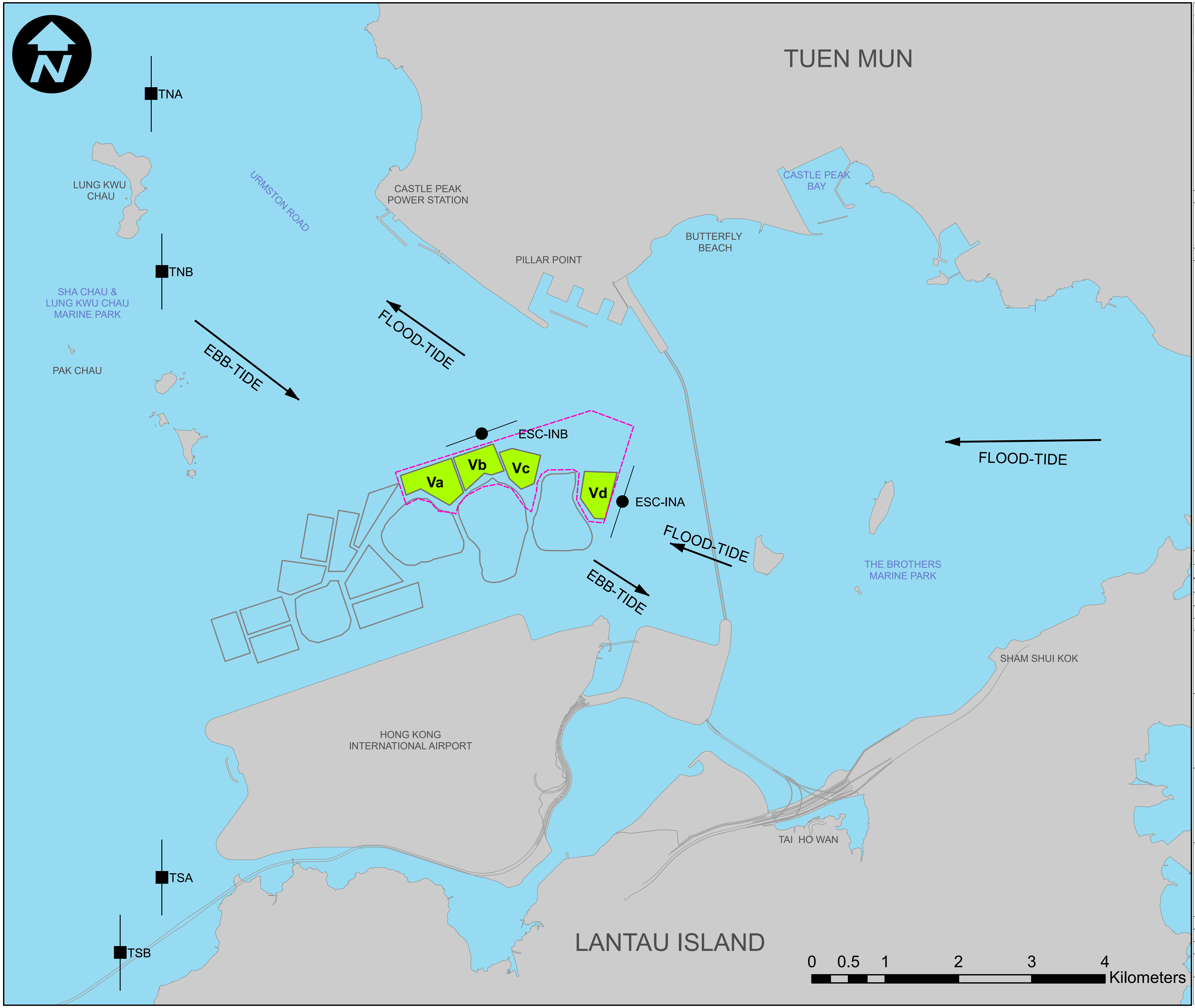
Drawn			Coordination		
Dwg check			Approved		
Scale at A3		Status		Rev	

Drawing Number

FIGURE 2.3



Key Plan:

Notes:

Key to symbols:

LEGEND

ESC CMP V

ESC USABLE AREA 1

DEMERSAL TRAWL SAMPLING STATIONS

IMPACT TRAWL STATION

REFERENCE TRAWL STATION

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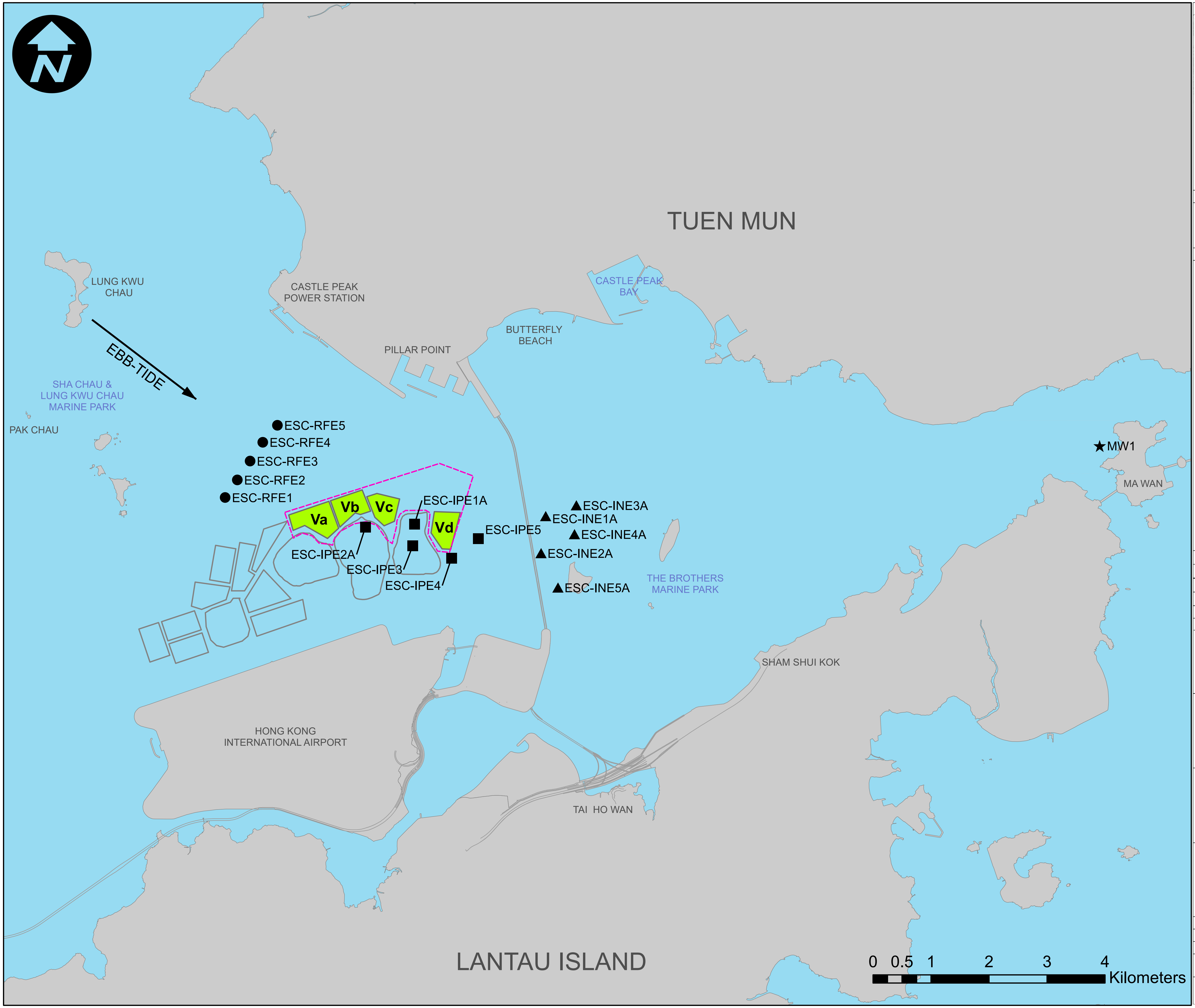
Title

MARINE BIOTA MONITORING STATIONS FOR ESC CMPS

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

Drawing Number

FIGURE 2.4



Key Plan:

Notes:

Key to symbols:

LEGEND

- ESC CMP V
- ESC USABLE AREA 1

WATER QUALITY SAMPLING STATIONS

- IMPACT STATION
- INTERMEDIATE STATION
- REFERENCE STATION
- MA WAN STATION

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Title

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

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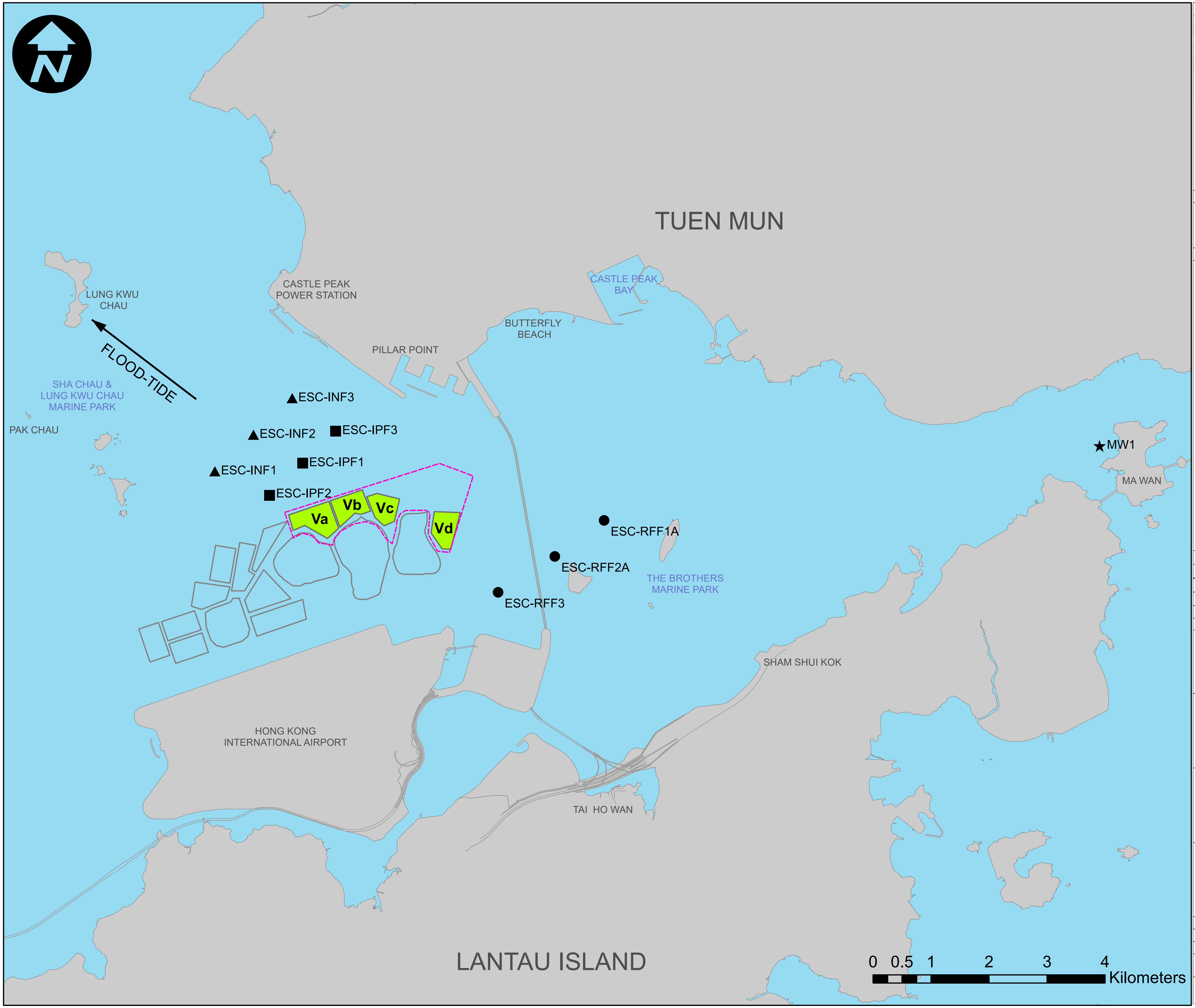
Drawn			Coordination	
Dwg check			Approved	
Scale at A3		Status		Rev

Drawing Number

FIGURE 2.5a



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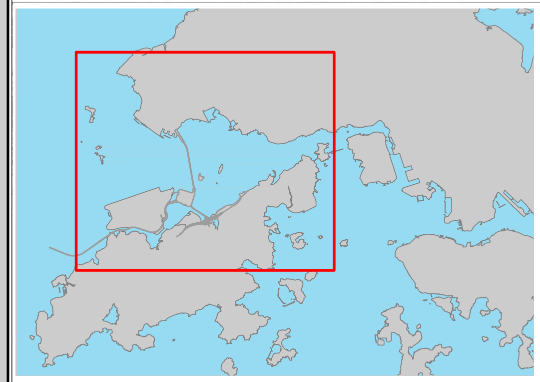

Notes:

Key to symbols:

LEGEND

- ESC CMP V
- ESC USABLE AREA 1

WATER QUALITY SAMPLING STATIONS

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

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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

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Drawn		Coordination	
Dwg check		Approved	
Scale at A3		Status	Rev

Drawing Number

FIGURE 2.5b

Appendices

A. Sampling Schedule

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

Parameter / Station Type	Station ID	Frequency	Jan 2021	Feb 2021	Mar 2021	Apr 2021	May 2021	Jun 2021	Jul 2021	Aug 2021	Sep 2021	Oct 2021	Nov 2021	Dec 2021	Jan 2022	Feb 2022	Mar 2022	Apr 2022	May 2022	Jun 2022	Jul 2022	Aug 2022	Sep 2022	Oct 2022	Nov 2022	Dec 2022	Jan 2023	Feb 2023	Mar 2023	Apr 2023	May 2023	Jun 2023	Jul 2023	Aug 2023	Sep 2023	Oct 2023	Nov 2023	Dec 2023	Jan 2024	Feb 2024	Mar 2024	Apr 2024	May 2024	Jun 2024	Jul 2024	Aug 2024	Sep 2024	Oct 2024	Nov 2024	Dec 2024	Jan 2025	Feb 2025	Mar 2025	Apr 2025	May 2025	Jun 2025	Jul 2025	Aug 2025	Sep 2025	Oct 2025	Nov 2025	Dec 2025	Jan 2026	Feb 2026	Mar 2026
Pit Specific Sediment Chemistry *		
Active-Pit		
	ESC-NPAA	Monthly	**6**	**6**	**6**	**6**	**6**	**6**	**6**	**6**	**6**	**6**	**6**	**6**	**6**	**6**	**6**	**6**	**6**	**6**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	2	2	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
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
	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
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
	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
Cumulative Impact Sediment Chemistry *		
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		
Near-pit Stations		
	ESC-TDA	2 times per year		**5**						**5**							**5#**					**5**						**5**						**5**						5						5						5						5						5	
	ESC-TDB1	2 times per year		**5**						**5**							**5#**					**5**						**5**						**5**						5						5						5						5						5	
Reference Stations		
	ESC-TRA	2 times per year		**5**						**5**							**5#**					**5**						**5**						**5**						5						5						5						5						5	
	ESC-TRB	2 times per year		**5**						**5**							**5#**					**5**						**5**						**5**						5						5						5						5						5	
Ma Wan Station		
	MW1	2 times per year		**5**						**5**							**5#**					**5**						**5**						**5**						5						5						5						5						5	
Tissue / Whole Body Sampling		
Near-pit Stations		
	ESC-INA	2 times per year		*						*						*							*					*						*						*						*						*						*						*	
	ESC-INB	2 times per year		*						*						*							*					*						*						*						*						*						*						*	
Reference North		
	TNA	2 times per year		*						*						*							*					*						*						*						*						*						*						*	
	TNB	2 times per year		*						*						*							*					*						*						*						*						*						*						*	
Reference South		
	TSA	2 times per year		*						*						*							*					*						*						*						*						*						*						*	
	TSB	2 times per year		*						*						*							*					*						*						*						*						*						*						*	
Demersal Trawling		
Near-pit Stations		
	ESC-INA	4 times per year	**5**	**5**					**5**	**5**					**5**	**5**						**5^**	**5^**				**5**	**5**					**5**	**5**					5	5					5	5					5	5					5	5					5	5	
	ESC-INB	4 times per year	**5**	**5**					**5**	**5**					**5**	**5**						**5^**	**5^**				**5**	**5**					**5**	**5**					5	5					5	5					5	5					5	5					5	5	
Reference North		
	TNA	4 times per year	**5**	**5**					**5**	**5**					**5**	**5**						**5^**	**5^**				**5**	**5**					**5**	**5**					5	5					5	5					5	5					5	5					5	5	
	TNB	4 times per year	**5**	**5**					**5**	**5**					**5**	**5**						**5^**	**5^**				**5**	**5**					**5**	**5**					5	5					5	5					5	5					5	5					5	5	
Reference South		
	TSA	4 times per year	**5**	**5**					**5**	**5**					**5**	**5**						**5^**	**5^**				**5**	**5**					**5**	**5**					5	5					5	5					5	5					5	5					5	5	
	TSB	4 times per year	**5**	**5**					**5**	**5**					**5**	**5**						**5^**	**5^**				**5**	**5**					**5**	**5**					5	5					5	5					5	5					5	5					5	5	
Capping *		
Ebb Tide		
Impact Station Downcurrent		
	ESC-IPE1A	4 times per year *																																																																
	ESC-IPE2A	4 times per year *																																																															
	ESC-IPE3	4 times per year *																																																															
	ESC-IPE4	4 times per year *																																																															
	ESC-IPE5	4 times per year *																																																															
Intermediate Station Downcurrent		
	ESC-INE1A	4 times per year *																																																														
	ESC-INE2A	4 times per year *																																																														
	ESC-INE3A	4 times per year *																																																														
	ESC-INE4A	4 times per year *																																																														
	ESC-INE5A	4 times per year *																																																														
Reference Station Upcurrent		
	ESC-RFE1	4 times per year *																																																														
	ESC-RFE2	4 times per year *																																																														
	ESC-RFE3	4 times per year *																																																														
	ESC-RFE4	4 times per year *																																																														
	ESC-RFE5	4 times per year *																																																														
Ma Wan Station		
	MW1	4 times per year *																																																														
Flood Tide		
Impact Station Downcurrent		
	ESC-IPF1	4 times per year *																																																														
	ESC-IPF2	4 times per year *																																																														
	ESC-IPF3	4 times per year *																																																														
Intermediate Station Downcurrent		
	ESC-INF1	4 times per year *																																																														
	ESC-INF2	4 times per year *																																																														
	ESC-INF3	4 times per year *																																																														
Reference Station Upcurrent		
	ESC-RFF1A	4 times per year *																																																														
	ESC-RFF2A	4 times per year *																																																														
	ESC-RFF3	4 times per year *																																																														
Ma Wan Station		
	MW1	4 times per year *																																																														
Routine Water Quality Monitoring *		
Ebb Tide		
Impact Station Downcurrent		
	ESC-IPE1A	Monthly*				**4**	**4**	**4**		**4**		**4**	**4**			**4**		**4**	**4**	**4**		**2**		**2**			**2**	**2**		**2**	**2**		**2**				**2**		2	2	2	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
	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
	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
	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
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
	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
	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
	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
	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
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
	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
	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
	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
	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
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
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
	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
	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
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
	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
	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
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
	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
	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
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
Water Column Profiling *		
Plume Stations		
	WCP1	Monthly*	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	WCP2	Monthly*	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Benthic Recolonisation Studies		
Capped Stations at CMP V		
	ESCV-CPA	2 times per year																																																														
	ESCV-CPB	2 times per year																																																														
	ESCV-CPC	2 times per year																																																														
	ESCV-CPD	2 times per year																																																														
Reference Stations		
	RBA	2 times per year																																																														
	RBB	2 times per year																																																														
	RBC1	2 times per year																																																														
Impact Monitoring for Dredging		
Upstream Stations		
	US1	3 times per week														**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 number 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 was postponed to August and September 2022.

B. Graphical Presentation of the Annual Monitoring Results for January to December 2023

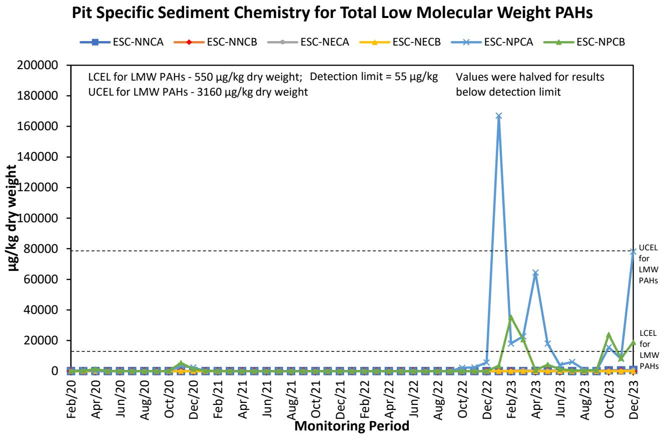


Figure 1: Levels of Total Low Molecular Weight Polycyclic Aromatic Hydrocarbons during Pit Specific Sediment Chemistry Monitoring for ESC CMP Vb from February 2020 to December 2023.

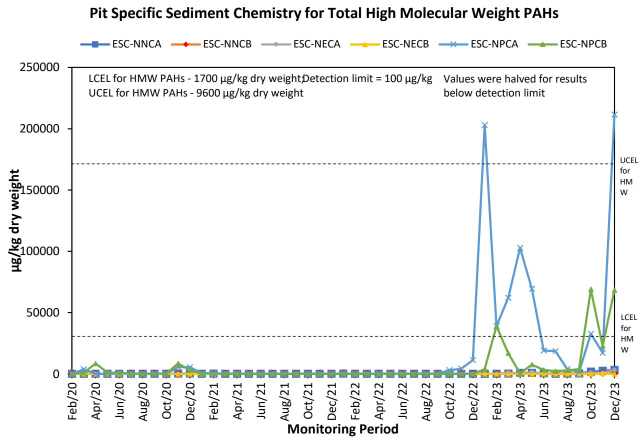


Figure 2: Levels of Total High Molecular Weight Polycyclic Aromatic Hydrocarbons during Pit Specific Sediment Chemistry Monitoring for ESC CMP Vb from February 2020 to December 2023.

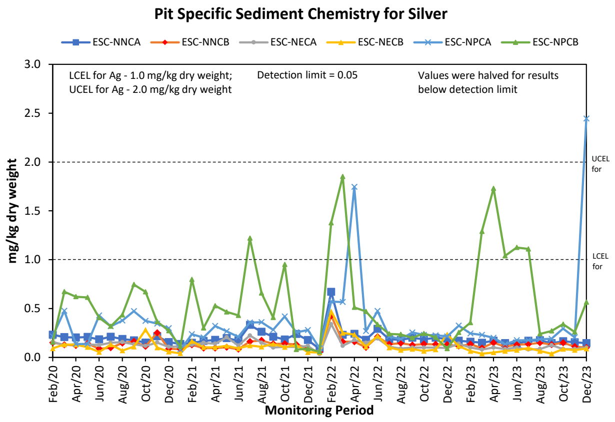


Figure 3: Levels of Silver during Pit Specific Sediment Chemistry Monitoring for ESC CMP Vb from February 2020 to December 2023.

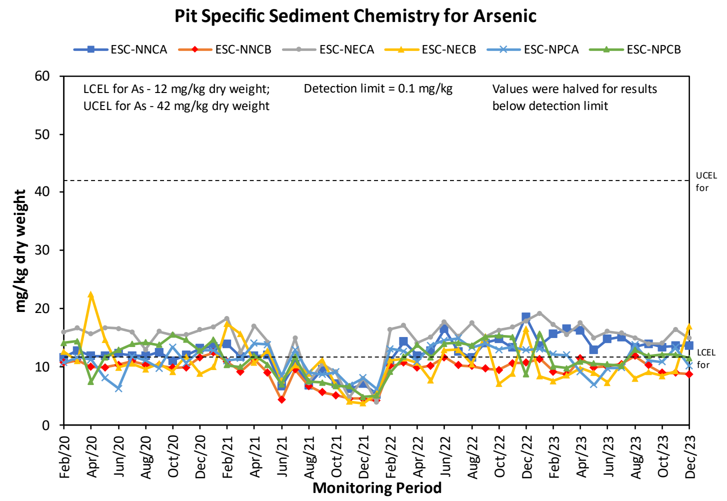


Figure 4: Levels of Arsenic during Pit Specific Sediment Chemistry Monitoring for ESC CMP Vb from February 2020 to December 2023.

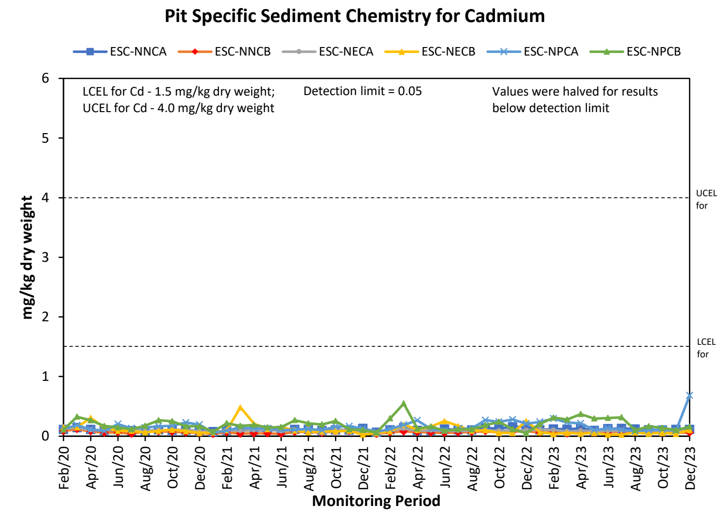


Figure 5: Levels of Cadmium during Pit Specific Sediment Chemistry Monitoring for ESC CMP Vb from February 2020 to December 2023.

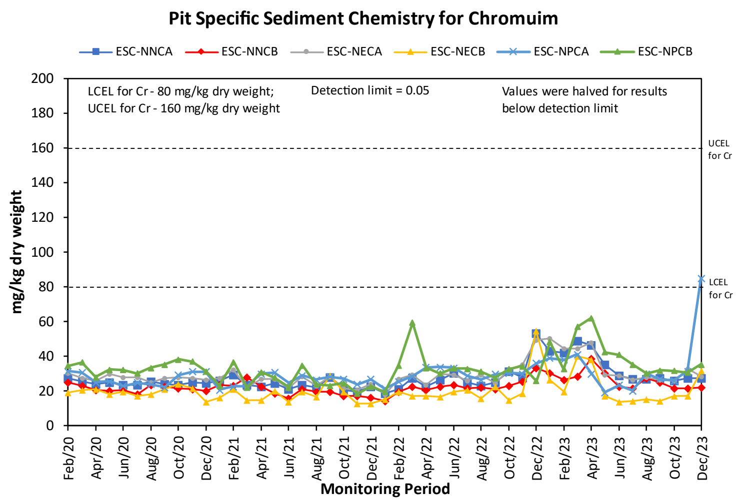


Figure 6: Levels of Chromium during Pit Specific Sediment Chemistry Monitoring for ESC CMP Vb from February 2020 to December 2023.

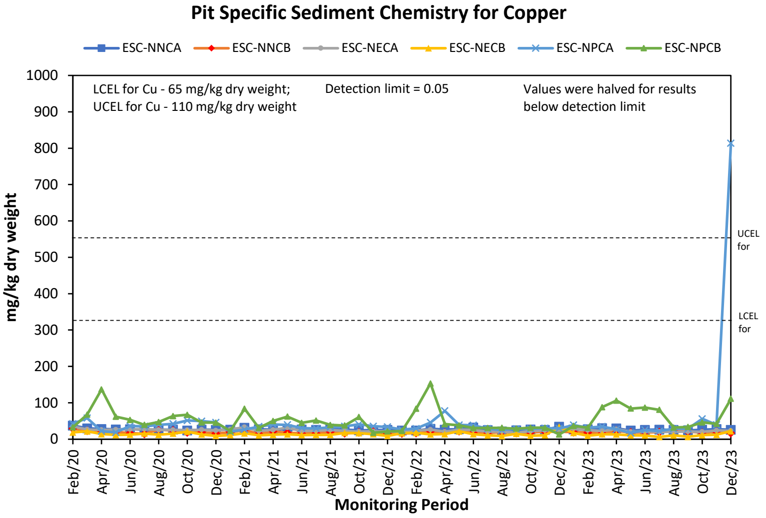


Figure 7: Levels of Copper during Pit Specific Sediment Chemistry Monitoring for ESC CMP Vb from February 2020 to December 2023.

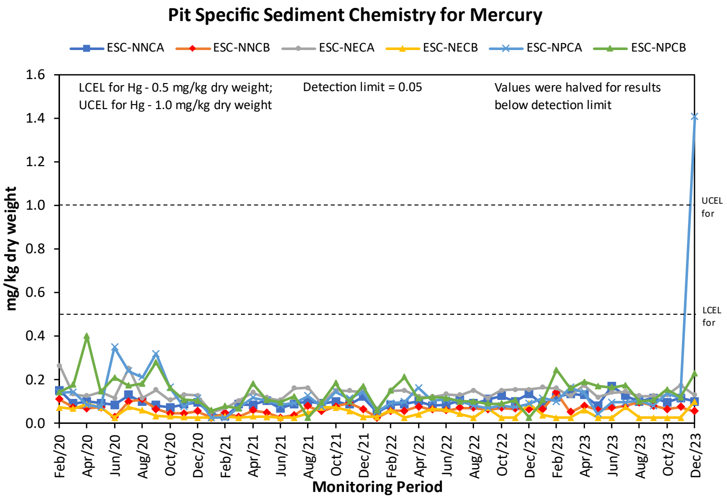


Figure 8: Levels of Mercury during Pit Specific Sediment Chemistry Monitoring for ESC CMP Vb from February 2020 to December 2023.

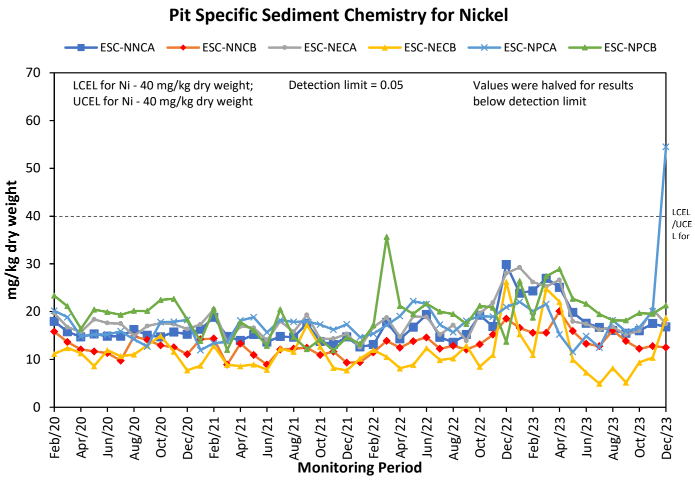


Figure 9: Levels of Nickel during Pit Specific Sediment Chemistry Monitoring for ESC CMP Vb from February 2020 to December 2023.

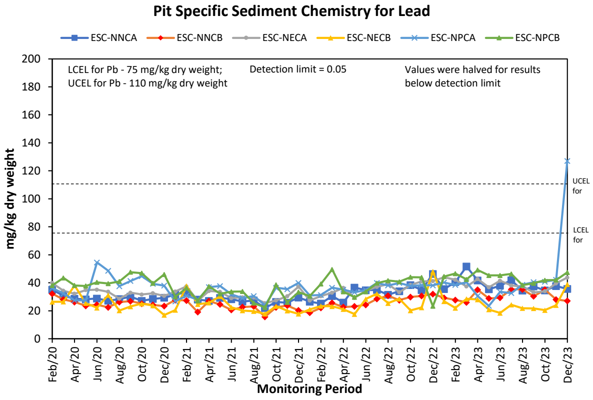


Figure 10: Levels of Lead during Pit Specific Sediment Chemistry Monitoring for ESC CMP Vb from February 2020 to December 2023.

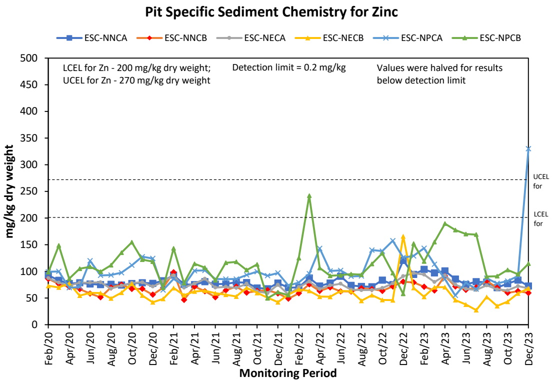


Figure 11: Levels of Zinc during Pit Specific Sediment Chemistry Monitoring for ESC CMP Vb from February 2020 to December 2023.

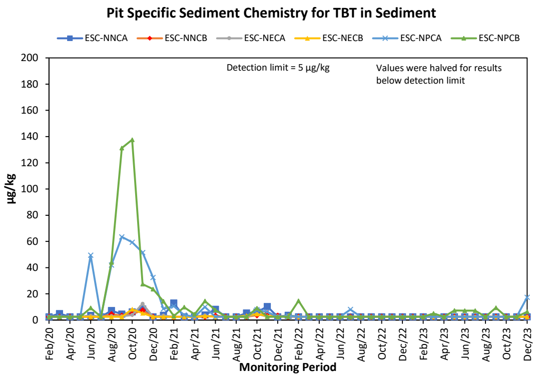


Figure 12: Levels of Tributyltin (TBT) in Sediment during Pit Specific Sediment Chemistry Monitoring for ESC CMP Vb from February 2020 to December 2023.

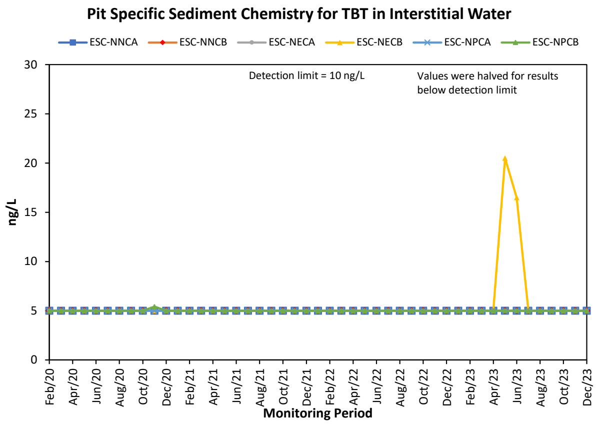


Figure 13: Levels of Tributyltin (TBT) in Interstitial Water during Pit Specific Sediment Chemistry Monitoring for ESC CMP Vb from February 2020 to December 2023.

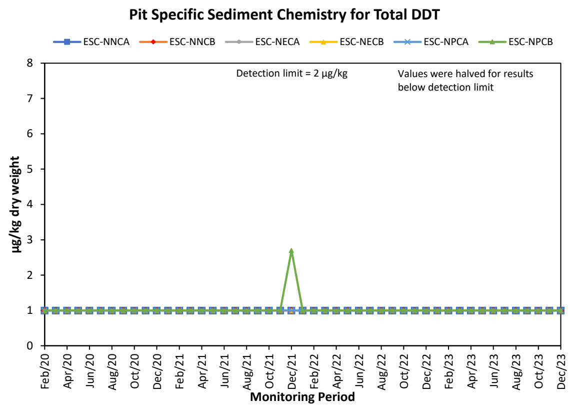


Figure 14: Levels of Total Dichloro-diphenyl-trichloroethane (DDT) during Pit Specific Sediment Chemistry Monitoring for ESC CMP Vb from February 2020 to December 2023.

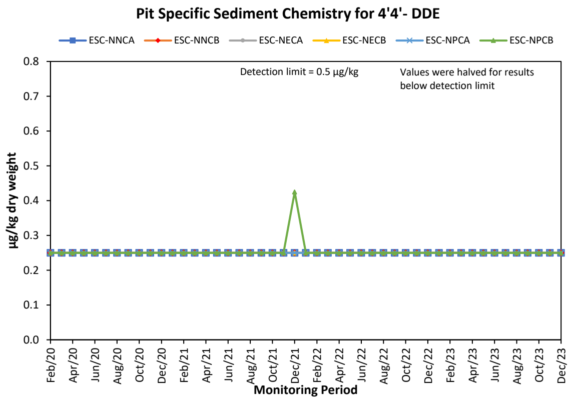


Figure 15: Levels of 4,4’-Dichloro-diphenyl-dichloroethylene (4,4’-DDE) during Pit Specific Sediment Chemistry Monitoring for ESC CMP Vb from February 2020 to December 2023.

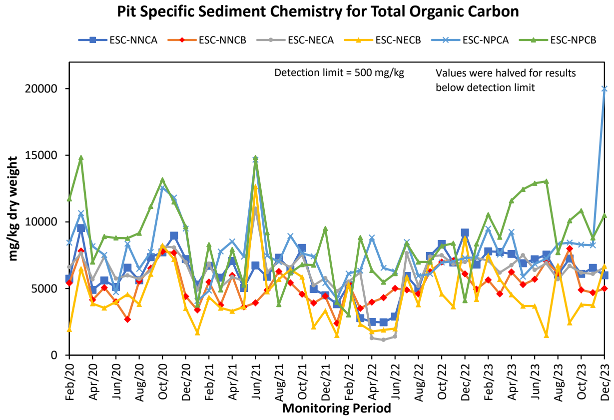


Figure 16: Levels of Total Organic Carbon (TOC) during Pit Specific Sediment Chemistry Monitoring for ESC CMP Vb from February 2020 to December 2023.

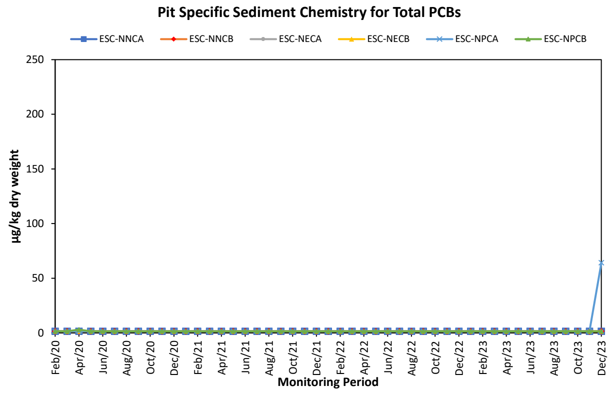


Figure 17: Levels of Total Polychlorinated Biphenyls (PCBs) during Pit Specific Sediment Chemistry Monitoring for ESC CMP Vb from February 2020 to December 2023.

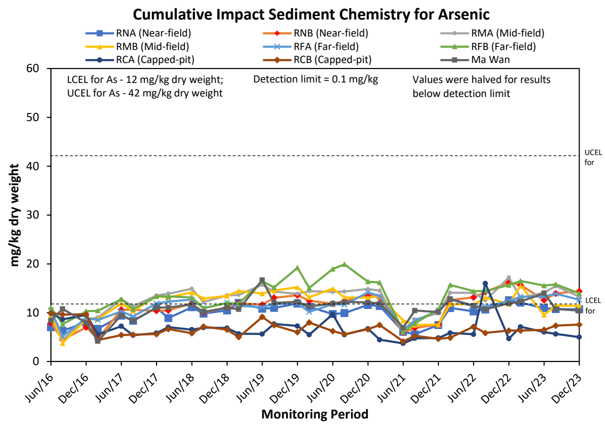


Figure 18: Levels of Arsenic during Cumulative Impact Sediment Chemistry Monitoring for ESC CMP Vb from June 2016 to December 2023.

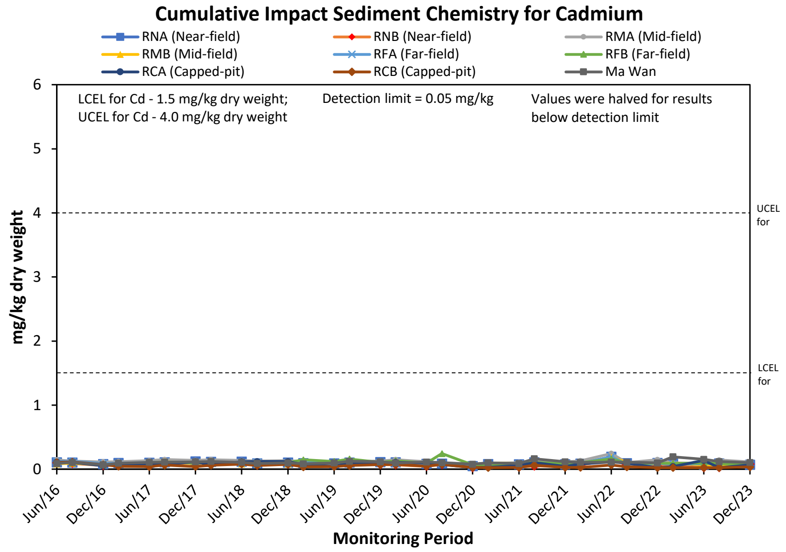


Figure 19: Levels of Cadmium during Cumulative Impact Sediment Chemistry Monitoring for ESC CMP Vb from June 2016 to December 2023.

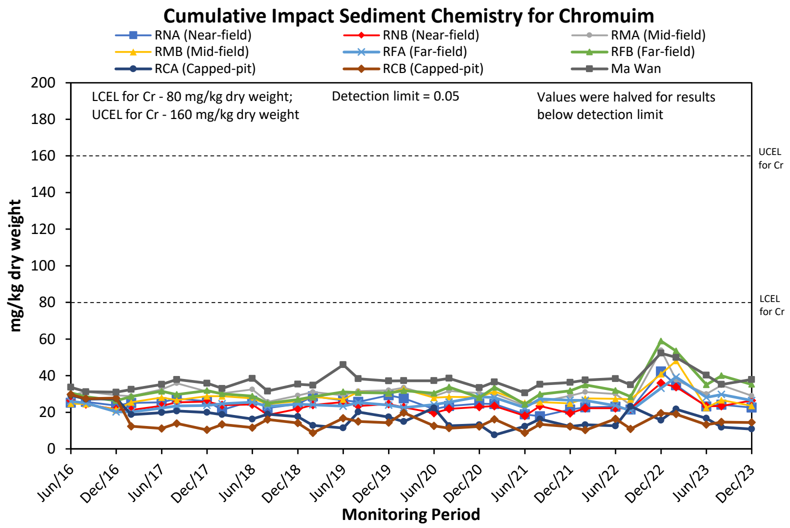


Figure 20: Levels of Chromium during Cumulative Impact Sediment Chemistry Monitoring for ESC CMP Vb from June 2016 to December 2023.

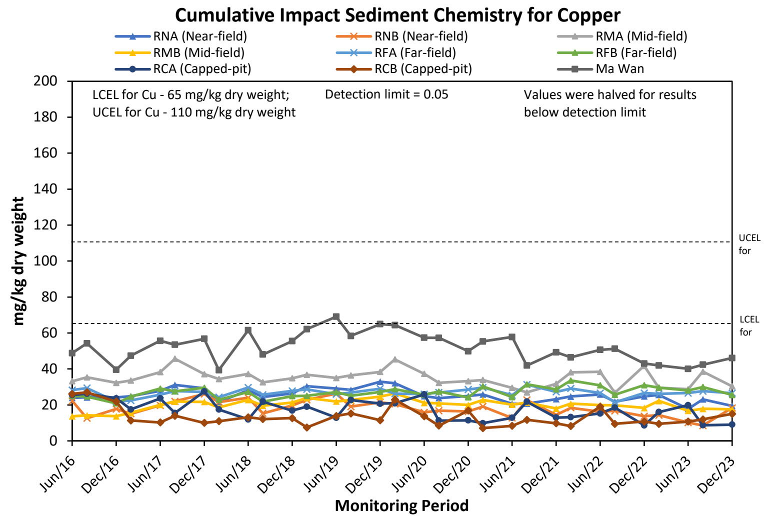


Figure 21: Levels of Copper during Cumulative Impact Sediment Chemistry Monitoring for ESC CMP Vb from June 2016 to December 2023.

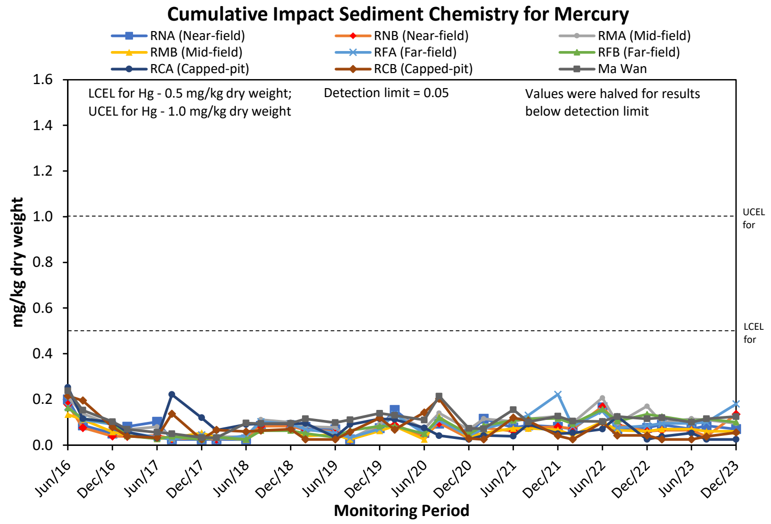


Figure 22: Levels of Mercury during Cumulative Impact Sediment Chemistry Monitoring for ESC CMP Vb from June 2016 to December 2023.

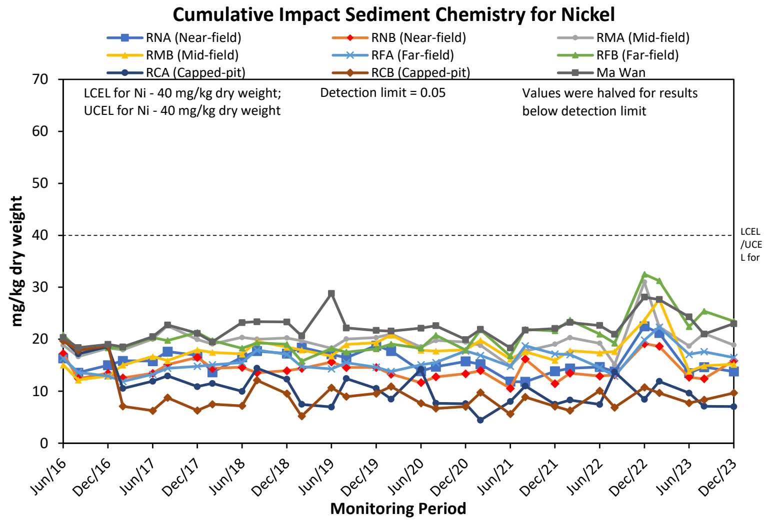


Figure 23: Levels of Nickel during Cumulative Impact Sediment Chemistry Monitoring for ESC CMP Vb from June 2016 to December 2023.

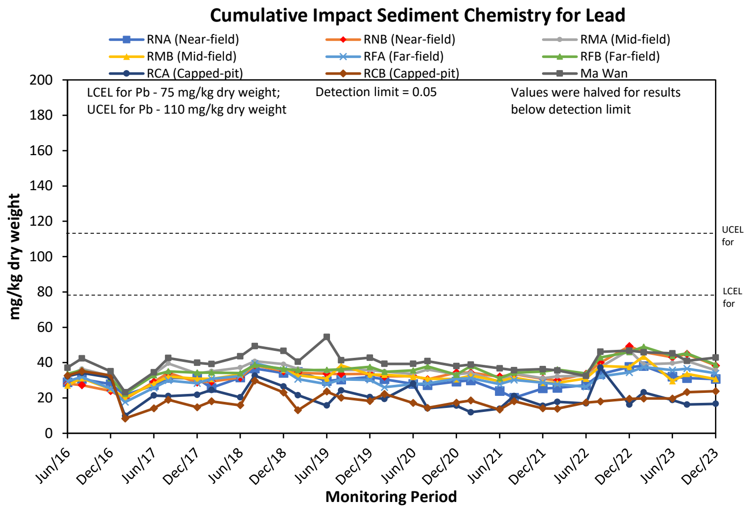


Figure 24: Levels of Lead during Cumulative Impact Sediment Chemistry Monitoring for ESC CMP Vb from June 2016 to December 2023.

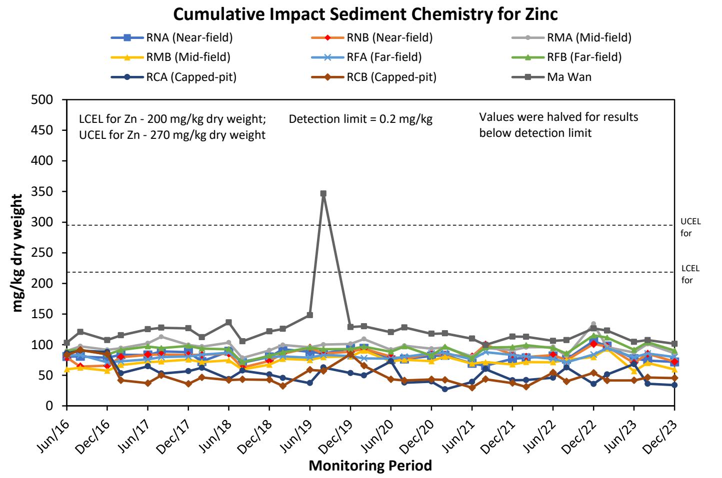


Figure 25: Levels of Zinc during Cumulative Impact Sediment Chemistry Monitoring for ESC CMP Vb from June 2016 to December 2023.

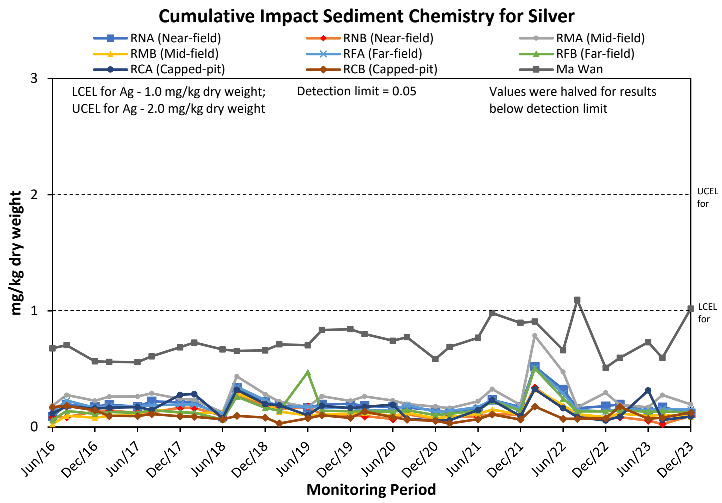


Figure 26: Levels of Silver during Cumulative Impact Sediment Chemistry Monitoring for ESC CMP Vb from June 2016 to December 2023.

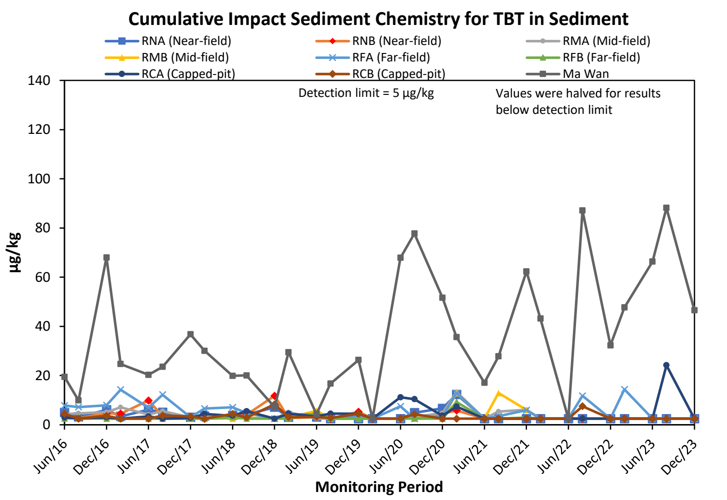


Figure 27: Levels of Tributyltin (TBT) in Sediment during Cumulative Impact Sediment Chemistry Monitoring for ESC CMP Vb from June 2016 to December 2023.

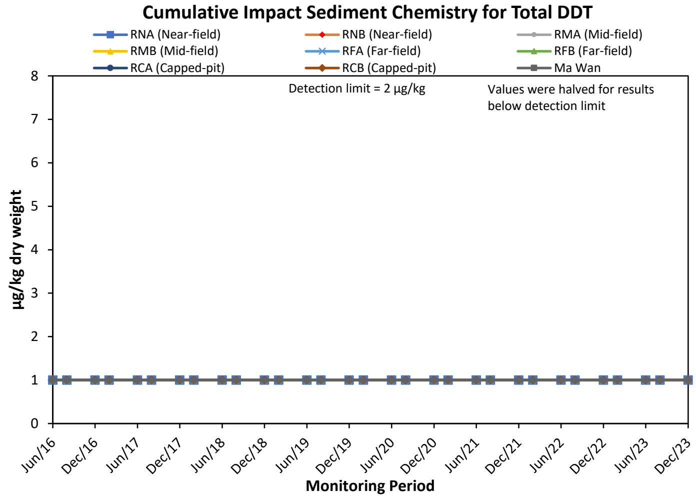


Figure 28: Levels of Total Dichloro-diphenyl-trichloroethane (DDT) during Cumulative Impact Sediment Chemistry Monitoring for ESC CMP Vb from June 2016 to December 2023.

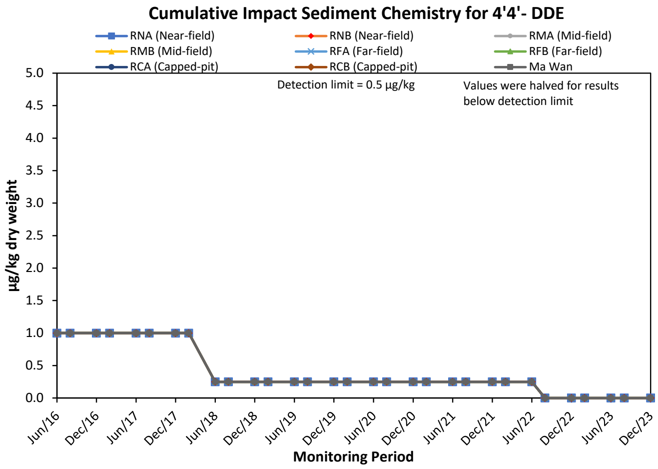


Figure 29: Levels of 4,4’-Dichloro-diphenyl-dichloroethylene (4,4’-DDE) during Cumulative Impact Sediment Chemistry Monitoring for ESC CMP Vb from June 2016 to December 2023.

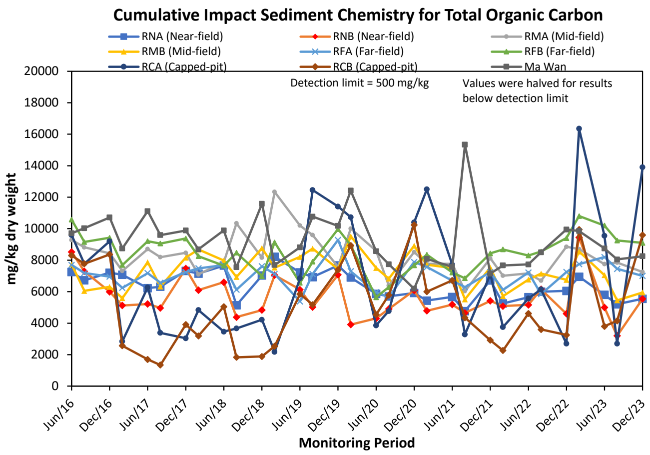


Figure 30: Levels of Total Organic Carbon (TOC) during Cumulative Impact Sediment Chemistry Monitoring for ESC CMP Vb from June 2016 to December 2023.

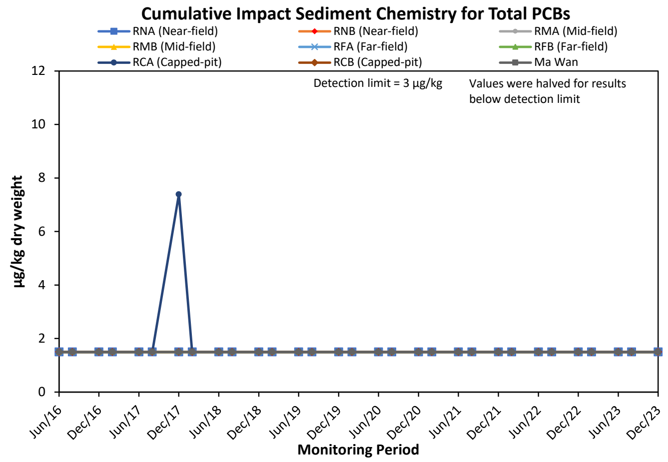


Figure 31: Levels of Total Polychlorinated Biphenyls (PCBs) during Cumulative Impact Sediment Chemistry Monitoring for ESC CMP Vb from June 2016 to December 2023.

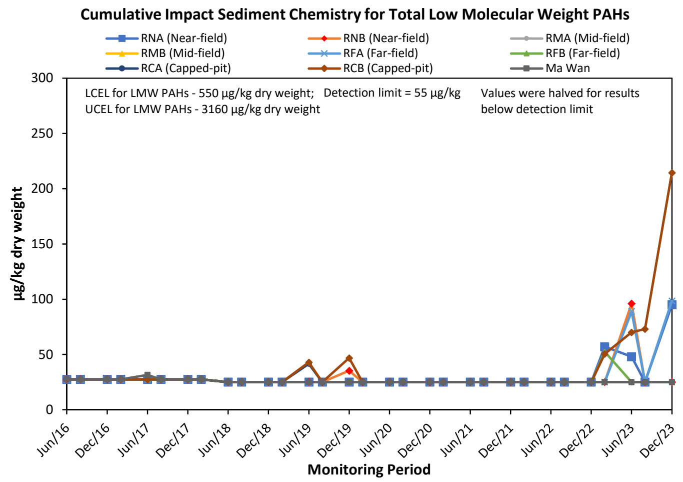


Figure 32: Levels of Total Low Molecular Weight Polycyclic Aromatic Hydrocarbons during Cumulative Impact Sediment Chemistry Monitoring for ESC CMP Vb from June 2016 to December 2023.

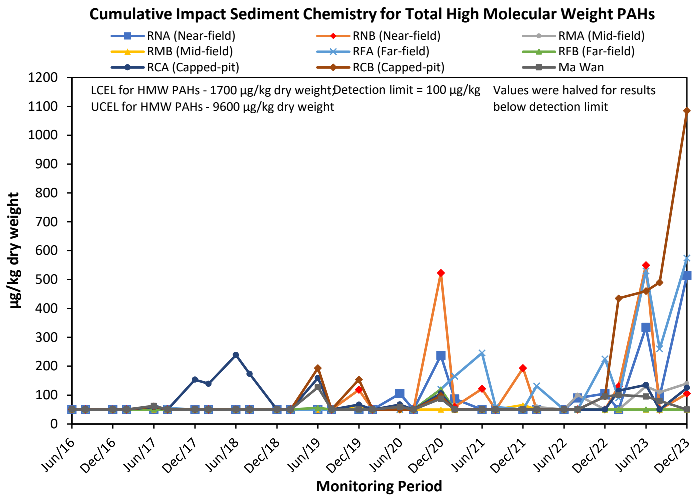


Figure 33: Levels of Total High Molecular Weight Polycyclic Aromatic Hydrocarbons during Cumulative Impact Sediment Chemistry Monitoring for ESC CMP Vb from June 2016 to December 2023.

Figure 34: Mean levels of Silver in tissue of the eight target species from March 2006 to September 2023.

Remarks:
Limit of Detection (LOD) =0.05 $mgkg^{-1}$; 50% LOD used if analysis <LOD; Missing samples represent insufficient tissue for analysis.

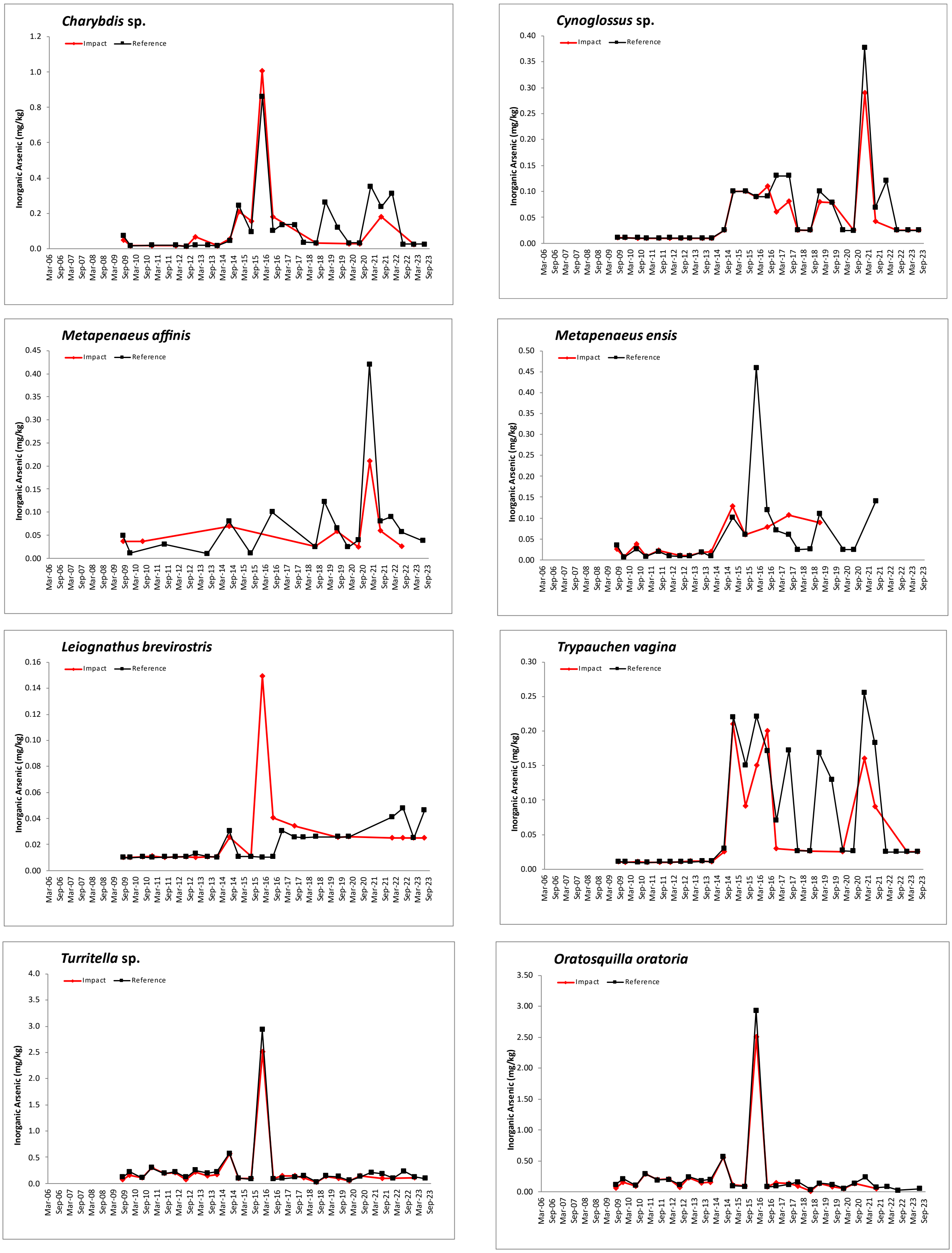


Figure 35: Mean levels of Inorganic Arsenic in tissue of the eight target species from March 2006 to September 2023.

Remarks:
Limit of Detection (LOD) =0.05 mgkg^{-1}; 50% LOD used if analysis <LOD; Missing samples represent insufficient tissue for analysis.
Monitoring of Inorganic Arsenic began in July 2009, following previous monitoring of Total Arsenic.

Figure 36: Mean levels of Cadmium in tissue of the eight target species from March 2006 to September 2023.

Remarks:
Limit of Detection (LOD) =0.05 mgkg^{-1}; 50% LOD used if analysis <LOD; Missing samples represent insufficient tissue for analysis.

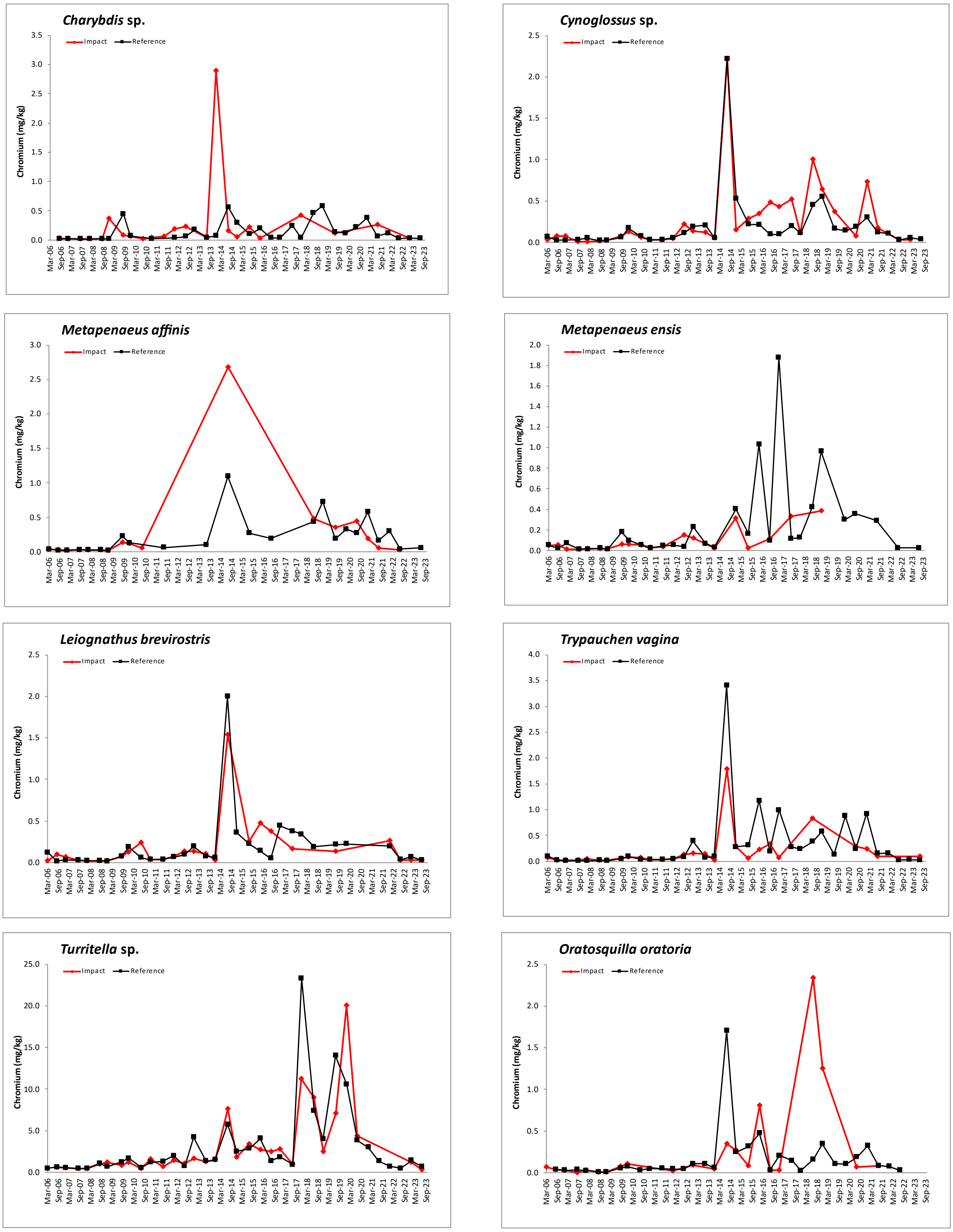


Figure 37: Mean levels of Chromium in tissue of the eight target species from March 2006 to September 2023.

Remarks:
Limit of Detection (LOD) =0.05 mgkg^{-1}; 50% LOD used if analysis <LOD; Missing samples represent insufficient tissue for analysis.

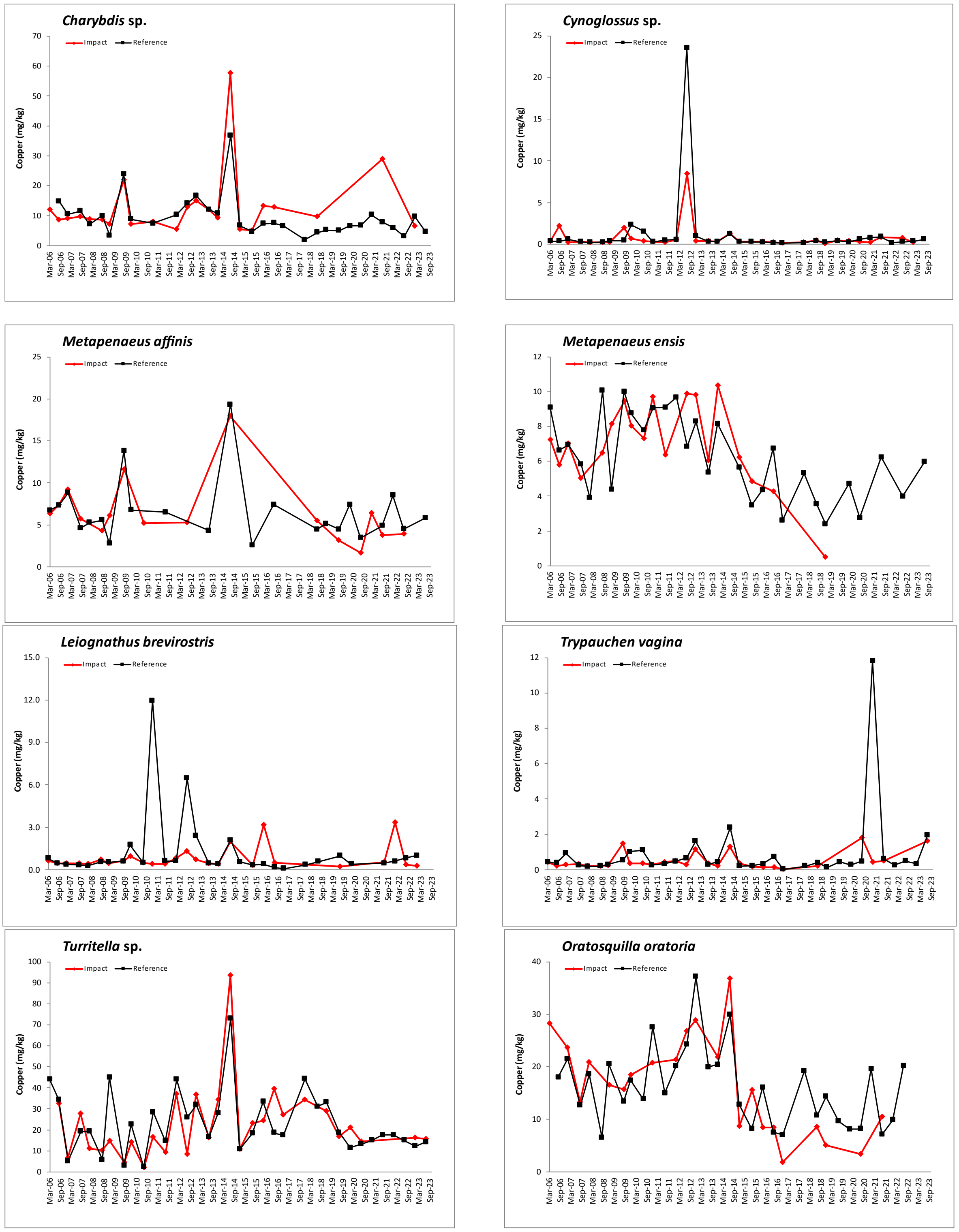


Figure 38: Mean levels of Copper in tissue of the eight target species from March 2006 to September 2023.

Remarks:
Limit of Detection (LOD) =0.05 mgkg^{-1}; 50% LOD used if analysis <LOD; Missing samples represent insufficient tissue for analysis.

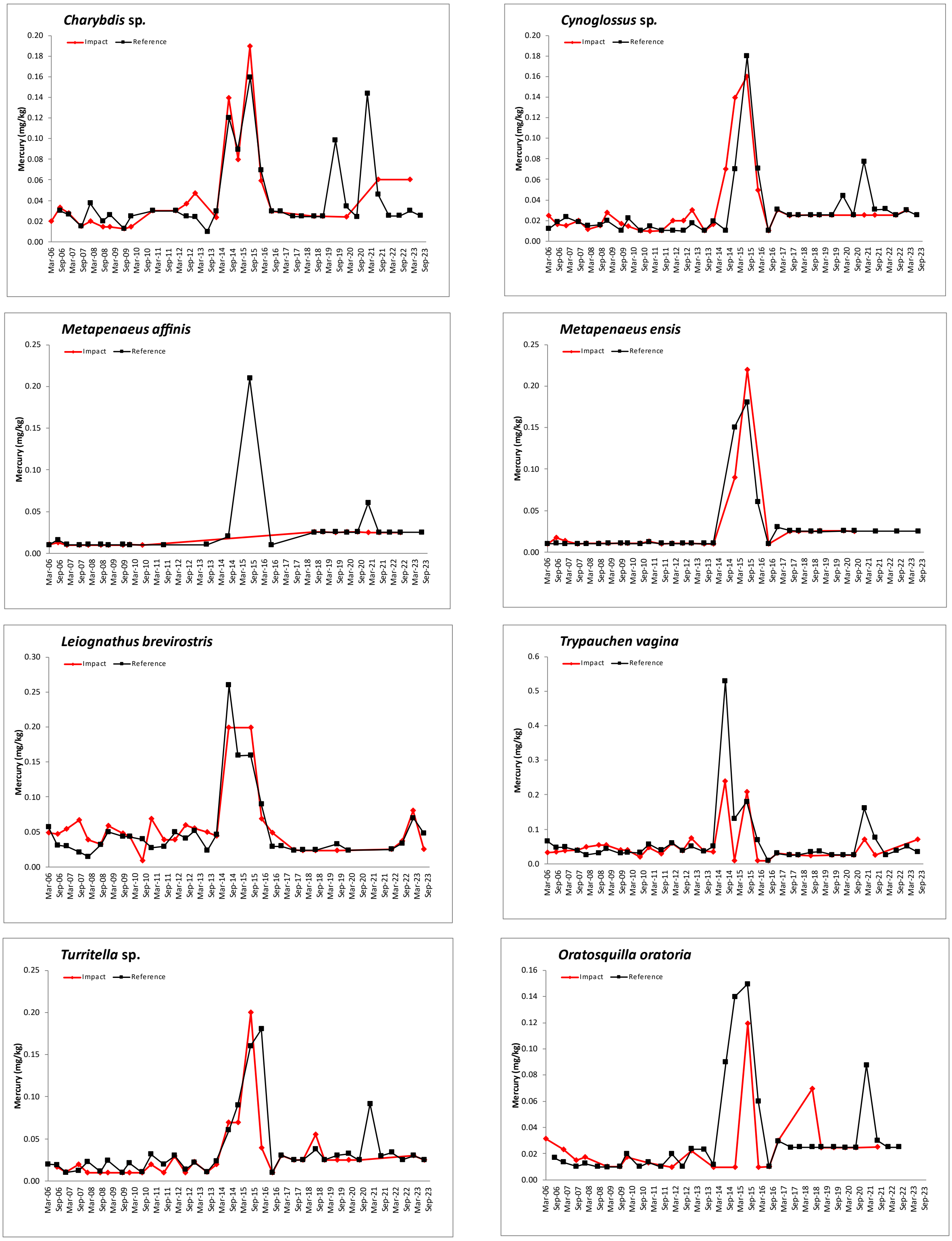


Figure 39: Mean levels of Total Mercury in tissue of the eight target species from March 2006 to September 2023.

Remarks:
Limit of Detection (LOD) =0.05 mgkg^{-1}; 50% LOD used if analysis <LOD; Missing samples represent insufficient tissue for analysis.

Figure 40: Mean levels of Nickel in tissue of the eight target species from March 2006 to September 2023.

Remarks:
Limit of Detection (LOD) =0.05 mgkg^{-1}; 50% LOD used if analysis <LOD; Missing samples represent insufficient tissue for analysis.

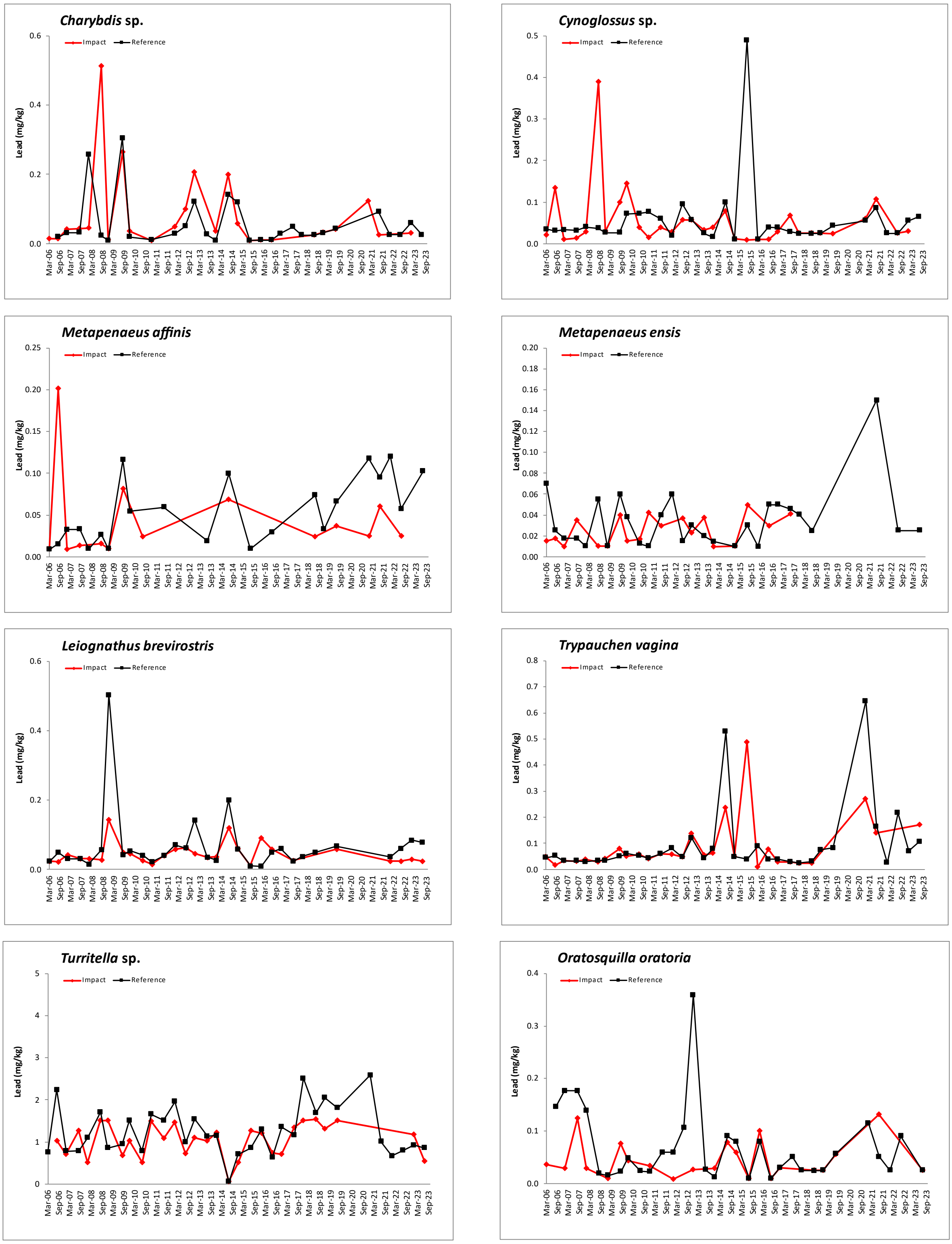


Figure 41: Mean levels of Lead in tissue of the eight target species from March 2006 to September 2023.

Remarks:
Limit of Detection (LOD) =0.05 $mgkg^{-1}$; 50% LOD used if analysis <LOD; Missing samples represent insufficient tissue for analysis.

Figure 42: Mean levels of Zinc in tissue of the eight target species from March 2006 to September 2023.

Remarks:
Limit of Detection (LOD) =0.05 mgkg^{-1}; 50% LOD used if analysis <LOD; Missing samples represent insufficient tissue for analysis.

Figure 43: Mean levels of 4,4’-Dichloro-diphenyl-dichloroethylene (4,4’-DDE) in tissue of the eight target species from March 2006 to September 2023.

Remarks:
Limit of Detection (LOD) =0.5 µgkg^{-1}; 50% LOD used if analysis <LOD; Missing samples represent insufficient tissue for analysis.

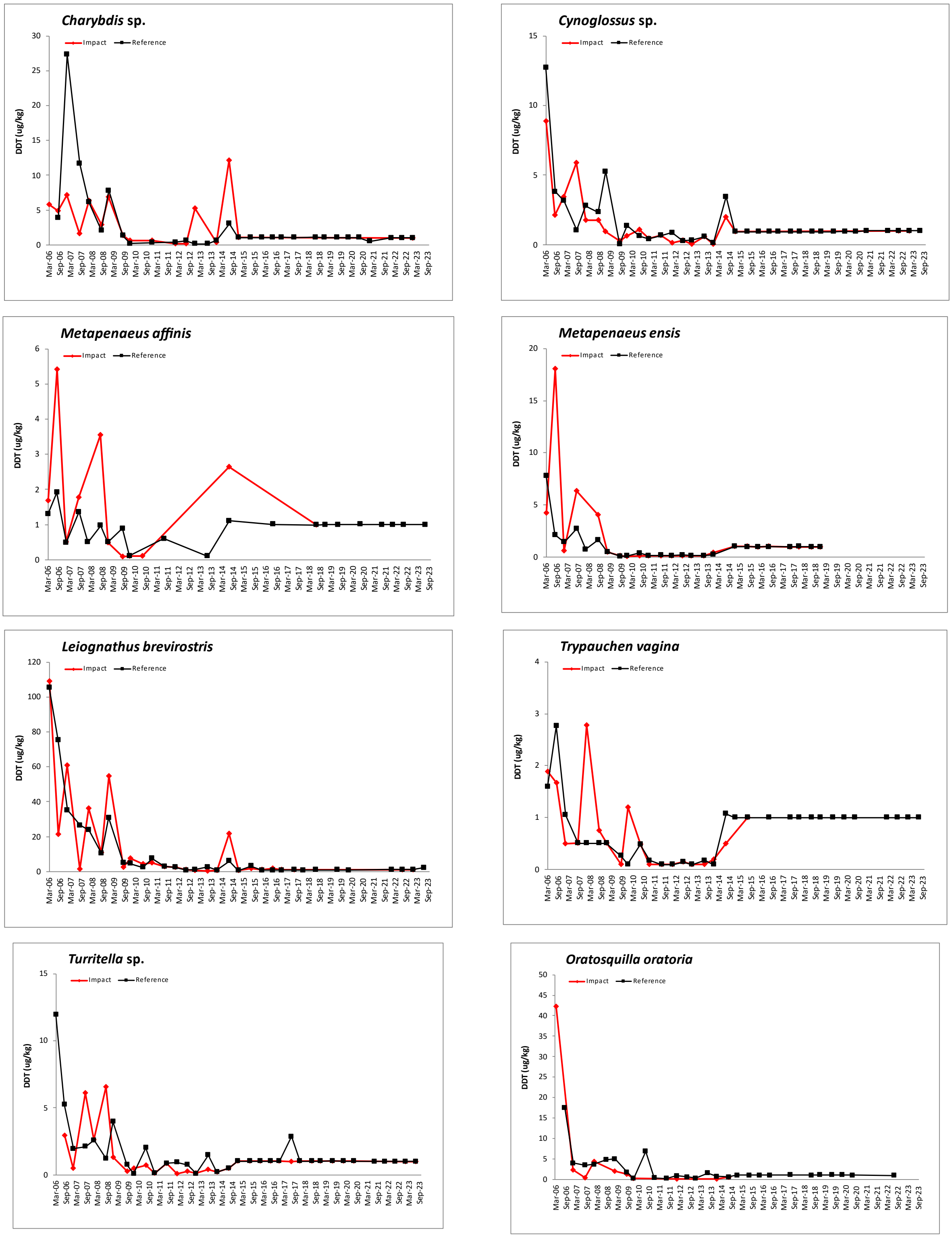


Figure 44: Mean levels of Total Dichloro-diphenyl-trichloroethane (DDT) in tissue of the eight target species from March 2006 to September 2023.

Remarks:
Limit of Detection (LOD) =2 μgkg^{-1}; 50% LOD used if analysis <LOD; Missing samples represent insufficient tissue for analysis.

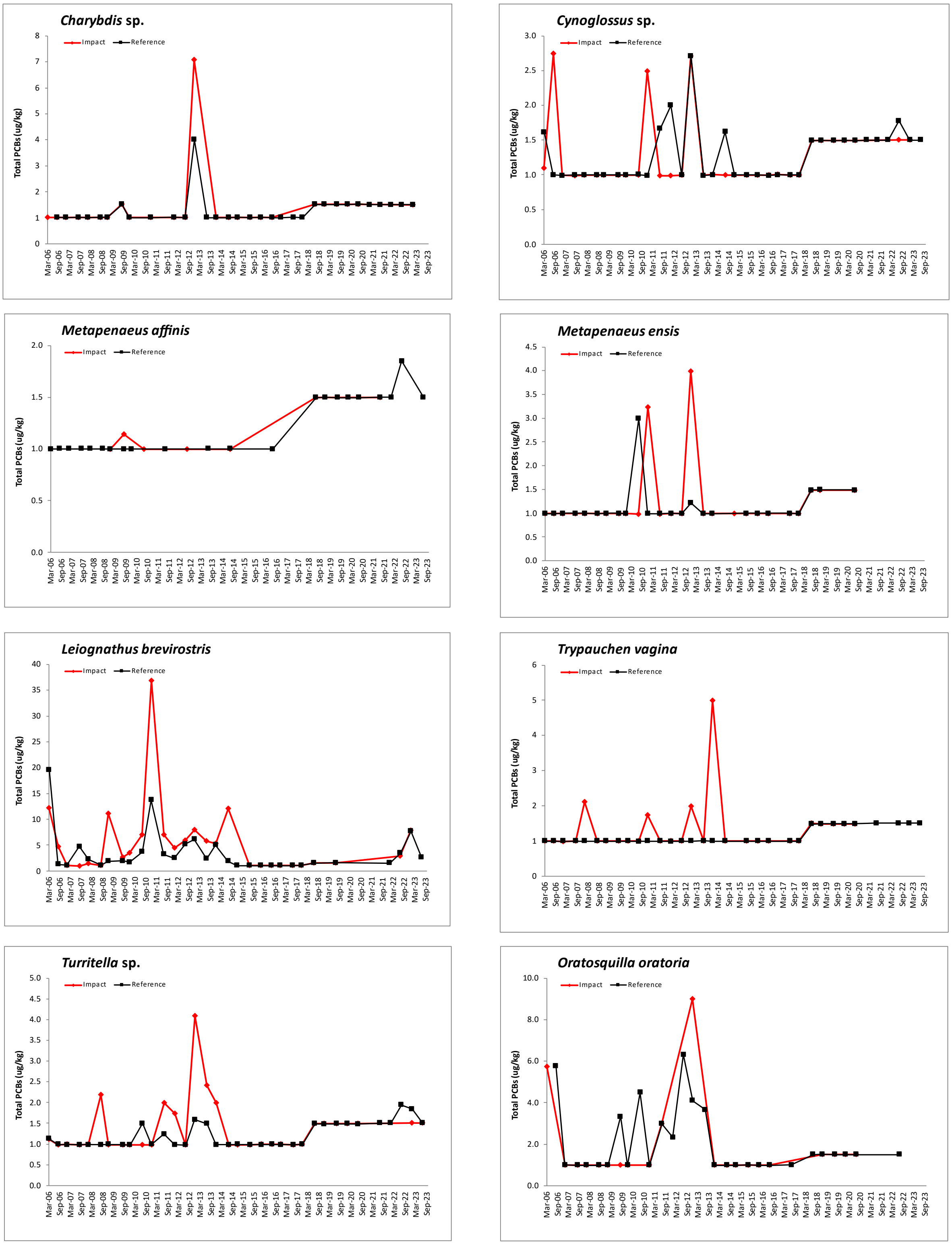


Figure 45: Mean levels of Total Polychlorinated Biphenyls (PCBs) in tissue of the eight target species from March 2006 to September 2023.

Remarks:
Limit of Detection (LOD) =3 μgkg^{-1}; 50% LOD used if analysis <LOD; Missing samples represent insufficient tissue for analysis.

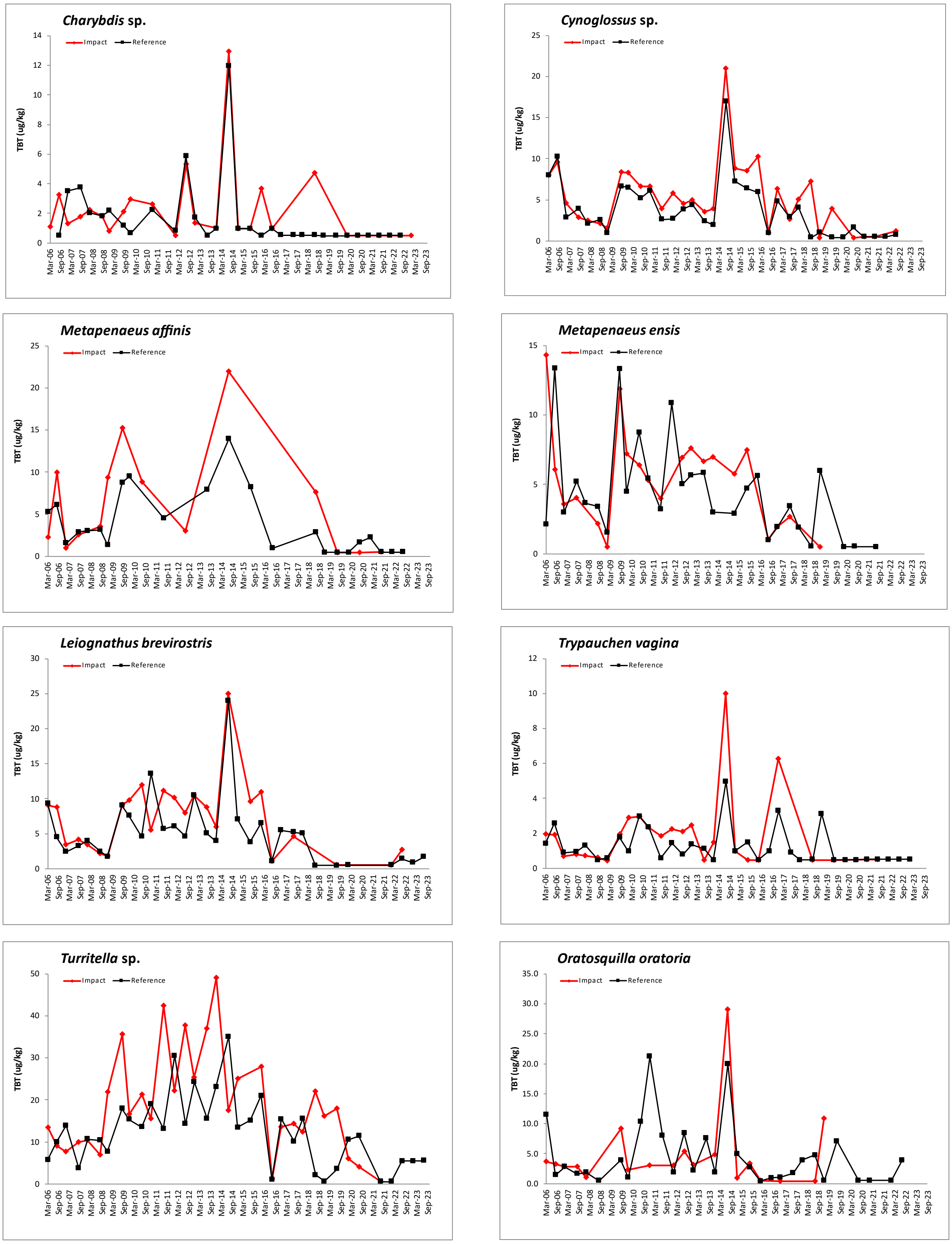


Figure 46: Mean levels of Tributyltin (TBT) in tissue of the eight target species from March 2006 to September 2023.

Remarks:
Limit of Detection (LOD) =1 μgkg^{-1}; 50% LOD used if analysis <LOD; Missing samples represent insufficient tissue for analysis.

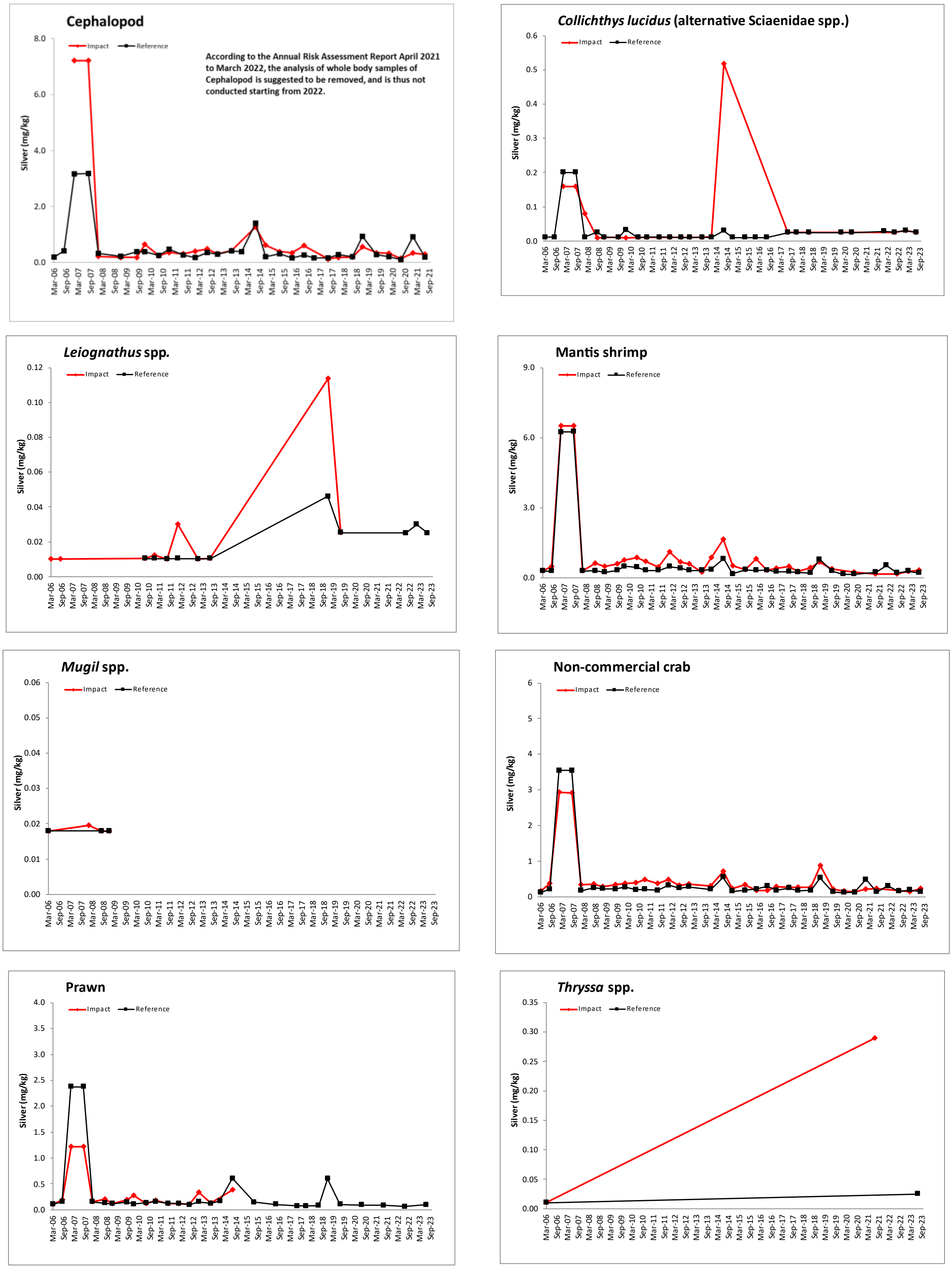
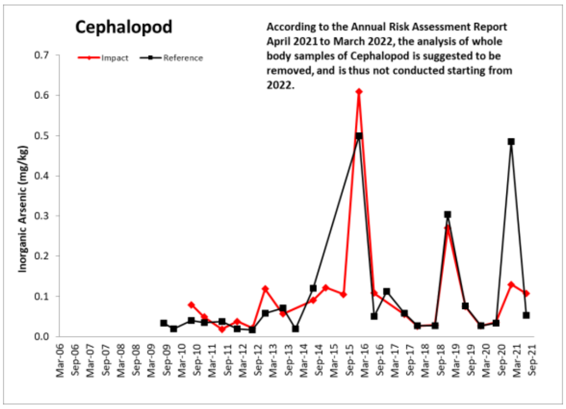
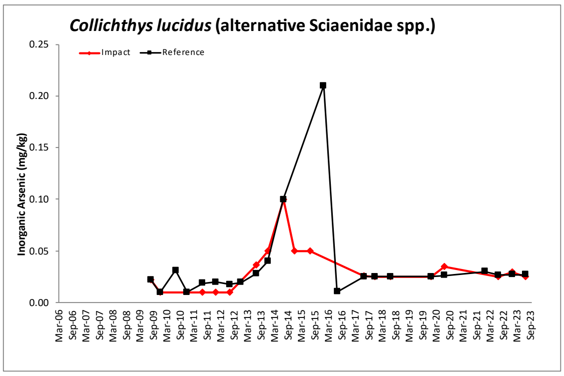
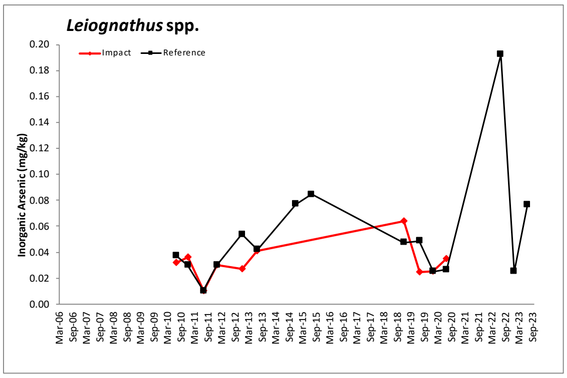


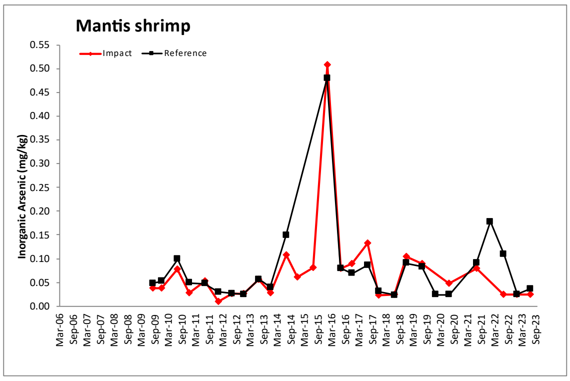
Figure 47: Mean levels of Silver in whole body samples of the eight target species from March 2006 to September 2023.

Remarks:
Limit of Detection (LOD) =0.05 mgkg^{-1}; 50% LOD used if analysis <LOD; Missing samples represent insufficient tissue for analysis.

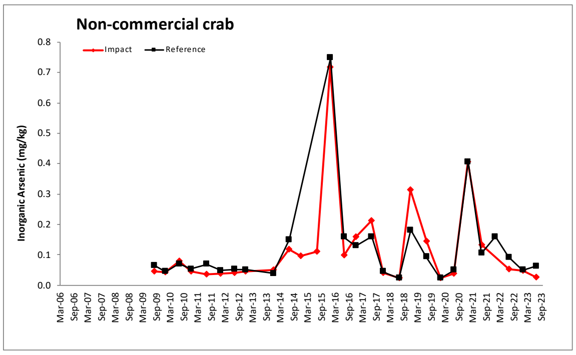


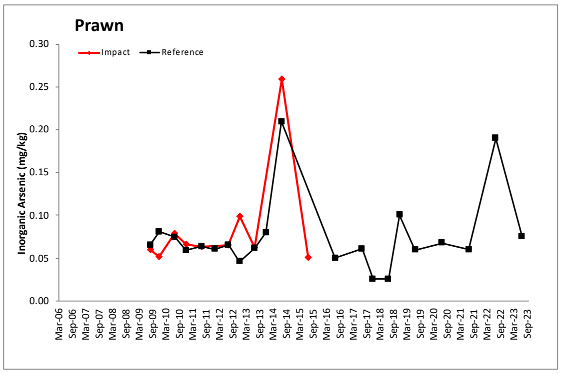






No data available for *Mugil* spp.





No data available for *Thryssa* spp.

Figure 48: Mean levels of Inorganic Arsenic in whole body samples of the eight target species from March 2006 to September 2023.

Remarks:
Limit of Detection (LOD) =0.05 mgkg^{-1}; 50% LOD used if analysis <LOD; Missing samples represent insufficient tissue for analysis.
Monitoring of Inorganic Arsenic began in July 2009, following previous monitoring of Total Arsenic.

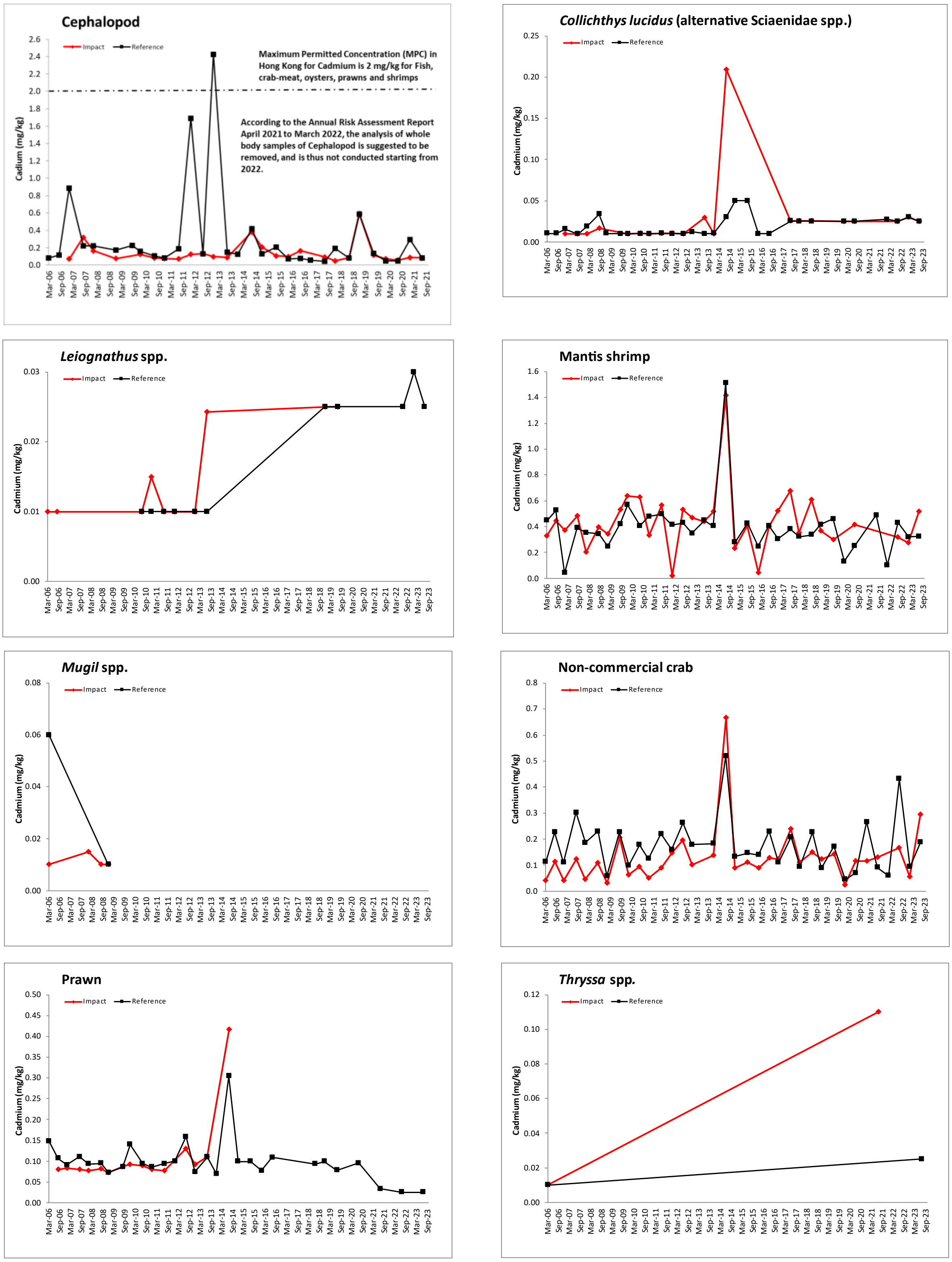


Figure 49: Mean levels of Cadmium in whole body samples of the eight target species from March 2006 to September 2023.

Remarks:
Limit of Detection (LOD) =0.05 mgkg^{-1}; 50% LOD used if analysis <LOD; Missing samples represent insufficient tissue for analysis.

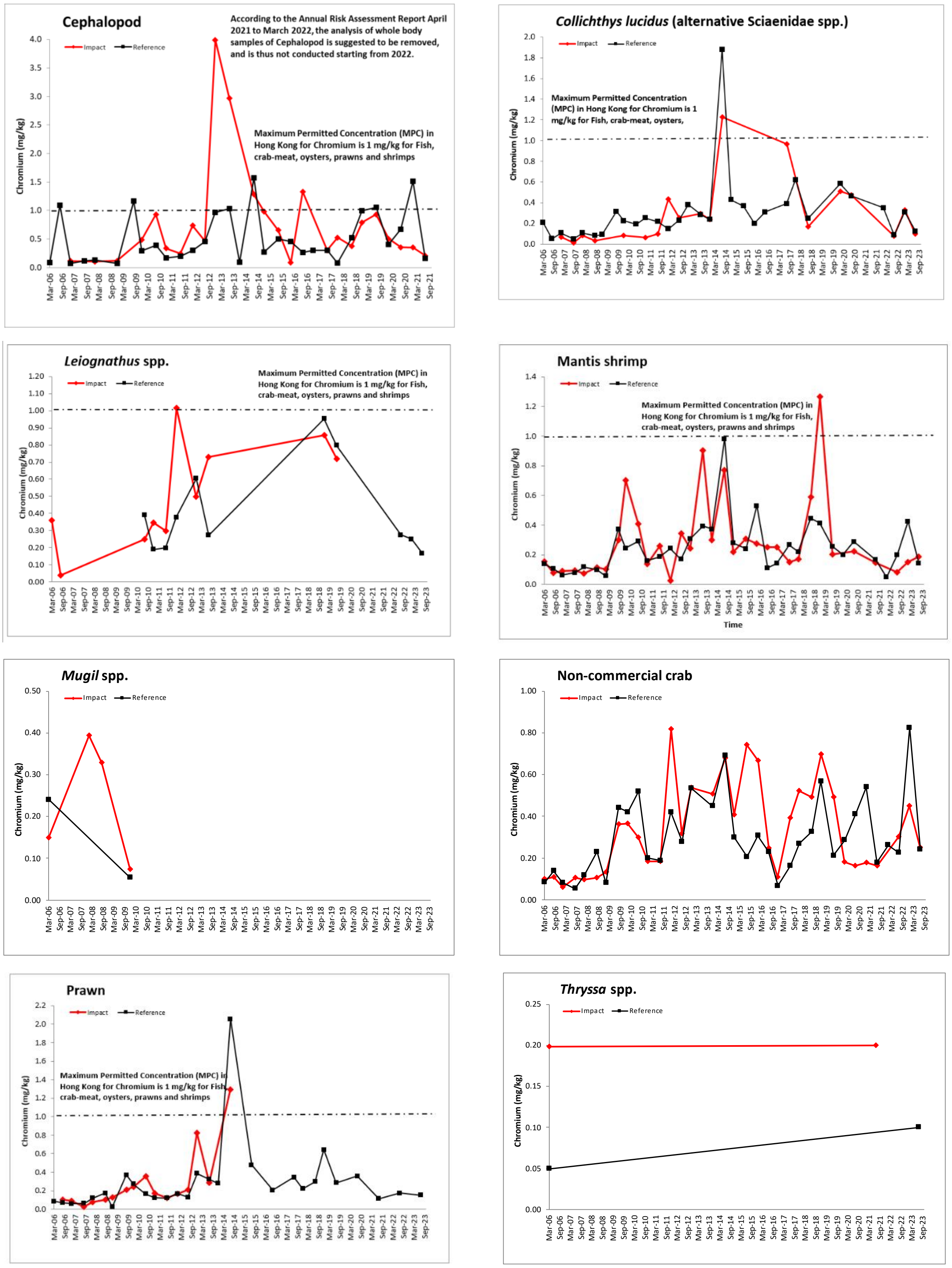


Figure 50: Mean levels of Chromium in whole body samples of the eight target species from March 2006 to September 2023.

Remarks:
Limit of Detection (LOD) =0.05 mgkg^{-1}; 50% LOD used if analysis <LOD; Missing samples represent insufficient tissue for analysis.

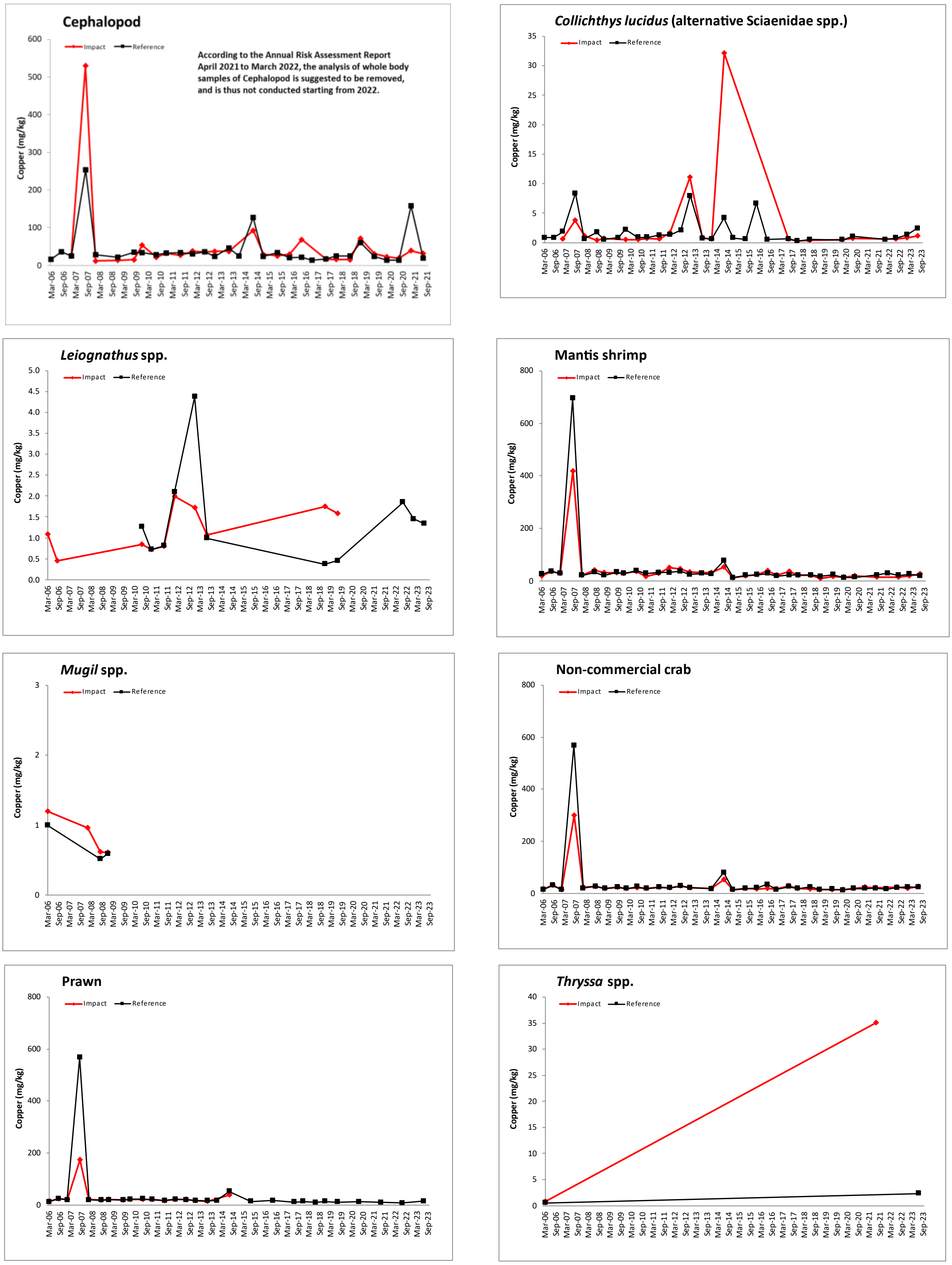


Figure 51: Mean levels of Copper in whole body samples of the eight target species from March 2006 to September 2023.

Remarks:
Limit of Detection (LOD) =0.05 mgkg^{-1}; 50% LOD used if analysis <LOD; Missing samples represent insufficient tissue for analysis.

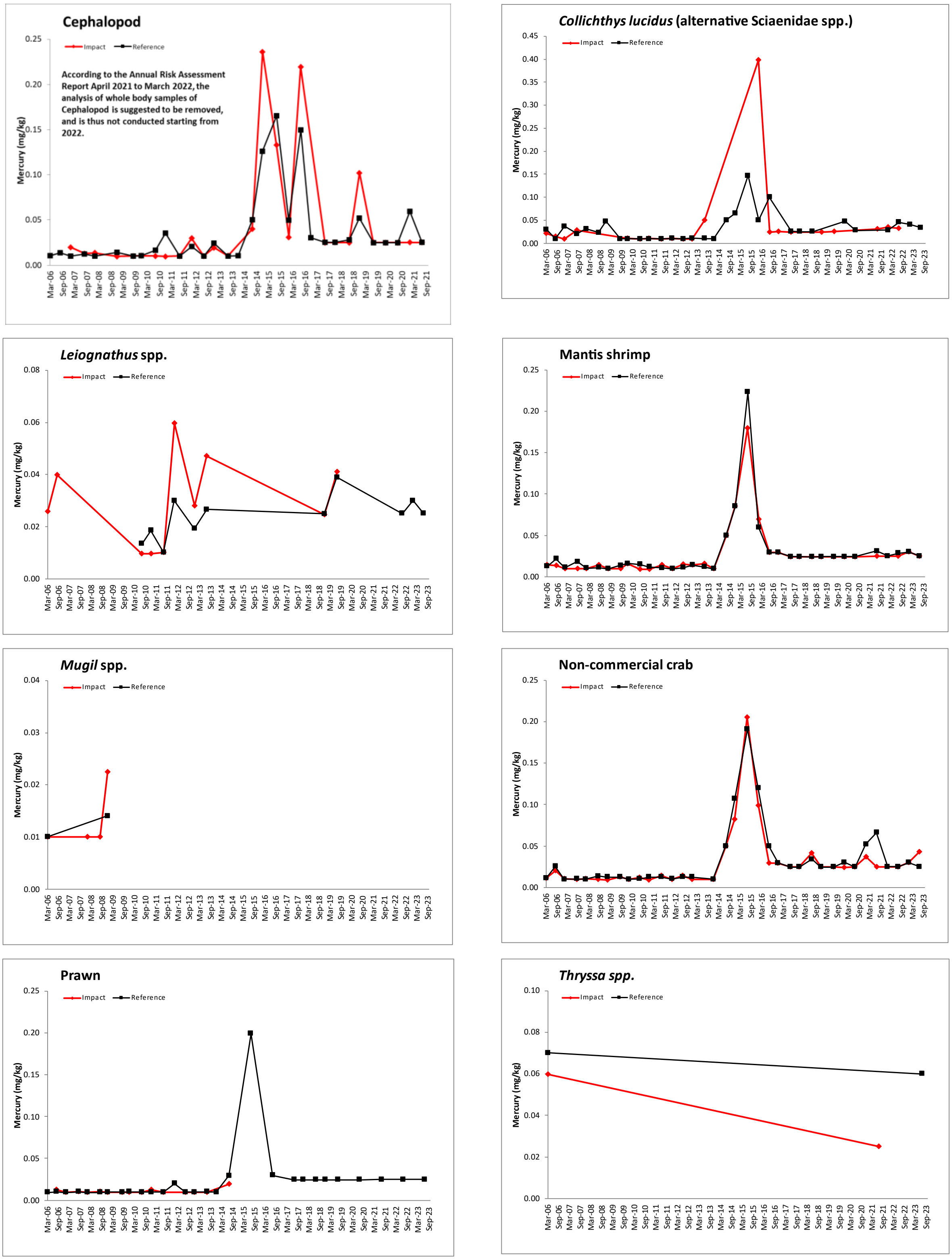


Figure 52: Mean levels of Total Mercury in whole body samples of the eight target species from March 2006 to September 2023.

Remarks:
Limit of Detection (LOD) =0.05 mgkg^{-1}; 50% LOD used if analysis <LOD; Missing samples represent insufficient tissue for analysis.

Figure 53: Mean levels of Nickel in whole body samples of the eight target species from March 2006 to September 2023.

Remarks:
Limit of Detection (LOD) =0.05 mgkg^{-1}; 50% LOD used if analysis <LOD; Missing samples represent insufficient tissue for analysis.

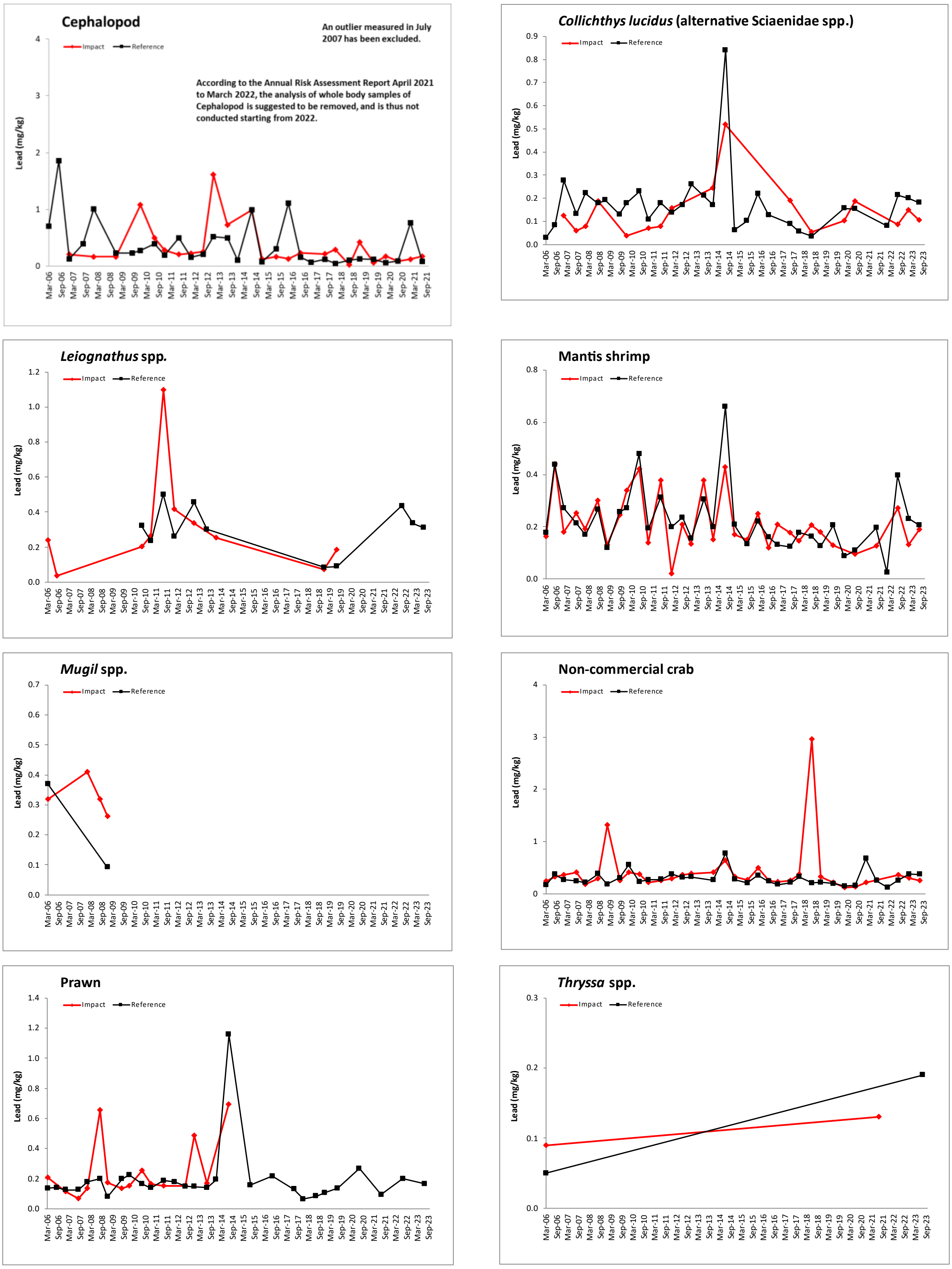


Figure 54: Mean levels of Lead in whole body samples of the eight target species from March 2006 to September 2023.

Remarks:
Limit of Detection (LOD) =0.05 mgkg^{-1}; 50% LOD used if analysis <LOD; Missing samples represent insufficient tissue for analysis.

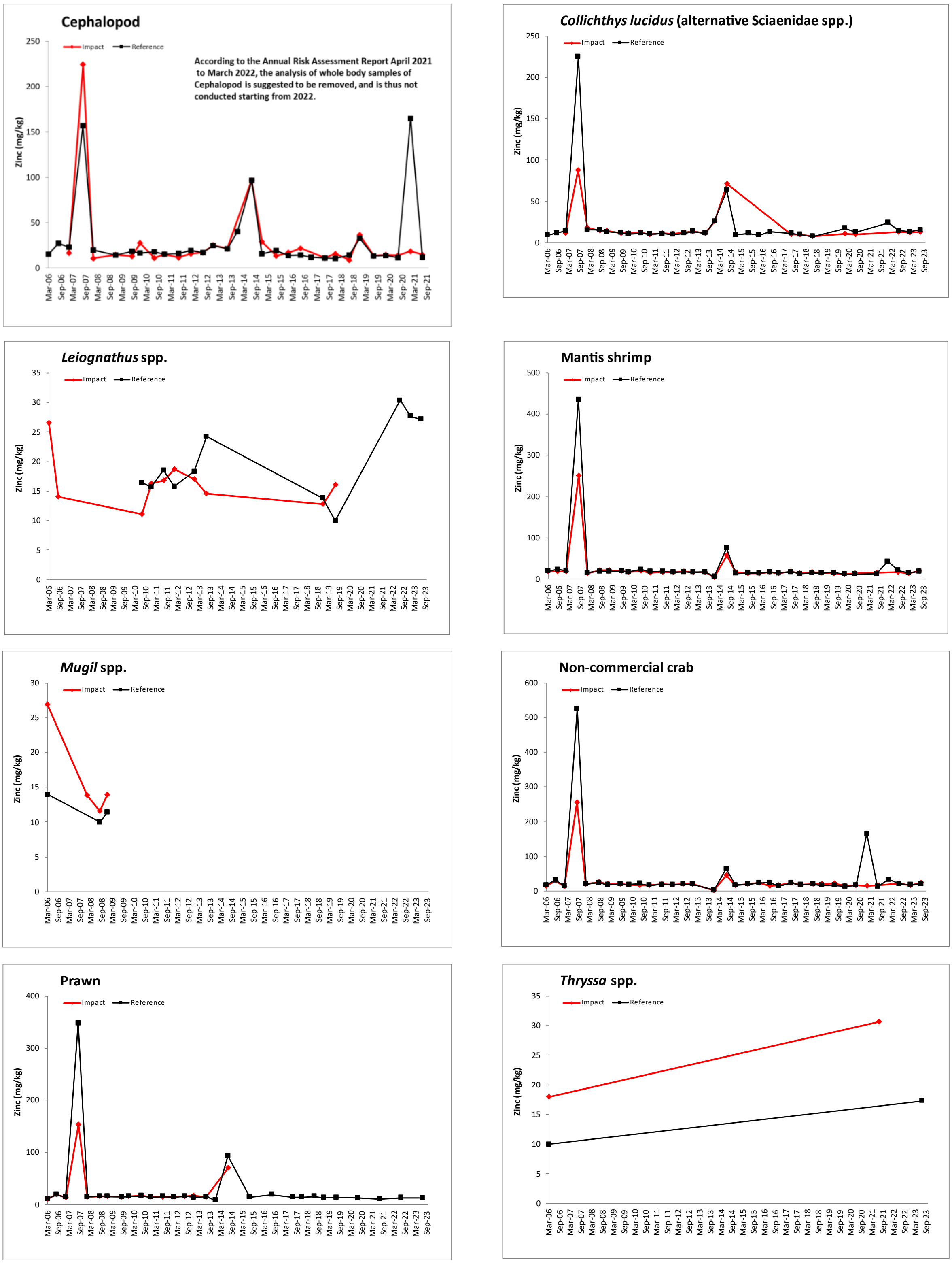


Figure 55: Mean levels of Zinc in whole body samples of the eight target species from March 2006 to September 2023.

Remarks:
Limit of Detection (LOD) =0.05 mgkg^{-1}; 50% LOD used if analysis <LOD; Missing samples represent insufficient tissue for analysis.

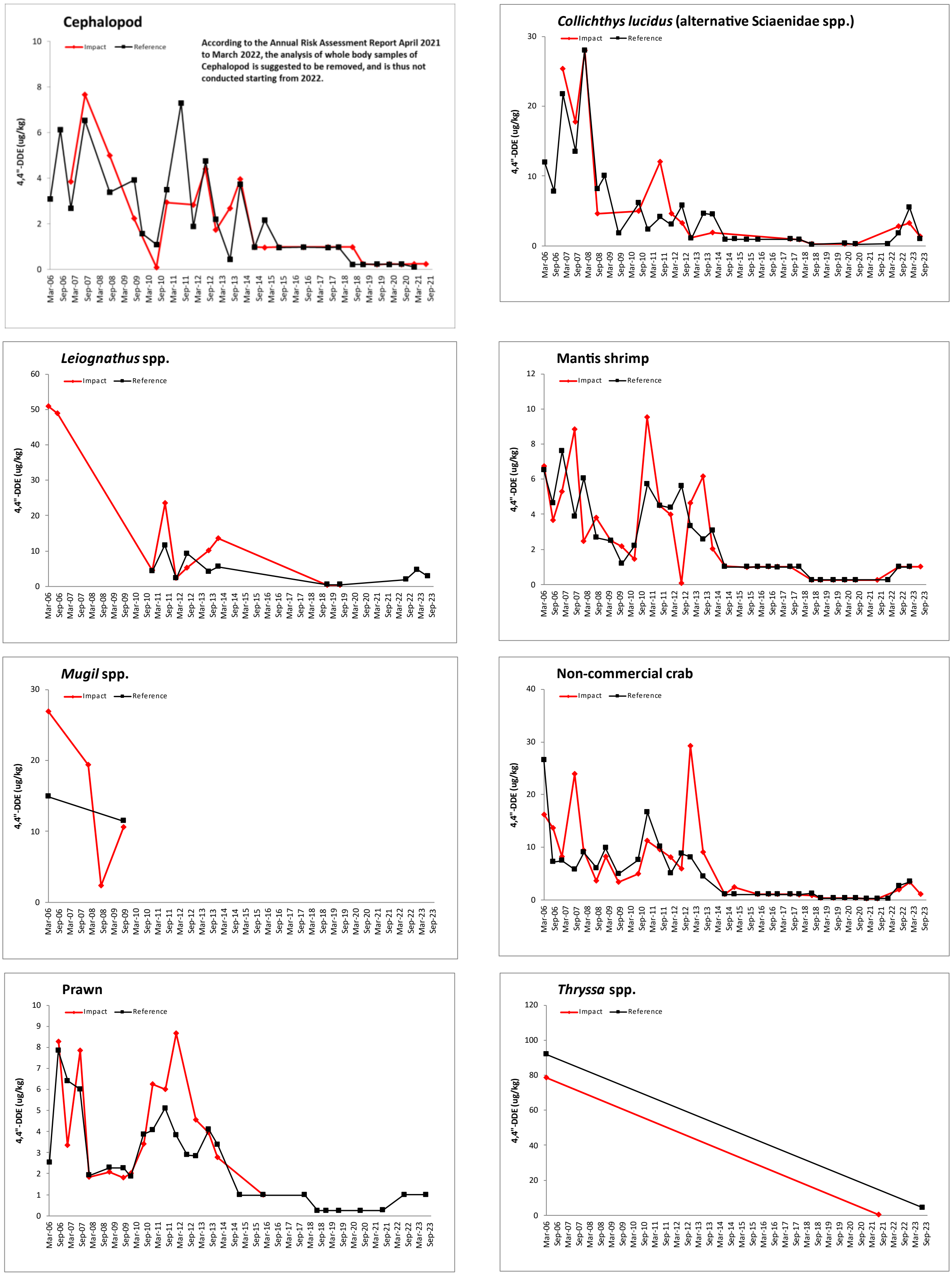


Figure 56: Mean levels of 4,4'-Dichloro-diphenyl-dichloroethylene (4,4'-DDE) in whole body samples of the eight target species from March 2006 to September 2023.

Remarks:
Limit of Detection (LOD) =0.5 μgkg^{-1}; 50% LOD used if analysis <LOD; Missing samples represent insufficient tissue for analysis.

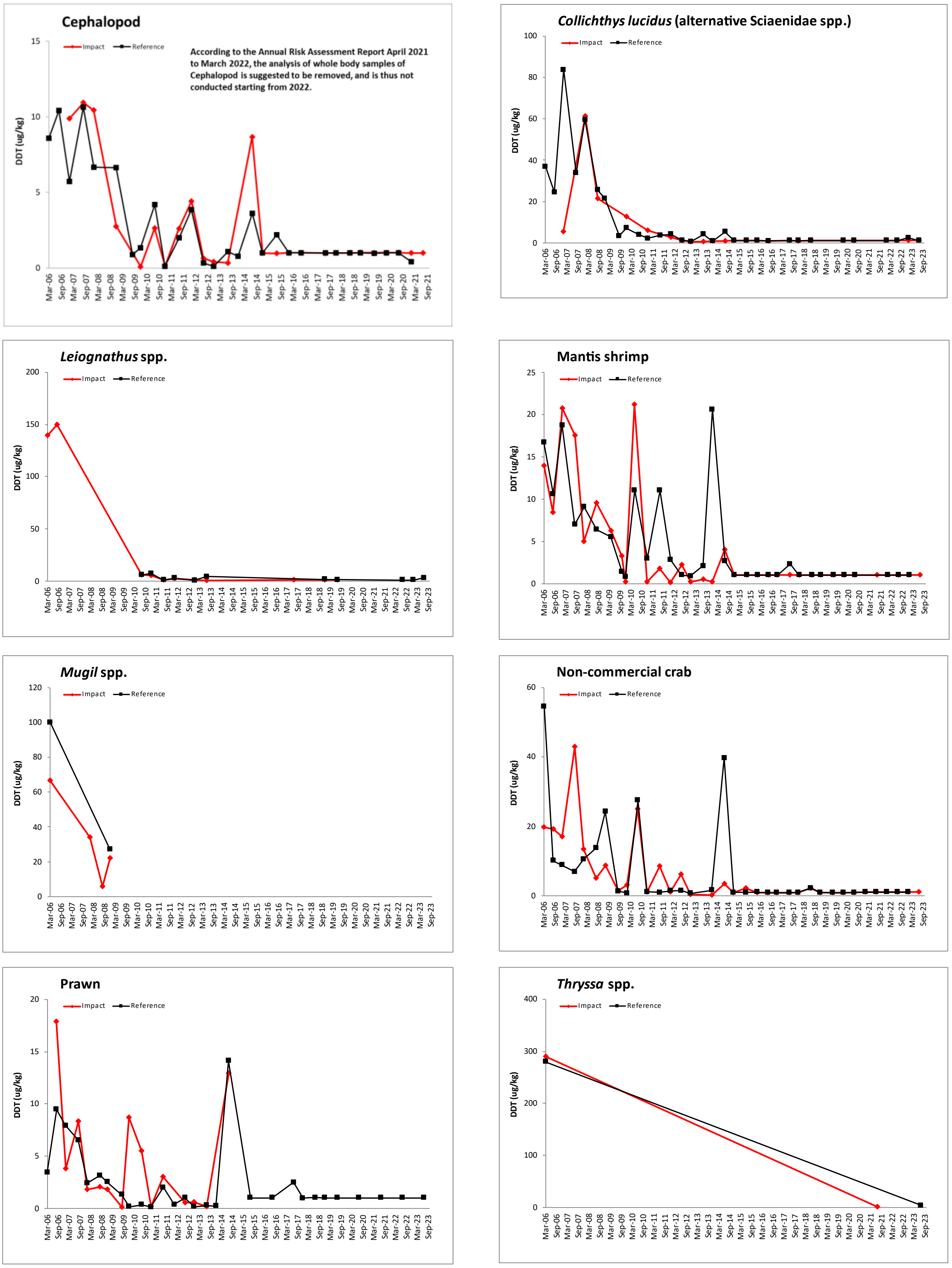


Figure 57: Mean levels of Total Dichloro-diphenyl-trichloroethane (DDT) in whole body samples of the eight target species from March 2006 to September 2023.

Remarks:
Limit of Detection (LOD) =2 µgkg^{-1}; 50% LOD used if analysis <LOD; Missing samples represent insufficient tissue for analysis.

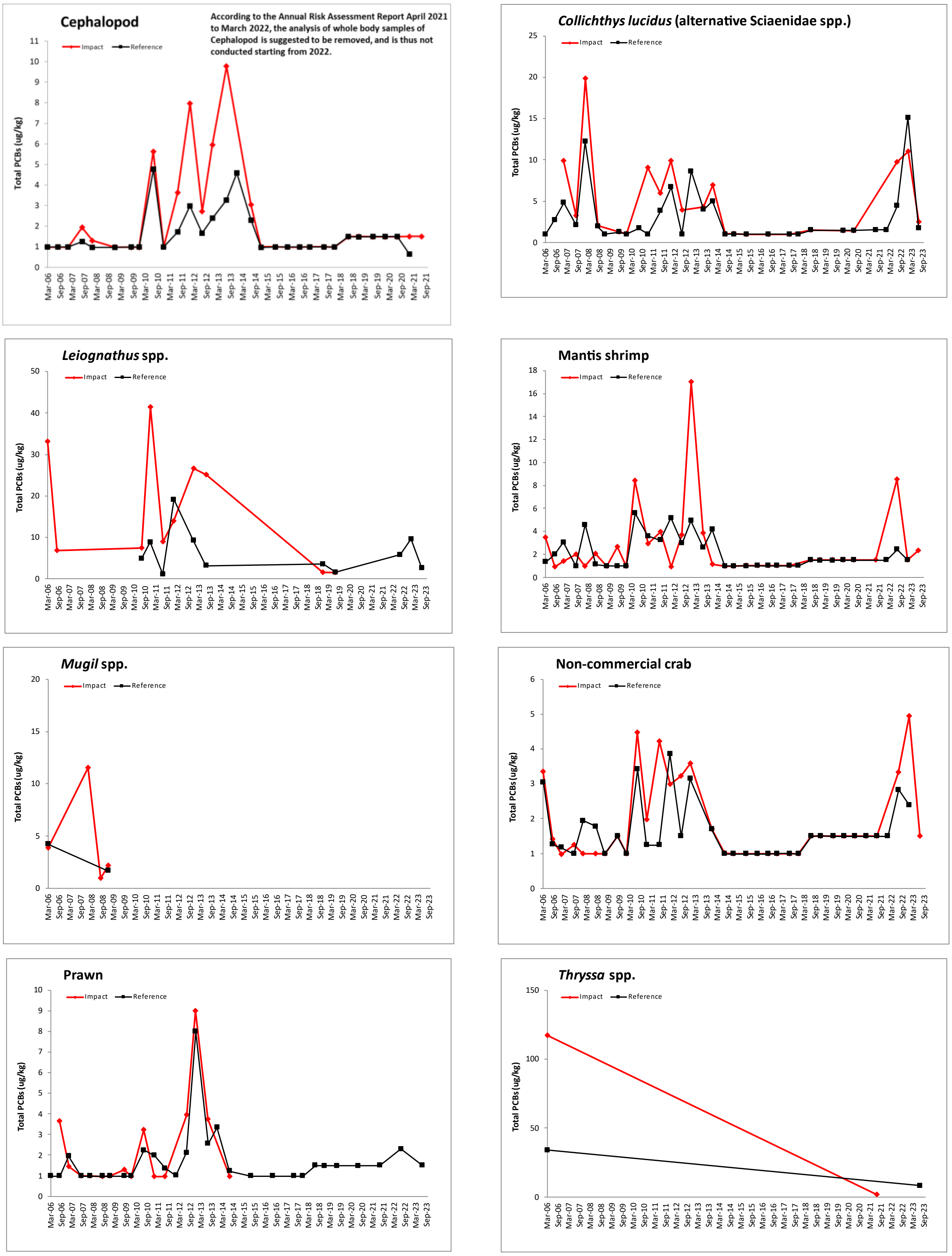


Figure 58: Mean levels of Total Polychlorinated Biphenyls (PCBs) in whole body samples of the eight target species from March 2006 to September 2023.

Remarks:
Limit of Detection (LOD) =3 μgkg^{-1}; 50% LOD used if analysis <LOD; Missing samples represent insufficient tissue for analysis.

Figure 59: Mean levels of Tributyltin (TBT) in whole body samples of the eight target species from March 2006 to September 2023.

Remarks:
Limit of Detection (LOD) =1 µgkg^{-1}; 50% LOD used if analysis <LOD; Missing samples represent insufficient tissue for analysis.

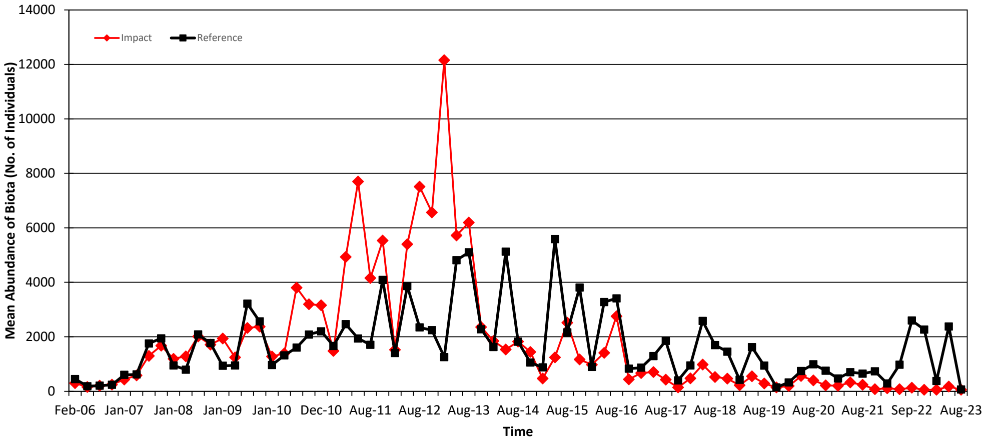


Figure 60: Mean Abundance of Biota from February 2006 to September 2023.

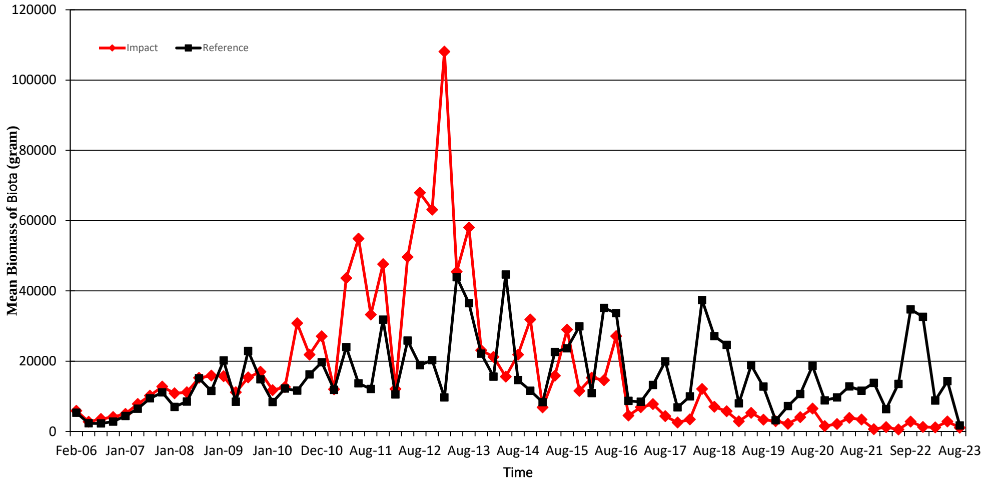


Figure 61: Mean Biomass of Biota from February 2006 to September 2023.

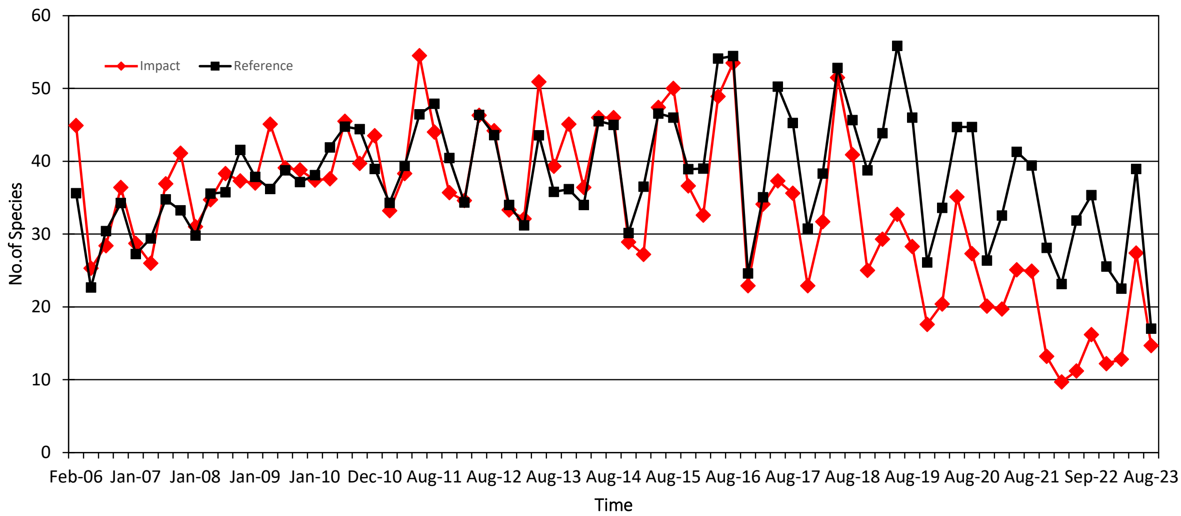


Figure 62: Mean Species Number of Biota from February 2006 to September 2023.

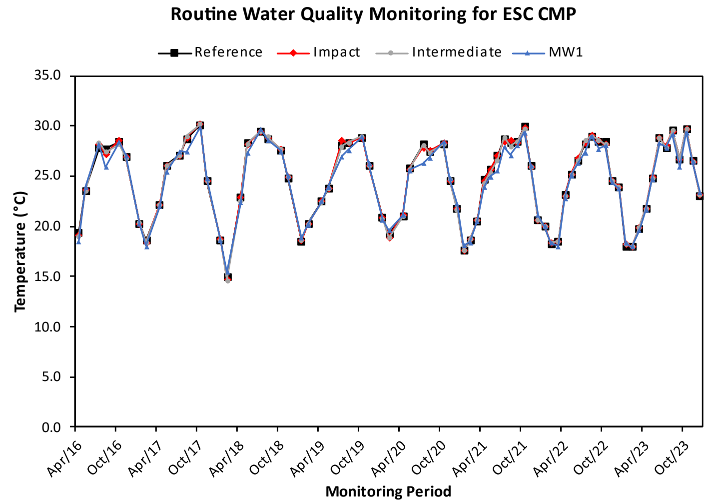


Figure 63: Levels of Temperature during in-situ Measurement for Routine Water Quality Monitoring of ESC CMPs from April 2016 to December 2023.

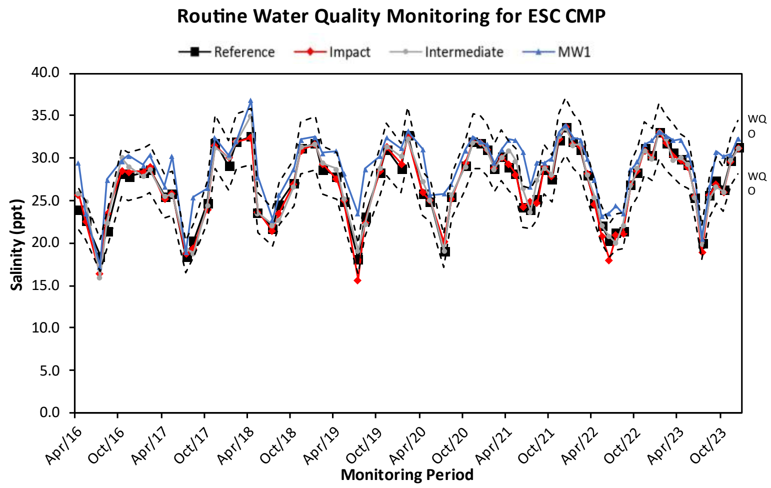


Figure 64: Levels of Salinity during in-situ Measurement for Routine Water Quality Monitoring of ESC CMPs from April 2016 to December 2023.

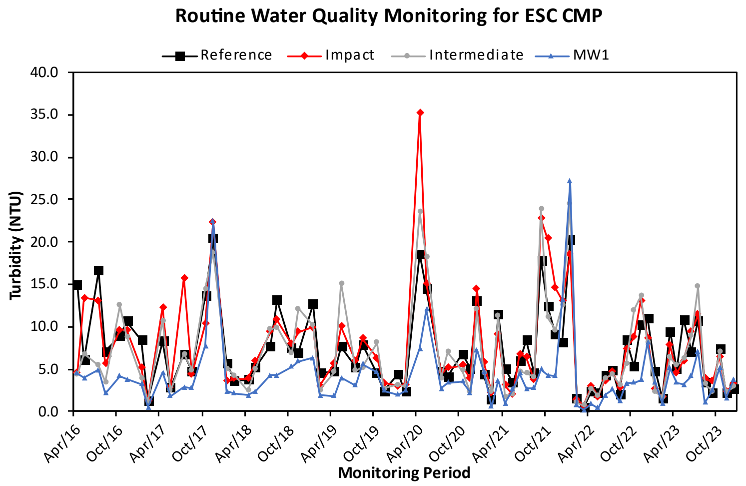


Figure 65: Levels of Turbidity during in-situ Measurement for Routine Water Quality Monitoring of ESC CMPs from April 2016 to December 2023.

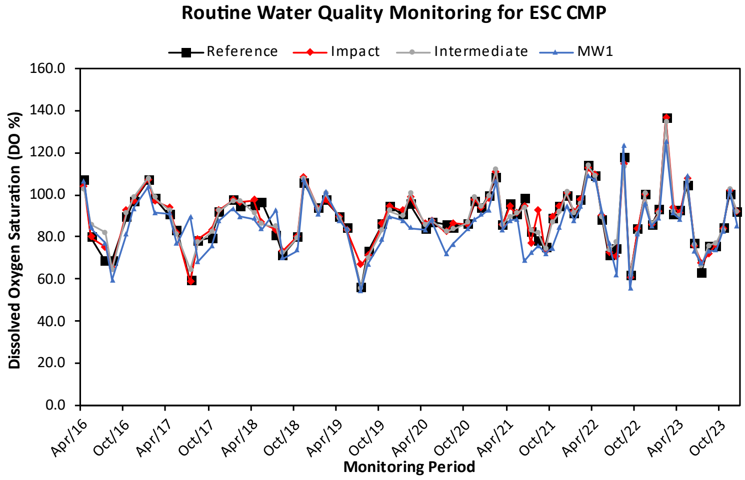


Figure 66: Levels of Dissolved Oxygen (%) during in-situ Measurement for Routine Water Quality Monitoring of ESC CMPs from April 2016 to December 2023.

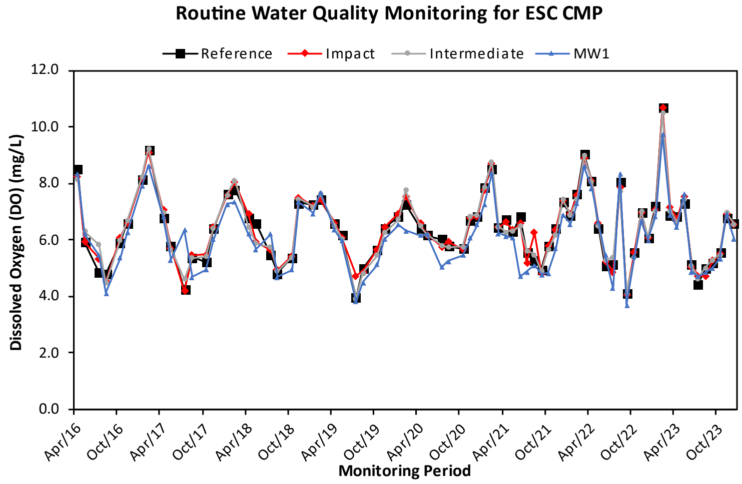


Figure 67: Levels of Dissolved Oxygen (mg/L) during in-situ Measurement for Routine Water Quality Monitoring of ESC CMPs from April 2016 to December 2023.

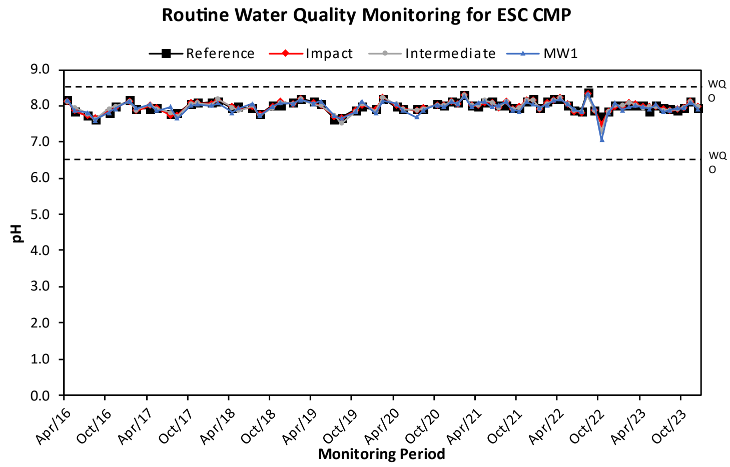


Figure 68: Levels of pH during in-situ Measurement for Routine Water Quality Monitoring of ESC CMPs from April 2016 to December 2023.

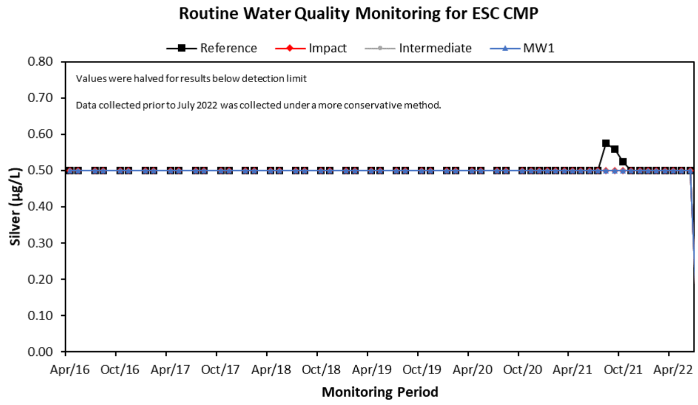


Figure 69a: Levels of Silver during Routine Water Quality Monitoring of ESC CMPs from April 2016 to June 2022.

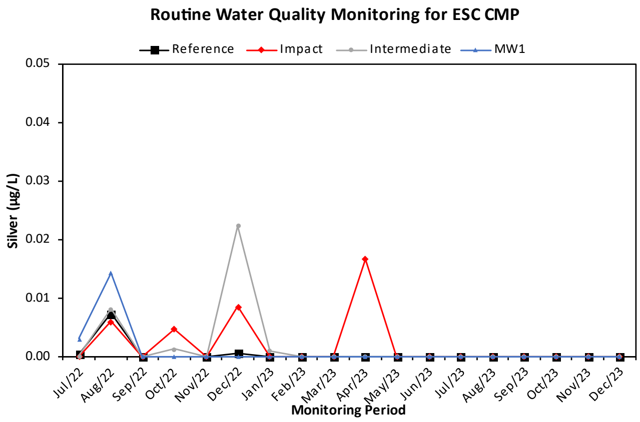


Figure 69b: Levels of Silver during Routine Water Quality Monitoring of ESC CMPs from July 2022 to December 2023.

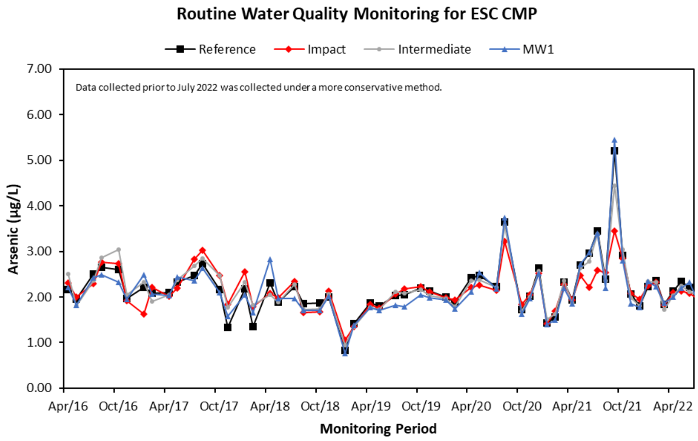


Figure 70a: Levels of Arsenic during Routine Water Quality Monitoring of ESC CMPs from April 2016 to June 2022.

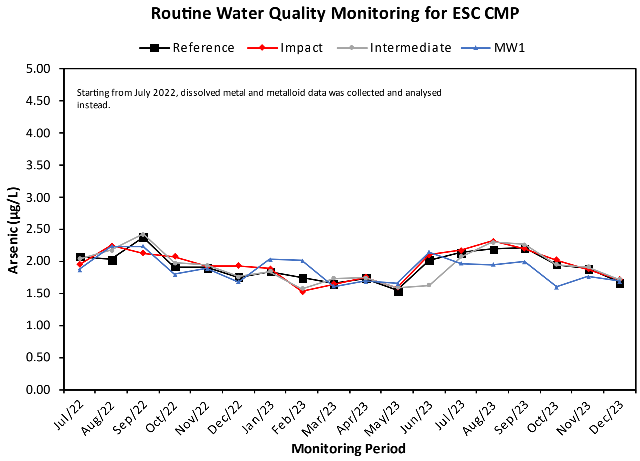


Figure 70b: Levels of Arsenic during Routine Water Quality Monitoring of ESC CMPs from July 2022 to December 2023.

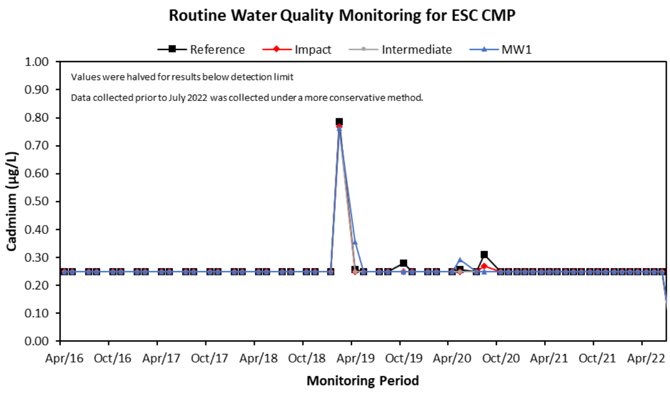


Figure 71a: Levels of Cadmium during Routine Water Quality Monitoring of ESC CMPs from April 2016 to June 2022.

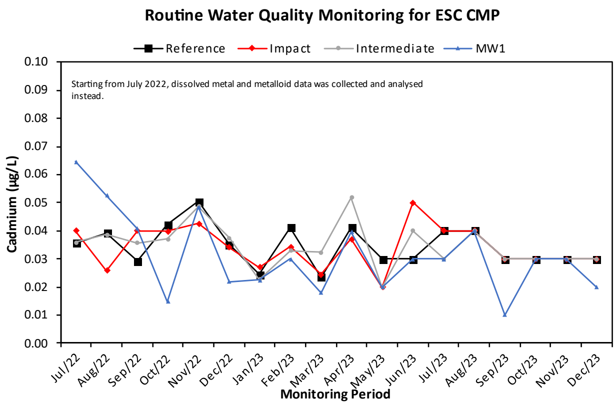


Figure 71b: Levels of Cadmium during Routine Water Quality Monitoring of ESC CMPs from July 2022 to December 2023.

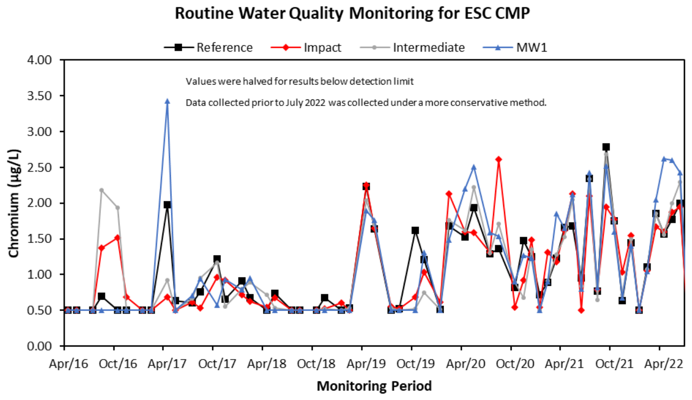


Figure 72a: Levels of Chromium during Routine Water Quality Monitoring of ESC CMPs from April 2016 to June 2022.

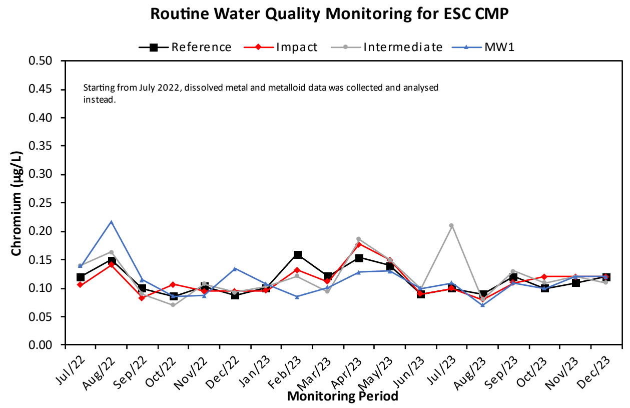


Figure 72b: Levels of Chromium during Routine Water Quality Monitoring of ESC CMPs from July 2022 to December 2023.

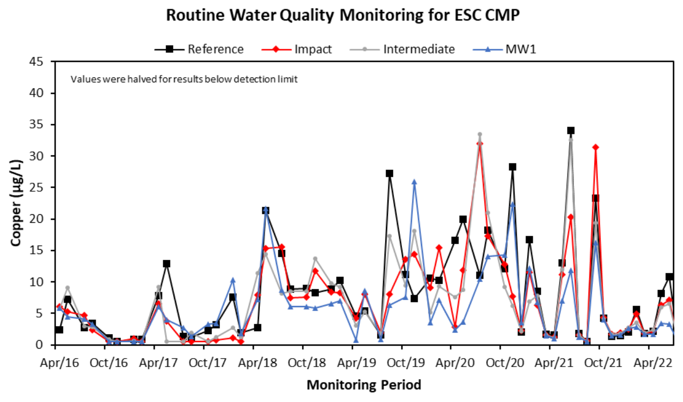


Figure 73a: Levels of Copper during Routine Water Quality Monitoring of ESC CMPs from April 2016 to June 2022.

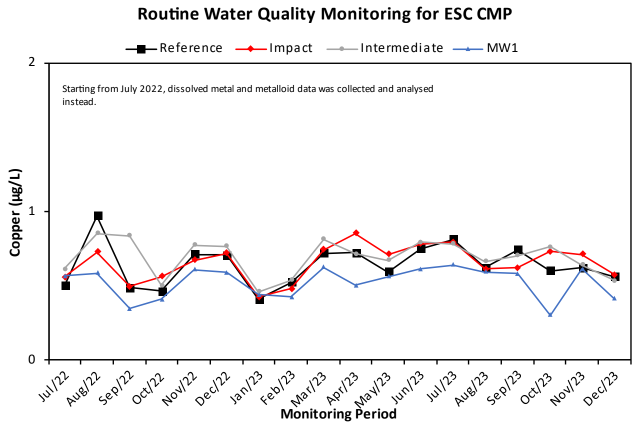


Figure 73b: Levels of Copper during Routine Water Quality Monitoring of ESC CMPs from July 2022 to December 2023.

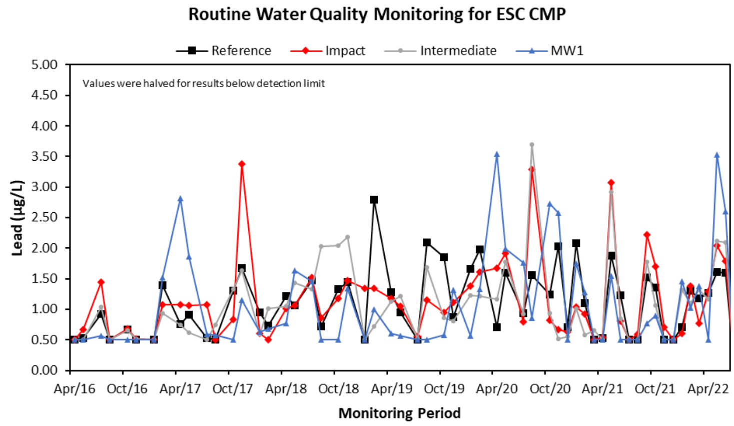


Figure 74a: Levels of Lead during Routine Water Quality Monitoring of ESC CMPs from April 2016 to June 2022.

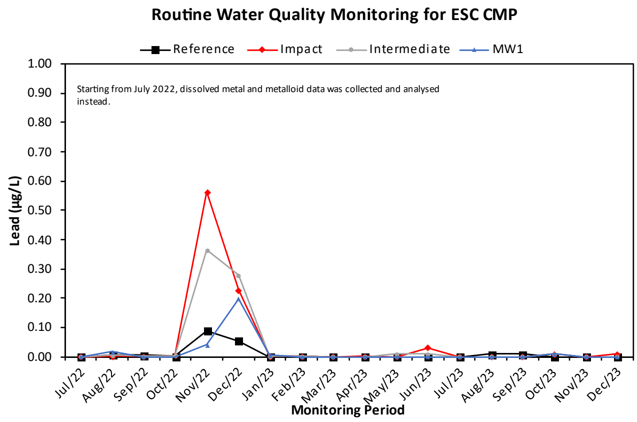


Figure 74b: Levels of Lead during Routine Water Quality Monitoring of ESC CMPs from July 2022 to December 2023.

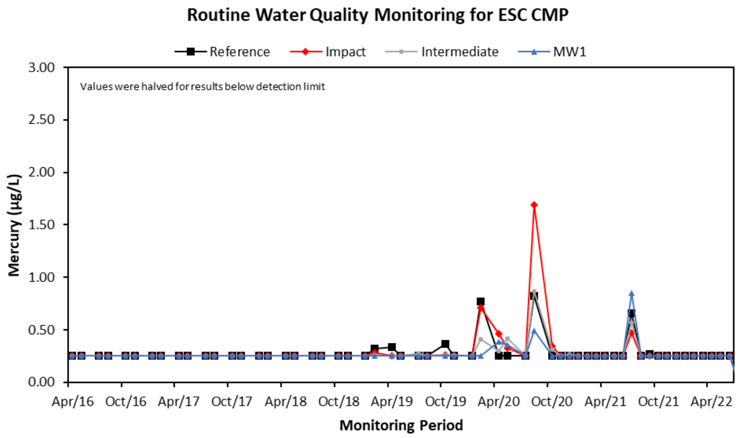


Figure 75a: Levels of Mercury during Routine Water Quality Monitoring of ESC CMPs from April 2016 to June 2022.

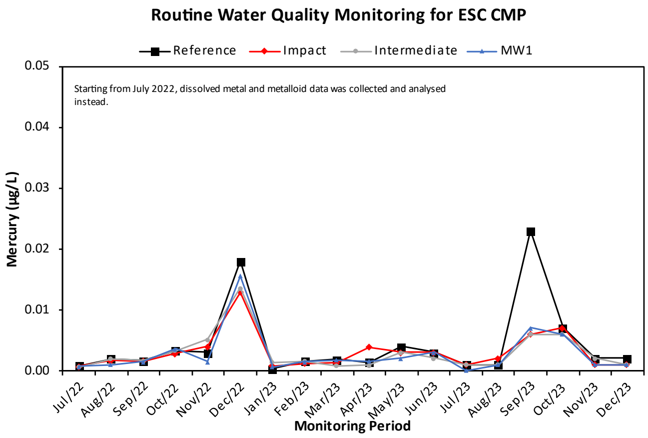


Figure 75b: Levels of Mercury during Routine Water Quality Monitoring of ESC CMPs from July 2022 to December 2023.

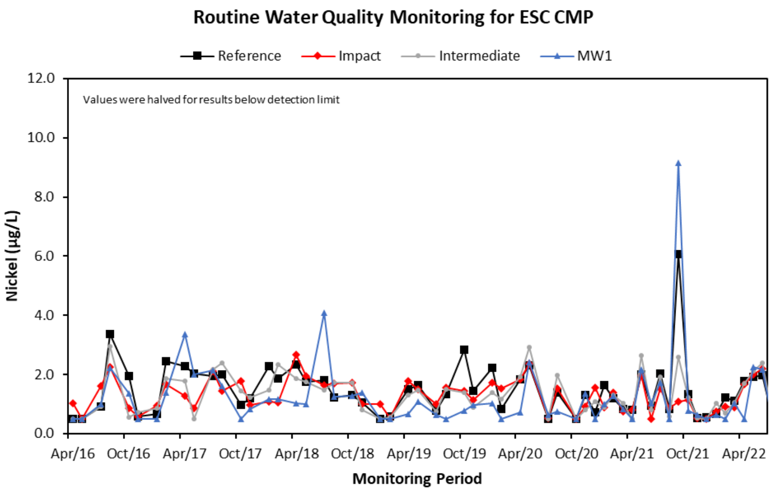


Figure 76a: Levels of Nickel during Routine Water Quality Monitoring of ESC CMPs from April 2016 to June 2022.

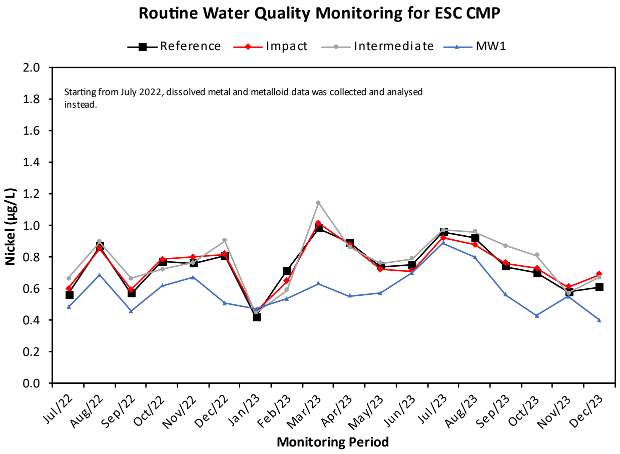


Figure 76b: Levels of Nickel during Routine Water Quality Monitoring of ESC CMPs from July 2022 to December 2023.

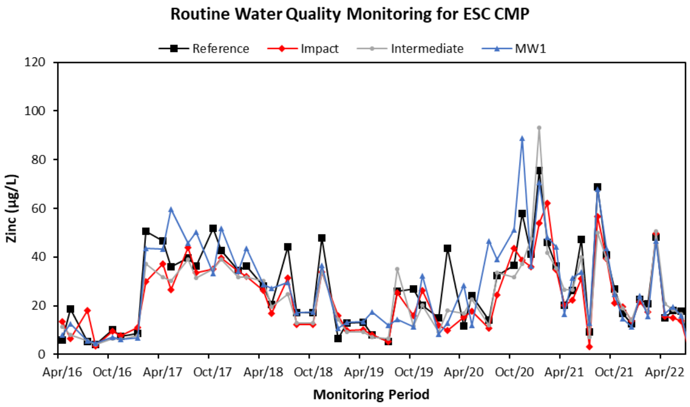


Figure 77a: Levels of Zinc during Routine Water Quality Monitoring of ESC CMPs from April 2016 to June 2022.

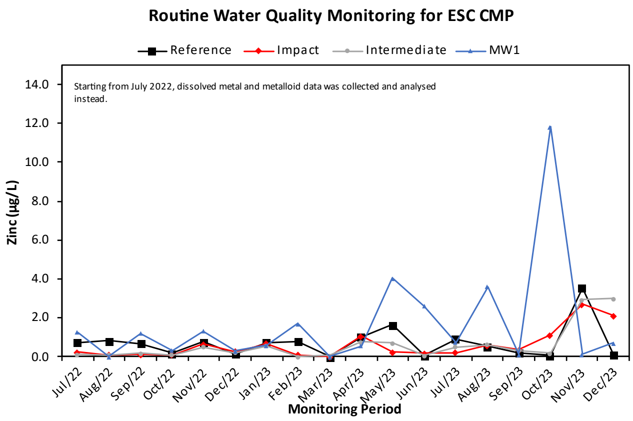


Figure 77b: Levels of Zinc during Routine Water Quality Monitoring of ESC CMPs from July 2022 to December 2023.

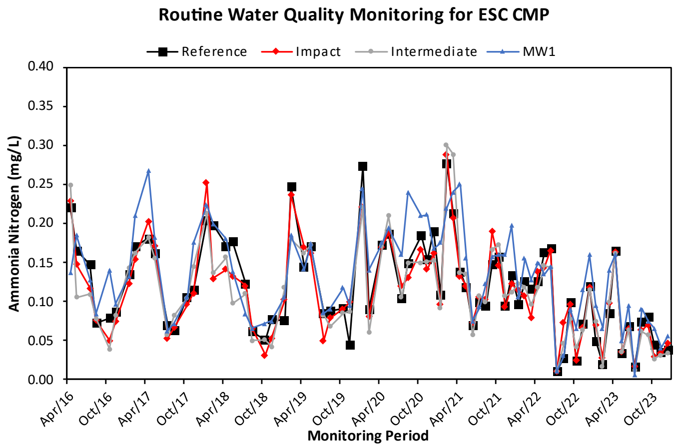


Figure 78: Levels of Ammonia-Nitrogen during Routine Water Quality Monitoring of ESC CMPs from April 2016 to December 2023.

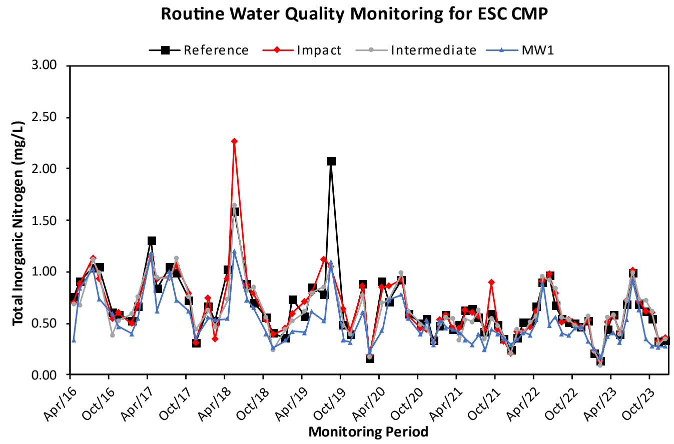


Figure 79: Levels of Total Inorganic Nitrogen during Routine Water Quality Monitoring of ESC CMPs from April 2016 to December 2023.

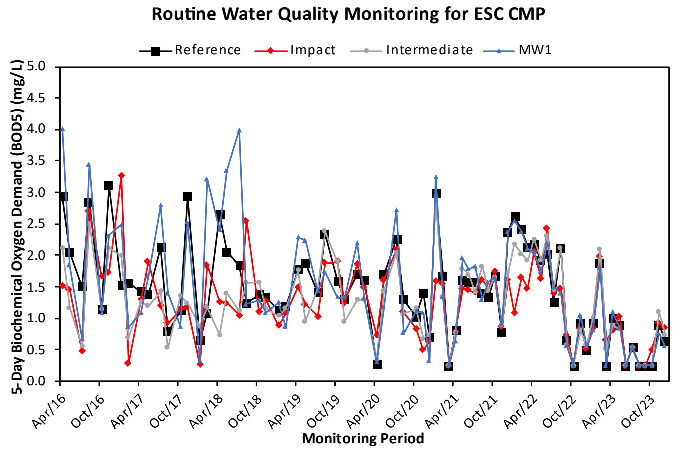


Figure 80: Levels of Biochemical Oxygen Demand during Routine Water Quality Monitoring of ESC CMPs from April 2016 to December 2023.

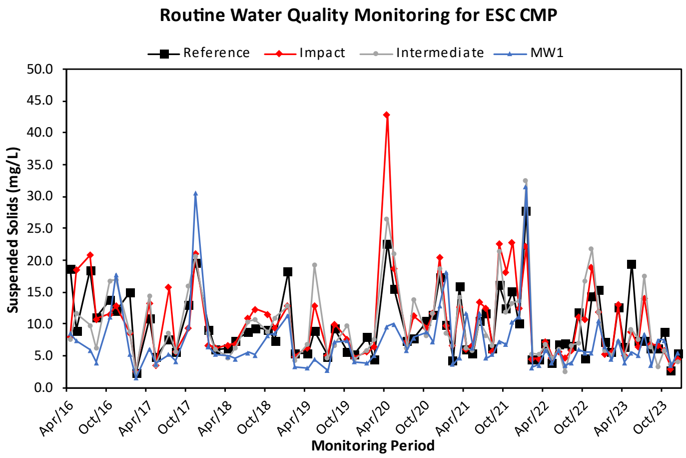


Figure 81: Levels of Total Suspended Solids during Routine Water Quality Monitoring of ESC CMPs from April 2016 to December 2023.

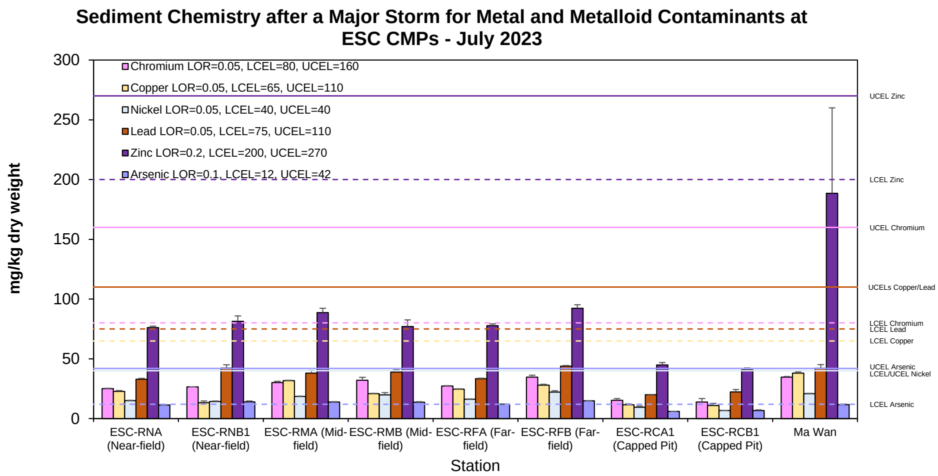


Figure 82: Concentration of Metals (Cr, Cu, Ni, Pb, Zn, As; mean +SD) in sediment samples collected from Sediment Chemistry after a Major Storm for ESC CMPs in July 2023.

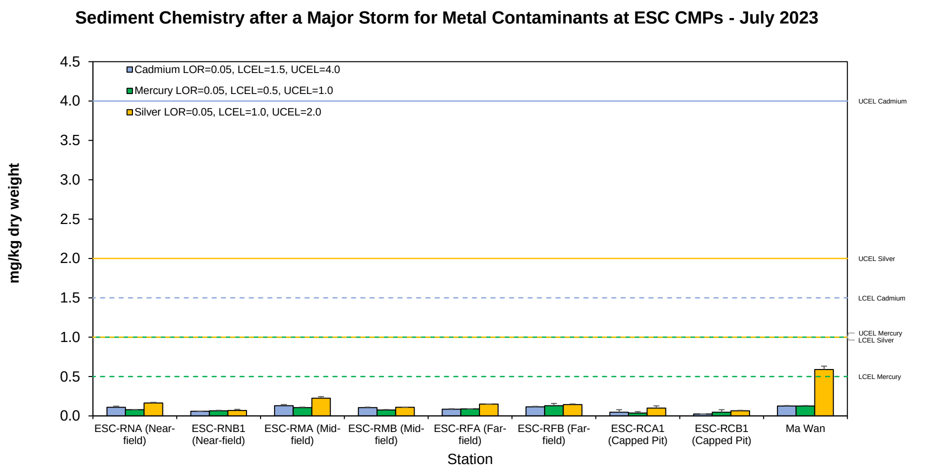


Figure 83: Concentration of Metals (Cd, Hg, Ag; mean +SD) in sediment samples collected from Sediment Chemistry after a Major Storm for ESC CMPs in July 2023.

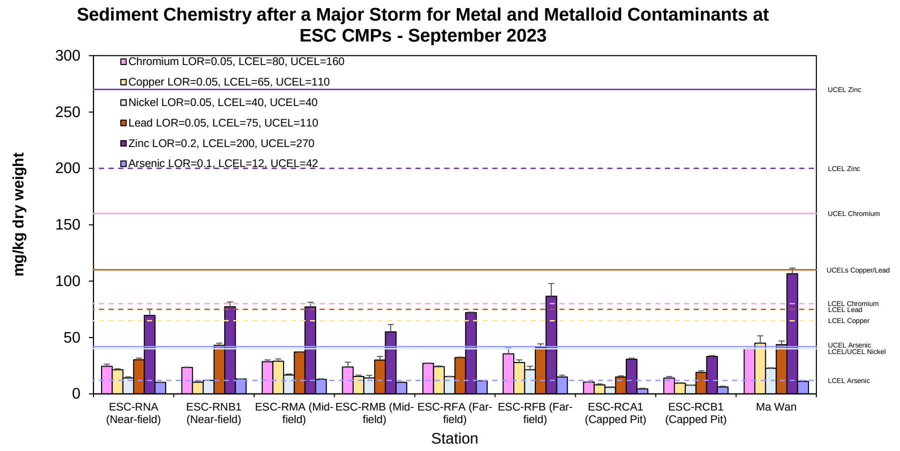


Figure 84: Concentration of Metals (Cr, Cu, Ni, Pb, Zn, As; mean +SD) in sediment samples collected from Sediment Chemistry after a Major Storm for ESC CMPs in September 2023.

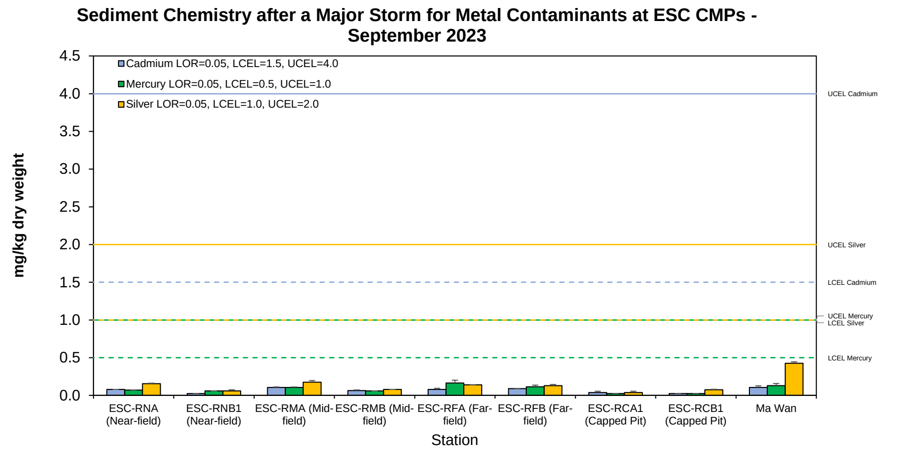


Figure 85: Concentration of Metals (Cd, Hg, Ag; mean +SD) in sediment samples collected from Sediment Chemistry after a Major Storm for ESC CMPs in September 2023.

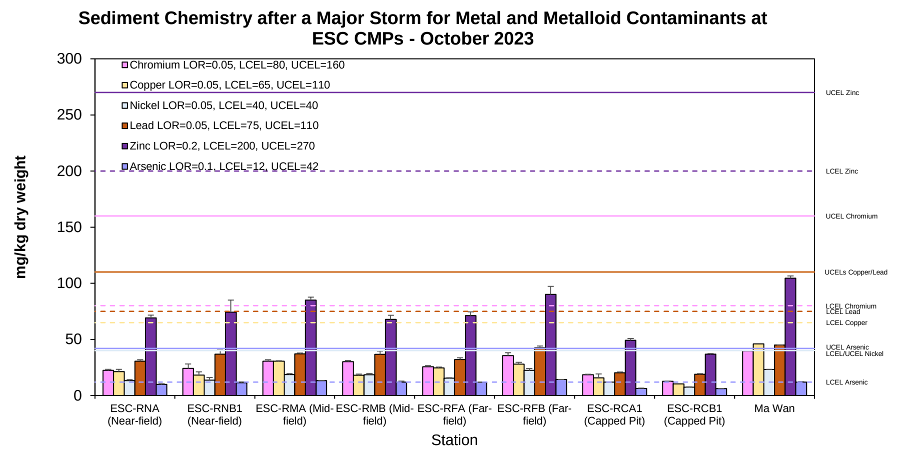


Figure 86: Concentration of Metals (Cr, Cu, Ni, Pb, Zn, As; mean +SD) in sediment samples collected from Sediment Chemistry after a Major Storm for ESC CMPs in October 2023.

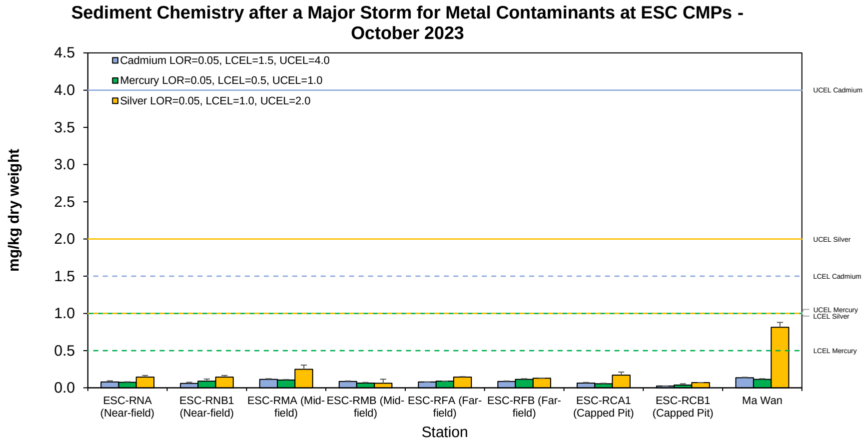


Figure 87: Concentration of Metals (Cd, Hg, Ag; mean +SD) in sediment samples collected from Sediment Chemistry after a Major Storm for ESC CMPs in October 2023.

C. Statistical Analysis

Routine Water Quality Monitoring for ESC CMPs – Statistical Analysis up to Dec 2023

Dissolved Oxygen

Ebb Tide

Source	Type II Sum of Square	Df	F value	Significance Level
Period	159.74	42	380.04	**
Area	0.78	3	26.06	**
Period:Area	7.90	126	6.27	**
Residuals	51.30	5126		

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

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

Flood Tide

Source	Type II Sum of Square	Df	F value	Significance Level
Period	6512.20	44	1156.04	**
Area	66.69	3	173.64	**
Period:Area	66.10	132	3.91	**
Residuals	462.82	3615		

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

SNK Results:
- Overall result:
  $$\left.\begin{array}{c}\text{Reference} = \text{Intermediate} \\ \text{Reference, Intermediate} > \text{Impact} > \text{Ma Wan}\end{array}\right\} \quad \therefore \text{no overall significant project related impact.}$$
- No potential project related spatial trend (i.e. Impact < Intermediate < Reference) were detected for all months over the study period.

[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	2359.24	42	278.12	**
Area	153.87	3	253.95	**
Period:Area	292.64	126	11.50	**
Residuals	1035.30	5126		

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

SNK Results:

- Overall result:
  $\text{Impact} > \text{Intermediate} > \text{Reference} > \text{Ma Wan} \} \quad \therefore \text{potential overall significant project related impact.}$
- 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	96565.96	44	121.03	**
Area	3307.07	3	60.79	**
Period:Area	13682.85	132	5.72	**
Residuals	65549.52	3615		

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

SNK Results:

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

Arsenic

Ebb Tide

Source	Type II Sum of Square	Df	F value	Significance Level
Period	9.89	7	46.11	**
Area	0.08	3	0.89	N.S.
Period:Area	1.14	21	1.78	**
Residuals	6.90	225		

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

SNK Results:
- Overall result:
  $\text{Impact} = \text{Ma Wan} = \text{Intermediate} = \text{Reference}\}$ ∴ 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.

Flood Tide

Source	Type II Sum of Square	Df	F value	Significance Level
Period	2.22	9	32.72	**
Area	0.06	3	2.87	**
Period:Area	0.49	27	2.38	**
Residuals	1.21	160		

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

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

Cadmium

Ebb Tide

Source	Type II Sum of Square	Df	F value	Significance Level
Period	0.0088	7	7.5027	**
Area	0.0006	3	1.2896	N.S.
Period:Area	0.0048	21	1.3627	N.S.
Residuals	0.0377	225		

Note:

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

SNK Results:

- Overall result:
  $\text{Reference} = \text{Intermediate} = \text{Impact} = \text{Ma Wan}\} \quad \therefore$ 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.

Flood Tide

Source	Type II Sum of Square	Df	F value	Significance Level
Period	0.0088	9	5.5861	**
Area	0.0003	3	0.5364	N.S.
Period:Area	0.0042	27	0.8947	N.S.
Residuals	0.0279	160		

Note:

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

SNK Results:

- Overall result:
  $\text{Intermediate} = \text{Impact} = \text{Reference} = \text{Ma Wan}\} \quad \therefore$ 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.

Chromium

Ebb Tide

Source	Type II Sum of Square	Df	F value	Significance Level
Period	10.42	7	8.46	**
Area	0.52	3	1.00	N.S.
Period:Area	6.50	21	1.76	**
Residuals	39.56	225		

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.

Flood Tide

Source	Type II Sum of Square	Df	F value	Significance Level
Period	2.87	9	5.12	**
Area	0.09	3	0.47	N.S.
Period:Area	1.47	27	0.87	N.S.
Residuals	9.96	160		

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 since July 2022.

Copper

Ebb Tide

Source	Type II Sum of Square	Df	F value	Significance Level
Period	12.57	7	54.20	**
Area	0.62	3	6.22	**
Period:Area	1.48	21	2.13	**
Residuals	7.45	225		

Note:

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

SNK Results:

- Overall result:

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

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

Flood Tide

Source	Type II Sum of Square	Df	F value	Significance Level
Period	2.65	9	10.46	**
Area	1.68	3	19.87	**
Period:Area	2.07	27	2.72	**
Residuals	4.50	160		

Note:

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

SNK Results:

- Overall result:

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

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

Mercury

Ebb Tide

Source	Type II Sum of Square	Df	F value	Significance Level
Period	$1.64x10^{-04}$	7	5.090814	**
Area	$3.27 x10^{-06}$	3	0.237106	N.S.
Period:Area	$7.57 x10^{-05}$	21	0.783421	N.S.
Residuals	$1.04 x10^{-03}$	225		

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

SNK Results:

- Overall result:
  Impact = Reference = 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.

Flood Tide

Source	Type II Sum of Square	Df	F value	Significance Level
Period	0.00433	9	7.81014	**
Area	0.00018	3	0.97209	N.S.
Period:Area	0.00105	27	0.62916	N.S.
Residuals	0.00986	160		

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

SNK Results:

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

Nickel

Ebb Tide

Source	Type II Sum of Square	Df	F value	Significance Level
Period	12.84	7	135.30	**
Area	0.43	3	10.50	**
Period:Area	0.64	21	2.25	**
Residuals	3.05	225		

Note:

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

SNK Results:

- Overall result:

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

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

Flood Tide

Source	Type II Sum of Square	Df	F value	Significance Level
Period	5.38	9	34.08	**
Area	2.03	3	38.54	**
Period:Area	0.70	27	1.47	N.S.
Residuals	2.81	160		

Note:

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

SNK Results:

- Overall result:

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

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

Zinc

Ebb Tide

Source	Type II Sum of Square	Df	F value	Significance Level
Period	170.40	7	18.44	**
Area	15.44	3	3.90	**
Period:Area	48.89	21	1.76	**
Residuals	297.04	225		

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

SNK Results:
- Overall result:

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

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

Flood Tide

Source	Type II Sum of Square	Df	F value	Significance Level
Period	56.87	9	11.82	**
Area	61.85	3	38.57	**
Period:Area	237.96	27	16.49	**
Residuals	85.52	160		

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

SNK Results:
- Overall result:

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

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

Ammonia Nitrogen

Ebb Tide

Source	Type II Sum of Square	Df	F value	Significance Level
Period	1199.06	42	341.65	**
Area	16.77	3	66.91	**
Period:Area	102.58	126	9.74	**
Residuals	327.98	3925		

Note:

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

SNK Results:

- Overall result:
  Ma Wan = Reference = Impact = Intermediate } ∴ no overall significant project related impact.
- 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	898.34	44	109.35	**
Area	7.91	3	14.13	**
Period:Area	64.75	132	2.63	**
Residuals	473.85	2538		

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	581.77	42	472.05	**
Area	21.95	3	249.33	**
Period:Area	40.21	126	10.87	**
Residuals	115.17	3925		

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	660.74	44	297.47	**
Area	13.19	3	87.10	**
Period:Area	42.23	132	6.34	**
Residuals	128.12	2538		

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	593.82	42	110.11	**
Area	13.81	3	35.86	**
Period:Area	191.99	126	11.87	**
Residuals	503.99	3925		

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	759.99	44	181.88	**
Area	19.97	3	70.08	**
Period:Area	157.65	132	12.58	**
Residuals	241.02	2538		

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

SNK Results:
- Overall result:

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

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

Suspended Solids

Ebb Tide

Source	Type II Sum of Square	Df	F value	Significance Level
Period	918.46	42	243.66	**
Area	42.67	3	158.49	**
Period:Area	150.99	126	13.35	**
Residuals	352.26	3925		

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
- 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	663.27	44	153.55	**
Area	15.65	3	53.14	**
Period:Area	127.48	132	9.84	**
Residuals	249.15	2538		

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

SNK Results:
- Overall result:
  $$\left.\begin{array}{r}\text{Impact} = \text{Intermediate}\\ \text{Reference} > \text{Impact, Intermediate} > \text{Ma Wan}\end{array}\right\} \therefore \text{no overall significant project related impact.}$$
- Months showing potential project related spatial trend (i.e. Impact > Intermediate > Reference):
  - Nov 2012, Jul 2013, Nov 2017, Aug 2018, Dec 2020, Sep 2021
- No potential project related spatial trend were detected for the reporting months.

Pit Specific Sediment Chemistry for ESC CMPs – Statistical Analysis up to December 2023

Arsenic

Source	Type II Sum of Square	Df	F value	Significance Level
Period	80.99	46	107.87	**
Area	7.97	2	244.13	**
Direction	9.51	1	582.90	**
Period:Area	18.95	92	12.62	**
Period:Direction	6.70	46	8.93	**
Area:Direction	8.93	2	273.52	**
Period:Area:Direction	17.35	92	11.55	**
Residuals	21.84	1338		

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

SNK Results:
- Overall result:

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

- 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, Nov 2020, Jul 2021, Mar 2022, Apr 2022[3], Jun 2022, Jul 2022, Aug 2022
- No potential project related spatial trend were detected for the reporting months.

Cadmium

Source	Type II Sum of Square	Df	F value	Significance Level
Period	85.49	46	17.77	**
Area	121.16	2	579.23	**
Direction	2.33	1	22.32	**
Period:Area	65.49	92	6.81	**
Period:Direction	30.50	46	6.34	**
Area:Direction	36.44	2	174.22	**
Period:Area:Direction	49.56	92	5.15	**
Residuals	139.93	1338		

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

SNK Results:
- Overall result:

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

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

[2] Direction: Stations located at downstream of the active pit during corresponding tide.
[3] Circled months represents consecutive months with significant spatial trend.

Chromium

Source	Type II Sum of Square	Df	F value	Significance Level
Period	35.98	46	53.90	**
Area	23.11	2	796.08	**
Direction	6.92	1	476.61	**
Period:Area	10.39	92	7.78	**
Period:Direction	4.41	46	6.61	**
Area:Direction	17.54	2	604.20	**
Period:Area:Direction	9.25	92	6.93	**
Residuals	19.42	1338		

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

SNK Results:
- Overall result:

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

- Months showing potential project related spatial trend (i.e. Active Pit > Pit Edge > Near Pit): Direction
  - Flood Tide: 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, Jul 2022, Aug 2023, Dec 2023
  - Ebb Tide: Apr 2020, Oct 2020, Nov 2020, May 2021, Oct 2021, Jan 2022, Feb 2022, Sep 2022, Mar 2023, Dec 2023
- Potential project related spatial trend was detected in two months for both flood tide and ebb tide direction over the reporting period.

Copper

Source	Type II Sum of Square	Df	F value	Significance Level
Period	81.42	46	52.00	**
Area	206.30	2	3030.22	**
Direction	19.24	1	565.24	**
Period:Area	41.78	92	13.34	**
Period:Direction	17.42	46	11.13	**
Area:Direction	52.82	2	775.80	**
Period:Area:Direction	43.07	92	13.75	**
Residuals	45.55	1338		

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

SNK Results:
- Overall result:

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

- Months showing potential project related spatial trend (i.e. Active Pit > Pit Edge > Near Pit): Direction
  - Flood Tide: Jul 2020, Oct 2020, May 2021, Jan 2023
  - Ebb Tide: Jul 2020, Oct 2020, Sep 2021, Jan 2022, Feb 2022, Dec 2023
- Potential project related spatial trend was detected in one month for both flood tide and ebb tide direction over the reporting period.

Lead

Source	Type II Sum of Square	Df	F value	Significance Level
Period	22.45	46	15.02	**
Area	30.06	2	462.55	**
Direction	8.93	1	274.84	**
Period:Area	14.72	92	4.92	**
Period:Direction	5.08	46	3.40	**
Area:Direction	8.84	2	136.06	**
Period:Area:Direction	7.73	92	2.59	**
Residuals	43.47	1338		

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

SNK Results:

- Overall result:

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

- 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, Aug 2023, Nov 2023, Dec 2023
    - 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, Mar 2023, Dec 2023
- Potential project related spatial trend was detected in three months (with two consecutive months) for flood tide and two months for ebb tide direction over the reporting period.

Regression Analysis Results:

Period	R Square	Adjusted R Square	Y-intercept	Slope	Significance Level
Nov-23	0.59	0.49	42.05	-0.90	N.S.
Dec-23	0.69	0.61	114.55	-18.30	**

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

Mercury

Source	Type II Sum of Square	Df	F value	Significance Level
Period	155.33	46	16.05	**
Area	117.37	2	278.87	**
Direction	80.17	1	380.94	**
Period:Area	83.12	92	4.29	**
Period:Direction	38.55	46	3.98	**
Area:Direction	108.21	2	257.11	**
Period:Area:Direction	43.93	92	2.27	**
Residuals	281.57	1338		

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

SNK Results:

- Overall result:

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

- 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	29.64	46	66.15	**
Area	23.90	2	1226.99	**
Direction	14.48	1	1486.11	**
Period:Area	12.51	92	13.96	**
Period:Direction	6.06	46	13.53	**
Area:Direction	21.95	2	1126.90	**
Period:Area:Direction	10.86	92	12.12	**
Residuals	13.03	1338		

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

SNK Results:

- Overall result:

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

- Months showing potential project related spatial trend (i.e. Active Pit > Pit Edge > Near Pit): Direction
    - Flood Tide: 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, Aug 2023, Dec 2023
    - Ebb Tide: Jun 2020, Jul 2020, Oct 2020, Oct 2021, Jan 2022, Feb 2022, Sep 2022, Mar 2023, Apr 2023, Dec 2023
- Potential project related spatial trend was detected in two months for flood tide and three months (with two consecutive months) for ebb tide direction over the reporting period.

Regression Analysis Results:

Period	R Square	Adjusted R Square	Y-intercept	Slope	Significance Level
Mar-23	0.87	0.83	28.50	-2.36	**
Apr-23	0.74	0.68	28.08	-1.76	**

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

Silver

Source	Type II Sum of Square	Df	F value	Significance Level
Period	201.18	46	51.45	**
Area	362.31	2	2131.10	**
Direction	3.61	1	42.47	**
Period:Area	83.83	92	10.72	**
Period:Direction	38.50	46	9.85	**
Area:Direction	40.85	2	240.26	**
Period:Area:Direction	65.92	92	8.43	**
Residuals	113.74	1338		

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

SNK Results:
- Overall result:

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

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

Zinc

Source	Type II Sum of Square	Df	F value	Significance Level
Period	21.72	46	41.21	**
Area	58.42	2	2549.38	**
Direction	3.92	1	342.07	**
Period:Area	17.83	92	16.91	**
Period:Direction	7.48	46	14.18	**
Area:Direction	9.58	2	418.09	**
Period:Area:Direction	13.31	92	12.63	**
Residuals	15.33	1338		

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, Nov 2022, Jan 2023
  - Ebb Tide: Apr 2020, Jun 2020, Jul 2020, Oct 2020, Mar 2021, May 2021, Jun 2021, Sep 2021, Feb 2022, Jun 2022, Jul 2022, Mar 2023, Dec 2023
- Potential project related spatial trend was detected in one month for flood tide direction and two months for ebb tide direction over the reporting period.

Total Organic Carbon

Source	Type II Sum of Square	Df	F value	Significance Level
Period	115.49	46	130.35	**
Area	74.43	2	1932.29	**
Direction	8.98	1	466.42	**
Period:Area	45.92	92	25.92	**
Period:Direction	14.63	46	16.52	**
Area:Direction	12.38	2	321.46	**
Period:Area:Direction	32.95	92	18.60	**
Residuals	25.77	1338		

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, Jan 2023, Oct 2023, Dec 2023
  - Ebb Tide: Jul 2020, Oct 2020, May 2021, Jun 2021, Oct 2021, Jul 2022, Feb 2023, Mar 2023, Aug 2023, Dec 2023
- Potential project related spatial trend was detected in three months for flood tide and four months (with two consecutive months) for ebb tide direction over the reporting period.

Regression Analysis Results:

Period	R Square	Adjusted R Square	Y-intercept	Slope	Significance Level
Feb-23	0.64	0.61	9666.67	-660.00	N.S.
Mar-23	0.31	0.24	7787.50	-405.00	N.S.

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

Cumulative Sediment Chemistry for ESC CMPs – Statistical Analysis up to December 2023

Arsenic

Source	Type II Sum of Square	Df	F value	Significance Level
Period	70.74	30	119.56	**
Area	104.93	4	1330.08	**
Period:Area	67.92	120	28.70	**
Residuals	44.87	2275		

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	74.67	30	21.09	**
Area	71.24	4	150.89	**
Period:Area	60.24	120	4.25	**
Residuals	268.51	2275		

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	11168.26	30	38.87	**
Area	81303.04	4	2122.44	**
Period:Area	19113.13	120	16.63	**
Residuals	21786.78	2275		

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	13588.75	30	14.99	**
Area	266895.97	4	2207.89	**
Period:Area	28444.77	120	7.84	**
Residuals	68752.18	2275		

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	33866.27	30	79.91	**
Area	78910.91	4	1396.43	**
Period:Area	21023.43	120	12.40	**
Residuals	32139.57	2275		

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	417.37	30	31.57	**
Area	50.48	4	28.64	**
Period:Area	237.45	120	4.49	**
Residuals	1002.44	2275		

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 = Far-Field = Mid-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	3409.55	30	25.55	**
Area	29832.06	4	1676.65	**
Period:Area	9651.28	120	18.08	**
Residuals	10119.59	2275		

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	178.28	30	36.37	**
Area	832.02	4	1273.05	**
Period:Area	89.48	120	4.56	**
Residuals	371.72	2275		

Note:

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

SNK Results:

- Overall result:
  - $\text{Ma Wan} > \begin{matrix}\text{Mid-Field} = \text{Far-Field} = \text{Near-Field} = \text{Capped-pit} \\ \text{Mid-Field, Far-Field, Near-Field, Capped-pit}\end{matrix}$ ∴ 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	18.03	30	25.46	**
Area	149.22	4	1580.69	**
Period:Area	49.69	120	17.55	**
Residuals	53.69	2275		

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	2155288112	30	47.27	**
Area	3651757872	4	600.71	**
Period:Area	4158141887	120	22.80	**
Residuals	3457496296	2275		

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 Toxicity for ESC CMPs – March 2023

Survival rate for burrowing amphipod *Leptochirus plumulosus*

Source	Type II Sum of Square	Df	F value	Significance Level
Area	0.0062	2	5.6478	**
Residuals	0.0120	22		

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

SNK Results:
- Reference = Near-Field = Ma Wan ∴no significant project related impact.

Growth rate for benthic polychaete *Neanthes arenaceodentata*

Source	Type II Sum of Square	Df	F value	Significance Level
Area	0.0005	2	1.3542	N.S.
Residuals	0.0044	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	0.00003	2	0.3140	N.S.
Residuals	0.00119	22		

Note:
1. Assume Gamma 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	1.6014	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	1.1833	N.S.
Residuals	21		

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

Sediment Toxicity for ESC CMPs – August 2023

Survival rate for burrowing amphipod *Leptochirus plumulosus*

Source	Type II Sum of Square	Df	F value	Significance Level
Area	0.0020	2	1.9629	N.S.
Residuals	0.0110	22		

Note:

3. Assume Gamma distribution
4. 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	0.0010	2	2.7280	N.S.
Residuals	0.0041	22		

Note:

3. Assume Gamma distribution
4. 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	0.0004	2	4.8500	**
Residuals	0.0008	22		

Note:

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

SNK Results:

➢ $\begin{cases} \text{Ma Wan} = \text{Reference} \\ \text{Reference} = \text{Near} - \text{Field} \\ \text{Ma Wan} > \text{Near} - \text{Field} \end{cases}$ $\therefore$ no significant project related impact.

Mortality rate for barnacles *Balanus Amphitrite*

Source	Df	F value	Significance Level
Area	2	8.7653	**
Residuals	21		

Note:

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

Post-hoc (Tukey's Test) Results:

➢ $\begin{cases} \text{Reference} = \text{Ma Wan} \\ \text{Near}-\text{Field} > \text{Reference} \\ \text{Near}-\text{Field} > \text{Ma Wan} \end{cases}$ ∴ potential significant project related impact.

Mortality rate for shrimp *Penaeus vannaamei*

Source	Df	F value	Significance Level
Area	2	4.0950	**
Residuals	21		

Note:

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

Post-hoc (Tukey's Test) Results:

➢ $\begin{cases} \text{Reference} = \text{Ma Wan} \\ \text{Near}-\text{Field} > \text{Reference} \\ \text{Near}-\text{Field} > \text{Ma Wan} \end{cases}$ ∴ potential significant project related impact.

Sediment Chemistry of ESC CMPs after a Major Storm Event (on 23 July 2023)

Arsenic

Source	Type II Sum of Square	Df	F value	Significance Level
Area	1.45	4	41.90	**
Residuals	0.11	13		

Note:

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

SNK Results:

➢ $\text{Mid-Field} > \text{Far-Field} > \text{Near-Field} > \text{Maw Wan} > \text{Capped-pit}$

Cadmium

Source	Type II Sum of Square	Df	F value	Significance Level
Area	0.0175	4	9.2673	**
Residuals	0.0061	13		

Note:

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

SNK Results:

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

Chromium

Source	Type II Sum of Square	Df	F value	Significance Level
Area	875.05	4	33.94	**
Residuals	83.80	13		

Note:

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

SNK Results:

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

Copper

Source	Type II Sum of Square	Df	F value	Significance Level
Area	2.63	4	16.58	**
Residuals	0.52	13		

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

SNK Results:

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

Lead

Source	Type II Sum of Square	Df	F value	Significance Level
Area	1.04	4	19.28	**
Residuals	0.18	13		

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

SNK Results:

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

Mercury

Source	Type II Sum of Square	Df	F value	Significance Level
Area	0.0136	4	8.6001	**
Residuals	0.0052	13		

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

SNK Results:

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

Nickel

Source	Type II Sum of Square	Df	F value	Significance Level
Area	382.06	4	24.26	**
Residuals	51.19	13		

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

SNK Results:

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

Silver

Source	Type II Sum of Square	Df	F value	Significance Level
Area	0.395	4	47.687	**
Residuals	0.027	13		

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

SNK Results:

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

Zinc

Source	Type II Sum of Square	Df	F value	Significance Level
Area	3.22	4	47.48	**
Residuals	0.22	13		

Note:
1. Assume Gamma 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

Sediment Chemistry of ESC CMPs after a Major Storm Event (on 5 September 2023)

Arsenic

Source	Type II Sum of Square	Df	F value	Significance Level
Area	1.89	4	18.23	**
Residuals	0.34	13		

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

SNK Results:

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

Cadmium

Source	Type II Sum of Square	Df	F value	Significance Level
Area	0.0114	4	6.2407	**
Residuals	0.0059	13		

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

SNK Results:

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

Chromium

Source	Type II Sum of Square	Df	F value	Significance Level
Area	2.39	4	29.15	**
Residuals	0.27	13		

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

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

Copper

Source	Type II Sum of Square	Df	F value	Significance Level
Area	4.39	4	14.62	**
Residuals	0.98	13		

Note:
3. Assume Gamma distribution
4. 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	1.67	4	17.07	**
Residuals	0.32	13		

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

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

Mercury

Source	Type II Sum of Square	Df	F value	Significance Level
Area	6.01	4	33.10	**
Residuals	0.59	13		

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

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

Nickel

Source	Type II Sum of Square	Df	F value	Significance Level
Area	2.60	4	27.34	**
Residuals	0.31	13		

Note:
3. Assume Gamma distribution
4. 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	0.195	4	29.857	**
Residuals	0.021	13		

Note:

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

SNK Results:

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

Zinc

Source	Type II Sum of Square	Df	F value	Significance Level
Area	2.39	4	37.04	**
Residuals	0.21	13		

Note:

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

SNK Results:

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

Sediment Chemistry of ESC CMPs after a Major Storm Event (on 11 October 2023)

Arsenic

Source	Type II Sum of Square	Df	F value	Significance Level
Area	3.12	4	49.02	**
Residuals	0.49	31		

Note:

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

SNK Results:

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

Cadmium

Source	Type II Sum of Square	Df	F value	Significance Level
Area	0.024	4	15.37	**
Residuals	0.012	31		

Note:

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

SNK Results:

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

Chromium

Source	Type II Sum of Square	Df	F value	Significance Level
Area	2213.08	4	45.27	**
Residuals	378.87	31		

Note:

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

SNK Results:

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

Copper

Source	Type II Sum of Square	Df	F value	Significance Level
Area	3491.17	4	38.99	**
Residuals	694.00	31		

Note:

5. Assume Gaussian distribution
6. 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	2.87	4	42.04	**
Residuals	0.53	31		

Note:

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

SNK Results:

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

Mercury

Source	Type II Sum of Square	Df	F value	Significance Level
Area	6.51	4	18.67	**
Residuals	2.70	31		

Note:

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

SNK Results:

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

Nickel

Source	Type II Sum of Square	Df	F value	Significance Level
Area	781.15	4	32.14	**
Residuals	188.36	31		

Note:

5. Assume Gaussian distribution
6. 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	14.80	4	17.26	**
Residuals	6.65	31		

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

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

Zinc

Source	Type II Sum of Square	Df	F value	Significance Level
Area	14326.07	4	43.57	**
Residuals	2548.11	31		

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

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

Summary of t-test on inorganic contaminants in whole body and tissue samples collected during January/February 2023

	Inorganic								
	As	Ag	Cd	Cr	Cu	Hg	Ni	Pb	Zn
Tissue									
Swimming Crab	-	-	-	-	-	-	-	-	-
Gastropod	-	-	-	-	-	-	-	-	-
Burrowing Fish	-	-	-	-	-	-	-	-	-
Demersal / Pelagic Fish	-	-	-	-	-	-	-	-	-
Flat Fish	-	-	-	-	-	-	-	-	-
Mantis Shrimp	-	-	-	-	-	-	-	-	-
Whole Body									
Demersal / Pelagic Fish	-	/	/	-	-	-	-	NS	-
Prawn	-	-	-	-	-	-	-	-	-
Mantis Shrimp	/	-	-	-	-	/	-	-	-
Crab	-	-	-	-	-	/	-	-	-

	DDT	4, 4'-DDE	TBT	PCB
Tissue				
Swimming Crab	-	-	-	-
Gastropod	-	-	-	-
Burrowing Fish	-	-	-	-
Demersal / Pelagic Fish	-	-	-	-
Flat Fish	-	-	-	-
Mantis Shrimp	-	-	-	-
Whole Body				
Demersal / Pelagic Fish	-	-	-	-
Prawn	-	-	-	-
Mantis Shrimp	/	/	-	/
Crab	-	/	-	-

Notes:

1. "NS" denotes no significant difference in contaminant concentration detected between Impact and Reference area ($p \geqslant 0.05$)
2. "I" denotes Impact area, "R" denotes reference area; Shaded grey cells indicate a significant difference in contaminant concentration between Impact and Reference areas ($p<0.05$)
3. "-" denotes insufficient samples of targeted species collected in Impact and/or Reference areas during January/February 2023, or the samples not fulfilling t-test assumptions, thus not being able to run *t*-tests for the parameters in tissue / whole body samples.
4. "/" denotes contaminant concentration below detection limit for all tissue / body samples in Impact and Reference area.

Remarks:

1. According to the Annual Risk Assessment Report April 2021 to March 2022, the analysis of whole body samples of Cephalopod is suggested to be removed, and thus it is not conducted starting from 2022.

Summary of *t*-test on inorganic contaminants in whole body and tissue samples collected during July/August 2023

	Inorganic								
	As	**Ag**	**Cd**	**Cr**	**Cu**	**Hg**	**Ni**	**Pb**	**Zn**
Tissue									
Swimming Crab	-	-	/	/	NS	/	-	/	R>I
Gastropod	-	-	-	-	-	-	-	-	-
Burrowing Fish	-	-	-	-	-	-	-	-	-
Demersal / Pelagic Fish	-	-	-	-	-	-	-	-	-
Flat Fish	-	-	-	-	-	-	-	-	-
Mantis Shrimp	-	-	-	-	-	-	-	-	-
Whole Body									
Demersal / Pelagic Fish	/	-	-	/	-	-	-	R>I	-
Prawn	-	-	-	-	-	-	-	-	-
Mantis Shrimp	-	-	-	-	-	-	-	-	-
Crab	-	-	-	-	-	-	-	-	-

	DDT	**4, 4'-DDE**	**TBT**	**PCB**
Tissue				
Swimming Crab	/	/	/	/
Gastropod	-	-	-	-
Burrowing Fish	-	-	-	-
Demersal / Pelagic Fish	-	-	-	-
Flat Fish	-	-	-	-
Mantis Shrimp	-	-	-	-
Whole Body				
Demersal / Pelagic Fish	/	-	NS	-
Prawn	-	-	-	-
Mantis Shrimp	-	-	-	-
Crab	-	-	-	-

Notes:

1. "NS" denotes no significant difference in contaminant concentration detected between Impact and Reference area ($p \geqslant 0.05$)
2. "I" denotes Impact area, "R" denotes reference area; Shaded grey cells indicate a significant difference in contaminant concentration between Impact and Reference areas ($p<0.05$)
3. "-" denotes insufficient samples of targeted species collected in Impact and/or Reference areas during July /August 2023, or the samples not fulfilling t-test assumptions, thus not being able to run *t*-tests for the parameters in tissue / whole body samples.
4. "/" denotes contaminant concentration below detection limit for all tissue / body samples in either Impact or Reference area.

Remarks:

1. According to the Annual Risk Assessment Report April 2021 to March 2022, the analysis of whole body samples of Cephalopod is suggested to be removed, and thus it is not conducted starting from 2022.

Fisheries Resource Data - Analysis up to Aug 2023

Abundance

Source	Type II Sum of Squares	Df	F value	Significance Level
Period	20902.5	72	249.453	**
Station	921.4	5	158.345	**
Period:Station	11108.7	360	26.515	**
Residuals	2039.0	1752		

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

ANOVA Results:
- Interaction effects statistically significant between Period and Station

Tukey test Results:
- Stations showing potential project related temporal trend (i.e. previous survey months > current survey months at IN-A and IN-B)
  ∴ None
- Months showing potential project related spatial trend (i.e. Reference site 1 > Reference site 2 > Reference site 3 > Reference site 4 > Impact site 1 >Impact site 2)
  ∴ 14 Jul, 15 Feb, 18 Jan, 18 Feb, 18 Aug, 18 Jul, 19 Feb, 19 Jul, 19 Aug, 20 Feb, 20 Aug, 21 Jan, 21 Feb, 21 Jul, 21 Aug, 22 Jan, 22 Aug, 22 Sep, **23 Jan, 23 Feb, 23 Jul, 23 Aug**
- Conclusion: No overall project related impact is indicated as there is no significant temporal decrease in abundance from impact sites.

Number of Species

Source	Type II Sum of Squares	Df	F value	Significance Level
Period	4027.9	72	70.7991	**
Station	510.7	5	129.2724	**
Period:Station	1878.1	360	6.6021	**
Residuals	1384.4	1752		

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

ANOVA Results:
- Interaction effects statistically significant between Period and Station

Tukey test Results:
- Stations showing potential project related temporal trend (i.e. previous survey months > current survey months at IN-A and IN-B)
  ∴ None
- Months showing potential project related spatial trend (i.e. Reference site 1 > Reference site 2 > Reference site 3 > Reference site 4 > Impact site 1 >Impact site 2)
  ∴ 17 Aug, 18 Jan, 18 Feb, 19 Jul, 19 Aug, 20 Feb, 21 Feb, 22 Aug, 22 Sep, **23 Aug**
- Conclusion: No overall project related impact is indicated as there is no significant temporal decrease in number of species from impact sites.

Shannon-Wiener Diversity

Source	Type II Sum of Squares	Df	F value	Significance Level
Period	98.14	72	41.960	**
Station	4.70	5	28.965	**
Period*Station	160.17	360	13.696	**
Residuals	56.91	1752		

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

ANOVA Results:
- Interaction effects statistically significant between Period and Station

SNK test Results:
- Stations showing potential project related temporal trend (i.e. previous survey months > current survey months at IN-A and IN-B)
  ∴ None
- Months showing potential project related spatial trend (i.e. Reference site 1 > Reference site 2 > Reference site 3 > Reference site 4 > Impact site 1 >Impact site 2)
  ∴ 10 Jan, 10 Feb, 10 Jul, 10 Aug, 11 Jul, 12 Jan, 12 Feb, 12 Aug, 13 Jan, 13 Feb, 20 Jan, 20 Feb, 20 Jul, 20 Aug, 21 Feb, 21 Jul, 22 Feb
- Conclusion: No overall project related impact is indicated as there is no significant temporal decrease in Shannon-Wiener diversity index from impact sites.

Pielou's Evenness

Source	Type II Sum of Squares	Df	F value	Significance Level
Period	102.5	72	46.541	**
Station	5.4	5	35.3589	**
Period*Station	159.8	360	14.5145	**
Residuals	53.6	1752		

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

ANOVA Results:
- Interaction effects statistically significant between Period and Station

SNK test Results:
- Stations showing potential project related temporal trend (i.e. previous survey months > current survey months at IN-A and IN-B)
  ∴ None
- Months showing potential project related spatial trend (i.e. Reference site 1 > Reference site 2 > Reference site 3 > Reference site 4 > Impact site 1 >Impact site 2)
  ∴ 10 Jan, 10 Feb, 10 Jul, 10 Aug, 11 Jul, 11 Aug, 12 Jan, 12 Feb, 12 Aug, 13 Jan, 13 Feb, 20 Feb, 21 Feb, 21 Jul, 22 Feb
- Conclusion: No overall project related impact is indicated as there is no significant temporal decrease in Pielous's evenness index from impact sites.

Species Richness

Source	Type II Sum of Squares	Df	F value	Significance Level
Period	80.2	72	44.903	**
Station	8.5	5	68.653	**
Period*Station	45.8	360	5.1123	**
Residuals	43.5	1752		

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

ANOVA Results:
- Interaction effects statistically significant between Period and Station

SNK test Results:
- Stations showing potential project related temporal trend (i.e. previous survey months > current survey months at IN-A and IN-B)
  ∴ None
- Months showing potential project related spatial trend (i.e. Reference site 1 > Reference site 2 > Reference site 3 > Reference site 4 > Impact site 1 >Impact site 2)
  ∴ 07 Feb, 12 Aug, 17 Jul, 19 Jul, 19 Aug, 20 Jan, 20 Feb, 20 Aug, 21 Jul, 22 Feb, 22 Aug, **23 Aug**
- Conclusion: No overall project related impact is indicated as there is no significant temporal decrease in species richness from impact sites.

Biomass

Source	Type II Sum of Squares	Df	F value	Significance Level
Period	981.6	72	122.626	**
Station	76.7	5	137.984	**
Period*Station	825.6	160	20.627	**
Residuals	194.8	1752		

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

ANOVA Results:
- Interaction effects statistically significant between Period and Station

SNK test Results:
- Stations showing potential project related temporal trend (i.e. previous survey months > current survey months at IN-A and IN-B)
  ∴ None
- Months showing potential project related spatial trend (i.e. Reference site 1 > Reference site 2 > Reference site 3 > Reference site 4 > Impact site 1 >Impact site 2)
  ∴ 06 Aug, 17 Feb, 17 Aug, 18 Jan, 18 Feb, 18 Jul, 18 Aug, 19 Jan, 19 Jul, 19 Aug, 20 Feb, 20 Jul, 20 Aug, 21 Jan, 21 Feb, 21 Jul, 21 Aug, 22 Jan, 22 Feb, 22 Jul, 22 Aug, **23 Jan, 23 Jul, 23 Aug**

- Conclusion: No overall project related impact is indicated as there is no significant temporal decrease in biomass from impact sites.