

FORM 5
ENVIRONMENTAL IMPACT ASSESSMENT ORDINANCE
(CHAPTER 499)
SECTION 13(1)

Application for Variation of an Environmental Permit

PART A PREVIOUS APPLICATIONS

No previous application for variation of an environmental permit.
 The environmental permit was previously amended.
Application No. :

PART B DETAILS OF APPLICANT

B1. Name : (person or company)
Drainage Services Department
[Note : In accordance with section 13(1) of the Ordinance, the person holding an environmental permit or a person who assumes responsibility for the designated project may apply for variation of the environmental permit.]
B2. Business Registration No. : [REDACTED]
(if applicable)
B3. Correspondence Address :
[REDACTED]
B4. Name of Contact Person : [REDACTED] B5. Position of Contact Person : [REDACTED]
B6. Telephone No. : [REDACTED] B7. Fax No. : [REDACTED]
B8. E-mail Address : (if any) [REDACTED]

PART C DETAILS OF CURRENT ENVIRONMENTAL PERMIT

C1. Name of the Current Environmental Permit Holder :
Drainage Services Department
C2. Application No. of the Current Environmental Permit : EP-516/2016
C3. The Current Environmental Permit was Issued in : month / year
|0|1| |2|0|1|7|

Important Notes : Please submit the application together with
(a) 3 copies of this completed form; and
(b) appropriate fee as stipulated in the Environmental Impact Assessment (Fees) Regulation
to the Environmental Protection Department at the following address :
The EIA Ordinance Register Office,
27th floor, Southorn Centre, 130 Hennessy Road,
Wan Chai, Hong Kong.

Tick (✓) the appropriate box



PART D PROPOSED VARIATIONS TO THE CONDITIONS IN CURRENT ENVIRONMENTAL PERMIT

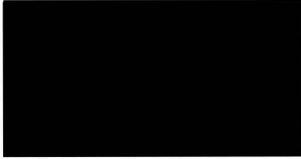
D1. Condition(s) in the Current Environmental Permit :	D2. Proposed Variation(s) :	D3. Reason for Variation(s) :	D4. Describe the environmental changes arising from the proposed variation(s) :	D5. Describe how the environment and the community might be affected by the proposed variation(s) :	D6. Describe how and to what extent the environmental performance requirements set out in the EIA report previously approved or project profile previously submitted for this project may be affected :	D7. Describe any additional measures proposed to eliminate, reduce or control any adverse environmental impact arising from the proposed variation(s) and to meet the requirements in the Technical Memorandum on Environmental Impact Assessment Process :
<p><u>Part C, Condition 2.15</u> Measures to Minimize Water Quality Impacts during Construction</p> <p>The Permit Holder shall implement the following mitigation measures to minimize the water quality impact due to construction works of the submarine outfall:</p> <p>(i) horizontal directional drilling method for the construction of the submarine outfall pipeline;</p> <p>(ii) marine works for the submarine outfall diffuser (dredging, construction and installation works at diffuser location and backfilling) to be carried out inside a fully enclosed and watertight cofferdam in accordance with the Silt Curtain and Cofferdam Deployment Plan in Condition 2.13 of this permit, and the cofferdam to be removed after completion of the marine works during ebb tide;</p>	<p><u>Part C, Condition 2.15</u> Measures to Minimize Water Quality Impacts during Construction</p> <p>The Permit Holder shall implement the following mitigation measures to minimize the water quality impact due to construction works of the submarine outfall:</p> <p>(i) horizontal directional drilling method for the construction of the submarine outfall pipeline;</p> <p>(ii) marine works for the submarine outfall diffuser (dredging, construction and installation works at diffuser location and backfilling) to be carried out inside <u>double-layered silt curtain barrier</u> in accordance with the Silt Curtain and Cofferdam Deployment Plan in Condition 2.13 of this permit, and the <u>marine steel casings for supporting double-layered silt curtain barrier shall only be extracted</u> during ebb tide;</p>	<p>The original sheetpile cofferdam recommended in the approved EIA was found technically infeasible as described in Section 2.2.1 of environmental review report in Attachment A and therefore a double-layered silt curtain barrier with marine steel casings is proposed as alternative mitigation measures during the marine works for the proposed submarine outfall diffuser. Therefore, amendment of Condition 2.15(ii) is proposed. As the marine steel casing for supporting the proposed alternative double layer silt curtain barrier would be installed and extracted following the construction of original sheetpile cofferdam, amendment of Condition (iii) and (iv) is proposed. As no removal of silty water from the proposed silt curtain barrier would be required, deletion of Condition 2.15 (vi) is proposed.</p> <p>With the implementation of proposed alternative</p>	<p>No adverse environmental impacts are anticipated from the proposed variations. For details, please refer to the environmental review report in Attachment A.</p>	<p>The environment and the community will not be adversely affected by the proposed variations. For details, please refer to the attached environmental review report at Attachment A.</p>	<p>The environmental requirements set out in the EIA Report previously approved for this project will not be affected by the proposed variations. For details, please refer to Attachment A.</p>	<p>No additional mitigation measures are required for the proposed variations.</p>

PART D PROPOSED VARIATIONS TO THE CONDITIONS IN CURRENT ENVIRONMENTAL PERMIT (CONTINUED)

D1. Condition(s) in the Current Environmental Permit :	D2. Proposed Variation(s) :	D3. Reason for Variation(s) :	D4. Describe the environmental changes arising from the proposed variation(s) :	D5. Describe how the environment and the community might be affected by the proposed variation(s) :	D6. Describe how and to what extent the environmental performance requirements set out in the EIA report previously approved or project profile previously submitted for this project may be affected :	D7. Describe any additional measures proposed to eliminate, reduce or control any adverse environmental impact arising from the proposed variation(s) and to meet the requirements in the Technical Memorandum on Environmental Impact Assessment Process :
<p><u>Part C, Condition 2.15 (Continued)</u></p> <p>(iii) sheet piles for the cofferdam to be installed by vibratory action;</p> <p>(iv) silt curtain to be installed to surround the cofferdam area during the installation and extraction works of the cofferdam in accordance with the Silt Curtain and Cofferdam Deployment Plan in Condition 2.13 of this permit;</p> <p>(v) dredging to be carried out by a closed grab dredger, and the marine sediment to be placed in sealed compartment of a marine barge; and</p> <p>(vi) silty water removed from the cofferdam to be desilted in a sedimentation tank before discharging back into the sea.</p>	<p><u>Part C, Condition 2.15 (iii) (Continued)</u></p> <p>(iii) <u>marine steel casings for supporting double-layered silt curtain barrier</u> to be installed by vibratory action;</p> <p>(iv) <u>the installation and extraction works of marine steel casings for supporting double-layered silt curtain barrier shall be conducted within silt curtain</u> in accordance with the Silt Curtain and Cofferdam Deployment Plan in Condition 2.13 of this permit; <u>and</u></p> <p>(v) dredging to be carried out by a closed grab dredger, and the marine sediment to be placed in sealed compartment of a marine barge.</p>	<p>mitigation measures, the overall duration of the corresponding part of the marine construction activities could be reduced from 10 months to 5 months and thereby minimise potential associated impacts on environment.</p>				

PART E DECLARATION BY APPLICANT

E1. I hereby certify that the particulars given above are correct and true to the best of my knowledge and belief. I understand the environmental permit may be suspended, varied or cancelled if any information given above is false, misleading, wrong or incomplete.



Signature of Applicant



Full Name in Block Letters



Position

on behalf of

Drainage Services Department
Company Name and Chop (as appropriate)



3-DEC-2014

Date

NOTES :

1. A person who constructs or operates a designated project in Part I of Schedule 2 of the Ordinance or decommissions a designated project listed in Part II of Schedule 2 of the Ordinance without an environmental permit or contrary to the permit conditions commits an offence under the Ordinance and is liable to a maximum fine of \$5,000,000 and to a maximum imprisonment for 2 years.
2. A person for whom a designated project is constructed, operated or decommissioned and who permits the carrying out of the designated project in contravention of the Ordinance commits an offence and is liable to a maximum fine of \$5,000,000 and to a maximum imprisonment for 2 years.

ENVIRONMENTAL REVIEW REPORT (FINAL)

Port Shelter Sewerage, Stage 3 –
Sewerage Works at Po Toi O under
Environmental Permit No. 516/2016

Drainage Services Department

1 DECEMBER 2025



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Appendices

Appendix 5A	Refined Model Grid Layout, Properties and Performance Verifications
Appendix 5B	Model Spin-up Test Results
Appendix 5C	Contour Plots for Water Quality Modelling

Prepared by:  _____ 1 December 2025 _____
Signature **Date**

Sarah YAU

Printed Name

Checked by:  _____ 1 December 2025 _____
Signature **Date**

Amy CHEUNG

Printed Name

Approved by:  _____ 1 December 2025 _____
Signature **Date**

Colin CHAN

Printed Name

1 Introduction

1.1 Background

- 1.1.1 The works for “Port Shelter Sewerage, Stage 3 - Sewerage Works at Po Toi O (the Project)” mainly comprise the following items:
- (i) Provision of village sewerage to the unsewered areas of Po Toi O.
 - (ii) Construction of a local sewage treatment plant (STP) at Po Toi O.
 - (iii) Construction of a submarine outfall and the associated diffuser for disposal of treated effluent from the STP at Po Toi O.
- 1.1.2 The general layout out plan of the Project assumed in EIA Report is illustrated in **Figure 1.1**.
- 1.1.3 The Project was classified as designated project under the Environmental Impact Assessment Ordinance (Cap. 499) (EIAO). An Environmental Impact Assessment (EIA) was completed in accordance with the EIAO under the Investigation Stage of the Project. The EIA Report for the Project (Register No.: AEIAR-206/2017) was approved on 27 January 2017 under the EIAO. The Environmental Permit (EP) (EP No: EP-516/2016), covering the construction and operation of Project, was granted on 27 January 2017.
- 1.1.4 Water quality mitigation measures were recommended in the approved EIA Report for construction of the submarine outfall diffuser. Change of these mitigation measures has been recently proposed under the detailed design stage of the Project to resolve engineering constraints.
- 1.1.5 In December 2024, the Drainage Services Department (DSD) commissioned Binnies Hong Kong Limited to undertake an environmental review for the proposed change under the Assignment “*Agreement No. CE65/2006(DS) Port Shelter Sewerage Stage 2 and Stage 3 – Design and Construction*”.

1.2 Purpose of this Report

- 1.2.1 The purpose of this Environmental Review Report (ERR) is to support an upcoming variation of EP (VEP) application by reviewing the potential environmental impact arising from the proposed change and demonstrating that there is no material change to the environmental impact of the project with the mitigation measures in place; and the project complies with the requirements described in the Technical Memorandum on EIA Process (EIAO-TM).

1.3 Report Structure

- 1.3.1 The remainder of this Report is organized as follows:
- (a) Section 2 presents the details of proposed change and identifies the potential environmental aspects of concern associated with the change.
 - (b) Section 3 presents the water quality impact review.

- (c) Section 4 presents the marine ecological impact review.
- (d) Section 5 presents the fisheries impact review.
- (e) Section 6 reviews the Environmental Management and Audit (EM&A) requirements.
- (f) Section 7 presents the conclusion of this ERR.

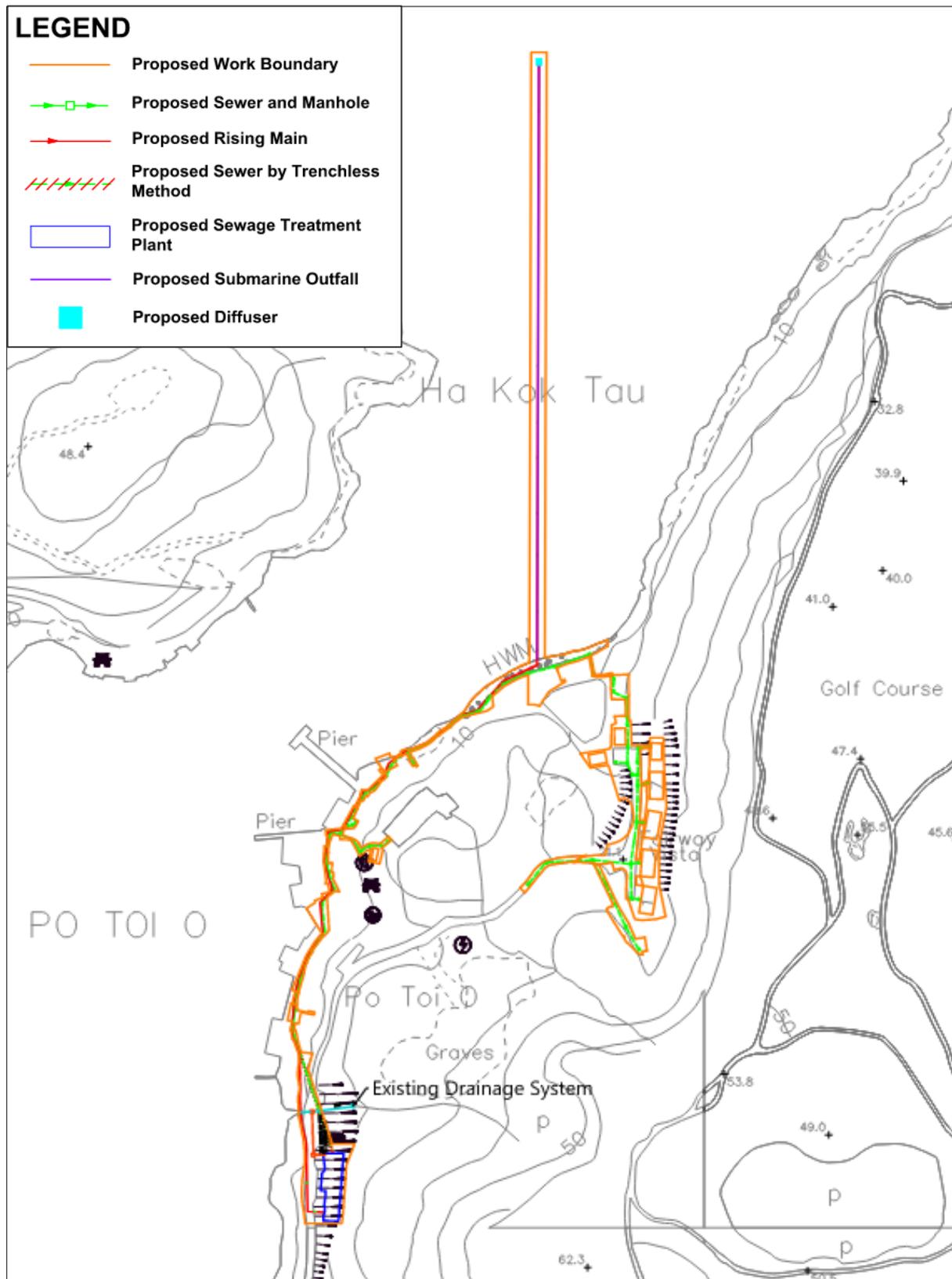


Figure 1.1 General Layout Plan

2 Proposed Change and Environmental Implications

2.1 Original Design in the Approved EIA Report (AEIAR-206/2017)

- 2.1.1 According to Section 5.8.5 of the approved EIA Report, installation works of submarine diffuser (involving dredging, construction and installation works at diffuser location and backfilling) shall be carried out inside fully enclosed watertight cofferdam. With reference to Section 5.6.2 of the EIA Report, the cofferdam should be formed by installation of steel sheetpiles to surround the works area. Lateral loading from wave and water pressure will be resisted by struts and walings system.
- 2.1.2 According to Sections 2.7.12 and 5.6.2 of the EIA Report, after erection of cofferdam, the water inside would be pumped out. Silty water removed from the cofferdam should be de-silted in a sedimentation tank before discharge back into the sea. Dredging within the cofferdam should be carried out by closed grab dredger. The dredging barge would be anchored outside the cofferdam and moved the closed grab into the cofferdam for dredging. No opening of cofferdam was proposed during the marine works and thus no release of sediment into water bodies was assumed. With reference to Section 5.8.6 of the EIA Report, the dredged sediment should be stored in sealed compartment of the barge. After installation of the diffuser, most of the works area would be backfilled with rockfill as described in Section 5.4.5 of the EIA Report. After the backfilling work is completed, the cofferdam would be removed.
- 2.1.3 The works area to be enclosed by the cofferdam at the diffuser point was assumed to be 10 m x 50 m (i.e. 500 m²). With reference to Section 5.4.6 of the EIA Report, installation and extraction of sheetpiles should be conducted by vibratory action. This would cause minor displacement of marine sediment, which would quickly settle without significant increase in suspended solids (SS). Single layer silt curtain should be deployed during the installation and extraction of sheetpiles.

2.2 Reasons for Proposed Change

- 2.2.1 The proposed submarine outfall diffuser is situated approximately 0.4 km from the Po Toi O shoreline, where seabed depths range from 15 to 18 meters below sea level. Following the recommendation in the approved EIA report, the installation sheetpile cofferdam was undertaken from 11 December 2023 to 13 January 2024 for construction works of the submarine outfall diffuser. However, unexpected high wave and current pressures were encountered at the site and adversely affected the structural integrity of the constructed cofferdam structure. Despite further adjustment in the cofferdam structural design, the recommended sheetpile cofferdam was remained to be technically infeasible due to the prevailing maritime condition and the cofferdam installation works was therefore unviable to complete. The sheetpiles of the incomplete cofferdam have been removed. As such, an alternative double-layered silt curtain barrier supported by temporary steel casings is therefore proposed, of which the solidity ratio would be improved, such that aforementioned high wave and current pressures acting on the proposed temporary works could be significantly reduced and associated adverse impact on the structural integrity would not be expected. Thus, this

alternative enhanced double-layered silt curtain barrier is considered technically feasible.

2.3 Proposed Change

Description of Proposed Change

- 2.3.1 This section outlines the proposed replacement of the use of a fully enclosed watertight cofferdam by an enhanced double-layered silt curtain barrier for marine works (dredging, construction and installation works at diffuser location and backfilling).
- 2.3.2 The construction sequences of the enhanced double-layered silt curtain barrier are presented as follows.
- (i) Installation of temporary steel casings to the bedrock level;
 - (ii) Installation of concrete blocks on seabed level;
 - (iii) Fixing silt curtain to the concrete blocks and temporary steel casings to form the silt curtain barrier system;
 - (iv) Dredging at the diffuser location using a closed-grab dredger, with sediments stored in a sealed compartment of the barge anchored outside the silt curtain barrier;
 - (v) Installation of diffuser;
 - (vi) Backfilling with rockfill material;
 - (vii) Dismantling of silt curtain barrier system including removal of silt curtain, temporary concrete blocks and temporary steel casings, to be conducted during ebb tide.

2.3.3 Typical silt curtain components are shown in **Figure 2.1**.

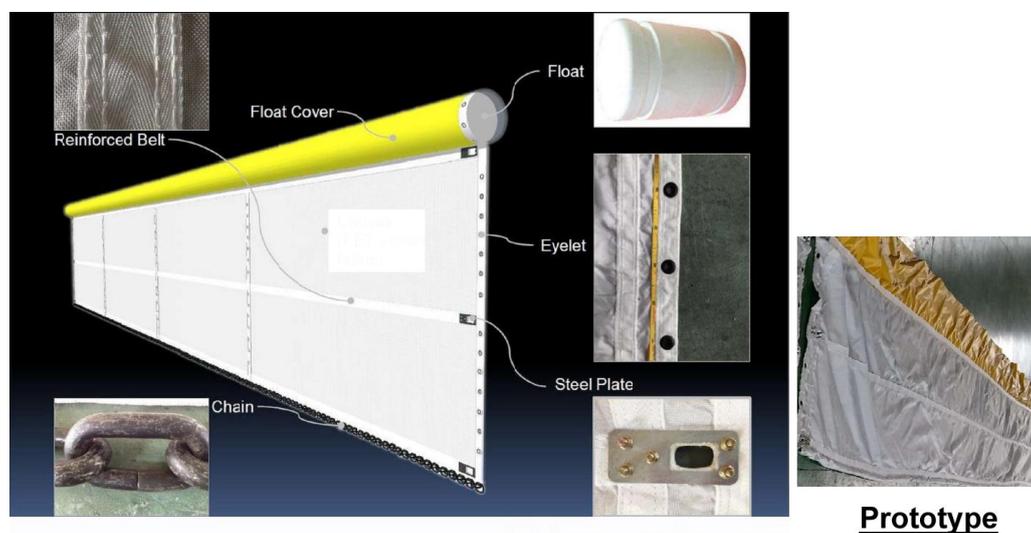


Figure 2.1 Photo of Similar Silt Curtain Components

- 2.3.4 The enhanced double-layered silt curtain barrier would be supported by concrete blocks installed (without leveling or dredging works) on seabed level and approx. 40 nos of dia. 1m temporary steel casings with length around 35m to bedrock level, subject to the final approval of updated Silt Curtain and Cofferdam Deployment Plan. After construction of proposed diffuser, the dredged trench would be backfilled with rockfill materials using derrick lighter equipped with closed grab subject to the final approval of updated Silt Curtain and Cofferdam Deployment Plan.
- 2.3.5 The enhanced double-layered silt curtain barrier will include a chain (5kg/m) at the toe of the curtain (see **Figure 2.1**) to surround the work area, thereby minimizing lateral movement of the barrier during dredging. No gaps will be retained between the seabed and the silt curtain. The float material at top of the silt curtain would ensure the silt curtain top be floated on the sea level, sufficient height of reinforced belt would be provided as an allowance of tidal changes.
- 2.3.6 The indicative arrangement of the enhanced double-layered silt curtain barrier is shown in **Figure 2.2**. The inner and outer layers of the barrier measure approximately 16.6 m × 30 m (498 m²) and 26.6 m × 40 m (1,064 m²), respectively.

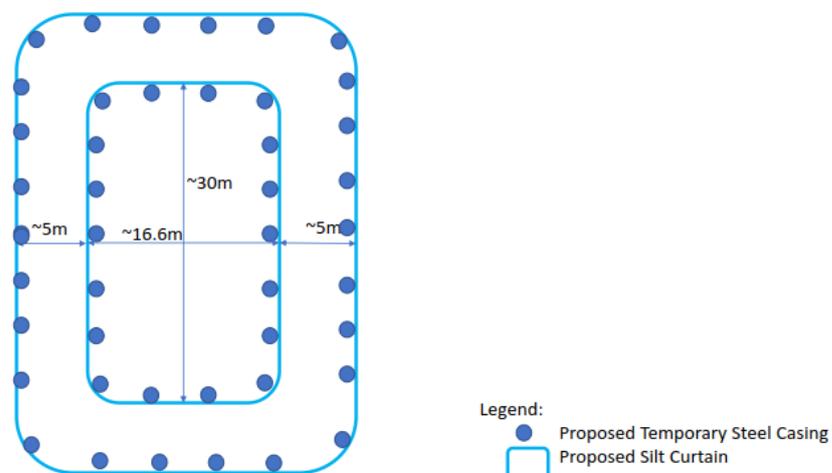


Figure 2.2 Indicative Arrangement of Enhanced Silt Curtain Barrier (Plan View)

- 2.3.7 Upon completion of the silt curtain barrier installation, marine works for the proposed diffuser—including dredging, diffuser installation, and backfilling—will proceed within the inner layer of the silt curtain barrier. A derrick lighter with closed grab would be mooring outside the silt curtain. As such, no opening of silt curtain will be required during dredging, installing of diffuser and backfilling. The enhanced double-layered silt curtain barrier, along with the steel casings, will be dismantled once the marine works are completed. Similar to the sheetpile installation approved in the EIA, no significant suspended solids (SS) release is expected from the insertion and removal of steel casings using vibratory action. A single-layer silt curtain will be deployed to surround the area during steel casing insertion and removal. As recommended for sheetpiles in the approved EIA Report, the proposed steel casings will be extracted during ebb tide to minimize water quality impacts on Po Toi O Bay.

- 2.3.8 Prior to the commencement of the works, an updated Silt Curtain and Cofferdam Deployment Plan in accordance with Environmental Permit condition 2.13 would be submitted to include the details, operation and maintenance of silt curtain(s) to be deployed during the construction.

Environmental Benefits of the Proposed Change

- 2.3.9 With the implementation of proposed alternative mitigation measures, the overall duration of the corresponding part of the marine construction activities could be reduced from 10 months to 5 months and thereby minimise potential associated impacts on environment (i.e. water quality, marine ecology and fisheries), public and traffic.

2.4 Stakeholder Engagement

- 2.4.1 Upon the proposed change from a fully enclosed water-tight cofferdam to the enhanced double layer silt curtain barrier, the relevant environmental concerns raised in the local consultation listed in the Table 2.7 of the EIA Report regarding the water quality impact of the marine works (particularly for dredging and backfilling works) around Po Toi O fish culture zone have to be reviewed and addressed.
- 2.4.2 Subsequent local consultation with relevant stakeholders including Village Representative of Po Toi O Village and the Sai Kung Po Toi O Fish Culture Business Association have been conducted on 16 April 2025. The relevant stakeholders expressed no objections to the proposed works.

2.5 Proposed Variations to the Environmental Permit

- 2.5.1 In connection with the proposed change of the Project as discussed in the previous sections, a number of conditions in the current environmental permit (EP No: EP-516/2016) shall be varied and these conditions, the proposed variations and the reason for variations are summarized in **Table 2-1** below.

Table 2-1 Proposed Variations to Original EP Conditions

Condition	Original Conditions	Proposed Variations	Reason for Variations
2.15 (ii)	marine works for the submarine outfall diffuser (dredging, construction and installation works at diffuser location and backfilling) to be carried out inside a fully enclosed and watertight cofferdam in accordance with the Silt Curtain and Cofferdam Deployment Plan in Condition 2.13 of this permit, and the cofferdam to be removed after completion of the marine works during ebb tide;	marine works for the submarine outfall diffuser (dredging, construction and installation works at diffuser location and backfilling) to be carried out inside <u>double-layered silt curtain barrier</u> in accordance with the Silt Curtain and Cofferdam Deployment Plan in Condition 2.13 of this permit, and the <u>marine steel casings for supporting double-layered silt curtain barrier shall only be extracted</u> during ebb tide;	The original sheetpile cofferdam recommended in the approved EIA was found technically infeasible as described in Section 2.2.1 and therefore a double-layered silt curtain barrier with marine steel casings is proposed as alternative mitigation measures during the marine works for the proposed submarine outfall diffuser.
2.15 (iii)	sheet piles for the cofferdam to be installed by vibratory action;	<u>marine steel casings for supporting double-layered silt curtain barrier</u> to be installed by vibratory action;	The marine steel casing for supporting the proposed alternative double layer silt curtain barrier would be installed and extracted following the construction of original sheetpile cofferdam.
2.15 (iv)	silt curtain to be installed to surround the cofferdam area during the installation and extraction works of the cofferdam in accordance with the Silt Curtain and Cofferdam Deployment Plan in Condition 2.13 of this permit;	<u>the installation and extraction works of marine steel casings for supporting double-layered silt curtain barrier shall be conducted within silt curtain</u> in accordance with the Silt Curtain and Cofferdam Deployment Plan in Condition 2.13 of this permit;	
2.15 (vi)	silty water removed from the cofferdam to be desilted in a sedimentation tank before discharging back into the sea.	= to be deleted =	No removal of silty water from the proposed silt curtain barrier would be required

2.6 Environmental Aspects of Concern

2.6.1 The proposed change would involve adaptation of alternative construction phase mitigation measure for submarine outfall diffuser installation works only. All other construction works and the site areas for both marine and land-based construction activities, as well as operation of the Project would not be affected.

Air Quality and Noise

2.6.2 The relevant works at the diffuser site are located far away (390m) from the nearest air and noise sensitive receivers (ASRs and NSRs). Since there would be no change in separation distance between the works area and the nearest ASRs and NSRs; and the Powered Mechanical Equipment (PME) deployed and the construction method for the steel casing installation, dredging works and submarine outfall diffuser installation,

backfilling and steel casing removal works would remain unchanged. As such, no adverse air quality and noise impact during construction arising from the proposed changes would be anticipated.

Waste Management

- 2.6.3 According to the latest proposed diffuser design, the diffuser location will remain unchanged compared with the approved EIA Report. The latest dredging area would be reduced from 10 m × 50 m to 16.6 m × 30 m, with estimated dredging volume to be reduced from 1,200 m³ to 191 m³. In addition, there will be no change on the proposed outlet and handling method for sediment disposal (i.e. open sea disposal) compared with the approved EIA Report. The Contractor will liaise separately with the marine dumping control section of the EPD for any extensions or updates to the marine dumping permit. Based on the above, there will be no adverse implications on waste management during construction phase.

Landscape and Visual

- 2.6.4 The scale and nature of all proposed construction works and installations during the construction and operation phases would remain unchanged. Besides, the proposed changes would only affect marine-based submarine outfall diffuser installation works. As such, no distinctive landscape character/ resources would be affected by the proposed project change and no adverse landscape and visual impact from the proposed project change during construction is therefore anticipated.

Built Heritage, Land Contamination and Terrestrial Ecology

- 2.6.5 Since the proposed changes would only affect marine-based submarine outfall diffuser installation works and all land-based construction works of the Project will remain unchanged, no adverse land contamination, terrestrial ecology and built heritage impact during construction is therefore anticipated.

Water Quality, Marine Ecology and Fisheries

- 2.6.6 The use of sheetpile cofferdam was originally proposed to mitigate the potential water quality impact arising from the installation works of submarine diffuser and the water quality impact assessment in the approved EIA was conducted based on this assumption. Further evaluation on water quality impact assessment is considered required for the adaptation of alternative mitigation measure of enhanced double-layered silt curtain barrier.
- 2.6.7 As the potential direct impact (i.e. loss of habitat / fishing ground / benthic spawning ground) and indirect impact (i.e. water quality) on marine ecology and fisheries would be subject to the proposed change, further evaluation on the assessments for marine ecological and fisheries impacts are considered required.
- 2.6.8 The key environmental aspects of concern of the proposed change are summarized in **Table 2-2** below.

Table 2-2 Environmental Aspects of Concerns

Environmental Aspects of the EIA Report	Construction Phase	Operational Phase
Air Quality Impact	No implication is anticipated	No implication is anticipated
Noise Impact	No implication is anticipated	
Waste Management Implications	No implication is anticipated	
Landscape and Visual Impact	No implication is anticipated	
Built Heritage Impact	No implication is anticipated	
Land Contamination	No implication is anticipated	
Terrestrial Ecological Impact	No implication is anticipated	
Water Quality Impact	Potential implication as assessed in Section 3	
Marine Ecological Impact	Potential implication as assessed in Section 4	
Fisheries Impact	Potential implication as assessed in Section 5	

3 Water Quality Impact Review

3.1 Introduction

- 3.1.1 This Section reviews the water quality implications from the proposed change of the Project during the construction phase (refer to **Section 2**).

3.2 Environmental Legislation, Standards and Guidelines

- 3.2.1 The legislation and criteria applicable to the evaluation of water quality impacts are described in Section 5.2 of the EIA Report. These legislation and criteria generally remain unchanged except for the updated Professional Persons Environmental Consultative Committee Practice Notes (ProPECC PNs) on "Construction Site Drainage" (ProPECC PN 2/24).

3.3 Description of the Environment

- 3.3.1 The Study Area of water quality impact assessment covers Po Toi O Bay, Clearwater Bay and waters surrounding Steep Island. As no changes to the marine works extent are proposed in the revised design, the Study Area in the EIA remains valid.
- 3.3.2 No changes to the environmental settings of the Study Area including the Port Shelter Water Control Zones (WCZ) have been identified after the EIA stage. No additional pollution sources have been identified in the Study Area since the completion of the EIA study. The baseline water quality data used in the EIA Report are still considered representative.

3.4 Identification of Water Quality Impact

- 3.4.1 The proposed change will only affect the mitigation measures recommended for the marine works (dredging, diffuser installation and backfilling) at the diffuser site. It is proposed to use the enhanced double-layered silt curtain barrier (instead of the watertight sheetpile cofferdam) to surround the marine works. There will be no changes to the remaining works of the Project as presented in the EIA Report. Thus, this Section reviews the water quality impacts due to the marine works only.
- 3.4.2 Descriptions of the proposed marine works are presented in **Section 2**. The key sources of water quality impacts during the marine works would be the dredging and installation / removal of steel casings, which would disturb the bed sediment. Sediment disturbances may increase the suspended solids (SS) and sediment-bound contaminants in the water column, with a possible consequence of reducing dissolved oxygen (DO) levels due to organic pollution of the disturbed sediment.
- 3.4.3 Installation of the prefabricated diffuser structure would be carried out after removal of the sediment. After the diffuser installation, backfilling would be carried out using rockfill with no fines content. The diffuser installation and backfilling would not create water quality impact and therefore no further review of these activities is required.

3.5 Water Sensitive Receivers

3.5.1 No changes to the water sensitive receivers (WSRs) identified in the EIA Report have been identified. The WSRs and their buffer distances from the proposed marine works are listed in **Table 3-1**. Their indicative locations are shown in **Figure 3.1**.

Table 3-1 Representative Marine Water Sensitive Receivers

Marine WSR	Indicator Point / ID	Distance from Marine Works for Diffuser (m)
Po Toi O (PTO) Fish Culture Zone (FCZ)	F1	543
	F2	632
	F3	689
Coral Communities at PTO	Cor1	168
	Cor2	217
	Cor3	326
	Cor4	359
	Cor5	299
	Cor6	221
	Cor7	201
Major Amphioxus Habitat	Amph	96
Clear Water Bay First Beach	Beach1	1283
Clear Water Bay Second Beach	Beach2	1170
Secondary Contact Recreation Subzone	SCRS1 – SCRS3	Direct encroachment
Spawning Grounds for Commercial Fisheries Area	SG1 – SG3	Direct encroachment
Coastal Protection Area	CPA	175

3.5.2 Inland watercourses (W1 to W3) as shown in **Figure 3.1** originate from higher elevations as compared to the sea level and therefore would flow downwards and towards the sea. As such, they would unlikely be affected by the proposed marine works and therefore not considered in this impact review.

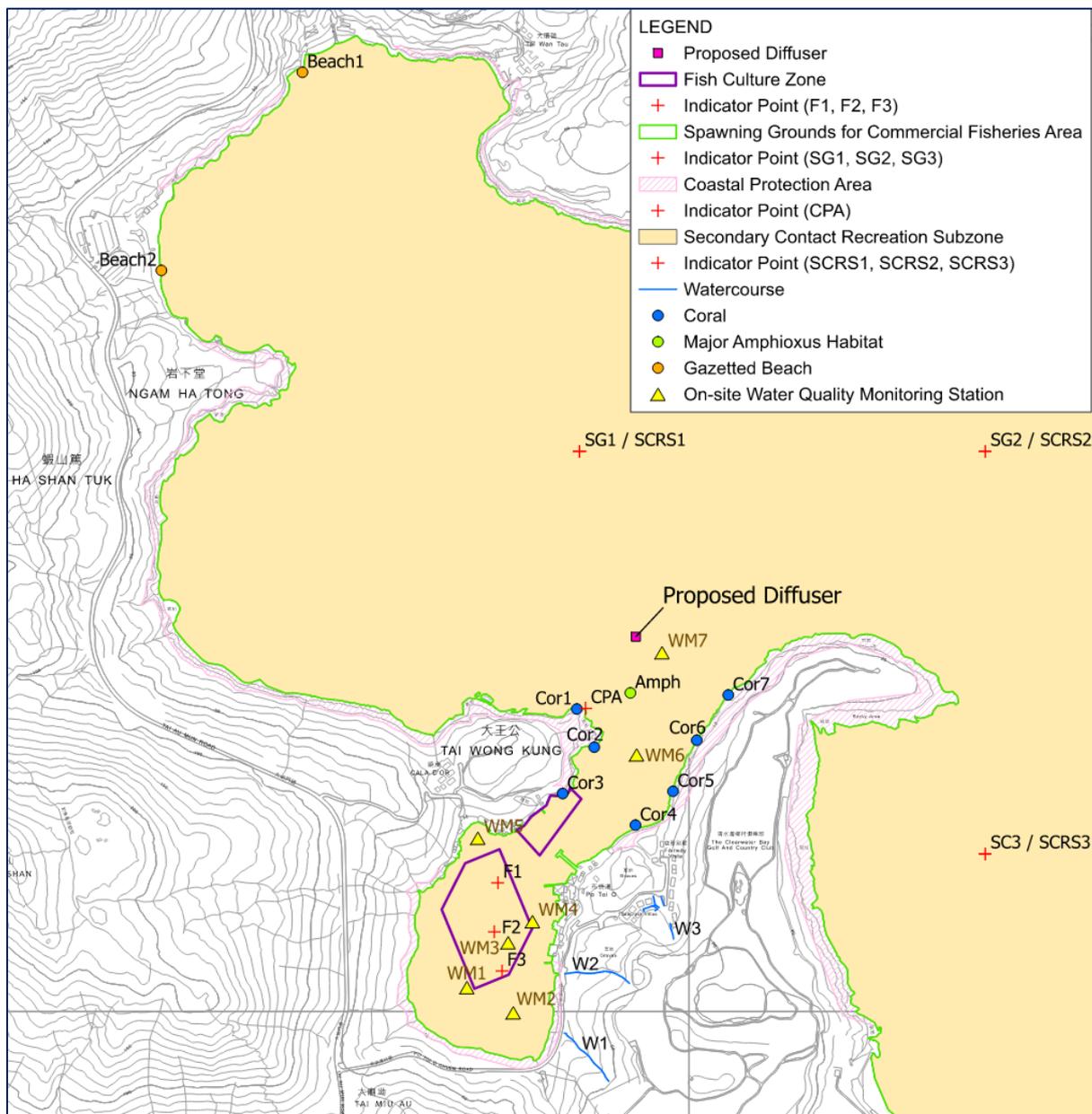


Figure 3.1 Water Sensitive Receivers and On-site Water Quality Monitoring Station

3.6 Impact Review Methodology

3.6.1 As discussed in **Section 2.3**, the proposed silt curtain barrier installation would involve insertion / extraction of steel casings with diameter of 1 m. Similar to the sheetpile cofferdam assumed in the EIA Report, installation and extraction of steel casing for silt curtain support would be conducted by vibratory action. The degree of seabed disturbance from these small-scale works would be minor and the associated potential water quality impacts have been qualitatively addressed in this ERR.

3.6.2 As presented in **Section 2.6.3** above, the proposed scale of dredging would be minor. Closed grab dredger and enhanced double-layered silt curtain barrier would be deployed to minimize the release of sediment from the dredging work. Despite of the minor dredging works and associated potential water quality impacts, in order to

demonstrate the compliance of Water Quality Objectives (WQOs) at WSRs, quantitative review has been conducted for the dredging work. The quantitative review methodology for dredging is described below.

Modelling Tools

Modelling Platforms

- 3.6.3 Mathematical modelling is performed using the hydrodynamic and water quality modelling platforms, namely the D-Flow Flexible Mesh and D-Water Quality of Delft3D Flexible Mesh Suite, developed by Deltares.
- 3.6.4 The D-Flow Flexible Mesh is applied to simulate the hydrodynamics effects of the Project. The D-Water Quality module is used to simulate the water quality effect based on the relevant flow fields determined by the D-Flow Flexible Mesh.

Model Selection and Development

- 3.6.5 The Regional Delft3D Flexible Mesh Hong Kong Model (HK-DFM Model) version 202210 provided by EPD is employed for this review. The HK-DFM Model covers the Pearl River Estuary, Macau, Ma Wan Channel, Cheung Chau, East Lamma Channel, Victoria Harbour, Tathong Channel, Nine Pin Islands, Po Toi Island, etc. All major influences on hydrodynamics (including the Pearl River discharges, spatio-temporal variations of meteorological forcing and oceanic current in the South China Sea) are incorporated into the HK-DFM Model.
- 3.6.6 For the purpose of this review, the grid layout of the HK-DFM Model has been refined in the assessment to give better representation of the coastline configuration near the Project site. Plots No. 01 to 03 of **Appendix 5A** shows the grid layout and properties of the refined HK-DFM Model. The refined model has a grid resolution of no greater than 36 m by 36 m at or in the vicinity of the proposed Project works.
- 3.6.7 The hydrodynamics performance of the refined HK-DFM Model has been verified to be consistent with the performance of the original HK-DFM Model as shown in Plots No. 04 to 12 of **Appendix 5A**. The main purpose of the model performance verification or comparison is to illustrate that the model settings of the refined model were carried out correctly.
- 3.6.8 The salinity levels predicted by the refined HK-DFM Model are also compared against the field data collected by EPD at MM19 in 2024 and the comparison results are included in Plot No. 13 of **Appendix 5A**. The refined model results are considered reasonable and further adjustment of the model parameter is not necessary.

Simulation Periods

- 3.6.9 For studying the construction phase impact, the simulations cover at least one 15-day full spring-neap cycle (excluding the spin-up period) for each of the dry season (26 January to 11 February) and wet season (20 July to 5 August). A spin-up period of 1 complete calendar year is provided for each simulation.
- 3.6.10 It is expected that a spin-up period for 10 months would be sufficient for the refined HK-DFM Model to produce stable and acceptable results. Spin-up test was conducted by comparing water levels predicted by the refined HK-DFM Model after 10-month

spin-up with that of after 12-month spin-up. The model results for Month 10 and Month 12 are compared in **Appendix 5B**. The comparison showed that the results for Month 10 and Month 12 are consistent with each other. Therefore, the spin-up period of 1 complete calendar year is considered sufficient.

General Model Settings

- 3.6.11 The general settings of the refined model such as the approach to the setup of boundary and initial conditions as well as the model coefficients and parameters follow those adopted in the original HK-DFM Model provided by EPD.

Review of Ambient Water Quality Data and Assessment Criteria

- 3.6.12 Significance of elevations of pollutants (e.g. SS and nutrients) would be reviewed with reference to the WQOs and the ambient water quality levels.
- 3.6.13 The WQOs for relevant parameters including SS, DO, unionized ammonia (UIA) and total inorganic nitrogen (TIN) are summarized in **Table 3-2**. With reference to the WQOs, any sediment plume generated from the Project shall not cause the ambient SS concentrations to be elevated by more than 30% at any time.

Table 3-2 Summary of Relevant Water Quality Objectives

Parameter	Port Shelter Water Control Zone	
	Fish Culture Zone (FCZ)	Other WSRs
SS	≤ 30% increase	
Depth-averaged DO	≥ 5 mg/L for 90% of samples	≥ 4 mg/L for 90% of samples
Bottom DO	≥ 2 mg/L for 90% of samples	
UIA	≤ 0.021 mg/L	
TIN	≤ 0.1 mg/L	

- 3.6.14 The on-site ambient water quality data collected under the EIA study in 2014 are tabulated in **Table 3-3** and the locations of the on-site stations are indicated in **Figure 3.1**. The water quality monitoring data obtained from EPD's monitoring station (MM19) closest to the WSRs during the period from 2020 to 2024 have also been considered and included in **Table 3-4** for comparison.

Table 3-3 On-site Water Quality Data Collected under the EIA Study in 2014

WSR	ID	Nearest On-site Station	Mean SS Level (Depth Average) (mg/L)		Mean DO Level (Depth Average) (mg/L)		Mean DO Level (Bottom) (mg/L)		Mean TIN Level (Depth Average) (mg/L)		Mean UIA Level (Depth Average) (mg/L)	
			Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet
PTO FCZ	F1 to F3	WM3	3.2	3.2	6.7	6.4	6.5	6.4	0.3	0.42	0.011	0.009
Coral Communities at PTO	Cor1 to Cor6	WM6	3.5	3.3	6.7	6.3	6.7	6.2	0.24	0.4	0.009	0.008
	Cor7											
Major Amphioxus Habitat	Amph	WM7	3.4	3.2	6.7	6.4	6.4	6.3	0.23	0.4	0.009	0.008
Clear Water Bay First / Second Beach	Beach 1 & Beach 2											
Secondary Contact Recreation Subzone	SCRS1 to SCRS3											
Spawning Grounds for Commercial Fisheries Area	SG1 to SG3											
Coastal Protection Area	CPA											

Table 3-4 Marine Water Quality Monitoring Data Collected by EPD at MM19 (2020 to 2024)

Parameter	Depth	Period	Ninepin Group (MM19)	
			Measured Level (mg/L)	
Mean SS Level ^{(1), (3)}	Depth average	Dry Season	3.7	
		Wet Season	4.1	
	Bottom	Dry Season	4.4	
		Wet Season	4.5	
Mean DO Level ^{(1), (3)}	Depth average	Dry Season	6.74	
		Wet Season	5.37	
	Bottom	Dry Season	6.70	
		Wet Season	4.79	
10%ile DO Level ^{(2), (3)}	Depth average	Dry Season	6.07	
		Wet Season	4.53	
	Bottom	Dry Season	6.00	
		Wet Season	3.41	
Mean TIN Level ^{(1), (3)}	Depth average	Dry Season	0.07	
		Wet Season	0.06	
	Bottom	Dry Season	0.07	
		Wet Season	0.06	
Mean UIA Level ^{(1), (3)}	Depth average	Dry Season	0.001	
		Wet Season	0.001	
	Bottom	Dry Season	0.001	
		Wet Season	0.001	

Notes:

(1) Ambient level is defined as average level of monitoring data collected by EPD from 2020 to 2024.

- (2) For comparison with the WQO, ambient DO level is also calculated as 10th percentile of monitoring data collected by EPD from 2020 to 2024.
- (3) The ambient data were analyzed and derived for both dry season (November to March) and wet season (April to October).

3.6.15 Potential impacts on benthic organisms (e.g. amphioxus and coral) may arise through excessive sediment deposition. The magnitude of the potential impacts is assessed based on the predicted sedimentation rate. The sediment deposition criterion of 100 g/m²/day is adopted for this EIA study, following the approach used in other recent EIA projects such as the EIA for Development of Tseung Kwan O Area 137 and Associated Reclamation Sites (AEIAR-265/2025) and EIA for Route 11 (Section between Yuen Long and North Lantau) (AEIAR-255/2023). The absolute sediment deposition criterion of 100 g/m²/day are only applicable to the benthic communities.

3.6.16 Data comparison indicates that using the ambient SS, TIN and UIA levels measured under the EIA study in 2014 would provide a more conservative impact review. The latest 10th percentile (10%ile) DO levels collected by EPD at MM19 are more conservative and therefore adopted. The ambient data and assessment criteria used for impact review are tabulated in **Table 3-5** below.

Table 3-5 Ambient Water Quality Data and Assessment Criteria

WSRs	ID	Assessment Water Depth	SS (mg/L)				DO (mg/L)			TIN (mg/L)			UIA (mg/L)		Assessment Criteria for Sediment Deposition Rate (g/m ² /day)	
			Ambient Level, see Note 2		Allowable Increase, see Note 3		Ambient Level, see Note 4		WQO, see Note 5	Ambient Level, see Note 2		WQO, see Note 6	Ambient Level, see Note 2			
			Dry	Wet	Dry	Wet	Dry	Wet		Dry	Wet		Dry	Wet		
PTO FCZ	F1	Depth average	3.2	3.2	1.0	1.0	6.07	4.53	5	0.30	0.42	0.10	0.011	0.009	0.021	-
	F2	Depth average	3.2	3.2	1.0	1.0	6.07	4.53	5	0.30	0.42	0.10	0.011	0.009	0.021	-
	F3	Depth average	3.2	3.2	1.0	1.0	6.07	4.53	5	0.30	0.42	0.10	0.011	0.009	0.021	-
Coral Communities at PTO	Cor1	Bottom	3.5	3.3	1.1	1.0	6.00	3.41	2	0.24	0.40	0.10	0.009	0.008	0.021	100
	Cor2	Bottom	3.5	3.3	1.1	1.0	6.00	3.41	2	0.24	0.40	0.10	0.009	0.008	0.021	100
	Cor3	Bottom	3.5	3.3	1.1	1.0	6.00	3.41	2	0.24	0.40	0.10	0.009	0.008	0.021	100
	Cor4	Bottom	3.5	3.3	1.1	1.0	6.00	3.41	2	0.24	0.40	0.10	0.009	0.008	0.021	100
	Cor5	Bottom	3.5	3.3	1.1	1.0	6.00	3.41	2	0.24	0.40	0.10	0.009	0.008	0.021	100
	Cor6	Bottom	3.5	3.3	1.1	1.0	6.00	3.41	2	0.24	0.40	0.10	0.009	0.008	0.021	100
	Cor7	Bottom	3.4	3.2	1.0	1.0	6.00	3.41	2	0.23	0.40	0.10	0.009	0.008	0.021	100
Major Amphioxus Habitat	Amph	Bottom	3.4	3.2	1.0	1.0	6.00	3.41	2	0.23	0.40	0.10	0.009	0.008	0.021	100
Clear Water Bay First Beach	Beach 1	Depth average	3.4	3.2	1.0	1.0	6.07	4.53	4	0.23	0.40	0.10	0.009	0.008	0.021	-
Clear Water Bay Second Beach	Beach 2	Depth average	3.4	3.2	1.0	1.0	6.07	4.53	4	0.23	0.40	0.10	0.009	0.008	0.021	-
Secondary Contact Recreation Subzone	SCRS1	Depth average	3.4	3.2	1.0	1.0	6.07	4.53	4	0.23	0.40	0.10	0.009	0.008	0.021	-
	SCRS2	Depth average	3.4	3.2	1.0	1.0	6.07	4.53	4	0.23	0.40	0.10	0.009	0.008	0.021	-
	SCRS3	Depth average	3.4	3.2	1.0	1.0	6.07	4.53	4	0.23	0.40	0.10	0.009	0.008	0.021	-

WSRs	ID	Assessment Water Depth	SS (mg/L)				DO (mg/L)			TIN (mg/L)			UIA (mg/L)			Assessment Criteria for Sediment Deposition Rate (g/m ² /day)
			Ambient Level, see Note 2		Allowable Increase, see Note 3		Ambient Level, see Note 4		WQO, see Note 5	Ambient Level, see Note 2		WQO, see Note 6	Ambient Level, see Note 2		WQO, see Note 6	
			Dry	Wet	Dry	Wet	Dry	Wet		Dry	Wet		Dry	Wet		
Spawning Grounds for Commercial Fisheries Area	SG1	Depth average	3.4	3.2	1.0	1.0	6.07	4.53	4	0.23	0.40	0.10	0.009	0.008	0.021	-
	SG2	Depth average	3.4	3.2	1.0	1.0	6.07	4.53	4	0.23	0.40	0.10	0.009	0.008	0.021	-
	SG3	Depth average	3.4	3.2	1.0	1.0	6.07	4.53	4	0.23	0.40	0.10	0.009	0.008	0.021	-
Coastal Protection Area	CPA	Depth average	3.4	3.2	1.0	1.0	6.00	3.41	2	0.23	0.40	0.10	0.009	0.008	0.021	-

Notes:

1. Shaded cells represent the proposed assessment criteria for construction phase.
2. The on-site water quality monitoring data collected under the EIA study in 2014 are adopted as ambient level for SS, TIN and UIA. Only depth average data are available from the approved EIA Report.
3. Allowable increase of SS is derived from 30% of the ambient level.
4. Ambient level for DO is defined as 10th percentile of monitoring data collected by EPD at the closest station (MM19) from 2020 to 2024. The ambient data were analysed and derived for both dry season (November to March) and wet season (April to October).
5. The WQO for DO under the WPCO is a 10th percentile value.
6. The WQOs for TIN and UIA under the WPCO are annual mean values.

Dredging

Elevation of Suspended Solids

Modelling Scenario

- 3.6.17 Water quality modelling was carried out to simulate the loss of fines and dispersion of sediment load from the dredging works. One mitigated modelling scenario was simulated assuming that dredging with closed grab was undertaken within the enhanced double-layered silt curtain barrier at the diffuser location.

Sediment Loss Rate

- 3.6.18 The EPD's Contaminated Spoil Management Study ¹ concluded that sediment loss from closed grab would be 11 kg/m³, 14 kg/m³ and 20 kg/m³ of mud removed for large, medium and small grab size respectively. In view of the small dredging volume, use of small grab size and a spill rate of 20 kg/m³ are assumed for the dredging work of this Project.

- 3.6.19 According to the latest design, the total dredging volume would be 191 m³. It is planned to complete the dredging work in 3 weeks, with an average dredging rate of 11 m³ per day. Under the model simulation for this review, dredging is conservatively assumed to be conducted in a faster production rate of 16 m³ per day. Assuming 12 working hours per day and a spill rate of 20 kg/m³, the loss rate for the dredging works is assumed to be about 0.01 kg/s.

Efficiency of Silt Curtain and Silt Screen

- 3.6.20 Under the proposed change, enhanced double-layered silt curtain barrier will be deployed for the dredging works.
- 3.6.21 Field trials undertaken under the "*Central Reclamation Phase III - Water Quality Assessment on the Use of Type A Fill in Final Reclamation Area East (VEP-296/2009)*" and "*Expansion of Hong Kong Airport into a Three-Runway System Three-Runway System (3RS)*" ² indicated that the efficiency of removing fine particles by applying double-layered silt curtains would be 86% and 87.4% respectively.
- 3.6.22 The efficiency of silt curtain would be inversely proportional to the magnitude of current velocity. The current velocities would be less than 0.1 m/s at proposed diffuser location. Deployment of silt curtain at the proposed marine construction site is considered practical and effective. It is proposed to adopt a SS removal efficiency of 87.4% for the enhanced double-layered silt curtain barrier with reference to the pilot test from the 3RS project. Thus, the sediment loss into the marine water would be minimized to about 0.001 kg/s after deployment of the enhanced double-layered silt curtain barrier.

¹ EPD Contaminated Spoil Management Study, Final Report, Volume 1, October 1991.

² Expansion of Hong Kong International Airport into a Three-Runway System. Pilot Test Report on Silt Curtain Efficiency, August 2017.

Modelling Parameters

3.6.23 The general parameters adopted for sediment plume modelling are as follows:

- Settling velocity – 0.5 mm/s
- Critical shear stress for deposition – 0.2 N/m²
- Critical shear stress for erosion – 0.3 N/m²
- Minimum depth where deposition allowed – 0.1 m
- Resuspension rate – 30 g/m²/d

3.6.24 The above parameters including the settling velocity of 0.5 mm/s have been adopted in numerous past studies in Hong Kong^{3, 4, 5, 6, 7, 8, 9} involving similar modelling work. With reference to these past studies, the critical shear stress values for erosion and deposition were determined by laboratory testing of a large sample of marine mud from Hong Kong as part of the WAHMO¹⁰ studies associated with the new airport at Chek Lap Kok.

Release of Contaminants and Oxygen Depletion

3.6.25 The sediment testing results presented in Section 9 of the approved EIA Report showed that the marine sediments to be dredged at the diffuser site are Category L materials with no exceedance of the Lower Chemical Exceedance Levels (LCELs). The potential release of metals and micro-pollutants from sediment into the water column is expected to be minimal during the dredging works and therefore no further review of these contaminants is conducted.

3.6.26 The key water quality parameters of concern include DO, TIN and UIA with numerical WQOs. An assessment of oxygen depletion and nutrient release during dredging operation were made in relation to the results of the predicted elevation in SS concentrations and the sediment quality data collected at the closest EPD's sediment quality monitoring station (PS6).

Oxygen Depletion

3.6.27 The maximum Chemical Oxygen Demand (COD) level (16,000 mg/kg) measured at PS6 over the period from 2020 to 2024 was used to determine the reductions in DO

³ Environmental Assessment (EA) Study for Backfilling of Marine Borrow Pits at North of the Brothers. EA Report, 2002.

⁴ Permanent Aviation Fuel Facility. EIA Report, 2002 (for Environmental Permit EP-139/2002)

⁵ EIA for Hong Kong Offshore Wind Farm in Southeastern Water (AEIAR-140/2009)

⁶ EIA for Development of a 100MW Offshore Wind Farm in Hong Kong (AEIAR-152/2010)

⁷ EIA for Additional Gas-fired Generation Units Project (AEIAR-197/2016)

⁸ EIA for Hong Kong Offshore LNG Terminal (AEIAR-218/2018)

⁹ EIA for New Contaminated Sediment Disposal Facility to the West of Lamma Island (AEIAR-241/2022)

¹⁰ Water Quality and Hydraulic Mathematical Models (WAHMO) - the first set of comprehensive mathematical models for simulation of hydrodynamics, water quality, waves, and sediment movement in Hong Kong waters.

concentration based on predicted increase in SS concentrations at the WSRs in accordance with the following equation:

$$DO_{DEP} = C \times COD \times K \times 10^{-6}$$

where DO_{DEP} = DO depletion (mg/L)

C = Predicted maximum increase of SS concentration (mg/L)

COD = Maximum COD (mg/kg) measured at PS6 during 2020 to 2024

K = Daily oxygen uptake factor (set as 1)

- 3.6.28 The daily oxygen uptake factor, K, is set to be 1 for the conservative assumption that once the sediment approaches the WSR, instantaneous oxidation of all the sediment COD would occur resulting in DO depletion in marine water.

Nutrient Release

- 3.6.29 TIN comprises NH_3-N and oxidized nitrogen. NH_3-N can exist in marine water as both UIA and ionized ammonia. For conservative estimation, it is assumed that all NH_3-N released from the sediment would turn into UIA. The maximum ammonia nitrogen (NH_3-N) level (11 mg/kg) measured at PS6 over the period from 2020 to 2024 was used to determine the elevations in NH_3-N concentration based on predicted increase in SS concentrations at the WSRs in accordance with the following equation:

$$NH_3-N_{ELE} = C \times NH_3-N \times 10^{-6}$$

where NH_3-N_{ELE} = NH_3-N elevation (mg/L)

C = Predicted maximum increase of SS concentration (mg/L)

NH_3-N = Maximum NH_3-N (mg/kg) measured at PS6 during 2020 to 2024

- 3.6.30 In the calculation, it is assumed that all of the NH_3-N in the sediment (that reaches the WSR) would be instantaneously released to the water, which may increase both the TIN and UIA levels at the WSRs. The elevations of TIN and UIA are assumed same as the elevation of NH_3-N .

Model Bathymetry

- 3.6.31 The model bathymetry schematization developed by EPD for use in the HK-DFM Model is adopted for modelling. The model bathymetry is shown in Plot No. 14 of **Appendix 5A**.

3.7 Review of Potential Impacts

Dredging

Elevation of Suspended Solids and Sediment Deposition

- 3.7.1 Loss of fines could arise from the proposed dredging works and the associated SS elevations and sediment depositions are predicted by means of mathematical

modelling. The predicted maximum SS elevations and maximum sedimentation rates with implementation of the proposed double-layered silt curtain barrier are presented in **Table 3-6** for representative WSRs. Contour plots of predicted maximum SS elevations and maximum sedimentation rates with implementation of the proposed silt curtain barrier are given in **Appendix 5C**. Full compliances with the WQO of no more than 30% increase from the ambient level and sedimentation rate criterion of less than 100 g/m²/day are predicted at all WSRs. No adverse SS and sedimentation impact is predicted.

Table 3-6 Predicted SS Elevations and Sedimentation Rates at Representative WSRs – Mitigated Scenario

WSRs	ID	Assessment Water Depth	Maximum SS Elevation (mg/L)				Maximum Sediment Deposition (g/m ² /day)		
			Dry Season		Wet Season		Assessment Criteria	Predicted Level	
			Assessment Criteria	Predicted Level	Assessment Criteria	Predicted Level		Dry Season	Wet Season
PTO FCZ	F1	Depth average	1.0	0.0001	1.0	< 0.0001	-	-	-
	F2	Depth average	1.0	< 0.0001	1.0	< 0.0001	-	-	-
	F3	Depth average	1.0	< 0.0001	1.0	< 0.0001	-	-	-
Coral Communities at PTO	Cor1	Bottom	1.1	0.0048	1.0	0.0123	100	0.23	0.53
	Cor2	Bottom	1.1	0.0016	1.0	0.0091	100	0.07	0.41
	Cor3	Bottom	1.1	0.0001	1.0	0.0006	100	0.01	0.02
	Cor4	Bottom	1.1	0.0007	1.0	0.0016	100	0.01	0.03
	Cor5	Bottom	1.1	0.0008	1.0	0.0039	100	0.03	0.09
	Cor6	Bottom	1.1	0.0043	1.0	0.0124	100	0.19	0.40
	Cor7	Bottom	1.0	0.0074	1.0	0.0035	100	0.33	0.16
Amphioxus	Amph	Bottom	1.0	0.0113	1.0	0.0206	100	0.49	0.83
Clear Water Bay First Beach	Beach 1	Depth average	1.0	0.0001	1.0	0.0002	-	-	-
Clear Water Bay Second Beach	Beach 2	Depth average	1.0	< 0.0001	1.0	0.0002	-	-	-
Secondary Contact Recreation Subzone	SCRS1	Depth average	1.0	0.0049	1.0	0.0011	-	-	-
	SCRS2	Depth average	1.0	0.0005	1.0	0.0002	-	-	-
	SCRS3	Depth average	1.0	0.0004	1.0	0.0005	-	-	-
Spawning Grounds for Commercial Fisheries Area	SG1	Depth average	1.0	0.0049	1.0	0.0011	-	-	-
	SG2	Depth average	1.0	0.0005	1.0	0.0002	-	-	-
	SG3	Depth average	1.0	0.0004	1.0	0.0005	-	-	-
Coastal Protection Area	CPA	Depth average	1.0	0.0046	1.0	0.0063	-	-	-

Dissolved Oxygen

3.7.2 The proposed change of the Project would not contribute to non-compliances with the WQOs for DO with the proposed mitigation measures in place. As shown in **Table 3-7**, the DO levels (4.53 mg/L) at three WSRs namely PTO FCZ (F1 to F3) with the Project, while less than the respective WQO of ≥ 5 mg/L for fish culture zone, would be same as the background DO level without the Project. Hence, the non-compliances are not induced by this Project. On the other hand, full WQO compliances for DO are predicted at all remaining WSRs for both with and without the Project scenarios.

Table 3-7 Predicted DO Levels at Representative WSRs – Mitigated Scenario

WSRs (Assessment Water Depth)	ID	DO (mg/L), see Note 2				
		WQO, see Note 1	Dry Season		Wet Season	
			Ambient Level	Predicted Level	Ambient Level, see Note 3	Predicted Level
PTO FCZ (Depth Average)	F1	5	6.07	6.07	<u>4.53</u>	<u>4.53</u>
	F2	5	6.07	6.07	<u>4.53</u>	<u>4.53</u>
	F3	5	6.07	6.07	<u>4.53</u>	<u>4.53</u>
Coral Communities at PTO (Bottom)	Cor1	2	6.00	6.00	3.41	3.41
	Cor2	2	6.00	6.00	3.41	3.41
	Cor3	2	6.00	6.00	3.41	3.41
	Cor4	2	6.00	6.00	3.41	3.41
	Cor5	2	6.00	6.00	3.41	3.41
	Cor6	2	6.00	6.00	3.41	3.41
	Cor7	2	6.00	6.00	3.41	3.41
Amphioxus (Bottom)	Amph	2	6.00	6.00	3.41	3.41
Clear Water Bay First Beach (Depth Average)	Beach 1	4	6.07	6.07	4.53	4.53
Clear Water Bay Second Beach (Depth Average)	Beach 2	4	6.07	6.07	4.53	4.53
Secondary Contact Recreation Subzone (Depth Average)	SCRS1	4	6.07	6.07	4.53	4.53
	SCRS2	4	6.07	6.07	4.53	4.53
	SCRS3	4	6.07	6.07	4.53	4.53
Spawning Grounds for Commercial Fisheries Area (Depth Average)	SG1	4	6.07	6.07	4.53	4.53
	SG2	4	6.07	6.07	4.53	4.53
	SG3	4	6.07	6.07	4.53	4.53
Coastal Protection Area (Depth Average)	CPA	4	6.00	6.00	3.41	3.41

Notes:

- (1) The WQO for DO allows exceedance of the objective value for 10% of samples. The ambient DO level is therefore calculated as 10%ile value using the monitoring data collected by EPD at the closest station (MM19) from 2020 to 2024. The EPD monitoring data are available for both depth average and bottom layer.
- (2) Value bolded and underlined denotes exceedance of the WQO value.
- (3) The ambient 10%ile level of depth-average DO for F1, F2 and F3 (4.53 mg/L) is less than the WQO of ≥ 5 mg/L for fish culture zone.

Nutrients

- 3.7.3 The proposed change of the Project would not contribute to any non-compliances with the WQOs for TIN with the proposed mitigation measures in place. As shown in **Table 3-8**, the predicted TIN levels (range from 0.23 to 0.42 mg/L) at all WSRs with the Project, while exceeded the respective WQO of ≤ 0.1 mg/L, would be the same as the background TIN levels without the Project. Hence, the non-compliances are not induced by this Project. On the other hand, full WQO compliances for UIA (i.e. ≤ 0.021 mg/L) are predicted at all WSRs for both with and without the Project scenarios.

Table 3-8 Predicted Levels of TIN and UIA at Representative WSRs – Mitigated Scenario

WSRs	ID	TIN (mg/L), see Note 3					UIA (mg/L)				
		WQO	Dry Season		Wet Season		WQO	Dry Season		Wet Season	
			Ambient Level, see Notes 2 & 4	Predicted Level, see Note 1	Ambient Level, see Notes 2 & 4	Predicted Level, see Note 1		Ambient Level, see Note 2	Predicted Level, see Note 1	Ambient Level, see Note 2	Predicted Level, see Note 1
PTO FCZ	F1	0.1	<u>0.30</u>	<u>0.30</u>	<u>0.42</u>	<u>0.42</u>	0.021	0.011	0.011	0.009	0.009
	F2	0.1	<u>0.30</u>	<u>0.30</u>	<u>0.42</u>	<u>0.42</u>	0.021	0.011	0.011	0.009	0.009
	F3	0.1	<u>0.30</u>	<u>0.30</u>	<u>0.42</u>	<u>0.42</u>	0.021	0.011	0.011	0.009	0.009
Coral Communities at PTO	Cor1	0.1	<u>0.24</u>	<u>0.24</u>	<u>0.40</u>	<u>0.40</u>	0.021	0.009	0.009	0.008	0.008
	Cor2	0.1	<u>0.24</u>	<u>0.24</u>	<u>0.40</u>	<u>0.40</u>	0.021	0.009	0.009	0.008	0.008
	Cor3	0.1	<u>0.24</u>	<u>0.24</u>	<u>0.40</u>	<u>0.40</u>	0.021	0.009	0.009	0.008	0.008
	Cor4	0.1	<u>0.24</u>	<u>0.24</u>	<u>0.40</u>	<u>0.40</u>	0.021	0.009	0.009	0.008	0.008
	Cor5	0.1	<u>0.24</u>	<u>0.24</u>	<u>0.40</u>	<u>0.40</u>	0.021	0.009	0.009	0.008	0.008
	Cor6	0.1	<u>0.24</u>	<u>0.24</u>	<u>0.40</u>	<u>0.40</u>	0.021	0.009	0.009	0.008	0.008
	Cor7	0.1	<u>0.23</u>	<u>0.23</u>	<u>0.40</u>	<u>0.40</u>	0.021	0.009	0.009	0.008	0.008
Amphioxus	Amph	0.1	<u>0.23</u>	<u>0.23</u>	<u>0.40</u>	<u>0.40</u>	0.021	0.009	0.009	0.008	0.008
Clear Water Bay First Beach	Beach 1	0.1	<u>0.23</u>	<u>0.23</u>	<u>0.40</u>	<u>0.40</u>	0.021	0.009	0.009	0.008	0.008
Clear Water Bay Second Beach	Beach 2	0.1	<u>0.23</u>	<u>0.23</u>	<u>0.40</u>	<u>0.40</u>	0.021	0.009	0.009	0.008	0.008
Secondary Contact Recreation Subzone	SCRS1	0.1	<u>0.23</u>	<u>0.23</u>	<u>0.40</u>	<u>0.40</u>	0.021	0.009	0.009	0.008	0.008
	SCRS2	0.1	<u>0.23</u>	<u>0.23</u>	<u>0.40</u>	<u>0.40</u>	0.021	0.009	0.009	0.008	0.008
	SCRS3	0.1	<u>0.23</u>	<u>0.23</u>	<u>0.40</u>	<u>0.40</u>	0.021	0.009	0.009	0.008	0.008
Spawning Grounds for Commercial Fisheries Area	SG1	0.1	<u>0.23</u>	<u>0.23</u>	<u>0.40</u>	<u>0.40</u>	0.021	0.009	0.009	0.008	0.008
	SG2	0.1	<u>0.23</u>	<u>0.23</u>	<u>0.40</u>	<u>0.40</u>	0.021	0.009	0.009	0.008	0.008
	SG3	0.1	<u>0.23</u>	<u>0.23</u>	<u>0.40</u>	<u>0.40</u>	0.021	0.009	0.009	0.008	0.008
Coastal Protection Area	CPA	0.1	<u>0.23</u>	<u>0.23</u>	<u>0.40</u>	<u>0.40</u>	0.021	0.009	0.009	0.008	0.008

Notes:

- (1) The predicted elevations of TIN and UIA are assumed same as the elevation of NH₃-N. Please refer to Sections 3.6.29 to 3.6.30 for details.
- (2) The on-site water quality monitoring data collected under the EIA study in 2014 are adopted as ambient level. Only depth average data are available from the approved EIA Report.
- (3) Value bolded and underlined denotes exceedance of the WQO value.
- (4) The ambient mean levels of depth-average TIN for all WSRs (in range of 0.23 to 0.42 mg/L) exceed the WQO of ≤0.1 mg/L.

Steel Casing Installation and Removal

- 3.7.4 The enhanced double-layered silt curtain barrier would be supported by approximate 40 nos. of temporary steel casings and each casing would have a diameter of around 1 m. Similar to the sheetpile cofferdam assumed in the EIA Report, installation and removal of steel casing for silt curtain support would be conducted by vibratory action. This would cause minor displacement of marine sediment, which would quickly settle without significant increase in SS.
- 3.7.5 According to the latest programme, the steel casing installation and removal works would be completed in 2 weeks, respectively. It is assumed 6 working days per week and 12 working hours per day. It is estimated that the maximum 4 nos. of steel casing would be installed per day.
- 3.7.6 It is assumed that the thickness of the steel casings would be 0.025m and the first 1 meter of sediment at the surface of the seabed would be disturbed by the steel casing installation and removal. The volume of sediment to be disturbed was assumed to be the same as the volume of sediment to be displaced by the steel casing within the surface sediment layer. After the initial insertion or removal through the first 1 meter of the surface sediment, these surface sediments would have been displaced or released by the vibratory action and no more sediment loss would occur from the remaining insertion or removal process. Sediment below 1 m of the existing seabed level is expected to be suppressed by the weight of sediment above and would unlikely be brought up to the surface by the action of steel casings. Only part (20 %) of the disturbed sediment would be entrained during the installation / removal of steel casings. Assuming a dry sediment density of 1,600 kg/m³ (the upper limit of different values adopted in various EIAs), the sediment loss rate would be 0.0023 kg/s (without silt curtain) (see calculations below):

Total Volume of Sediment Disturbed per Day (m³/day)

$$\begin{aligned} &= \text{Perimeter of Steel Casing (m)} \times \text{Thickness of Steel Casing (m)} \times \text{Depth of Surface} \\ &\quad \text{Sediment that would be Disturbed (m)} \times \text{No. of steel casing to be installed /} \\ &\quad \text{removed per day} \\ &= 3.14 \text{ m} \times 0.025 \text{ m} \times 1 \text{ m} \times 4 \text{ per day} \\ &= 0.31 \text{ m}^3/\text{day} \end{aligned}$$

Total Mass of Sediment Released per Day (kg/day)

$$\begin{aligned} &= \text{Total Volume of Sediment Disturbed per Day (m}^3/\text{day)} \times \text{Sediment Density} \\ &\quad \text{(kg/m}^3\text{)} \times \text{Sediment Entrainment Rate (\%)} \\ &= 0.31 \text{ m}^3/\text{day} \times 1,600 \text{ kg/m}^3 \times 20\% \\ &= 101 \text{ kg/day} \end{aligned}$$

Sediment Loss Rate (kg/s) (Without Silt Curtain)

$$\begin{aligned} &= \text{Total Mass of Sediment Released per Day (kg/day)} \div \text{Working Hour per Day} \\ &\quad \text{(hr/day)} \div \text{Number of Second per Hour (s/hr)} \end{aligned}$$

$$\begin{aligned} &= 192 \text{ kg/day} \div 12 \text{ hr/day} \div 3600 \text{ s/hr} \\ &= 0.0023 \text{ kg/s} \end{aligned}$$

- 3.7.7 As mentioned in **Section 2.3.7**, a single-layer silt curtain will be deployed to surround the area during steel casing installation and removal. With the assumption of 75% SS removal efficiency of the single-layer silt curtain, the sediment loss rate during steel casing installation / removal within silt curtain would be 0.0006 kg/s, which is smaller than the sediment loss rate of 0.001 kg/s during dredging after deployment of the enhanced double-layered silt curtain barrier as presented in **Section 3.6.22**. The steel casing installation and removal is not the worst-case scenario in terms of the potential water quality impact as compared to the dredging works. The steel casing installation and extraction would be carried out within silt curtain to minimize the water quality impact. Therefore, no adverse water quality impact would be envisaged.

3.8 Mitigation Measures

- 3.8.1 The mitigation measures proposed in EIA for “Works in the Sea” has been updated as described in **Sections 3.8.2 to 3.8.4**. The mitigation measures for works near waterbodies, good site practices and prevention of pollution from chemicals remain unchanged.

Works in the Sea

- 3.8.2 Steel casings for supporting the enhanced double-layered silt curtain barrier in marine waters should be installed and removed by vibratory action. Single layer silt curtain should be equipped during the installation and extraction works.
- 3.8.3 Marine works (dredging, construction and installation works at diffuser location, backfilling) shall be carried out inside the enhanced double-layered silt curtain barrier. The double layered silt curtain barrier including the supporting marine steel casings, would only be removed after completion of work during ebb tide to avoid water quality impact on the Po Toi O Bay.
- 3.8.4 Dredging should be carried out by closed-grab dredger. The marine sediment should be placed in sealed compartment of the marine barge.

3.9 Review of Residual Impacts

- 3.9.1 With proper implementation of the proposed alternative mitigation measures and the measures recommended in the approved EIA, the proposed change of the Project would not cause any non-compliances with the WQOs at all identified WSRs during the construction phase. No residual impact is therefore anticipated.

3.10 Environmental Monitoring and Audit Requirements

- 3.10.1 All the Environmental Monitoring and Audit (EM&A) requirements recommended in the EIA Report and the EM&A Manual would remain valid and unchanged except that

the implementation of fully-enclosed cofferdam is replaced by enhanced double-layered silt curtain barrier.

3.10.2 The original EM&A works during dredging works and during cofferdam installation/removal would be followed for the proposed enhanced double-layered silt curtain barrier scheme.

3.11 Conclusion

3.11.1 A quantitative water quality impact assessment has been conducted to review the potential water quality impact arising from the proposed project change. With proper implementation of the recommended mitigation measures in the approved EIA Report and in this review, the water quality modelling results showed that the proposed change of the Project would not result in non-compliances with the WQOs at all identified sensitive receivers. Overall, no adverse water quality impact is therefore anticipated.

4 Marine Ecological Impact Review

4.1 Introduction

- 4.1.1 This Section reviews the marine ecological implications from the proposed change of the Project during the construction phase (refer to **Section 2**).

4.2 Environmental Legislation, Standards and Guidelines

- 4.2.1 The legislation and criteria applicable to the evaluation of marine ecological impacts are described in Section 7.2 of the EIA Report. These legislation and criteria generally remain unchanged except the following EIAO guidance notes have been updated:
- EIAO GN No. 7/2023 – Ecological Baseline Survey for Ecological Impact Assessment
 - EIAO GN No. 11/2023 – Methodologies for Marine Ecological Baseline Surveys

4.3 Study Area

- 4.3.1 The Study Area for marine ecological impact assessment shares the same Study Area as the water quality impact assessment (covering Po Toi O Bay, Clearwater Bay and waters surrounding Steep Island). As no changes to the marine works extent are proposed in the revised design, the Study Area in the EIA remains valid.
- 4.3.2 Same as the finding of EIA, no site of conservation importance as defined in Annex 16 of the EIAO-TM was identified.

4.4 Review of Potential Impacts

Direct Impact – Habitat loss

Original Design in Approved EIA Report

- 4.4.1 In the EIA Report, it was estimated that about 500 m² of muddy seabed would be lost due the seabed dredging within the cofferdam during the construction phase. The size of cofferdam assumed in the EIA Report was 10m x 50m (i.e. 500m²). Except the area occupied by the diffuser of 5 m², all dredged seabed would be backfilled to the original seabed level with rockfill. The cofferdam would also be removed after the completion of backfilling. Therefore, the EIA assumed that about 495 m² and 5 m² of muddy seabed would be lost temporarily and permanently due to the diffuser installation. The overall direct impact on marine ecology was evaluated to be ***insignificant***.

Proposed Design Considered in this ERR

- 4.4.2 According to the proposed design presented in **Section 2**, all dredging would be carried out inside the inner layer of the enhanced double-layered silt curtain barrier

with an area of about 16.6 m × 30 m (i.e. 498m²). There would be no change of the size and location of the proposed diffuser. The resulted temporary and permanent loss of muddy seabed would be about 493 m² and 5 m² respectively. The proposed change would not increase the amount of habitat loss during both construction and operational phases.

- 4.4.3 Under the proposed design, the direct impacts due to the marine works would remain to be localized, largely temporary and reversible, and not directly affecting any species of conservation importance as evaluated in the EIA Report. The overall direct impact on marine ecology under the proposed design would remain to be ***insignificant***.

Summary of Ecological Impacts on Muddy Seabed

- 4.4.4 Under the proposed design, the significance of ecological impacts on subtidal habitat (i.e. muddy seabed) would remain to be ***minor*** as presented in the EIA Report. The updated impact evaluation is summarized in **Table 4-1**.

Table 4-1 Evaluation of the Significance of Ecological Impact on Subtidal Habitats (Muddy Seabed)

Criteria	Evaluation
Habitat quality	Low
Species	No species of conservation importance
Impact Size /Abundance	- 5 m ² lost permanently, 493 m ² will be backfilled - Low number of fauna
Impact Duration	- Short term construction impact - Long term operational impact during normal operation
Impact Reversibility	Irreversible for the diffuser footprint, reversible for remaining area
Impact Magnitude	Small
Overall Impact	Minor

Indirect Impact – Water Quality Deterioration

Original Design in Approved EIA Report

- 4.4.5 In the approved EIA Report, installing and extracting the sheetpile cofferdam was identified as the only marine based construction activity causing indirect water quality impact. The EIA Report assumed that no indirect water quality impact would occur due to dredging enclosed within the watertight sheetpile cofferdam. The size of the cofferdam was assumed to be about 10 m x 50 m in area. As discussed in Section 7.15 of the approved EIA Report, increase in suspended solids (SS) could bring potential impact on marine ecology as certain levels of SS would depress both health and survival rate of fish, coral communities and amphioxus. However, the installation and extraction of sheetpile cofferdam would be conducted by vibratory action which would only cause minor displacement of marine sediment. With proper implementation of silt curtain, the displaced sediment would settle quickly and would not significantly increase the

SS level in water column. It was concluded in the EIA Report that the overall indirect impact on marine ecology would be *insignificant*.

Proposed Design Considered in this ERR

- 4.4.6 The enhanced double-layered silt curtain barrier would involve insertion of about 40 nos. of steel casings to support the erection of silt curtains. Each steel casing would have a diameter of only 1 m, which is minor in scale. Similar to the sheetpile cofferdam assumed in the EIA Report, installation and extraction of steel casing would be conducted by vibratory action, which would not cause significant sediment release. Silt curtain would be deployed around the steel casing installation / extraction to minimize the water quality impact. No adverse associated water quality impact would be envisaged.
- 4.4.7 On the other hand, there could be loss of sediment through the enhanced double-layered silt curtain barrier during the dredging work as the silt curtain barrier is not watertight. This may cause increases of fines and sediment-bound nutrients in the marine water. Oxygen depletion may also occur in the receiving water due to the organic pollution of the disturbed sediment. As detailed in the water quality impact review (**Sections 3.4 and 3.6**), the parameters of concern include elevations of SS, total inorganic nitrogen (TIN) and unionized ammonia (UIA) as well as decreases of dissolved oxygen (DO) in marine water. These water quality changes may adversely affect the health and survival of marine organisms.
- 4.4.8 However, according to the findings of water quality impact review, full compliances with the WQO of no more than 30% increase of SS from the ambient level and sedimentation rate criterion of less than 100 g/m²/day and the proposed change of the Project would not cause any non-compliances with the WQOs for DO, TIN and UIA at all representative water sensitive receivers (WSRs) including Po Toi O (PTO) Fish Culture Zone (FCZ), coral communities at PTO (Cor1 to Cor7) and amphioxus at PTO (Amph). With implementation of the enhanced double-layered silt curtain barrier, no adverse water quality impact arising from the small-scale dredging work would be anticipated (refer to **Section 3.7**).
- 4.4.9 As no adverse water quality impacts on the identified marine ecological receivers are predicted from the proposed change, the overall indirect impact on marine ecology of the Project would remain to be *insignificant* as stated in the approved EIA Report.

4.5 Recommendations & Mitigation Measures

- 4.5.1 Apart from the measures recommended for sheet-pile cofferdam, other mitigation measures recommended in Section 7.17 in the approved EIA Report would remain applicable and would be implemented. Under the proposed changes, the mitigation measures recommended (in Section 3.8 of this review) to mitigate the potential water quality arising from the project change in this review would also mitigate the potential marine ecological impact, these measures include:

Works in the Sea

- 4.5.2 Steel casings for supporting the enhanced double-layered silt curtain barrier in marine waters should be installed and removed by vibratory action. Single layer silt curtain should be equipped during the installation and extraction works.
- 4.5.3 Marine works (dredging, construction and installation works at diffuser location, backfilling) shall be carried out inside the enhanced double-layered silt curtain barrier. The double layered silt curtain barrier including the supporting marine steel casings, would only be removed after completion of work during ebb tide to avoid water quality impact on the Po Toi O Bay.
- 4.5.4 Dredging should be carried out by closed-grab dredger. The marine sediment should be placed in sealed compartment of the marine barge.

4.6 Review of Residual Impacts

- 4.6.1 Under the proposed change and with the implementation of the mitigation measures recommended in the EIA Report with the proposed change.

4.7 Environmental Monitoring and Audit Programme

- 4.7.1 All the Environmental Monitoring and Audit (EM&A) requirements recommended in the EIA Report and the EM&A Manual would remain valid and unchanged.

4.8 Conclusion

- 4.8.1 A review of the marine ecological impact of the EIA Report was conducted with reference to the proposed change as detailed in **Section 2** and the predicted water quality during construction. It is concluded that the proposed change would not affect the overall marine ecology impact as presented in the approved EIA Report. The marine ecological impact of the Project would remain to be insignificant with the proposed project change with the recommended mitigation measures in place.

5 Fisheries Impact Review

5.1 Introduction

- 5.1.1 This Section reviews the fisheries impacts from the proposed change of the Project during the construction phase (refer to **Section 2**).

5.2 Environmental Legislation, Standards and Guidelines

- 5.2.1 The legislation and criteria applicable to the evaluation of fisheries impacts are described in Section 8.2 of the EIA Report. These legislation and criteria have been reviewed and remain valid.

5.3 Study Area

- 5.3.1 The Study Area for fisheries impact assessment shares the same Study Area as the water quality impact assessment (covering Po Toi O Bay, Clearwater Bay and waters surrounding Steep Island). As no changes to the marine works extent are proposed in the revised design, the Study Area in the EIA remains valid.

5.4 Description of the Environment & Baseline Fisheries Information

Capture Fisheries

Fishing Vessels

- 5.4.1 According to the latest AFCD Port Survey 2021¹¹, around 200 – 400 vessels were operated near Po Toi O in 2021 and that was comparable with around 100 – 400 vessels in 2006 as presented in the approved EIA Report (based on Port Survey 2006).

Adult Fish Production and Value

- 5.4.2 According to the latest AFCD Port Survey 2021¹¹, the fisheries production of vessels operating in the Study Area was 100 – 200 kg/ha in 2021. The overall fisheries production within the Study Area remains to be low to medium abundance among Hong Kong waters as presented in the EIA Report.
- 5.4.3 An updated fisheries survey was carried out in 2021 in accordance with Condition 2.11 of the EP to ascertain the impact on fisheries resources in the vicinity of the planned location of the submarine outfall diffuser before the outfall construction. The survey results are presented in the Updated Fisheries Survey Report (UFSR)¹² submitted to EPD in October 2021. The UFSR concluded that the overall commercial value of adult

¹¹ Agriculture, Fisheries and Conservation Department (AFCD). Port Survey 2021. [online] https://www.afcd.gov.hk/english/fisheries/fish_cap/fish_cap_latest/files/common/PS2021Report_ENG.pdf.

¹² Updated Fisheries Survey Report for Environmental Permit (EP No: EP-516/2016): <https://www.epd.gov.hk/eia/register/english/permit/ep5162016/documents/udfsr/pdf/udfsr.pdf>

fish resources in the Study Area including their species, richness, diversity and evenness was low. It was also concluded in the UFSR that the content presented in the EIA Report with respect to the potential impacts to adult fish resources will remain valid and unchanged.

Fish Spawning and Nursery Grounds

- 5.4.4 According to the EIA Report, the Study Area of this Project is located in an important spawning area. This EIA finding remains unchanged.

Artificial Reefs

- 5.4.5 Twelve artificial reef (AR) sites were deployed by AFCD between Steep Island, Tiu Chung Chau and Basalt Island as identified in the EIA Report. The information presented in the EIA Report on these AR sites remains valid and unchanged. These AR sites are located over 2 km away from the proposed marine works of the Project. No other AR site is identified in the Study Area.

Culture Fisheries

- 5.4.6 The Po Toi O Fish Culture Zone (FCZ) is within the semi-enclosed bay of Po Toi O (PTO). The information presented in the EIA Report on this FCZ remains valid and unchanged. The FCZ is located about 480 m away from the proposed marine works of the Project. No other FCZ is identified in the Study Area.

5.5 Review of Potential Impacts

Direct Impact

Original Design in Approved EIA Report

- 5.5.1 According to the approved EIA Report, the proposed marine works including dredging would be carried out inside the watertight sheetpile cofferdam. It was assumed that about 1,920 m² (including the cofferdam area of about 500 m², the extra sea area to be surrounded by silt curtain of about 400 m² as well as the sea surface to be occupied by marine barges of about 1,020 m²) of fishing ground (including 500 m² of benthic spawning ground and seabed) would be temporarily lost during the Project construction. The occupied area would be released once the construction work is finished. Among the occupied area, 5 m² of the important spawning ground would be permanently lost upon the completion of diffuser installation. The direct fisheries impact was expected to be localized, largely temporary and reversible. The overall direct impact was evaluated to be ***insignificant***.

Proposed Design Considered in this ERR

- 5.5.2 According to the latest design presented in **Section 2**, all dredging works would be carried out inside the inner layer of the enhanced double-layered silt curtain barrier with an area of about 16.6 m × 30 m (i.e. 498 m²). The proposed size of the entire silt curtain barrier including the outer layer of silt curtain would be about 26.6 m × 45 m

(i.e. 1,064 m²). Assuming 1,020 m² of extra sea surface would be occupied by the marine barges as assumed in the approved EIA Report, about 2,084 m² (= 1,064 + 1,020 m²) of fishing ground (including 498 m² of benthic spawning ground and seabed) would be temporarily lost during the Project construction. The occupied area would be released once the construction work is finished. Among the occupied area, 5 m² of the important spawning ground would be permanently lost upon the completion of diffuser installation.

- 5.5.3 The direct fisheries impacts under the proposed design would remain to be localized, largely temporary and reversible as evaluated in the EIA Report. With reference to the UFSR, as discussed in **Section 5.4.3**, the overall commercial value of adult fish resources in the Study Area was low. The overall direct impact on capture fisheries would remain to be ***insignificant*** under the proposed design.
- 5.5.4 There would be no direct impact on FCZ and AR sites.

Indirect Impact – Water Quality Deterioration

Original Design in Approved EIA Report

- 5.5.5 In the approved EIA Report, installing and extracting the sheetpile cofferdam was identified as the only marine based construction activity causing indirect water quality impact. The EIA Report assumed that no indirect water quality impact would occur due to dredging enclosed within the watertight sheetpile cofferdam. The size of cofferdam was assumed to be about 10 m x 50 m in area. As discussed in Section 8.6 of the approved EIA Report, certain levels of suspended solids (SS) would depress both health and survival rate of fish. However, the installation and extraction of sheetpile cofferdam would be conducted by vibratory action, which would only cause minor displacement of marine sediment. With proper implementation of silt curtain, the displaced sediment would settle quickly and would not significantly increase the SS level in water column. It was concluded that the indirect water quality impact on capture and culture fisheries, and spawning and nursery grounds would be ***insignificant***.

Proposed Design Considered in this ERR

- 5.5.6 The enhanced double-layered silt curtain barrier would involve insertion of steel casings to support the erection of silt curtains. Each steel casing would have a diameter of only 1 m, which is minor in scale. Similar to the sheetpile cofferdam assumed in the EIA Report, installation and extraction of steel casing would be conducted by vibratory action, which would not cause significant sediment release. Silt curtain would be deployed around the steel casing installation / extraction to minimize the water quality impact. No adverse associated water quality impact would be envisaged.
- 5.5.7 On the other hand, there could be loss of sediment through the enhanced double-layered silt curtain barrier during the dredging work as the silt curtain barrier is not watertight. This may cause increases of fines and sediment-bound nutrients in the marine water. Oxygen depletion may also occur in the receiving water due to the organic pollution of the disturbed sediment. As detailed in the water quality impact

review (**Sections 3.4 and 3.6**), the parameters of concern include elevations of SS, total inorganic nitrogen (TIN) and unionized ammonia (UIA) as well as decreases of dissolved oxygen (DO) in marine water. These water quality changes may adversely affect the health and survival of fish.

- 5.5.8 However, according to the findings of water quality impact review, full compliances with the WQO of no more than 30% increase of SS from the ambient level and sedimentation rate criterion of less than 100 g/m²/day and the proposed change of the Project would not cause any non-compliances with the WQOs for DO, TIN and UIA at all closest water sensitive receivers (WSRs) including PTO FCZ and spawning grounds for commercial fisheries area. With implementation of the enhanced double-layered silt curtain barrier, no adverse water quality impact arising from the small-scale dredging work would be anticipated (refer to **Section 3.7**). Moreover, as discussed in **Section 5.4.3**, the overall commercial value of adult fish resources in the Study Area was low. As such, the indirect water quality impact on capture and culture fisheries, and spawning and nursery grounds would remain to be *insignificant* under the proposed design.

Summary of Fisheries Impact

- 5.5.9 Same as the EIA findings, the significance of overall impacts on fisheries would be *insignificant* under the proposed design. The updated evaluation of fisheries impact is presented in **Table 5-1**:

Table 5-1 Evaluation of the Significance of Impacts on Fisheries

Criteria	Evaluation
Nature of impact	<ul style="list-style-type: none"> - A tiny area of benthic habitat loss due to dredging; - Temporary disturbance on marine traffic; and - Insignificant deterioration in water quality in construction phase as dredging will be conducted within the enhanced double-layered silt curtain barrier
Size of affected area	<ul style="list-style-type: none"> - Temporary working area in construction phase: about 2,084 m², in which 5 m² benthic habitat will be lost permanently
Loss of fisheries resources / production	<ul style="list-style-type: none"> - Loss in fishing ground: about 2,084 m² temporary in construction phase, 5 m² permanent - Not anticipated for aquaculture activity - Overall Impact: Insignificant
Destruction and disturbance of nursery and spawning grounds	<ul style="list-style-type: none"> - Loss in important spawning ground: 493 m² temporary in construction phase, 5 m² permanent; - Water quality deterioration will be insignificant in construction phase. - No adverse impact on water quality is expected in operational phase. - Overall Impact: Insignificant
Impact on fishing activity	<ul style="list-style-type: none"> - Temporary loss of about 2,084 m² of fishing ground - Overall Impact: Insignificant
Impact on aquaculture activity	<ul style="list-style-type: none"> - No direct loss of PTO FCZ;

Criteria	Evaluation
	<ul style="list-style-type: none"> - Water quality deterioration will be localized around dredging area in construction phase. - No adverse impact is expected in operational phase. - Overall Impact: Insignificant

5.6 Recommendations & Mitigation Measures

5.6.1 Apart from the measures recommended for sheet-pile cofferdam, the mitigation measures recommended in Section 8.8 in the approved EIA Report would remain applicable and would be implemented. Under the proposed changes, the mitigation measures recommended (in **Section 3.8** of this review) to mitigate the potential water quality arising from the project change in this review would also mitigate the potential fisheries impact, these measures include:

Works in the Sea

5.6.2 Steel casings for supporting the enhanced double-layered silt curtain barrier in marine waters should be installed and removed by vibratory action. Single layer silt curtain should be equipped during the installation and extraction works.

5.6.3 Marine works (dredging, construction and installation works at diffuser location, backfilling) shall be carried out inside the enhanced double-layered silt curtain barrier. The double layered silt curtain barrier including the supporting marine steel casings, would only be removed after completion of work during ebb tide to avoid water quality impact on the Po Toi O Bay.

5.6.4 Dredging should be carried out by closed-grab dredger. The marine sediment should be placed in sealed compartment of the marine barge.

5.7 Review of Residual Impacts

5.7.1 The residual fisheries impact of the Project with the proposed design change would remain as acceptable level during construction as predicted in the approved EIA Report.

5.8 Environmental Monitoring and Audit Programme

5.8.1 All the Environmental Monitoring and Audit (EM&A) requirements recommended in the EIA Report and the EM&A Manual would remain valid and unchanged.

5.9 Conclusion

5.9.1 A review of the fisheries impact of the EIA Report was conducted with reference to the proposed change as detailed in **Section 2** and the predicted water quality during construction. It is concluded that the proposed change would not affect the overall fisheries impact as presented in the approved EIA Report. The fisheries impact of the

Project would remain to be insignificant with the proposed design change with the recommended mitigation measures in place.

6 Environmental Monitoring & Audit Requirements

6.1 Introduction

6.1.1 The objectives and requirements of Environmental Monitoring and Audits (EM&A) for the construction and operation of the Project have been summarized in Section 12 of the EIA Report and detailed in the standalone EM&A Manual for the Project.

6.2 Change in EM&A Requirements Associated with Proposed Change

6.2.1 Based on the findings of this ERR, the EM&A requirements proposed in the EIA Report would remain applicable to the Project. No changes to the EM&A requirements in the EIA Report are proposed except that the implementation of fully-enclosed cofferdam is replaced by enhanced double-layered silt curtain barrier.

6.2.2 The original EM&A works during dredging works and during cofferdam installation/removal would be followed for the proposed enhanced double-layered silt curtain barrier scheme.

7 Conclusions

- 7.1.1 An environmental review has been conducted for the proposed change of water quality mitigation measure for the marine works as presented in **Section 2**. The potential environmental issues pertinent to the proposed change have been assessed and the required mitigation and EM&A requirements have also been reviewed. Overall, it is concluded that there is no material change to the environmental impact of the project with the mitigation measures in place; and the project complies with the requirements described in the EIAO-TM.

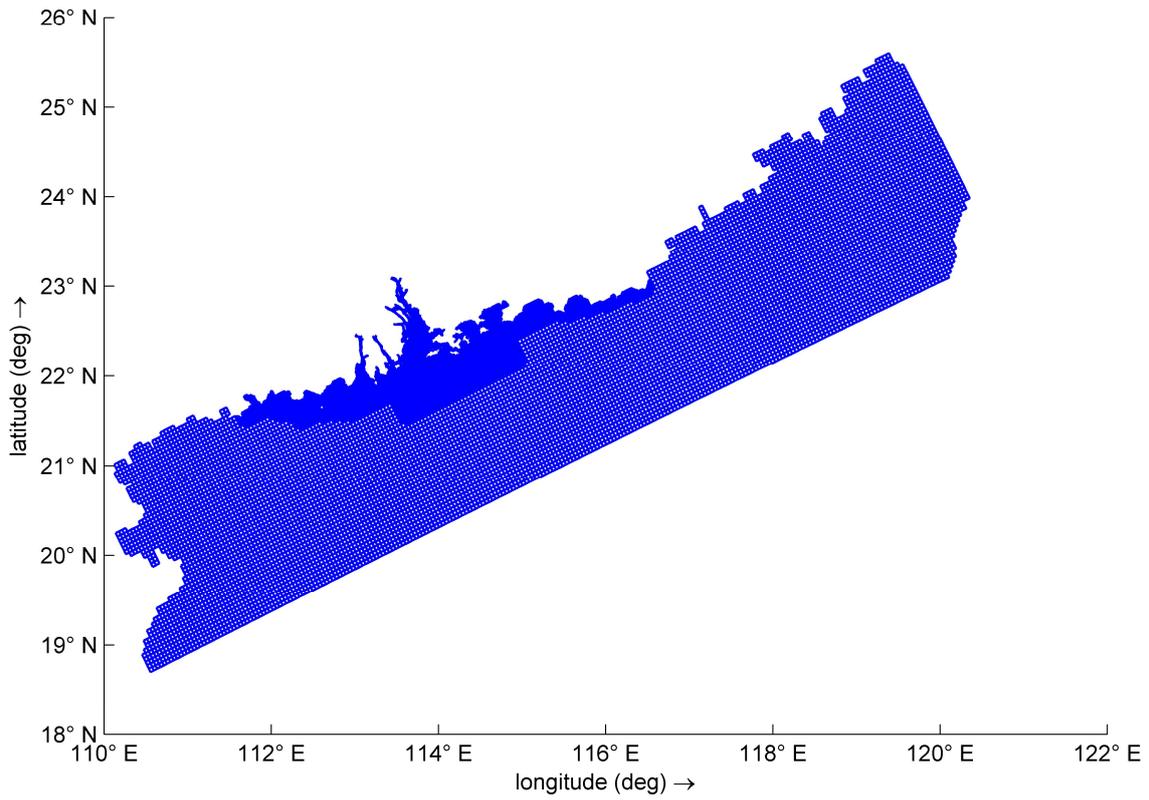
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Appendix 5A – Refined Model Grid Layout, Properties and Performance Verifications

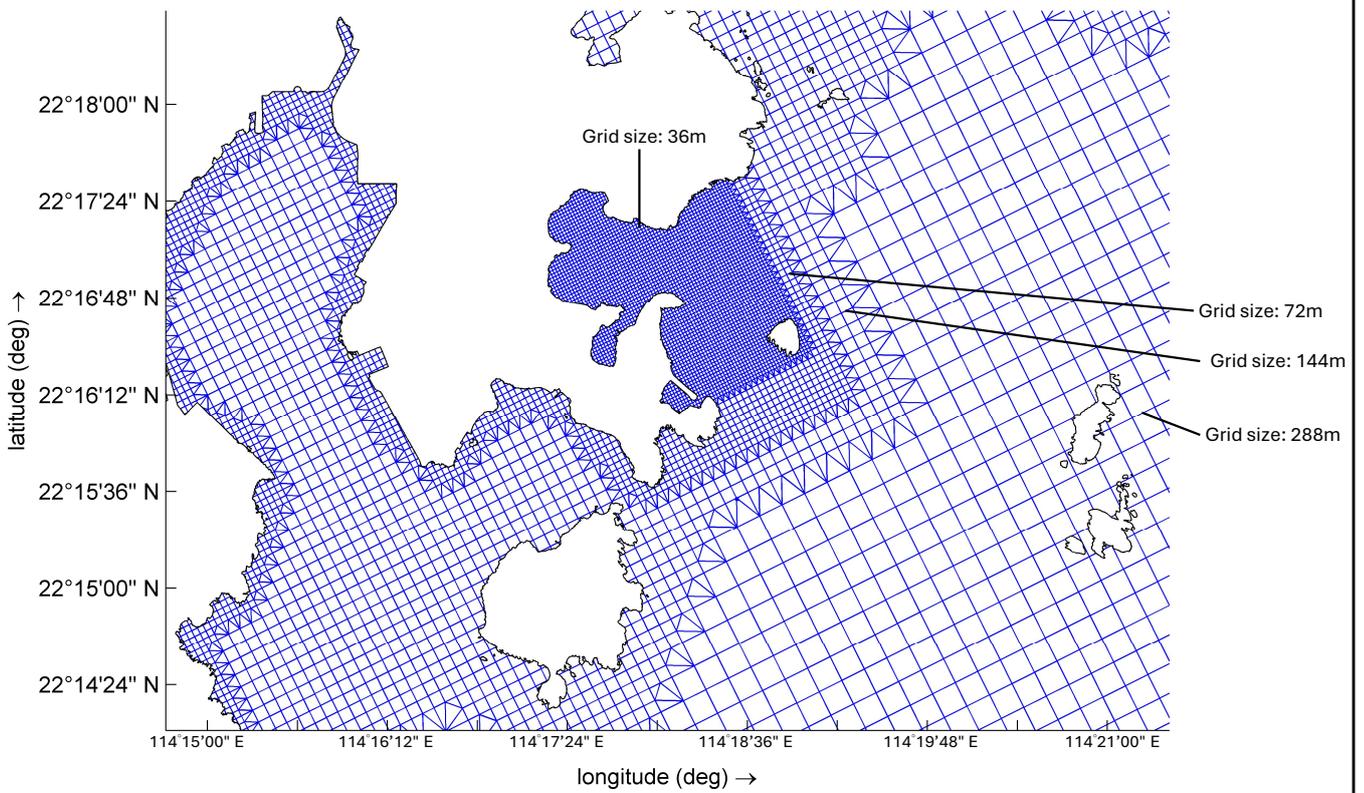
Appendix 5A Refined Model Grid Layout, Properties and Performance Verifications

Scenario	Description	Page & Location
	Refined Model Grid Layout and Coverage - Overview	1 Upper
	Refined Model Grid Layout and Coverage – Assessment Area	1 Bottom
	Refined Model Grid Layout and Coverage - Zoom-in at Po Toi O	2 Upper
	Model Grid Properties - Orthogonality	3 Upper
	Location of Indicator Points and Cross-Section	4 Upper
Dry Season	Water Level at MM19	5 Upper
Dry Season	Depth Averaged Current Velocity at MM19	5 Middle
Dry Season	Depth Averaged Current Direction at MM19	5 Bottom
Dry Season	Surface Salinity at MM19	6 Upper
Dry Season	Mid-Depth Salinity at MM19	6 Middle
Dry Season	Bottom Salinity at MM19	6 Bottom
Dry Season	Momentary Flow through Cross Section 1	7 Upper
Dry Season	Accumulated Flow through Cross Section 1	7 Bottom
Dry Season	Momentary Flow through Cross Section 2	8 Upper
Dry Season	Accumulated Flow through Cross Section 2	8 Bottom
Wet Season	Water Level at MM19	9 Upper
Wet Season	Depth Averaged Current Velocity at MM19	9 Middle
Wet Season	Depth Averaged Current Direction at MM19	9 Bottom
Wet Season	Surface Salinity at MM19	10 Upper
Wet Season	Mid-Depth Salinity at MM19	10 Middle
Wet Season	Bottom Salinity at MM19	10 Bottom
Wet Season	Momentary Flow through Cross Section 1	11 Upper
Wet Season	Accumulated Flow through Cross Section 1	11 Bottom
Wet Season	Momentary Flow through Cross Section 2	12 Upper
Wet Season	Accumulated Flow through Cross Section 2	12 Bottom
	Modeled and Observed Depth Averaged Salinity	13 Top
	Model Bathymetry	14 Top

Mesh 2D



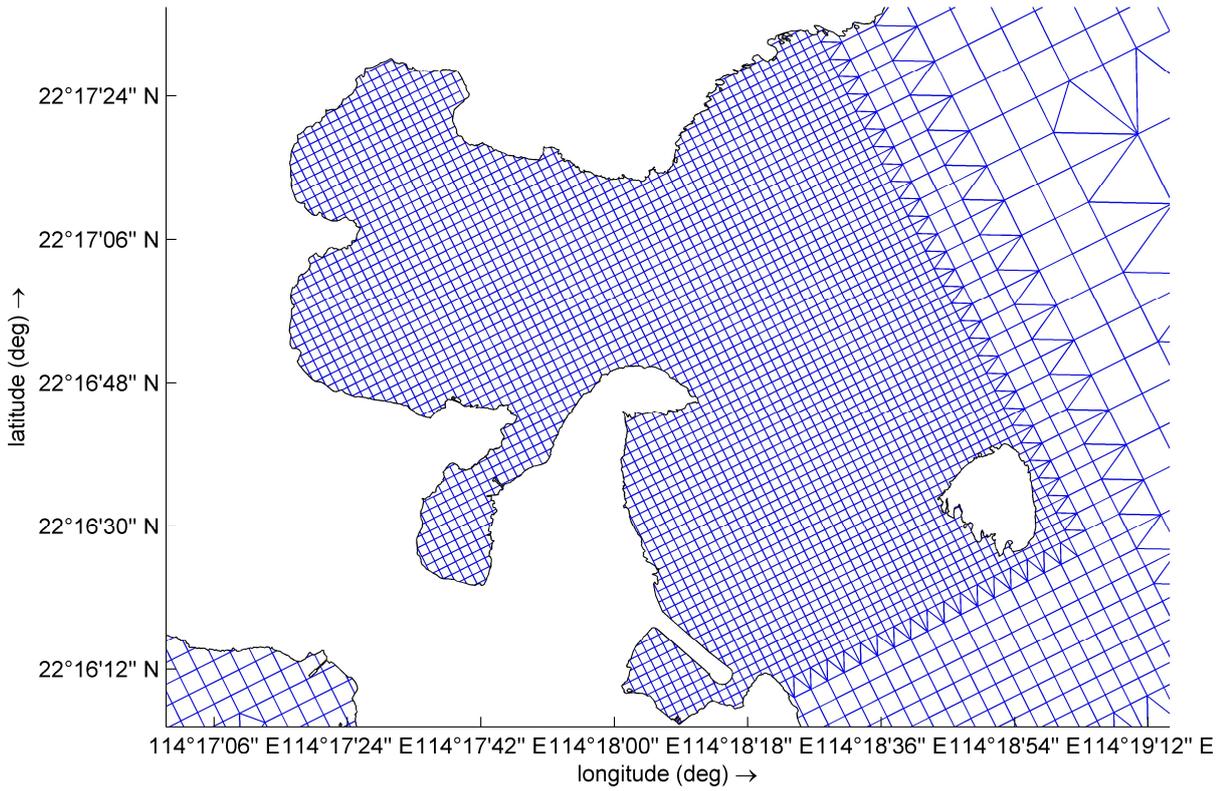
Mesh 2D



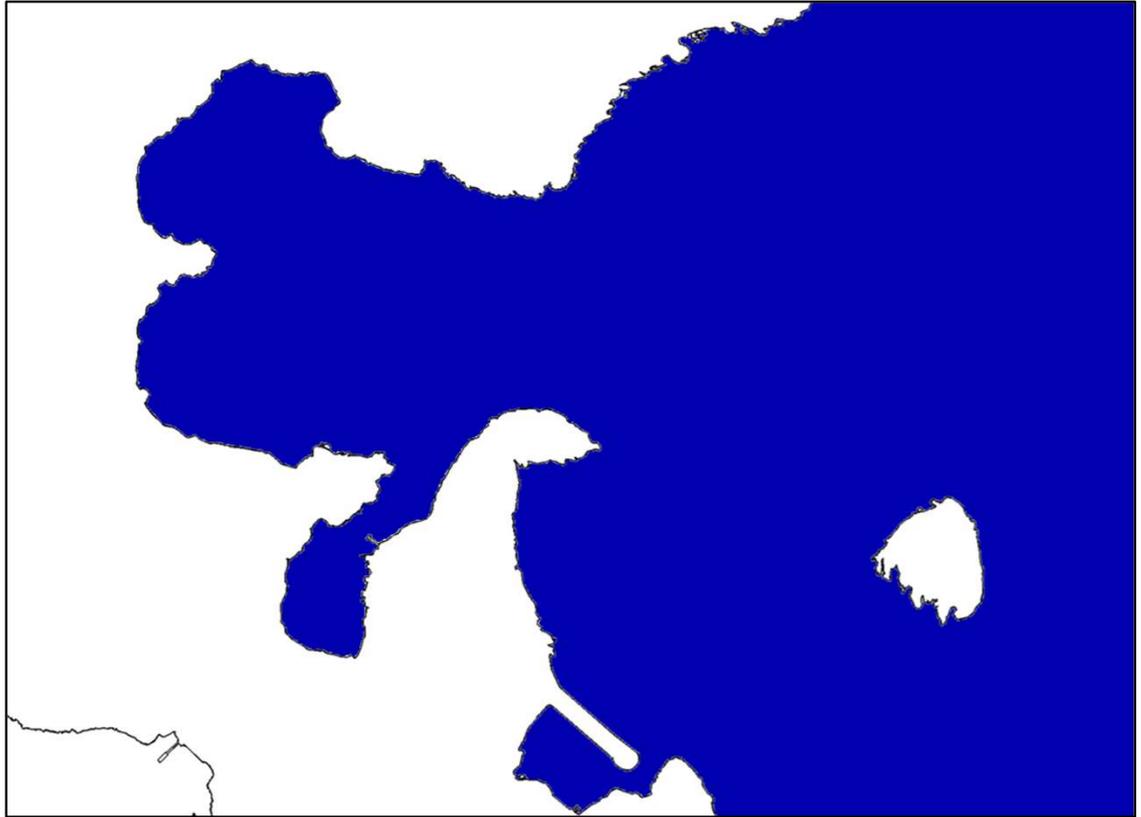
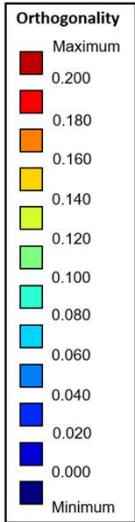
**Refined Model Grid Layout and Coverage
Upper – Overview; Lower – Assessment Area**

**Port Shelter Sewage, Stage 3 –
Sewage Works at Po Toi O**

Mesh 2D

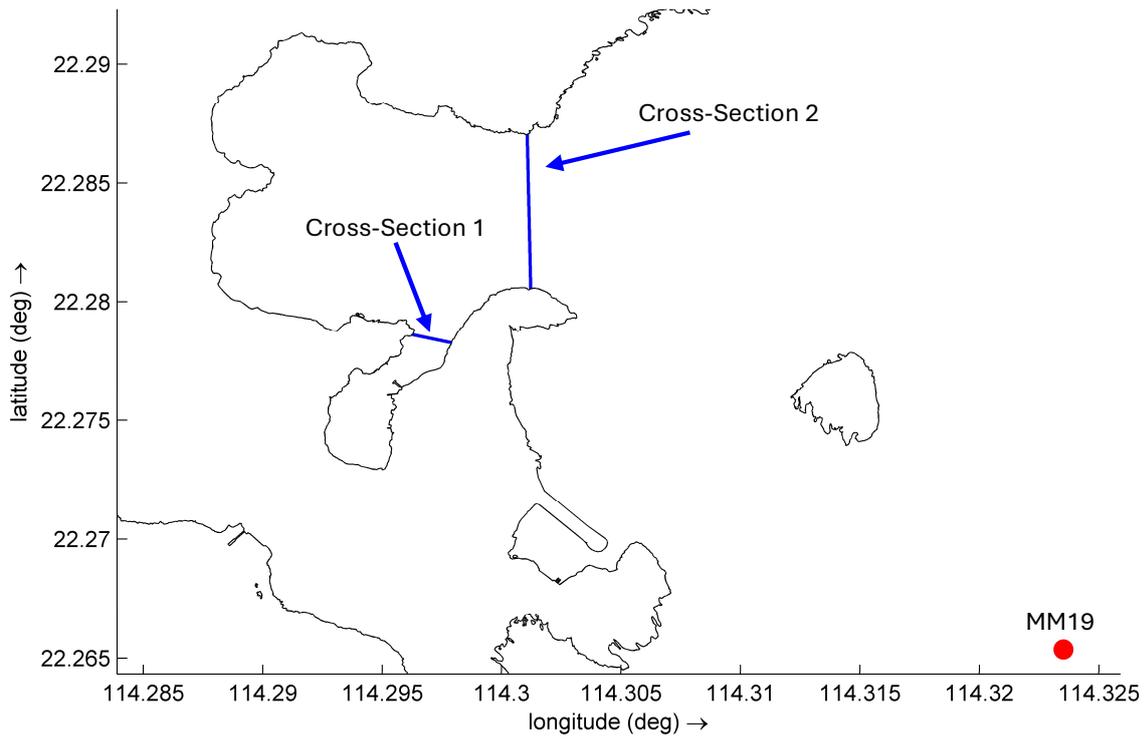


Refined Model Grid Layout and Coverage (Zoom-in at Po Toi O)		
	Port Shelter Sewage, Stage 3 – Sewage Works at Po Toi O	
Binnies	Appendix 5A	2



Orthogonality

Model Grid Properties - Orthogonality		
	Port Shelter Sewage, Stage 3 – Sewage Works at Po Toi O	
Binnies	Appendix 5A	3



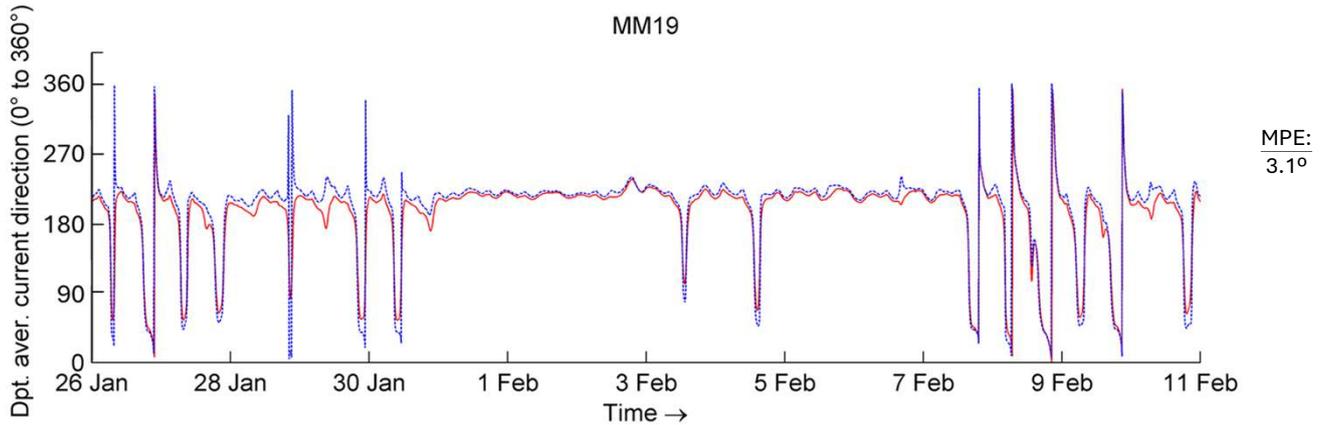
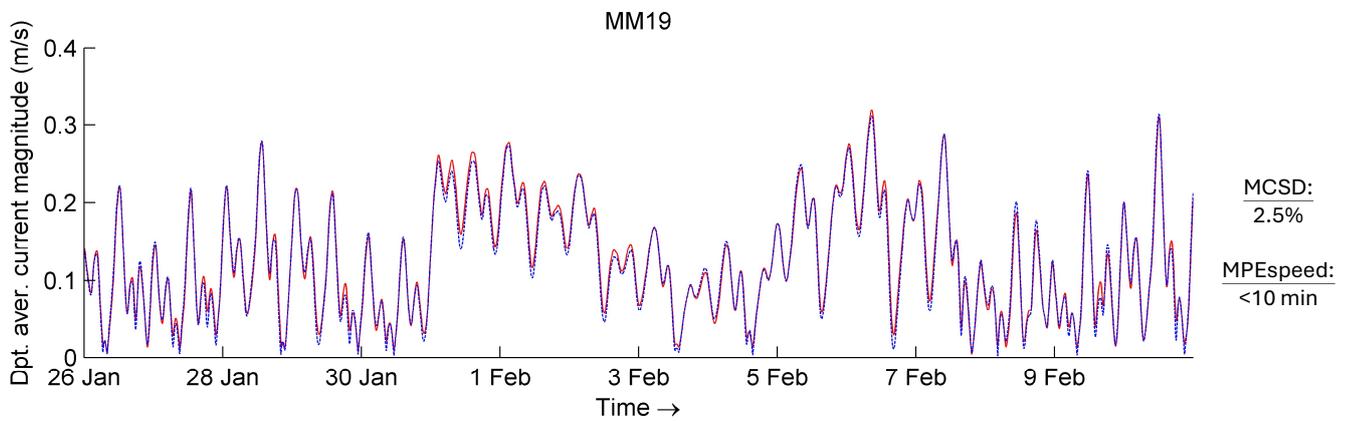
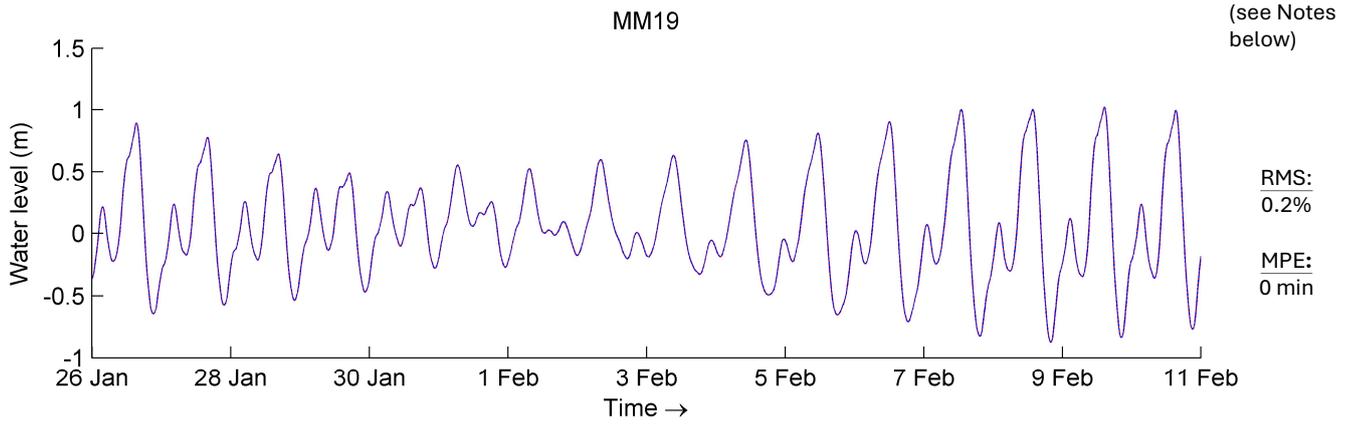
Location of Indicator Points and Cross-Section

**Port Shelter Sewage, Stage 3 –
Sewage Works at Po Toi O**

Binnies

Appendix 5A

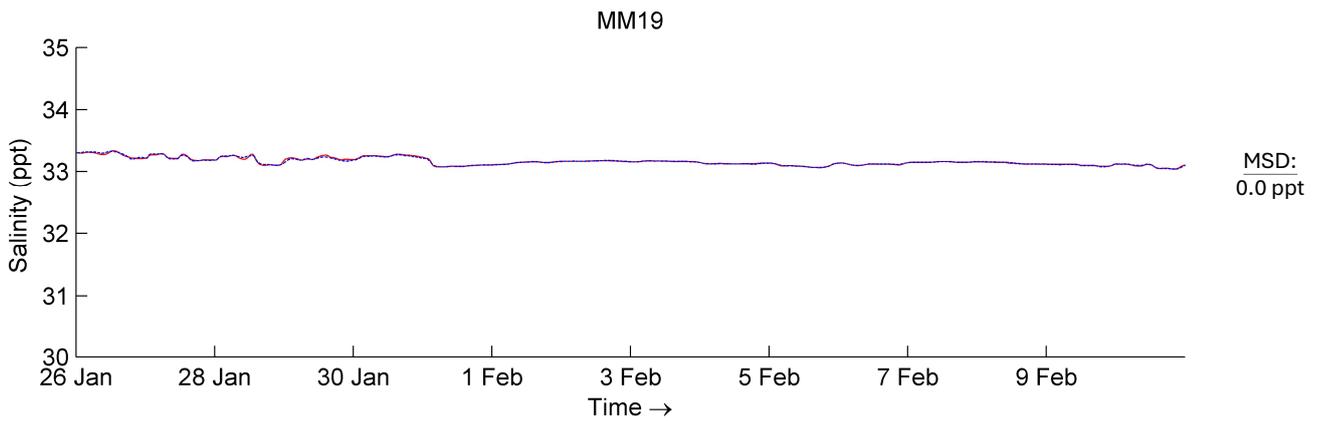
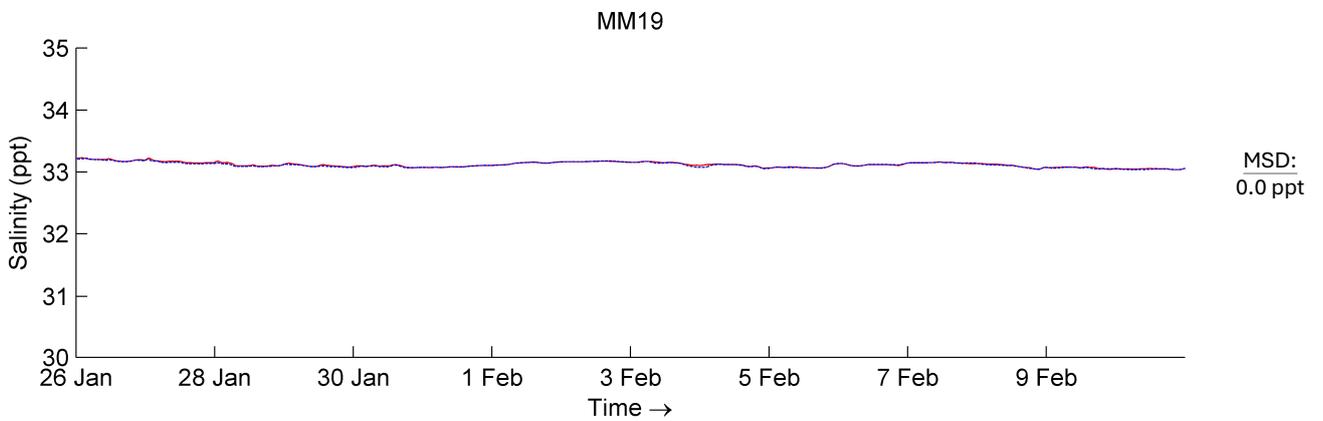
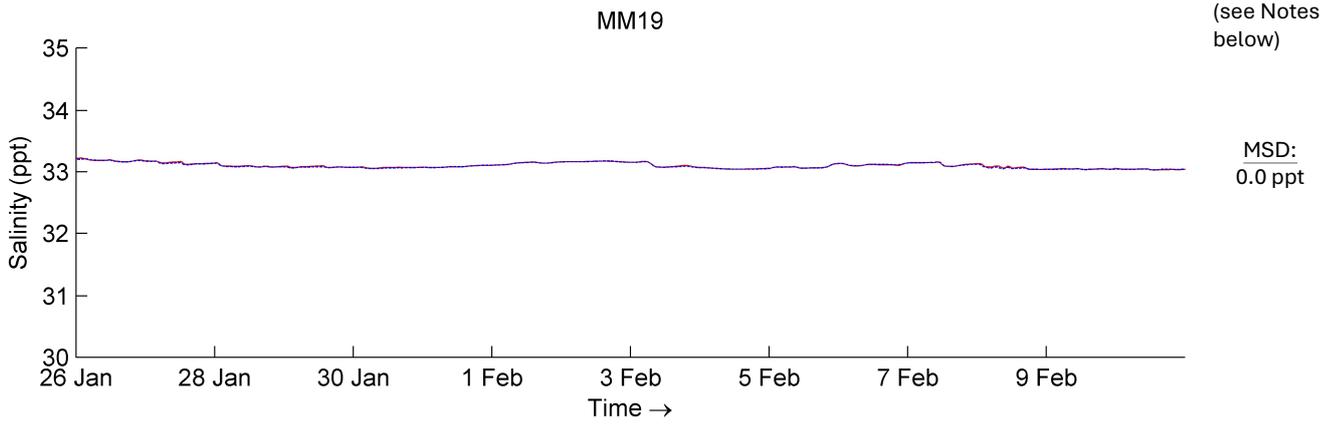
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Notes:

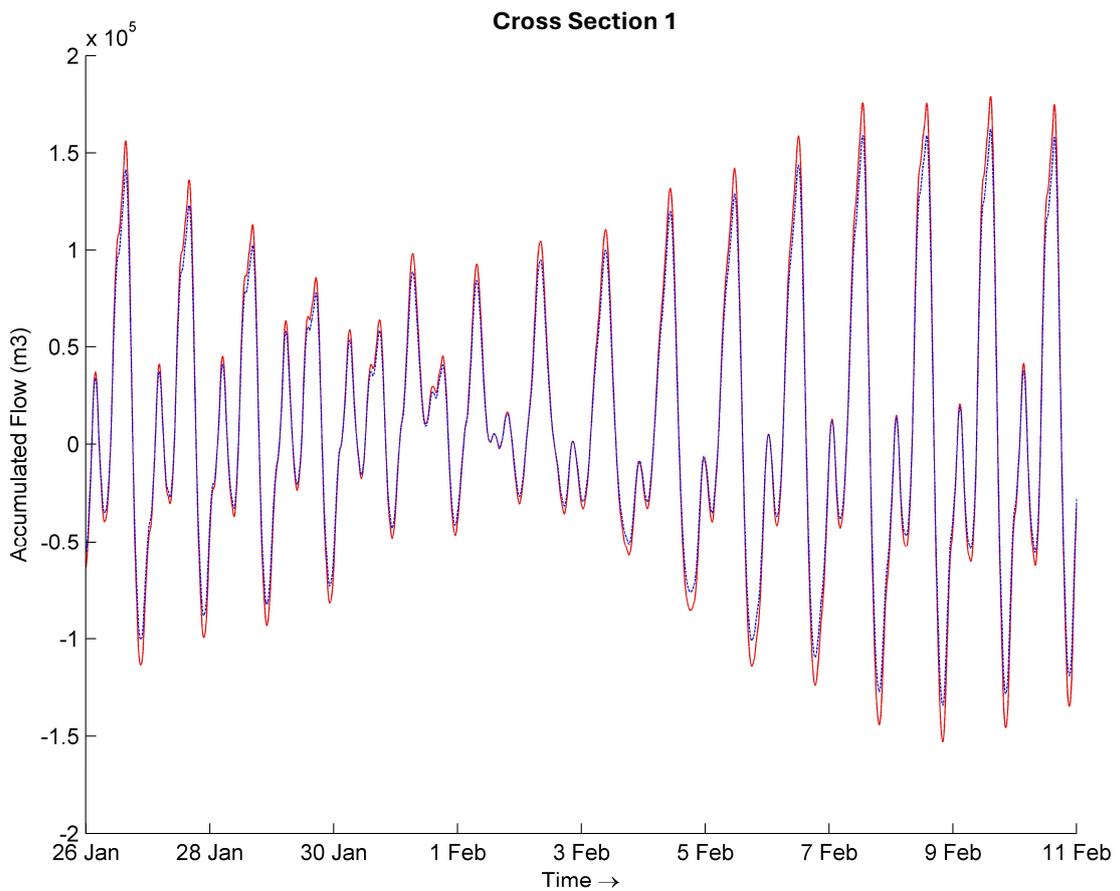
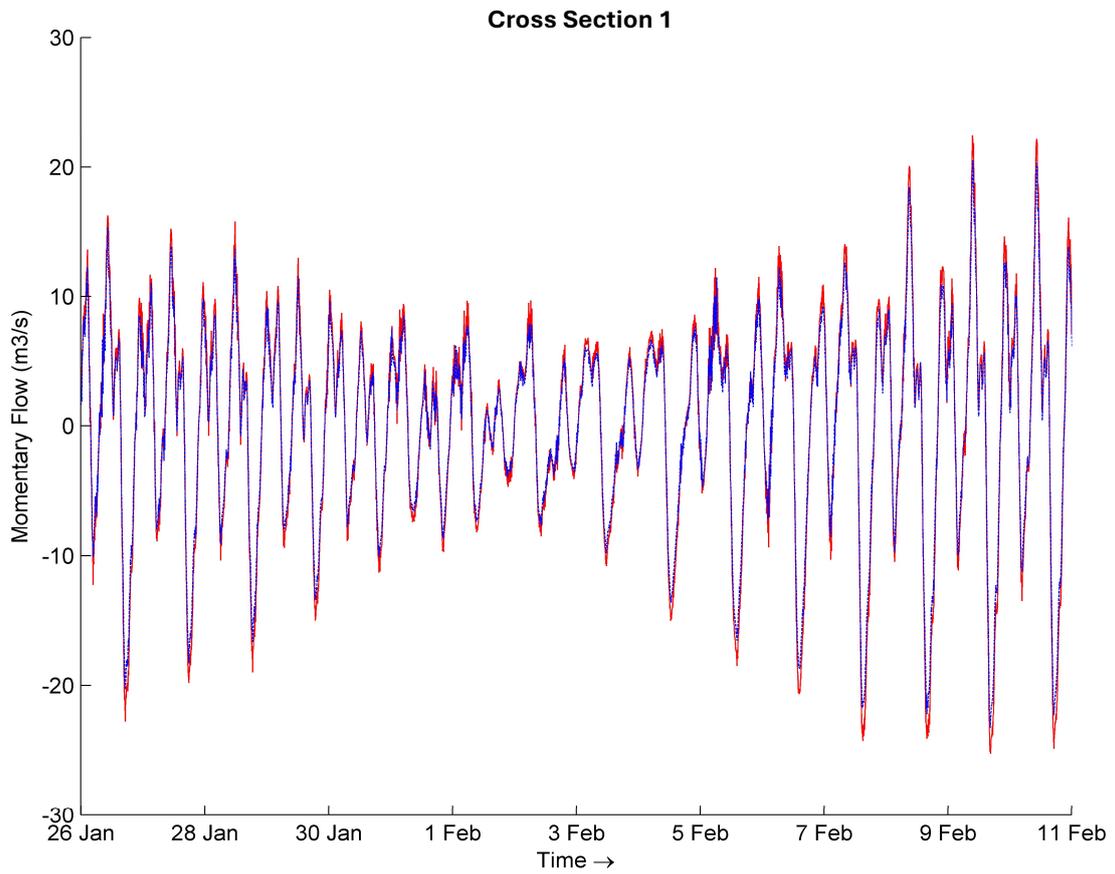
RMSE - Root mean square error; MPE - Maximum phase error at high water and low water; MCSD - Maximum current speed deviation, MPEspeed: Maximum phase error at peak speed, MDE: Maximum direction error at peak speed

Water Level, Depth Averaged Current Velocity and Direction at MM19 Red : Original Model ; Blue : Refined Model		Dry Season
	Port Shelter Sewage, Stage 3 – Sewage Works at Po Toi O	
Binnies	Appendix 5A	5

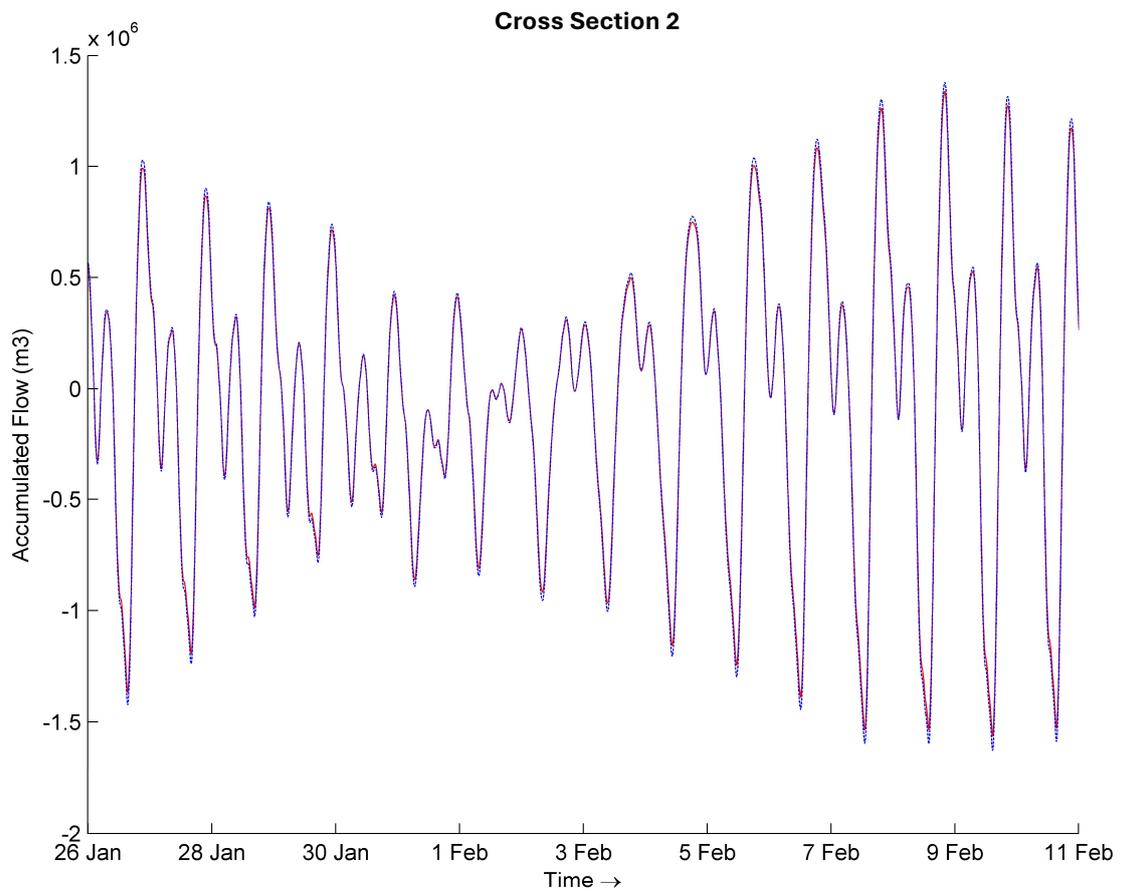
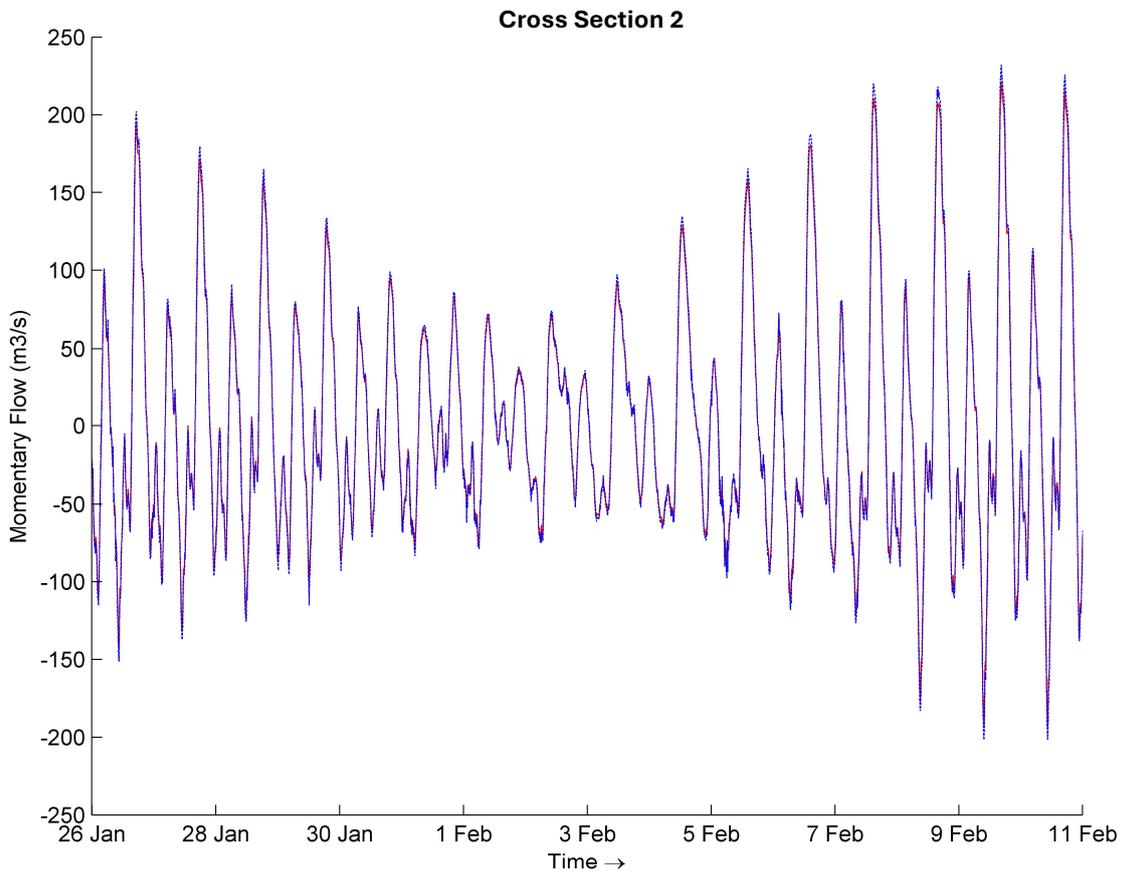


Notes: MSD - Maximum Salinity Deviation

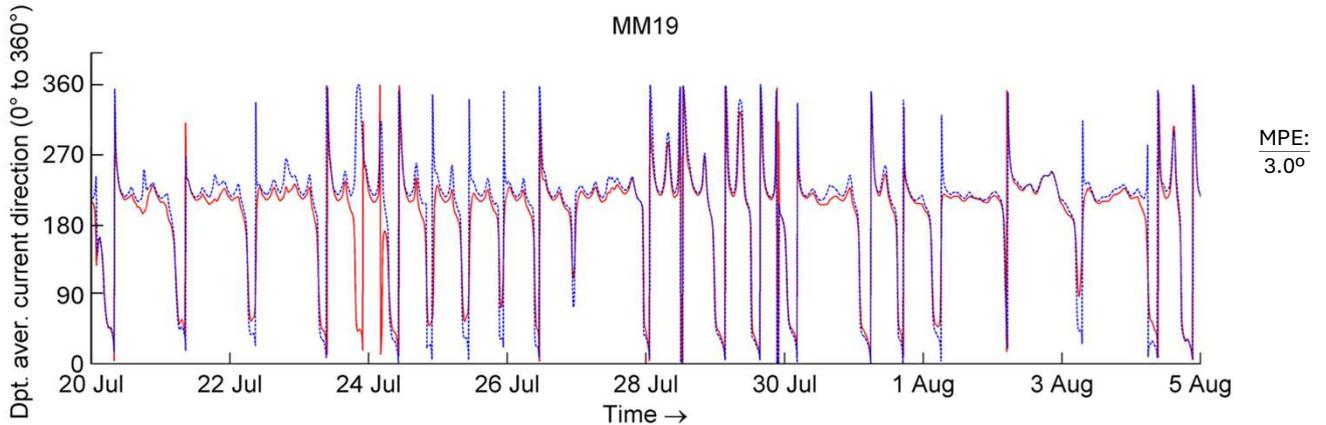
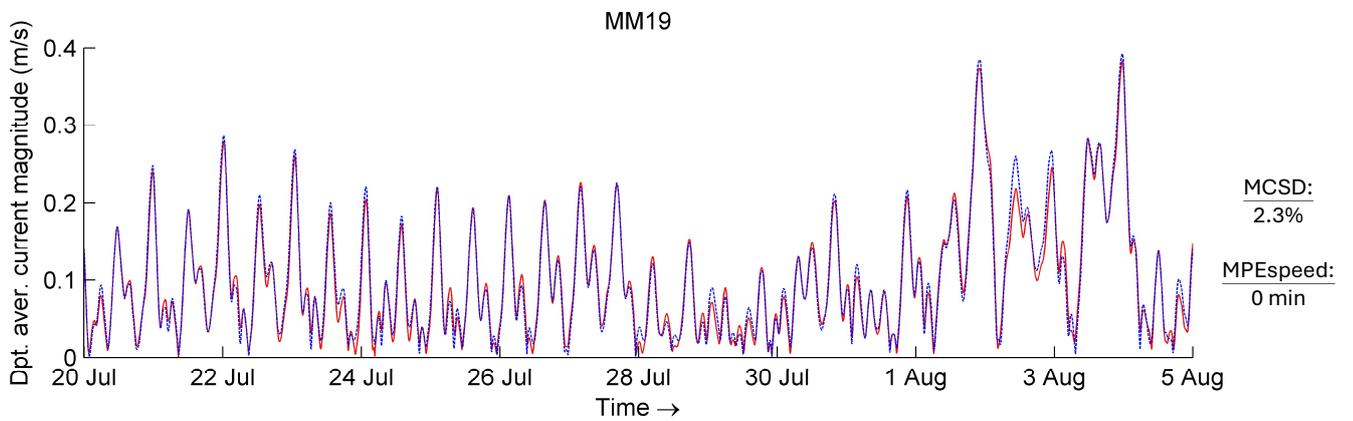
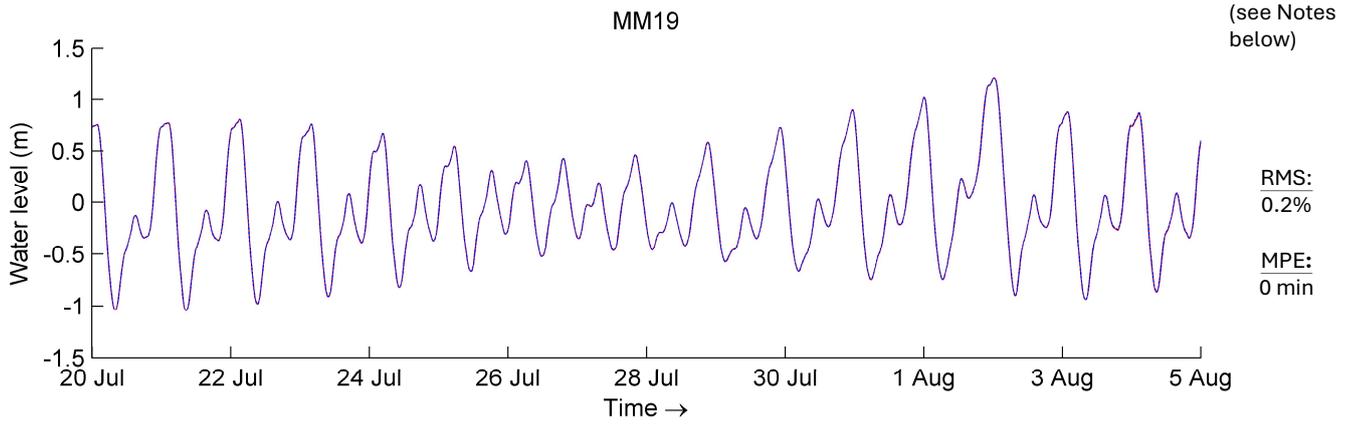
Surface, Mid-Depth and Bottom Salinity at MM19 Red : Original Model ; Blue : Refined Model		Dry Season
	Port Shelter Sewage, Stage 3 – Sewage Works at Po Toi O	
Binnies	Appendix 5A	6



Momentary Flow and Accumulated Flow through Cross Section 1 Red: Original Model; Blue: Refined Model	Dry Season
	Port Shelter Sewage, Stage 3 – Sewage Works at Po Toi O
Binnies	Appendix 5A
	7



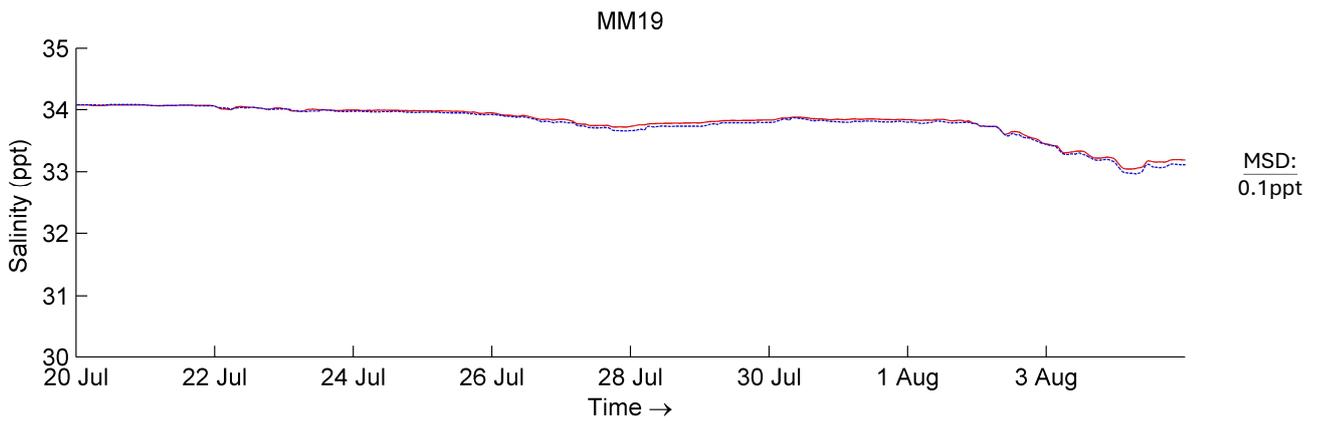
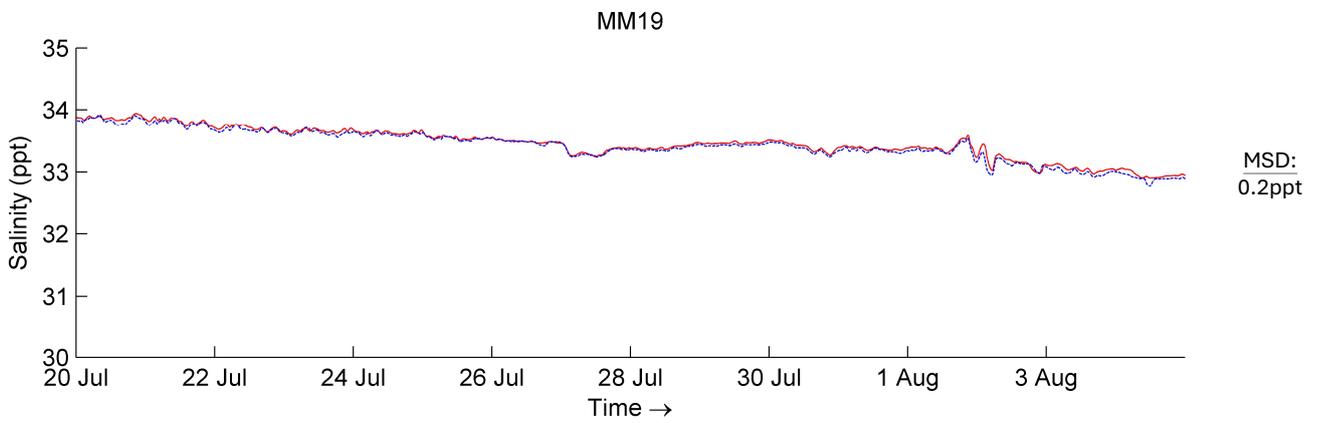
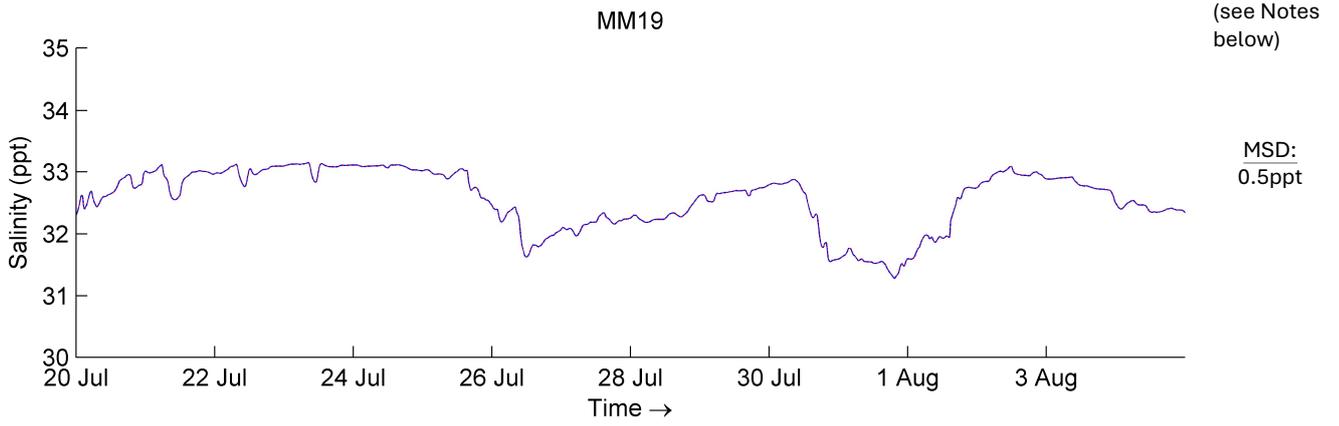
Momentary Flow and Accumulated Flow through Cross Section 2 Red: Original Model; Blue: Refined Model	Dry Season
	Port Shelter Sewage, Stage 3 – Sewage Works at Po Toi O
Binnies	Appendix 5A
	8



Notes:

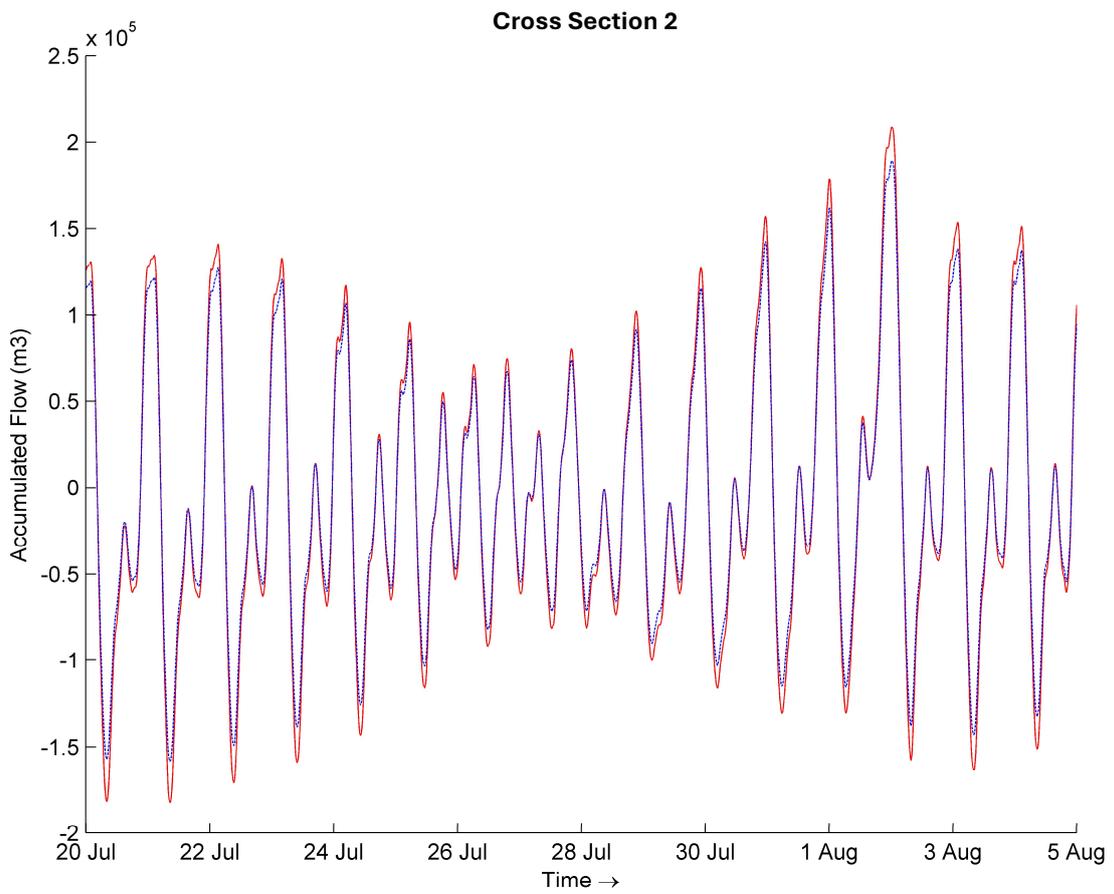
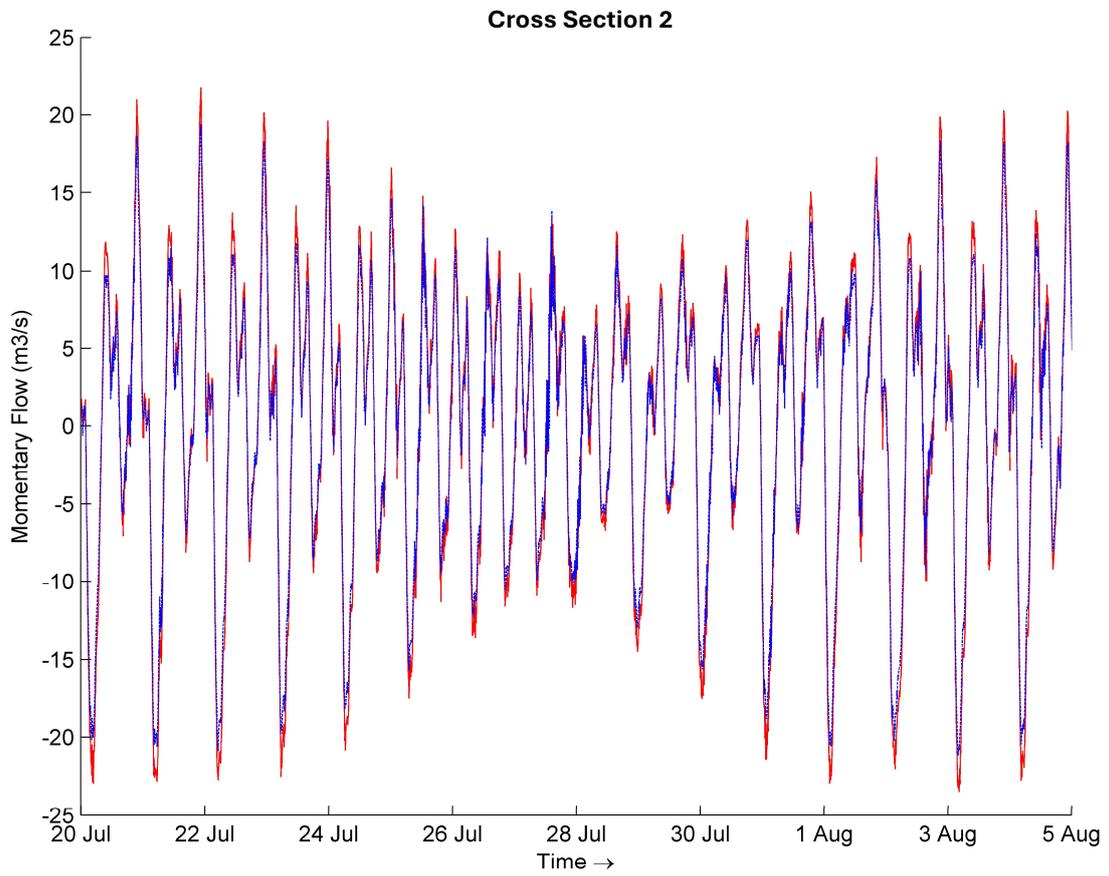
RMSE - Root mean square error; MPE - Maximum phase error at high water and low water; MCSD - Maximum current speed deviation, MPEspeed: Maximum phase error at peak speed, MDE: Maximum direction error at peak speed

Water Level, Depth Averaged Current Velocity and Direction at MM19 Red : Original Model ; Blue : Refined Model		Wet Season
	Port Shelter Sewage, Stage 3 – Sewage Works at Po Toi O	
Binnies	Appendix 5A	9

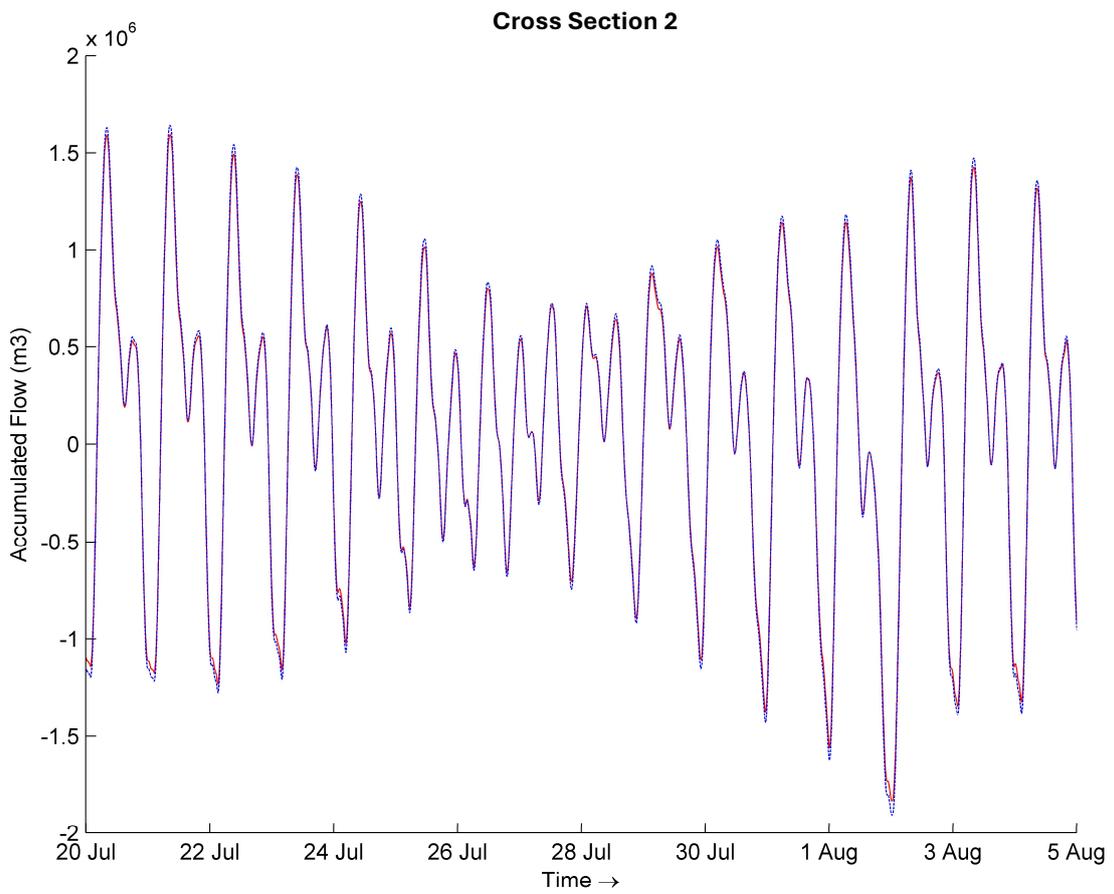
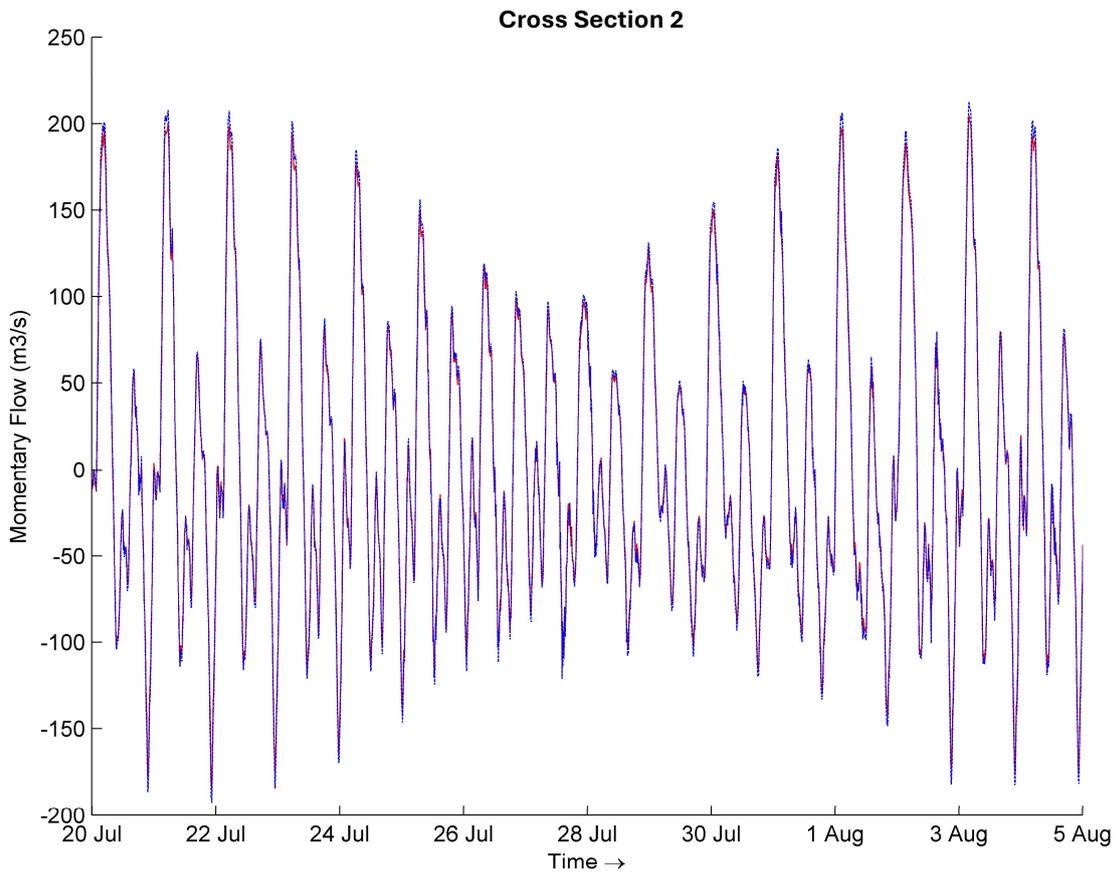


Notes: MSD - Maximum Salinity Deviation

Surface, Mid-Depth and Bottom Salinity at MM19 Red : Original Model ; Blue : Refined Model		Wet Season
	Port Shelter Sewage, Stage 3 – Sewage Works at Po Toi O	
Binnies	Appendix 5A	10

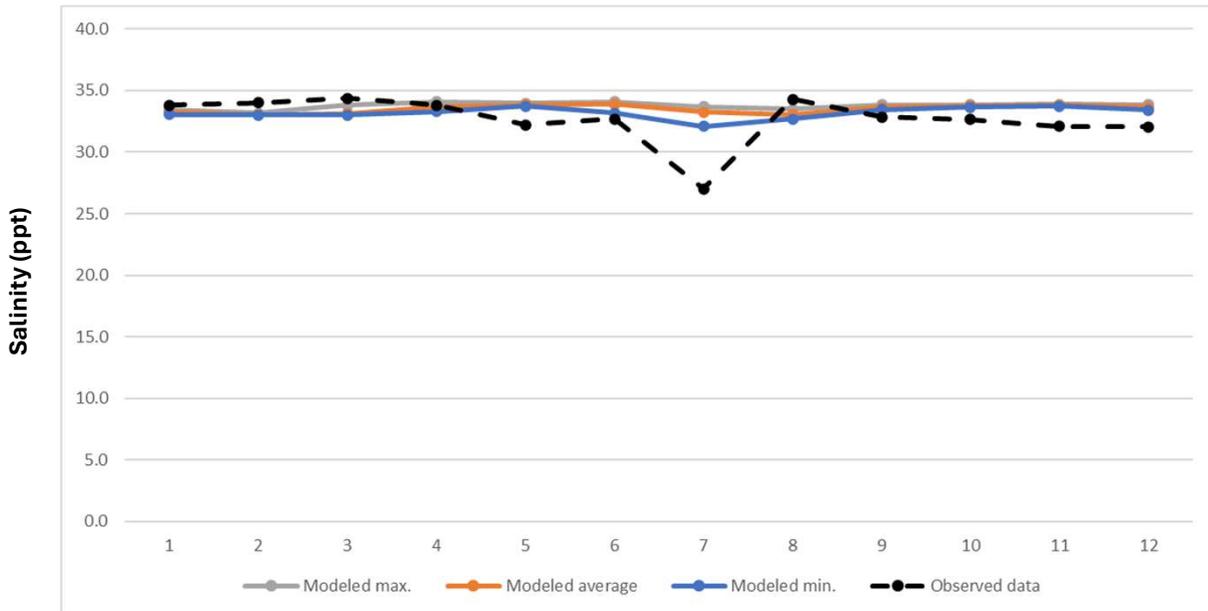


Momentary Flow and Accumulated Flow through Cross Section 1 Red: Original Model; Blue: Refined Model	Wet Season
	Port Shelter Sewage, Stage 3 – Sewage Works at Po Toi O
Binnies	Appendix 5A



Momentary Flow and Accumulated Flow through Cross Section 2 Red: Original Model; Blue: Refined Model	Wet Season
	Port Shelter Sewage, Stage 3 – Sewage Works at Po Toi O
Binnies	Appendix 5A

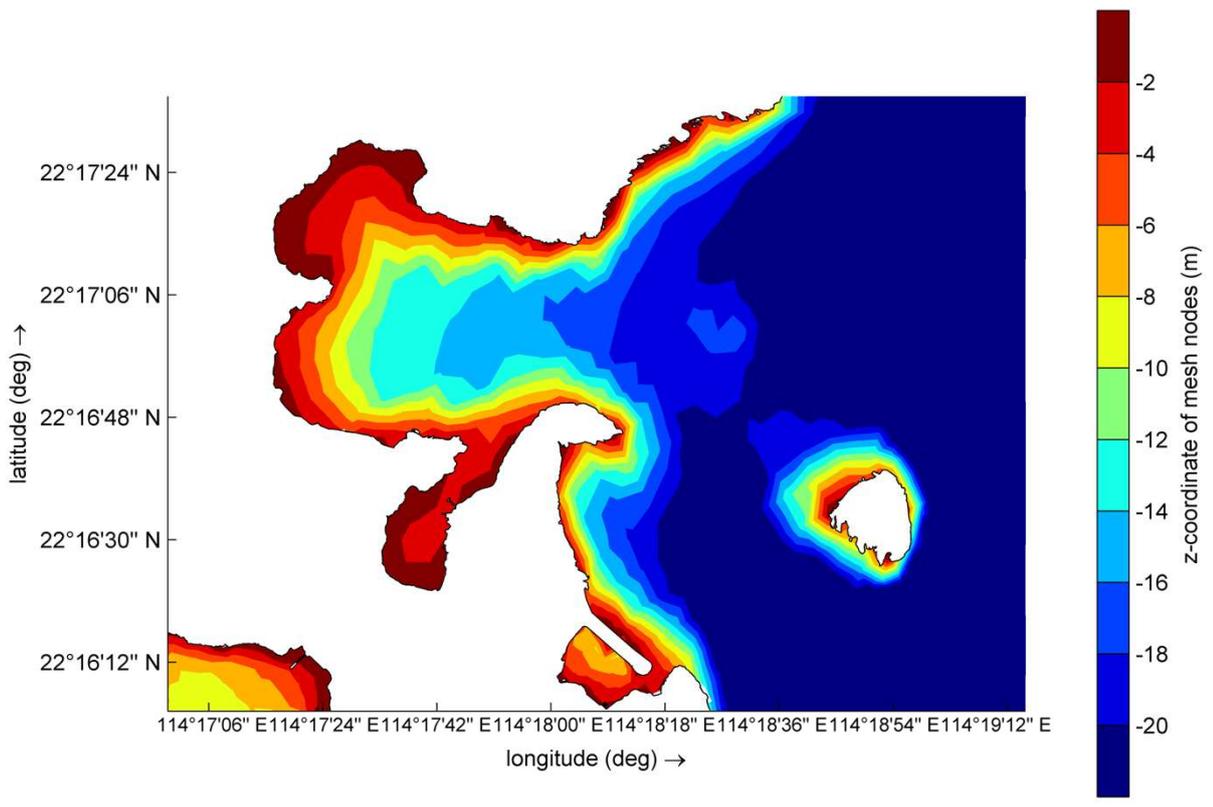
MM19 (Depth Average)



Data Interpretation

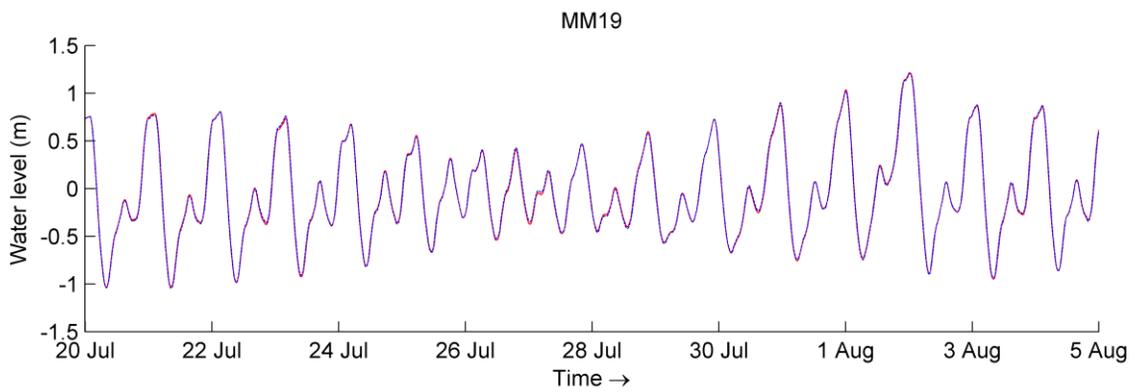
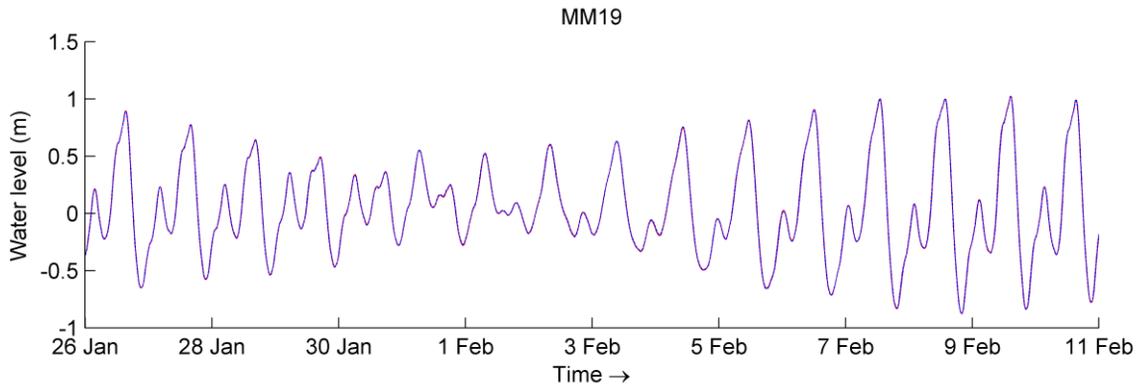
The observed data are within similar range of modelled data. The model performance is considered reasonable in terms of salinity prediction.

Modeled and Observed Depth Average Salinity at MM19		
	Port Shelter Sewage, Stage 3 – Sewage Works at Po Toi O	
Binnies	Appendix 5A	13



Model Bathymetry		
	Port Shelter Sewage, Stage 3 – Sewage Works at Po Toi O	
Binnies	Appendix 5A	14

Appendix 5B – Model Spin-up Test Results

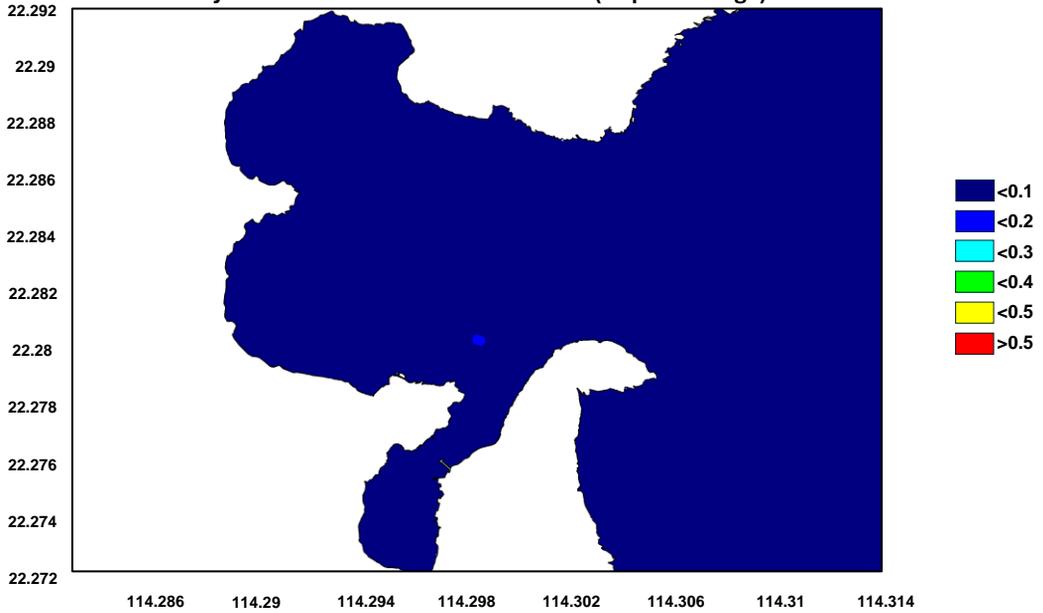


Water Level at MM19
Red : Results after 10-Month Simulation;
Blue : Results after 12-Month Simulation
Upper: Dry Season Lower: Wet Season

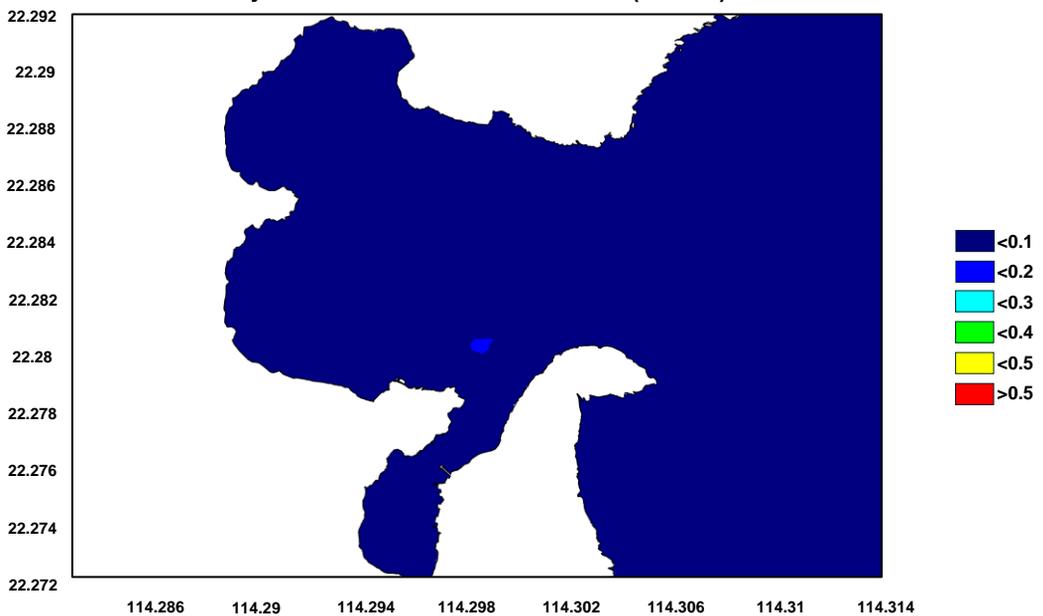
**Port Shelter Sewage, Stage 3 –
 Sewage Works at Po Toi O**

Appendix 5C – Contour Plots for Water Quality Modelling

Dry Season – Maximum SS Elevations (Depth Average)



Dry Season – Maximum SS Elevations (Bottom)



Maximum Extent of Suspended Solid Elevation (mg/L)
 Upper: Depth-Average
 Lower: Bottom

Dry Season

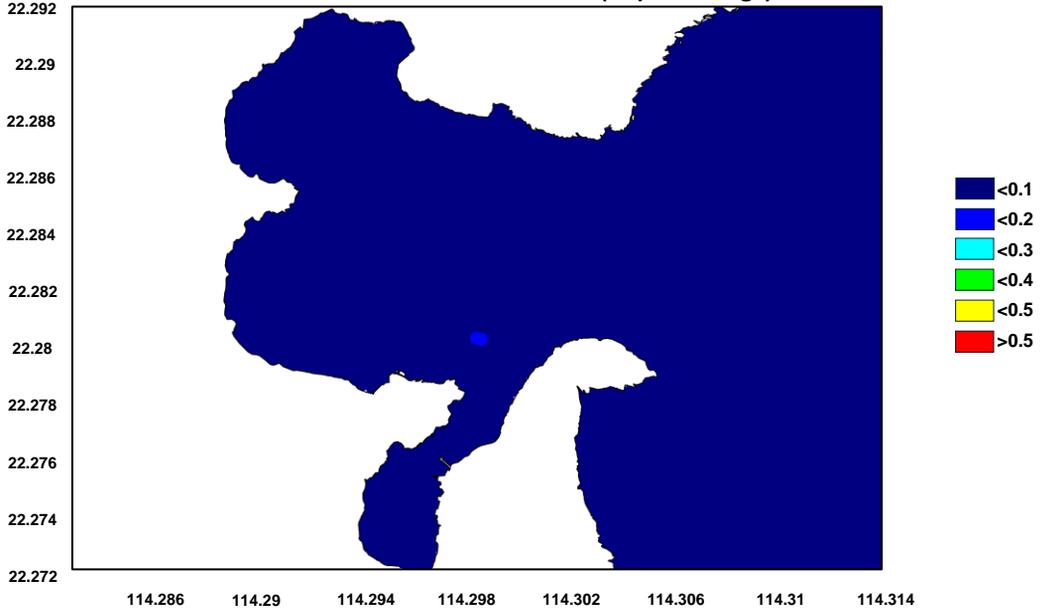
Port Shelter Sewage, Stage 3 –
 Sewage Works at Po Toi O

Binnies

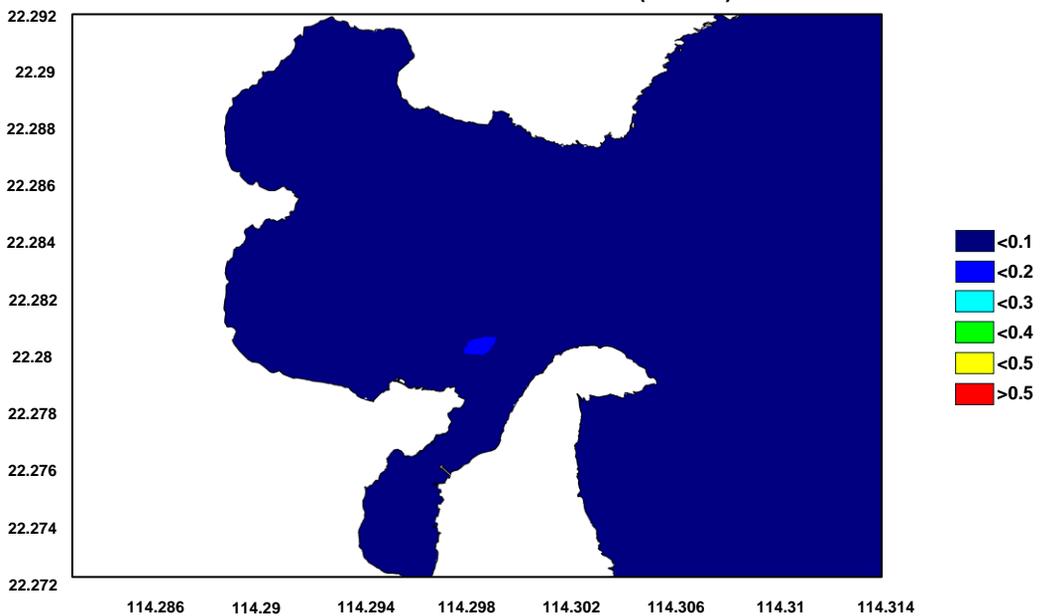
Appendix 5C

1

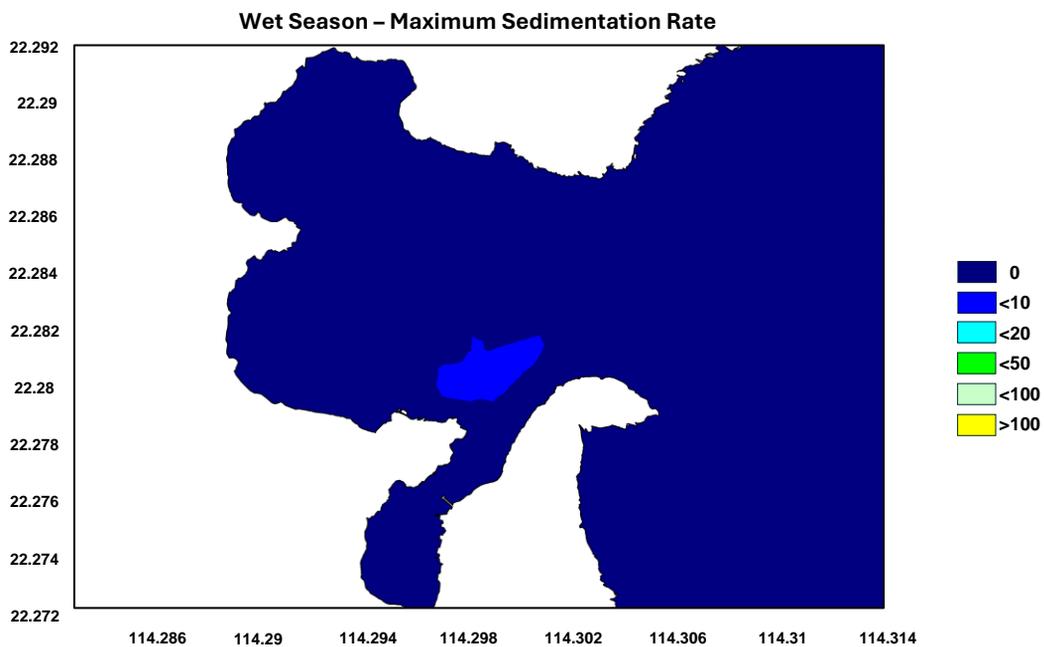
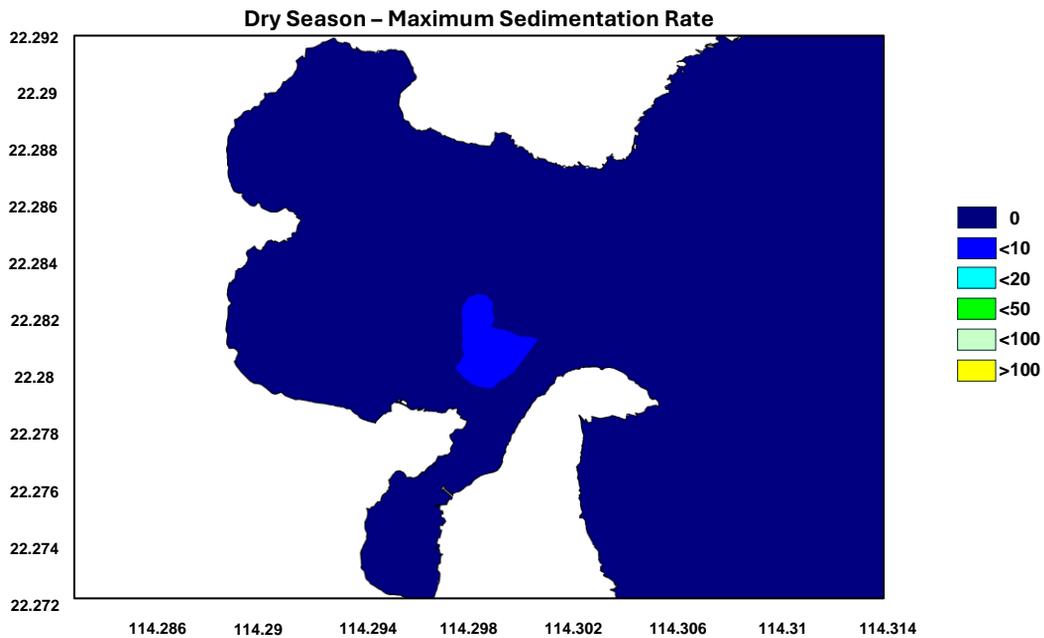
Wet Season – Maximum SS Elevations (Depth Average)



Wet Season – Maximum SS Elevations (Bottom)



Maximum Extent of Suspended Solid Elevation (mg/L) Upper: Depth-Average Lower: Bottom	Wet Season	
	Port Shelter Sewage, Stage 3 – Sewage Works at Po Toi O	
Binnies	Appendix 5C	2



Maximum Sedimentation Rate (g/m2/day) Upper: Dry Season Lower: Wet Season		
	Port Shelter Sewage, Stage 3 – Sewage Works at Po Toi O	
Binnies	Appendix 5C	3