

Agreement No. CE 69/2015 (CE)

Tung Chung New Town Extension (East) – Design and Construction

Eco-shoreline Implementation Plan (Rev. A)

June 2023



Your Ref.

Our Ref. 198377-0699

Date 12 June 2023

Sustainable Lantau Office
Civil Engineering and Development Department
13/F, North Point Government Offices
333 Java Road, North Point
Hong Kong

Attention: Mr. Eddie LAM / Mr. K.T. WO

Dear Sir / Madam,

Agreement No. CE 59/2017 (EP)
Independent Environmental Checker for Tung Chung New Town Extension – Investigation
Eco-shoreline Implementation Plan

We refer to the Eco-shoreline Implementation Plan for Tung Chung New Town Extension (East) (TCE) dated June 2023 and certified by the Environmental Team Leader of TCE on 12 June 2023. Please note we have no adverse comments on the captioned submission. The captioned submission is hereby verified in accordance with the requirement stipulated in Condition 2.14 of EP-519/2016.

Should you have any query, please feel free to contact the undersigned at 2608 7314 (chuawo@binnies.com) or our Edward Lau at 3894 9695 (lauky@binnies.com).

Yours faithfully,
for and on behalf of
BINNIES HONG KONG LIMITED

MANUEL CHUA
INDEPENDENT ENVIRONMENTAL CHECKER

cc: ET Leader / TCE – ERM (Attn: Mr. Kelvin So) [by Email: Kelvin.So@erm.com]
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Tung Chung New Town Extension

Environmental Certification Sheet for Environmental Permit No. EP-519/2016


Reference Document/Plan

Document/Plan to be Certified:	Eco-shoreline Implementation Plan
Date of Report:	June 2023

Reference EP Condition

Environmental Permit Condition:	Condition 2.14
<p>The Permit Holder shall, no later than 3 months before the commencement of construction of the eco-shoreline at Tung Chung East, submit 3 hard copies and 1 electronic copy of a detailed Eco-shoreline Implementation Plan (The Plan) to the Director for approval. The Plan shall include at least the following information:</p> <ul style="list-style-type: none">(i) the form of eco-shoreline to be adopted for the artificial seawall along the reclamation boundary at Tung Chung East;(ii) a robust and innovative eco-shoreline design with clear objectives of enhancing its ecological, landscape, visual and other functions;(iii) an implementation programme;(iv) detailed management arrangements; and(v) a monitoring programme with indicators for success.	

ET Certification

I hereby certify that the above referenced document/plan complies with the above referenced condition of EP-519/2016	
Kelvin So Environmental Team Leader ERM-Hong Kong Limited	 Date: 12 June 2023

Qualified Ecologist Certification

I hereby confirm that the Qualified Ecologist of the ET has been consulted in preparing ecological aspects of the above referenced document/plan.

Raymond Chow
Qualified Ecologist
ERM-Hong Kong, Limited



Date: 12 June 2023

Revision Number	Date of Report	Amendment
-	Sep 2020	First submission
A	Jun 2023	Section 1.2.2 updated Section 1.1.3 updated Section 2.1.1 updated Diagram 2.1 updated Section 2.2.2 updated Diagram 2.2 updated Section 3.1.4 updated Diagram 3.1 updated Section 6.1.2 updated Table 6.1 to 6.4 updated Diagram 6.2 updated Section 6.3 updated Diagram 6.3 updated Section 6.3.4 updated Section 6.4.1 updated Section 6.4.2 updated Section 6.4.3 updated Section 6.5.1 updated Section 6.5.4 added Section 6.6 added Appendix A updated Appendix B updated

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APPENDICES

Appendix A – Implementation Programme for Eco-shoreline

**Appendix B – Environmental Mitigation Implementation Schedule – Eco-shoreline
Implementation Plan**

1. INTRODUCTION

1.1. The Project

1.1.1 AECOM Asia Co Ltd has been commissioned by the Civil Engineering and Development Department (CEDD) to undertake Agreement No. CE 69/2015 (CE) – Tung Chung New Town Extension (East) – Design and Construction. The Agreement commenced on 16 June 2016 and is scheduled to be completed in June 2027.

1.1.2 The reclamation, site formation, engineering infrastructure and associated works to support developments of both Tung Chung East (TCE) and Tung Chung West (TCW) are funded by PWP Item "7786CL - Tung Chung New Town Extension". The Technical Feasibility Statement for 7786CL was approved in September 2014. 7786CL is to be delivered by two consultancy agreements namely, Tung Chung New Town Extension (East) - Design and Construction (this Assignment) and Tung Chung New Town Extension (West) - Design and Construction (Agreement No. CE 70/2015(CE)).

1.1.3 The Project of this Assignment (the Project) includes reclamation, site formation and engineering infrastructure works (including construction of Road P1) for the developments of TCE, provision of salt water supply to Tung Chung New Town (TCNT) and Siu Ho Wan (SHW) topside and infrastructure works in Tung Chung Area 58 in the existing TCNT. The scope of the Project comprises the following principal works components:

a) Works in TCE

- (i) Reclamation of about 120 hectares of seabed abutting the coastal area between Tung Chung Phase 3A and Tai Ho Bay Inlet and associated site formation works for the proposed developments;
- (ii) Engineering infrastructure works including roads, drainage, sewerage including sewage pumping stations, and waterworks to support the proposed developments;
- (iii) Provision of a marina;
- (iv) Construction of a salt water pumping station for flushing use in TCNT, TCE, TCW and SHW topside;
- (v) Landscaping, streetscaping and ancillary works; and
- (vi) Provision of environmental mitigation measures for the works mentioned in (i) to (v) above;

b) Works in the existing TCNT or SHW

- (i) Construction of a Fresh Water Service Reservoir (FWSR) near Chek Lap Kok New Village or at Siu Ho Wan for TCE and TCW;
- (ii) Construction of a Salt Water Service Reservoir (SWSR) near Chek Lap Kok New Village for flushing use in TCNT, TCE, TCW and SHW topside;
- (iii) Site formation works including natural terrain hazards mitigation measures for the works mentioned in (i) and (ii) above;
- (iv) Waterworks for salt water supply for toilet flushing in SHW topside; and
- (v) Engineering infrastructure works including roads, drainage, sewerage and waterworks to support the land allocation at Area 58 of the existing TCNT.

c) Works related to Road P1

- (i) Reclamation of about 9 hectares of seabed for Road P1 (section between TCE and Tai Ho);
- (ii) Construction of Road P1 with cycle track (section between TCE and Tai Ho) and associated engineering infrastructure works including drainage, sewerage and waterworks;
- (iii) Site formation works for a cycle park of about 2 hectares near Tai Ho Interchange;
- (iv) Improvement works to existing Tung Chung Waterfront Road and Ying Hei Road, including construction of noise barriers and footbridges, resurfacing of road pavement, etc., for upgrading them to a primary distributor as part of Road P1;
- (v) Construction of an elevated interchange near Tai Ho connecting Road P1 to North Lantau Highway and Cheung Tung Road (Tai Ho Interchange);
- (vi) Landscaping, streetscaping works and ancillary works; and
- (vii) Provision of environmental mitigation measures for the works mentioned in (i) to (vi) above.

1.1.4 Recognising the limited ecological value of standard artificial seawall design, the Project Environmental Impact Assessment (EIA) Report (CEDD, 2015) recommended that ecological enhancement measures are considered in the seawall design for the TCE Potential Development Area (PDA) and Road P1 (Tung Chung - Tai Ho Section) Extension reclamation. This would provide mitigation for marine ecological impacts resulting from the Project, which include the permanent loss of 145 ha of marine waters/seabed (considered a minor to moderate scale impact, **Diagram 1.1**). Ecologically enhanced seawalls could partially compensate this impact by providing habitat for intertidal and subtidal marine communities.

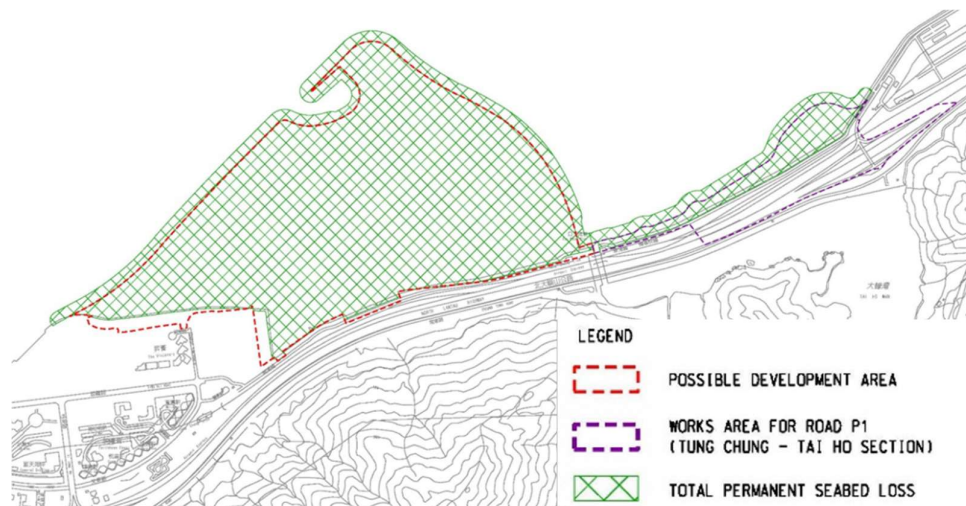


Diagram 1.1 – Extent of Permanent Seabed Habitat Loss (CEDD, 2015)

1.2. Scope of this Document

- 1.2.1. Pursuant to the Project Environmental Permit (Permit No. EP-519/2016) Condition 2.14, the Permit Holder shall, no later than 3 months before the commencement of construction of the eco-shoreline at Tung Chung East, submit 3 hard copies and 1 electronic copy of a detailed Eco-shoreline Implementation Plan (The Plan) to the Director of Environmental Protection for approval. The Plan shall include at least the following information:
- (i) the form of eco-shoreline to be adopted for the artificial seawall along the reclamation boundary at Tung Chung East;
 - (ii) a robust and innovative eco-shoreline design with clear objectives of enhancing its ecological, landscape, visual and other functions;
 - (iii) an implementation programme;
 - (iv) detailed management arrangements; and
 - (v) a monitoring programme with indicators for success.
- 1.2.2. The eco-shoreline design for TCE comprises three typologies (rocky, mangrove and vertical). Construction of these typologies commenced as follows:
- Vertical Eco-shoreline: February 2022
 - Rocky Eco-shoreline: March 2022
 - Mangrove Eco-shoreline: December 2021

2. FORM OF ECO-SHORELINE

2.1. General

- 2.1.1. Section 9.8.4.3 of the EIA Report defines an eco-shoreline as ‘any shoreline which provides beneficial functions to the local ecosystems through a range of active or passive solutions, whilst providing coastal protection’. Section 9.8.4.4 of the EIA Report recommends that a study should be conducted to investigate the proper form of eco-shoreline to be adopted for the artificial seawall along the reclamation. During the detailed design of the reclamation, an eco-shoreline study report was submitted and three basic options for eco-shoreline design, namely mangrove eco-shoreline, rocky eco-shoreline and vertical eco-shoreline, were recommended for the TCE Potential Development Area (PDA) and Road P1 (Tung Chung - Tai Ho Section) Extension reclamation. The distribution of eco-shoreline is as shown in **Diagram 2.1**.
- 2.1.2. Eco-shoreline is to provide ecological functions to mitigate the loss of general marine habitat, while the function of coastal and shoreline protection should be provided by seawall structure. Elements of eco-shoreline such as mangroves, mudflat, oyster basket and bio-blocks will be installed/planted on top of seawall structure. The seawall structure was designed in accordance with Port Works Design Manual.

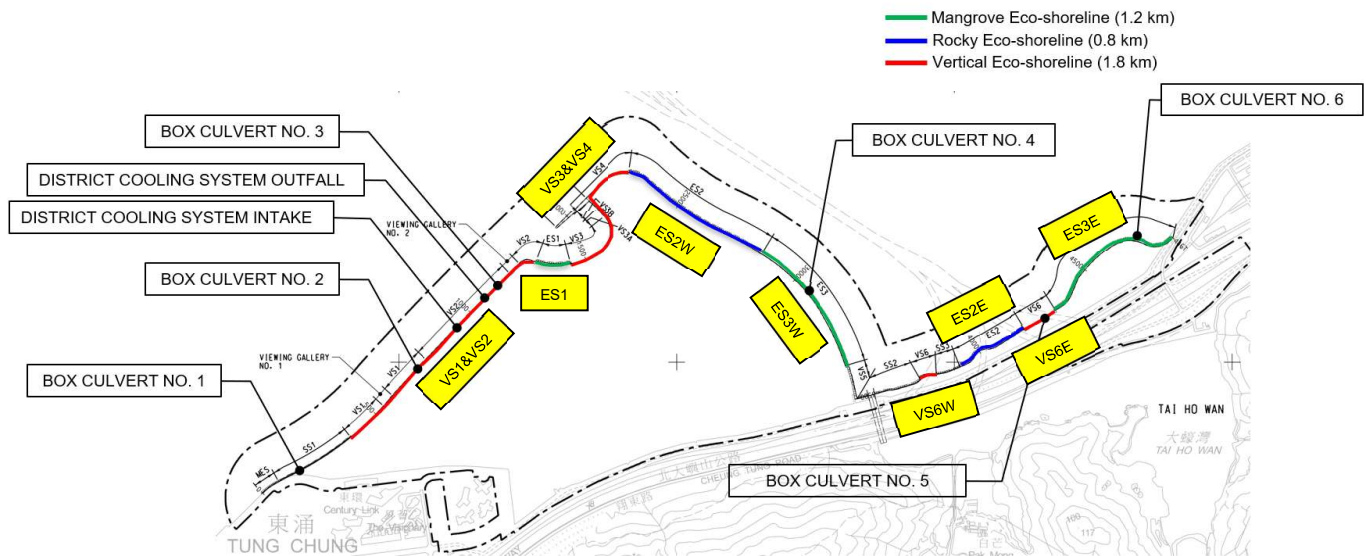


Diagram 2.1 – Layout Plan for Eco-shoreline

Note: Location of box culverts, District Cooling System outfall and intake are indicative

2.2. Mangrove Eco-shoreline

- 2.2.1. The mangrove eco-shoreline comprises of mudflats, mangroves and oyster baskets which highlighted in green and blue shown in the **Diagram 2.2**.
- 2.2.2. The sediment and nutrient rich, low salinity waters of Tung Chung support extensive soft-shore communities such as mangrove, mudflats and sandy beaches, where suitably sheltered shorelines occur. These communities tend to be more productive and diverse than hard shorelines in the area. Mudflats would be sourced locally within the Pearl River Estuary region and would be agreed by the *Project Manager*, ET and IEC before informing EPD.
- 2.2.3. The mangrove eco-shoreline design is proposed for the Road P1 (Tung Chung – Tai Ho Section), and the majority of the eastern coast of the TCE PDA, as well as an area on the western side of the marina. The typical arrangement of the proposed design is shown in **Diagram 2.2**, which incorporates mangrove and mudflat habitat into the shoreline.

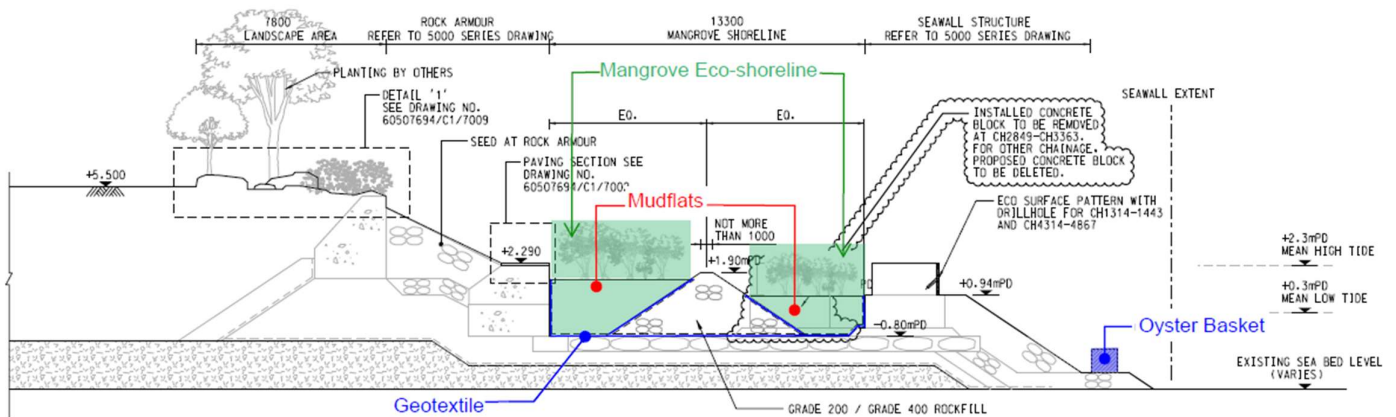


Diagram 2.2 – Typical Section of Mangrove Eco-shoreline

2.3. Rocky Eco-shoreline

2.3.1. Rocky eco-shoreline comprises of bio-blocks and oyster basket which highlighted in blue shown in the **Diagram 2.3**.

2.3.2. Although hard-shoreline habitats are likely to support a lower abundance and diversity of intertidal fauna and flora than soft-shoreline habitats, they provide habitats that support different community types not associated with the mangrove and mudflats, particularly epifaunal species such as rock oysters (*Saccostrea cucullata*), limpets (e.g. *Cellana* sp.), barnacles (e.g. *Balanus* sp.), whelks (e.g. *Thais* sp.) mussels (e.g. *Perna viridis*), nerites (*Nerita* spp.) and littorinid gastropods (e.g. *Littoraria* sp. and *Echinolittorina* sp.). Furthermore, they can also add visual interest to the shoreline design. For these reasons, rocky eco-shoreline has been included in the eco-shoreline plan for the Project.

2.3.3. The rocky eco-shoreline design is proposed for the north-eastern coast of the TCE PDA. This location has been selected as it is the most exposed section of coastline to be constructed under the project, therefore environmental conditions would naturally favour hard shoreline in this area. A typical section of the proposed design is shown in **Diagram 2.3**, which incorporates a band of rocky habitat into the shoreline.

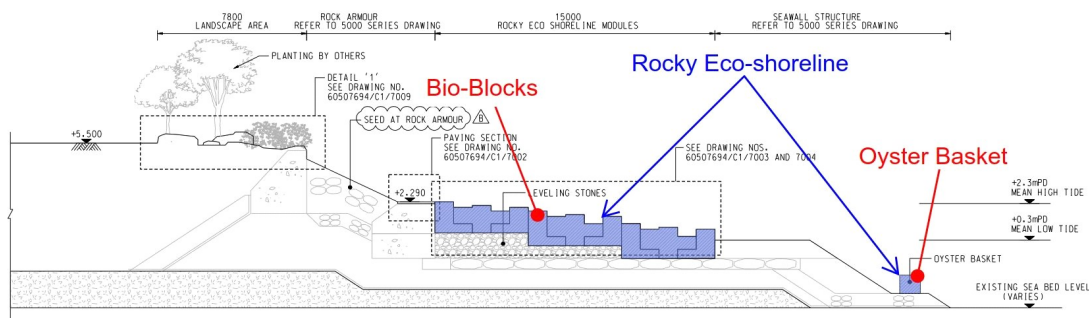


Diagram 2.3 – Typical Section of Rocky Eco-shoreline

2.4. Vertical Eco-shoreline

- 2.4.1. Vertical eco-shoreline comprises of eco-pattern, eco-drillhole, eco-pot and bird resting area which highlighted in orange shown in the **Diagram 2.4**.
- 2.4.2. Standard vertical seawalls have a structurally simple, narrow intertidal zone of very limited ecological value. However, even these habitats can be enhanced to some degree by increasing surface complexity.
- 2.4.3. The vertical eco-shoreline design will be implemented on the western coast of the TCE PDA, as well as the vertical seawall on the eastern coast of the TCE PDA. A typical section of the design is shown in **Diagram 2.4**.

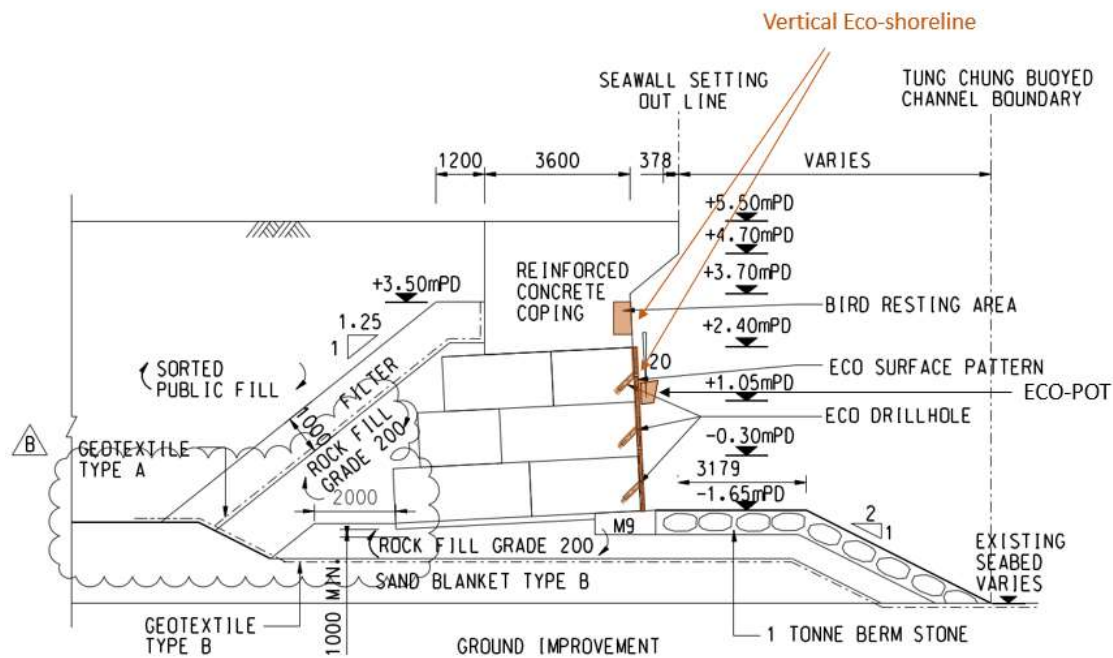


Diagram 2.4 – Typical Section of Vertical Eco-shoreline

3. ECO-SHORELINE DESIGN

3.1. Mangrove Eco-shoreline

Design Concept

- 3.1.1. The concept for the Mangrove Eco-shoreline is based on the wetland sill design, where a sill is constructed to provide a sheltered platform suitable for the establishment and growth of mangroves. The platform needs to be protected from wave action (which could lead to the scouring and loss of fine sediments from mudflats), while at the same time allowing tidal exchange required for mangrove growth and the movement of marine wildlife (e.g., marine larvae and fishes) in and out of the eco-shoreline area. The design would achieve this by using concrete blocks at the seaward edge of the eco-shoreline platform. Tidal exchange and the movement of wildlife through the sill will be facilitated by staggering the sill at approximately 30m intervals (**Diagram 3.1**). Some limited additional tidal exchange would occur through the base of the platform, where a geotextile fabric would allow water exchange while preventing the loss of fine sediments from mudflats.

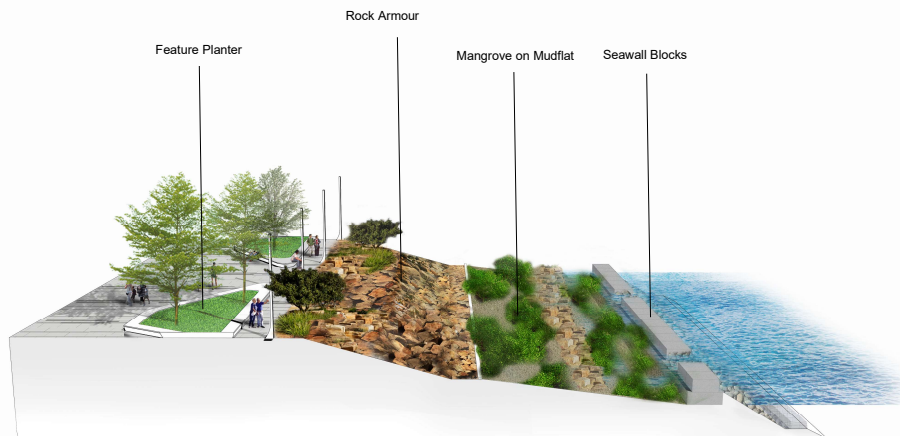


Diagram 3.1 – Design of Mangrove Eco-shoreline

- 3.1.2. Mangroves can grow in a variety of mudflats, from fine silts through to relatively coarse sand. While suitable mudflats for mangrove growth would likely accumulate naturally over time, the rate of accretion would be very slow. Artificial filling of the platform is therefore required. The mudflats (approximately 2m thick) should be graded to be at just below high tide (+2.29 mPD) at the landward side of the platform, down to mean low tide (+0.29 mPD) at the seaward side (**Diagram 2.2**). This would create a range of potential mangrove and mudflats habitats.

- 3.1.3. Mangroves grow relatively poorly in pure saltwater: higher growth rates are achieved in brackish waters with lower salinity. While salinity levels in the TCE are thought to be within the range found at naturally occurring mangrove stands in Hong Kong, additional freshwater input to mangrove eco-shoreline can be provided by directing stormwater run-off from the promenade area landward of the eco-shoreline directly into the mangrove area.

Planting

- 3.1.4. To speed up the establishment of the eco-shoreline, mangroves will be planted in the platform. Only mangrove species native to Hong Kong and common in the existing Tung Chung area will be utilised. Mangrove planting considers the following elements:

- Native species to be used in the planting include *Acanthus ilicifolius*, *Aegiceras corniculatum*, *Avicennia marina*, *Bruguiera gymnorhiza*, *Lumnitzera racemosa*, and *Kandelia obovata*.
- Where possible, consent will be sought from the owners (i.e DLO, WWF-Hong Kong) and any other relevant authorities of nearby established mangrove stands (e.g., Tung Chung Bay, Mai Po) for collection of seeds/droppers of these species, as using locally sourced seeds (as opposed to using nursery-grown plants from abroad) will maintain the integrity of local genetic stock diversity. Local seed stocks are also potentially better adapted to local conditions which may also be of importance for succession of locally-adapted secondary species.
- Collected seeds/droppers should be moved to a nursery area for establishment. Developing a small nursery close to mangrove planting sites is an established method for germinating and cultivating collected seeds/droppers. Typically, nurseries require the following:
 - **Size:** Experience from overseas (Hoang, V.T., and Pham, T.T. (2010), Management of Natural Resources in the Coastal Zone of Soc Trang Province: Mangrove Nursery Manual. GTZ: 44p) suggests around 325m² flat area is needed to grow 10,000 seedlings per year (allowing for 20% mortality), together with 100-200m² general working area.
 - **Water Supply:** mangrove seeds and seedlings need require daily watering, so an adequate water supply is needed. Although brackish or salt water can be used, germination success and growth rates for most species are much higher if freshwater is used
 - **Drainage:** adequate drainage is required to prevent flooding and washing out of seeds/seedlings.
- Established mangrove seedlings will be planted out in the mangrove/mudflat eco-shoreline at approximately 1 m intervals.

Viewing of Eco-shoreline

- 3.1.5. The public will be able to view the mangrove and mudflat habitat from the promenade constructed landward of the eco-shoreline.
- 3.1.6. Information signage will be provided to inform the public about the development of the eco-shoreline and the flora and fauna found in the eco-shoreline habitats. Appropriate signage will be provided to warn the public about potential hazards in the eco-shoreline area.

3.2. Rocky Eco-shoreline

Design Concept

3.2.1. The basic concept for the rocky eco-shoreline adopts rectangular shaped concrete blocks arranged to provide a natural looking shoreline. Concrete blocks were adopted for the following reasons:

- Natural stone is more difficult and expensive to source and dress to the dimensions needed.
- Using concrete provides an opportunity to cast holes, ledges and other surface structures that will increase the habitat value of the blocks.
- Some concrete solutions with lower pH and other characteristics have been designed to minimise toxicity and maximise ecologically usable surface.

3.2.2. The section shown in **Diagram 3.2** has been designed with a low gradient to maximise the intertidal area of the rocky shoreline, increasing the number of niches available for intertidal organisms. The block-size is approximately 1 m³. By positioning some of the seaward blocks at a higher level than adjacent landward blocks, rock pools will be formed at low-tide that can provide a refuge for intertidal organisms (**Diagram 3.3**). Furthermore, holes, ledges and other surface structures will be cast into the blocks to further increase habitat value. It is important to create rockpools at different tidal levels to maximise species diversity; some habitat-specialist species are tidal-height specific, while other species require different tidal height pools throughout their life-cycle. To enhance the performance of bio-blocks to serve as the habitat for inter-tidal organism, the pH value of bio-block is also designed to be pH 9-10, which is less alkaline than the ordinary concrete of around pH13.

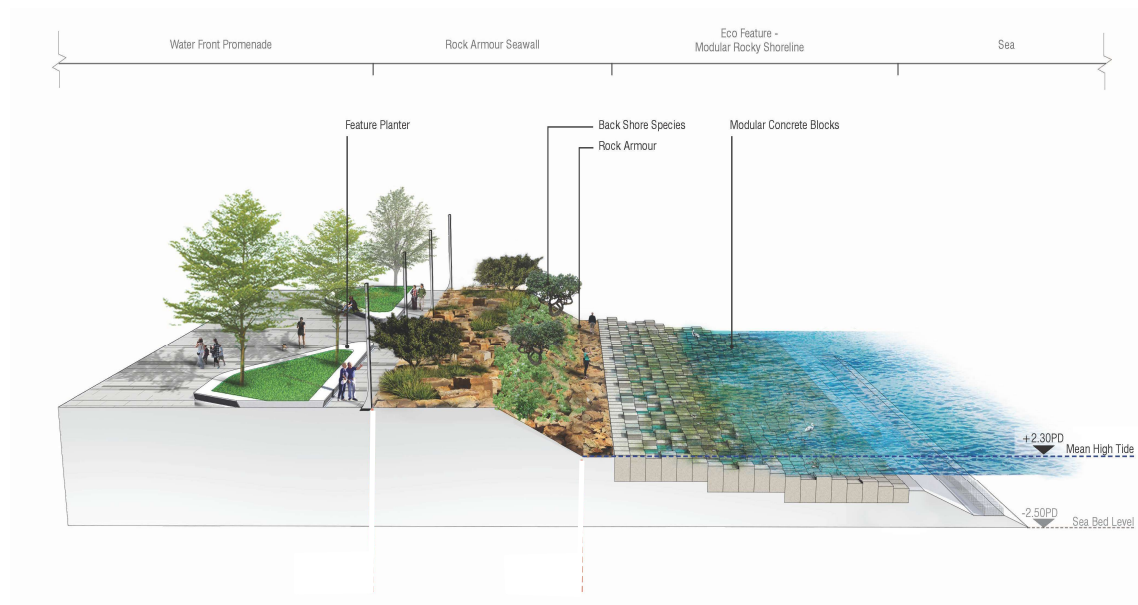


Diagram 3.2 – Design of Rocky Eco-shoreline

TUNG CHUNG NEW TOWN EXTENSION (EAST) ECO-SHORELINE TYPOLOGIES
MODULAR ROCKY SHORELINE AT TIDAL CHANGE

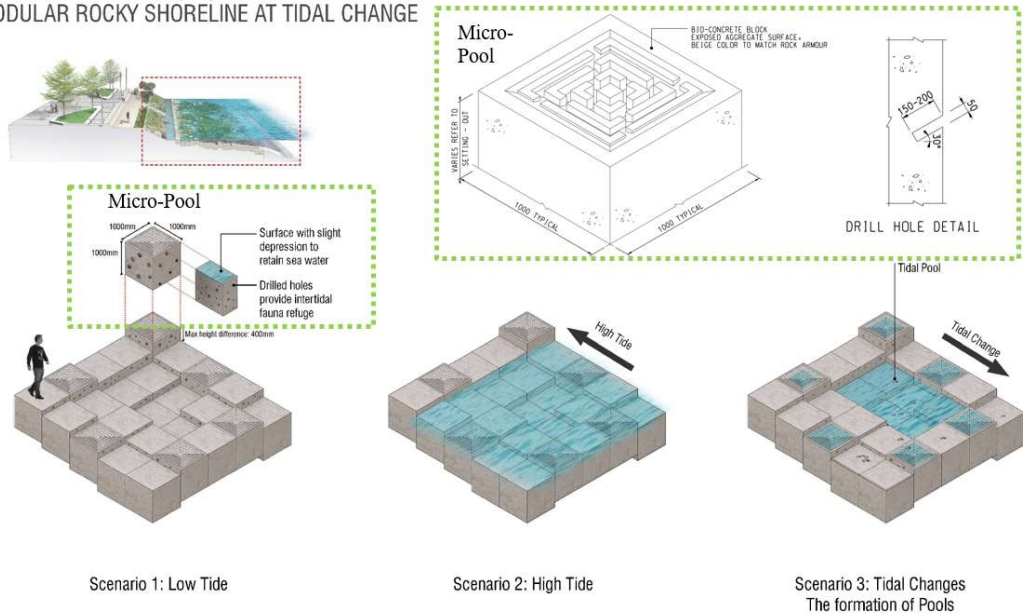


Diagram 3.3 – Detail of Bio-Block with Configuration and Micro-pools to Create Rockpools

Viewing of Eco-shoreline

- 3.2.3. The public will be able to view the rocky eco-shoreline from the promenade constructed landward of the eco-shoreline (labelled as water front promenade in **Diagram 3.2**).
- 3.2.4. It is recognised that the lower shore would be colonised by algae (making surfaces slippery) and rock oysters (which have sharp shells) posing a potential hazard to the public. Appropriate signage will be provided to warn the public about potential hazards in the eco-shoreline area.
- 3.2.5. Information signage will be provided to inform the public about the development of the eco-shoreline and the flora and fauna found in the eco-shoreline habitats.

3.3. Vertical Eco-shoreline

Design Concept

- 3.3.1. The basic concept for the vertical eco-shoreline is to provide surface treatment to block-work used to form the sea-wall.
- 3.3.2. Additional enhancement features included in the vertical seawall design comprise:
- Small (e.g. 5 – 10 cm in diameter and 15 cm deep) holes will be drilled in the seawall at a 45 degree angle (so they retain water at low tide) to provide refuge for crabs, fish and other larger fauna. The holes will cover inter-tidal and sub-tidal areas of the seawall, and be provided at 50 cm – 100 cm intervals.
 - Larger cavities (e.g. 80 cm high, 40 cm wide and deep) pre-cast into the concrete should be included above the high tide level every 10 m – 30 m. These will provide platforms for wetland birds (e.g. White Wagtail *Motacilla alba*) to hunt and rest.

- Eco-pots made of clay with internal dimension of 300mm (length) x 150mm (width) x 300mm (depth) and pot thickness of 40mm shall be attached to the vertical eco-shoreline at 10m intervals with the top of the eco-pot at +1.3mPD. This will provide a refuge for marine organism by retaining water during low tide.

Public Information

- 3.3.3. Information signage will be provided to inform the public about the development of the eco-shoreline and the flora and fauna found in the eco-shoreline habitats. Appropriate signage will be provided to warn the public about potential hazards in the eco-shoreline area.

3.4. Oyster Baskets

Introduction

- 3.4.1. In addition to the three basic eco-shoreline typologies described in the previous sections, the project also presents other opportunities for ecological enhancement works. In the limited sub-tidal areas at the toe of proposed eco-shorelines, oyster baskets filled with oyster shells are deployed to increase habitat complexity and enhance ecosystem function and services.
- 3.4.2. For rocky and mangrove eco-shoreline, there will be a small platform (2-3m wide) at the toe of the seawall below average low tide level for deployment of oyster baskets as indicated in **Diagrams 2.2 and 2.3**. Examples of typical oyster basket design are shown in **Diagram 3.4**.



Diagram 3.4 – Oyster Basket filled with Oyster Shells

- 3.4.3. For the current project, oyster baskets with the following characteristics will be deployed:
- Mesh size of the oyster basket is about 5 cm.
 - Dimension of oyster basket: 300 mm x 300 mm x 700 mm
 - Oyster baskets will be made of stainless steel wire.
 - Baskets can be filled to approximately 60% capacity with oyster shells.

4. IMPLEMENTATION PROGRAMME

4.1. General

4.1.1. The programme for implementation of the eco-shoreline is outlined in **Appendix A**.

5. DETAILED MANAGEMENT ARRANGMENTS

5.1. Vertical Eco-shoreline

5.1.1. The maintenance agents of vertical eco-shoreline are summarised in **Table 5.1**. The eco-features are installed on the vertical surface of the vertical seawall as shown in **Diagram 2.4**. The eco-features are part of the vertical seawall. There is no specific management issue for these eco-features

Item	Description	Maintenance Agent
1	Eco-features, including bird resting area, eco-surface pattern, eco-drillhole and eco-pot	Port Works Division/ CEDD

Table 5.1 – Maintenance Agents of Vertical Eco-shoreline

5.2. Mangrove and Rocky Eco-shoreline

5.2.1. The maintenance agents for mangrove and rocky eco-shoreline is summarized in **Table 5.2**. The eco-features are installed on the surface of the slopping seawall as shown in **Diagram 2.2 and 2.3**. The eco-features are part of the slopping seawall. There is no specific management issue for these eco-features.

Item	Description	Maintenance Agent
1	Planter for Mangrove	Port Works Division/ CEDD
2	Planter for Bio-blocks	Port Works Division/ CEDD
3	Oyster Basket	Port Works Division/ CEDD

Table 5.2 – Maintenance Agents of Mangrove and Rocky Eco-shoreline

6. MONITORING PROGRAMME WITH INDICATORS FOR SUCCESS

6.1. General

6.1.1. Section 9.11.2.2 of the Project EIA Report outlines eco-shoreline monitoring requirements: The colonisation and establishment of fauna and/or flora on the eco-shoreline at TCE PDA and Road P1 reclamation should be monitored. The monitoring survey should include quantitative ecological survey methods and measurements of water quality parameters, and cover dry and wet seasons. As it is expected that this measure will also benefit fisheries species in the marine ecosystems, besides ecological components, the monitoring should also include monitoring on fisheries resources (in particular the recruitments of fisheries species).

6.1.2. Section 11.4.6 of the updated EM&A Manual further details eco-shoreline monitoring requirements, which are reproduced here for ease of reference:

- The colonisation and establishment of fauna and/or flora on the eco-shoreline at TCE PDA and Road P1 reclamation should be monitored. Marine ecosystems are expected to be enhanced by the eco-shoreline, and hence monitoring of the eco-shoreline shall include quantitative ecological survey methods and measurements of water quality parameters, and cover dry and wet seasons. As it is expected that this measure will also benefit fisheries species in the marine ecosystems, besides ecological components, the monitoring should also include monitoring on fisheries resources (in particular the recruitments of fisheries species). Monitoring shall be conducted for at least 3 years after the completion of reclamation works, twice in wet season and twice in dry season, in order to determine the effectiveness of the eco-shoreline. Reference sites shall be selected in nearby artificial seawalls, to be monitored following the same methods, to facilitate comparisons and evaluation of effectiveness. The need of extension of monitoring will be reviewed upon completion of the monitoring and subject to the findings of the monitoring surveys.

(Remarks: The monitoring works will be conducted by the Monitoring Team employed by CEDD. Based on the actual works programme, the eco-shoreline monitoring shall be conducted for at least 3 years after completion of eco-shoreline. The updated monitoring programme is presented in Section 6.4.)

- Marine ecosystems include intertidal communities and subtidal hard substrate communities, which should be conducted both qualitatively and quantitatively. Species and abundance of biota should be recorded. Diversity index and evenness index should be provided for evaluation and comparison purposes.
- Parameters for water quality monitoring include dissolved oxygen (DO), dissolved oxygen saturation (DO%), temperature, turbidity, salinity, pH and suspended solids (SS), and the measure methodology could make reference to Water Quality monitoring.
- Regarding the monitoring of fisheries recruitment, it is recommended the monitoring survey should be monthly covering May to August (the spawning periods of marine fishes). The principal sampling method may involve the use of small seine net or plankton net. Other sampling methods such as fish cages, tidal nets and night-time survey could also be considered and recommended where appropriate. Reference sites shall be selected in nearby locations, to be monitored following the same methods, to facilitate comparisons and evaluation of effectiveness.

6.1.3. Based on these specifications, monitoring locations, methodologies and programme have been developed.

6.2. Monitoring Locations

6.2.1. Eco-shoreline Monitoring locations are shown in **Diagram 6.1**.

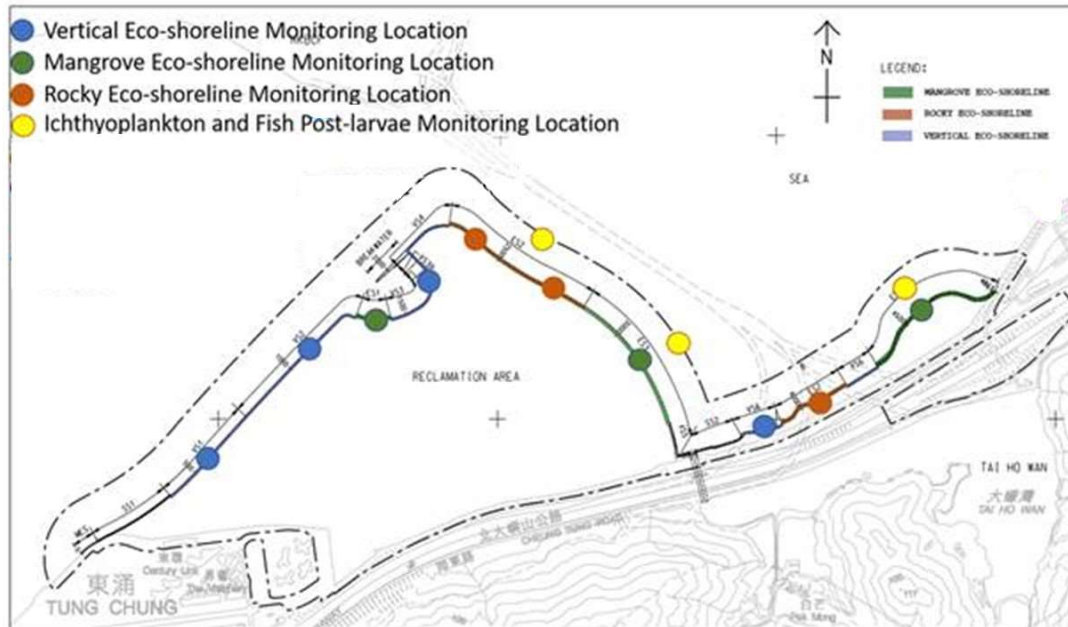


Diagram 6.1 – Eco-shoreline Monitoring Locations

6.2.2. Reference monitoring locations are shown in **Diagram 6.2**. Locations R2 and R3 were selected along typical sloping rip-rap shoreline close to the proposed eco-shoreline (presumably with similar environmental conditions). Location R1 is a typical vertical shoreline with no enhancement features. An additional fish sampling location (R4) is included at Tung Chung Bay to compare the species abundance at a natural mangrove site. Representative photographs of the reference locations are provided in **Diagram 6.3**

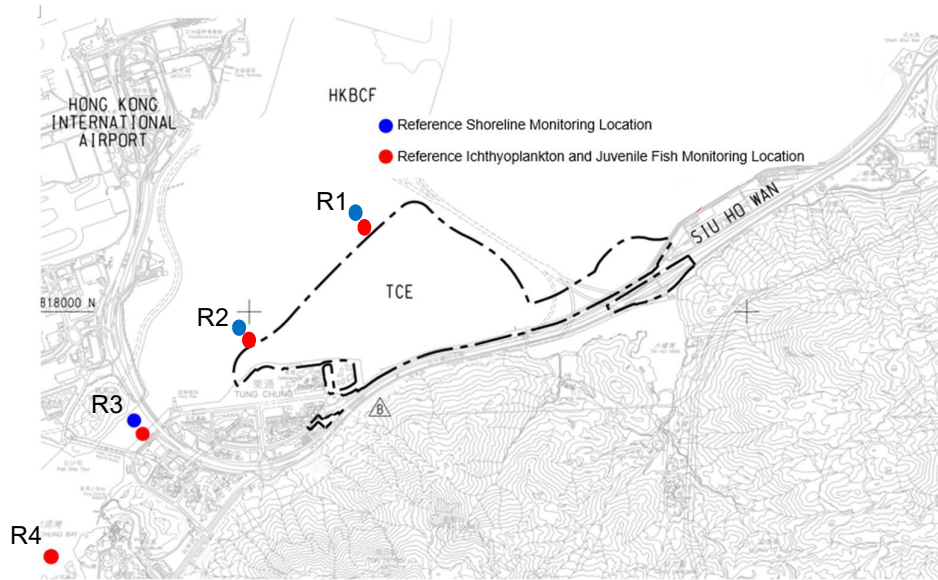


Diagram 6.2 – Proposed Reference Monitoring Locations

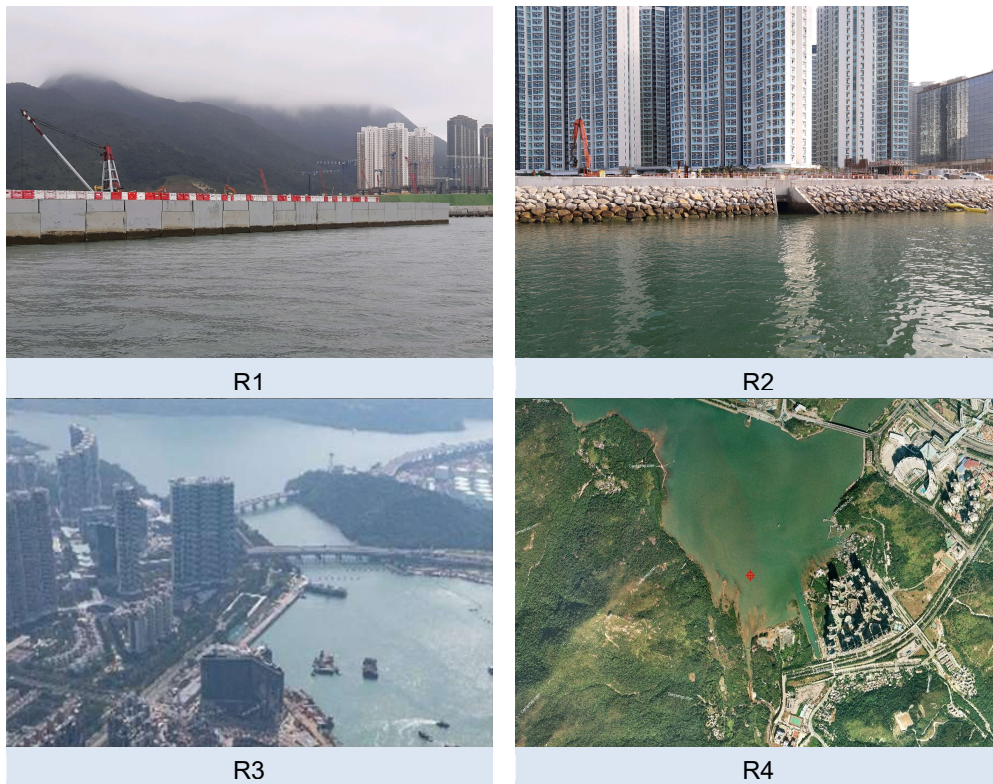


Diagram 6.3 – Photos of Proposed Reference Monitoring Locations

6.3. Monitoring Methodologies

Mangrove Eco-shoreline

6.3.1. Mangrove eco-shoreline monitoring methodology at each survey location is described in **Table 6.1**. Mangrove eco-shoreline Monitoring locations (3 numbers) are shown in **Diagram 6.1**

Table 6.1 – Mangrove Eco-shoreline Monitoring Methodology

Parameter	Methodology	No. of Sample at each monitoring location	Details	Frequency
Avifauna	Point count	1	Single point count undertaken at each sampling point. Surveys undertaken for a period of 15min covering all visible areas (i.e., 360°) at a radius of 100m from the survey point. Record made of avifauna species richness and abundance in different habitats (i.e., mangrove, mudflat, open water, seawall, landscape promenade) as well as any notable behaviour (hunting, roosting, nesting).	To be monitored at low tide, twice in wet season and twice in dry season, at least 3 years
Epifauna	Transect	3	1m ² quadrat surveyed at three points (high, medium and low shore) along each transect. Species richness and abundance/frequency recorded. Diversity index and evenness index should be calculated.	To be monitored at low tide, twice in wet season and twice in dry season, at least 3 years
Infauna	Transect	3	0.25m ² quadrat surveyed at three points (high, medium and low shore) along each transect. The top 0.1m mudflat layer within the quadrat will be collected and screened through 0.5mm mesh size sieve. Fauna sorted will be identified and counted.	To be monitored at low tide, twice in wet season and twice in dry season, at least 3 years
Vegetation	Transect	3	2m ² quadrat surveyed at three points (high, medium and low shore) along each transect. The following information about each plant within the quadrat will be recorded: species, height, number of leaves and health (signs of chlorosis/necrosis).	To be monitored at low tide, twice in wet season and twice in dry season, at least 3 years
	Fixed Point Sample	3	General mangrove health (% mortality) at each location will be recorded, with fixed point photographs taken for easy comparison of mangrove health.	
Mudflat Properties	Core Sample	3	2-3cm diameter core sample taken at high, middle and low shore. Particle size, organic content, C, N, pH and salinity, should be measured.	To be monitored at low tide, twice in wet season and twice in dry season, at least 3 years

Mudflat Level	Fixed gauge at seaward and landward side of the mangrove area	3	Measure top level of mudflat.	To be monitored at low tide, twice in wet season and twice in dry season, at least 3 years
Water Quality	Spot sample	3	Dissolved oxygen (DO), dissolved oxygen saturation (DO%), temperature, turbidity, salinity, pH and suspended solids (SS), should be measured.	To be monitored at low tide, twice in wet season and twice in dry season, at least 3 years

Rocky Eco-shoreline

6.3.2. Rocky eco-shoreline monitoring methodology at each survey location is described in **Table 6.2**. Rocky eco-shoreline Monitoring locations (3 numbers) are shown in **Diagram 6.1**

Table 6.2 – Rocky Eco-shoreline Monitoring Methodology

Parameter	Methodology	No. of Sample at each monitoring location	Details	Frequency
Avifauna	Point count	1	Single point count undertaken at each sampling point. Surveys undertaken for a period of 15min covering all visible areas (i.e., 360°) at a radius of 100m from the survey point. Record made of avifauna species richness and abundance in different habitats (i.e., mangrove, mudflat, open water, seawall, landscape promenade) as well as any notable behaviour (hunting, roosting, nesting).	To be monitored at low tide, twice in wet season and twice in dry season, at least 3 years
Epifauna	Transect	3	1m ² quadrat surveyed at three points (high, medium and low shore) along each transect. Species richness and abundance/frequency recorded. Diversity index and evenness index should be calculated.	To be monitored at low tide, twice in wet season and twice in dry season, at least 3 years
Water Quality	Spot sample	3	Dissolved oxygen (DO), dissolved oxygen saturation (DO%), temperature, turbidity, salinity, pH and suspended solids (SS), should be measured.	To be monitored at low tide, twice in wet season and twice in dry season, at least 3 years

Vertical Eco-shoreline

6.3.3. Vertical eco-shoreline monitoring methodology at each survey location is described in **Table 6.3**. Vertical eco-shoreline Monitoring locations (4 numbers) are shown in **Diagram 6.1**

Table 6.3 – Vertical Eco-shoreline Monitoring Methodology

Parameter	Methodology	No. of Sample at each monitoring location	Details	Frequency
Avifauna	Point count	1	Single point count undertaken at each sampling point. Surveys undertaken for a period of 15min covering all visible areas (i.e., 360°) at a radius of 100m from the survey point. Record made of avifauna species richness and abundance in different habitats (i.e., mangrove, mudflat, open water, seawall, landscape promenade) as well as any notable behaviour (hunting, roosting, nesting).	To be monitored at low tide, twice in wet season and twice in dry season, at least 3 years
Epifauna	Transect	3	1m ² quadrat surveyed at three points (high, medium and low shore) along each transect. Species richness and abundance/frequency recorded. Diversity index and evenness index should be calculated.	To be monitored at low tide, twice in wet season and twice in dry season, at least 3 years
Water Quality	Spot sample	3	Dissolved oxygen (DO), dissolved oxygen saturation (DO%), temperature, turbidity, salinity, pH and suspended solids (SS), should be measured.	To be monitored at low tide, twice in wet season and twice in dry season, at least 3 years

Ichthyoplankton and Juvenile Fish Monitoring

6.3.4. Ichthyoplankton and juvenile fish monitoring methodology at each survey location is described in **Table 6.4**. Ichthyoplankton and juvenile fish monitoring locations (3 numbers) are shown in **Diagram 6.1**

Table 6.4 – Ichthyoplankton and Juvenile Fish Monitoring Methodology

Parameter	Methodology	No. of Sample at each monitoring location	Details	Frequency
Ichthyoplankton	Plankton net	1	Sampling undertaken with one pair of bongo net with 0.5mm mesh size, towed at a speed of around 1 - 2 knots against the flow for 10 minutes. The mouth of one of the nets should be fitted with a flowmeter to record the volume of water filtered and allow calculation of ichthyoplankton density (i.e., number of fish per 100m ³ of water filtered). Samples to be sorted in the laboratory, with all fish larvae to be identified and counted, and diversity/ evenness should be calculated. A minimum of three replicates shall be performed for sampling ichthyoplankton each time at each sampling locations for collection of representative data. Should vessels be used for the sampling, the Fisheries Protection Ordinance (Cap. 171) shall be observed and relevant permits applied for as necessary.	To be monitored on a monthly basis covering May to August, at least 3 years
Juvenile Fish	Purse Seine	3	Sampling undertaken with mesh size of 6mm for purse seine and 12-16mm for cage traps: - Purse seine survey to be completed in around 20 minutes. - Five baited cage traps to be deployed overnight (i.e. 12-24 hours) at each sampling location The catches were identified to species level as far as practicable and the species composition, abundance, size and biomass in weight were measured, and diversity/ evenness should be calculated. Should vessels be used for the sampling, the Fisheries Protection Ordinance (Cap. 171) shall be observed and relevant permits applied for as necessary.	To be monitored on a monthly basis covering May to August, at least 3 years

Reference Site Monitoring

6.3.5. Reference monitoring should be undertaken using the same methodologies adopted for Mangrove Eco-shoreline (**Table 6.1**), Rocky Eco-shoreline Monitoring (**Table 6.2**),

Vertical Eco-shoreline (**Table 6.3**) and Ichthyoplankton and Juvenile Fish Monitoring (**Table 6.4**). Reference monitoring locations are shown in **Diagram 6.2**.

6.4. Monitoring Programme

6.4.1. Eco-shoreline is scheduled to be completed by 2023 Q2. Monitoring shall be conducted for at least 3 years after the completion of the eco-shoreline. The monitoring works will commence as follows:

- Vertical Eco-shoreline: August 2023 (tentative)
- Rocky Eco-shoreline: August 2023 (tentative)
- Mangrove Eco-shoreline: August 2023 (tentative)
- Ichthyoplankton and Juvenile Fish Monitoring: May 2024 (tentative)

Mangrove, Rocky and Vertical Eco-shoreline

6.4.2. Each year every point (including reference point) shall be monitored at low tide, twice in the wet season and twice in the dry season for at least 3 years. The need of extension of monitoring will be reviewed upon completion of monitoring and subject to the findings of monitoring surveys.

Ichthyoplankton and Juvenile Fish Monitoring

6.4.3. Each year every point (including reference point) shall be monitored during the spawning periods of marine fishes. The monitoring will be carried out on a monthly basis covering May to August for at least 3 years. The need of extension of monitoring will be reviewed upon completion of monitoring and subject to the findings of monitoring surveys.

6.5. Analysis and Reporting

6.5.1. The progress reports should be prepared in half-year basis for outlining monitoring activities undertaken during the reporting period, summarizing monitoring results (including any key findings), and summarizing works to be undertaken in the next monitoring period.

6.5.2. During the monitoring period, an annual report should be prepared that includes the following:

- Description of monitoring works undertaken in the Reporting period
- Presentation of the results of monitoring works
- Comparison of monitoring results with reference sites of rocky and vertical eco-shorelines
- Comparison of monitoring results with previous monitoring periods
- Analysis of monitoring data. For large data sets where samples are not independent (due to proximity of the monitoring sites), it is recommended multivariate analysis is adopted for data analysis. Non-metric Multidimensional Scaling can be used to identify trends in biological data across different sampling locations, and correlate these with environmental data.
- Presentation of Indicators of Success
- Identification of management and maintenance issues

- Identification of opportunities for further enhancement works
- 6.5.3. A final report should be produced at the end of the monitoring period detailing all of the monitoring results, conclusion and recommendation.
- 6.5.4. Monitoring findings during the monitoring period will be reported and presented in Monthly EM&A Reports. Progress reports, annual reports and final report will be submitted to AFCD and EPD with ET's certifications and IEC's verifications.

6.6. Indicators for Success

- 6.6.1. Indicators of success as described below should be assessed on a yearly basis for each of the monitoring locations shown in **Diagram 6.1**. This assessment should be included in the Annual Report.

Community Indicators for Success

- 6.6.2. Community indicators for success for the eco-shoreline include:
- For mangrove, rocky and vertical eco-shoreline, increasing avifauna and epifauna (all three eco-shoreline types) and infauna (mangrove eco-shoreline only) species richness and diversity over the first two years of monitoring.
 - For epi-faunal, ichthyoplankton and juvenile fish community data, it is expected that eco-shoreline data would be characterized by higher species richness and more diverse communities than reference sites. Non-metric Multidimensional Scaling (NMDS) multivariate analysis of these three data sets should be undertaken separately. It is expected that (after a minimum colonization period of 1-1.5 years) NMDS plots should demonstrate that community data from eco-shoreline sites are differentiated from reference sites, with the principal axes of the NMDS plot correlated with species richness and diversity, as well as species that are recorded only from the eco-shoreline sites.

Specific Indicators for Success

- 6.6.3. Specific indicators for success of each eco-shoreline typology have been developed based on monitoring data collected from the Siu Ho Wan (SHW) Trial Site, as well as established vertical eco-shoreline (with ecological enhancement elements including holes and ridges) along the northern shore of the Tung Chung East (TCE) Project Site. This data has been reviewed and potential indicators for success identified, as described below.
- 6.6.4. Epifaunal transect surveys of the SHW trial mangrove eco-shoreline, showed that the crustacean *Amphibalanus amphitrite* was recorded in 9 of 12 surveys in the 2nd year of establishment, with at least 1% coverage per m² recorded. Worm *Polychaeta* spp. and crustacean *Macrophthalmidae* spp. were recorded in over 3 of 6 surveys in each wet and dry seasons in the 2nd year of establishment. During the wet season, crustacean *Uca (Tubuca)* spp. was occasionally recorded in the 2nd year of establishment.
- 6.6.5. For the mangrove species in SHW Trial Site, the survivorship of *Avicennia marina* and *Kandelia obovata* were significantly better than the other mangrove plants (such as *Lumnitzera racemosa* and *Aegiceras corniculatum*), which the highest survival rate was 70% after the 1st year of establishment. Over 60 % of *Kandelia obovata* and

Avicennia marina were recorded with leaves after the 1st year of establishment. The average height of *Kandelia obovata* increased by 20% and more than 60% in the 1st and 2nd year of establishment respectively, while *Avicennia marina* increased by 36% and 40%. No data on flowering or fruiting of mangroves was recorded in the SHW Monitoring Report, but casual observations from the site indicate that some individuals of both *Avicennia marina* and *Kandelia obovata* bore flowers and fruits after the 2nd year of establishment. The presence of flowers and/or fruits on mangrove plants within the eco-shoreline could also therefore be an indicator that the community is moving towards becoming self-sustaining.

- 6.6.6. Epifaunal transect surveys of SHW trial rocky eco-shoreline and the TCE sloping seawall site recorded common species such as bivalves *Saccostrea cucullata*, crustacean *Amphibalanus Amphitrite*, gastropods *Monodonta labio* and *Reishia clavigera* at both sites since the 1st year of establishment. However, some other species were only recorded at the SHW trial rocky eco-shoreline such as crustacean *Metopograpsus* sp., gastropods *Littoraria articulata* and *Nipponacmea* sp. Crustacean *Metopograpsus* sp. was recorded intermittently in both wet and dry seasons. More records of *Metopograpsus* sp. with higher than 0.1 individual per m² were recorded in the 2nd year of establishment. In addition, gastropods *Littoraria articulata*, *Monodonta labio*, *Reishia clavigera* and *Nipponacmea* sp. were recorded in the SHW Trial Site most months since the 1st year of establishment. More records of higher densities of *Littoraria articulata*, *Monodonta labio* and *Reishia clavigera* (more than 0.5 individual per m²) were recorded in the 2nd year of establishment. The presence of the aforementioned epifauna species could indicate the success of a rocky eco-shoreline.
- 6.6.7. The TCE vertical eco-shoreline supported bivalves *Saccostrea cucullata*, gastropods *Littoraria articulata* and crustaceans *Metopograpsus* sp. and *Tetraclita squamosa*. The presence of these epifaunal species can indicate the success of vertical eco-shoreline.
- 6.6.8. Based on the data outlined above, reference specific indicators of success for vertical, rocky and mangrove eco-shorelines have been identified and summarized in **Table 6.5** below. As well as the target densities and occurrence indicated in **Table 6.5**, these indicators of success should also be compared with data from the reference sites. It is expected that these metrics would be higher at the eco-shoreline sites than the reference site after 2-3 years of establishment.

Table 6.5 Summary of Indicator of Success on Vertical, Rocky and Mangrove Eco-shorelines in Transect Surveys

Indicator of success	1 year		2 year		3 year	
	Dry Season	Wet Season	Dry Season	Wet Season	Dry Season	Wet Season
Vertical Eco-shoreline (epifaunal surveys)	Bivalves <i>Saccostrea cucullata</i> : =>1% coverage per m ² in at least one survey		Bivalves <i>Saccostrea cucullata</i> : =>2% coverage per m ²		Bivalves <i>Saccostrea cucullata</i> : =>5% coverage per m ²	
	Crustacean <i>Tetraclita squamosa</i> : =>1% coverage per m ² in at least one survey		Crustacean <i>Tetraclita squamosa</i> : =>2% coverage per m ²		Crustacean <i>Tetraclita squamosa</i> : =>5% coverage per m ²	
	Presence of Crustacean <i>Metopograpsus</i> sp.		Crustacean <i>Metopograpsus</i> sp.: =>1 individual per m ²		Crustacean <i>Metopograpsus</i> sp.: =>2 individuals per m ²	
	*Gastropod <i>Littoraria articulata</i> : =>1 individual per m ² in at least one survey		*Gastropod <i>Littoraria articulata</i> : =>2 individuals per m ²		*Gastropod <i>Littoraria articulata</i> : =>3 individuals per m ²	
Rocky Eco-shoreline (epifaunal surveys)	Gastropod <i>Monodonta labio</i> : =>1 individual per m ² in at least one survey		Gastropod <i>Monodonta labio</i> : =>1 individual per m ²		Gastropod <i>Monodonta labio</i> : =>2 individuals per m ²	
	*Gastropod <i>Littoraria articulata</i> : =>1 individual per m ² in at least one survey		*Gastropod <i>Littoraria articulata</i> : =>2 individuals per m ²		*Gastropod <i>Littoraria articulata</i> : =>3 individuals per m ²	
	*Gastropod <i>Nipponacmea</i> sp.: => 1 individual per m ² in over 10% quadrats surveyed		*Gastropod <i>Nipponacmea</i> sp.: =>1 individual per m ² in over 20% quadrats surveyed		*Gastropod <i>Nipponacmea</i> sp.: =>1 individual per m ² in over 40% quadrats surveyed	
	Gastropod <i>Reishia clavigera</i> : =>1 individual per m ² in at least one survey per season		Gastropod <i>Reishia clavigera</i> : =>1 individual per m ²		Gastropod <i>Reishia clavigera</i> : =>2 individuals per m ²	
	*Presence of Crustacean <i>Metopograpsus</i> sp.		*Crustacean <i>Metopograpsus</i> sp.: =>1 individual per m ² in over 20% quadrats surveyed		*Crustacean <i>Metopograpsus</i> sp.: => 1 individual per m ² in over 30% quadrats surveyed	

Indicator of success	1 year		2 year		3 year	
	Dry Season	Wet Season	Dry Season	Wet Season	Dry Season	Wet Season
Mangrove Eco-shoreline (epifaunal, infaunal and vegetation surveys)	Maintain 70% survival rate of mangrove species <i>Kandelia obovata</i> and <i>Avicennia marina</i> respectively		Maintain 70% survival rate of mangrove species <i>Kandelia obovata</i> and <i>Avicennia marina</i> respectively		Maintain 70% survival rate of mangrove species <i>Kandelia obovata</i> and <i>Avicennia marina</i> respectively	
	/		/		Presence of flowers/fruit on <i>Avicennia marina</i> and <i>Kandelia obovata</i>	
	Maintain 60% <i>Kandelia obovata</i> and <i>Avicennia marina</i> with leaves		Maintain 60% <i>Kandelia obovata</i> and <i>Avicennia marina</i> with leaves		Maintain 60% <i>Kandelia obovata</i> and <i>Avicennia marina</i> with leaves	
	The average height of <i>Kandelia obovata</i> and <i>Avicennia marina</i> increase by more than 15% after 1 year		The average height of <i>Kandelia obovata</i> and <i>Avicennia marina</i> increase by more than 20% after 2 years		The average height of <i>Kandelia obovata</i> and <i>Avicennia marina</i> increase by more than 25% after 3 years	
	/		/		Crustacean <i>Uca (Tubuca)</i> spp.: => 1 individual per m ² recorded in over 20% quadrats surveyed	
	Crustacean <i>Amphibalanus Amphitrite</i> : => 1% coverage per m ² in at least one survey		Crustacean <i>Amphibalanus Amphitrite</i> : => 2% coverage per m ²		Crustacean <i>Amphibalanus Amphitrite</i> : => 5% coverage per m ²	
	Presence of Crustacean <i>Macrophthalmidae</i> spp.		Crustacean <i>Macrophthalmidae</i> spp.: => 1 individual per m ² in epi-fauna/in-fauna survey		Crustacean <i>Macrophthalmidae</i> spp.: => 2 individuals per m ² in epi-fauna/in-fauna survey	
Worm <i>Polychaeta</i> spp.: => 1 individual per m ² recorded in in-fauna survey in at least one survey		Worm <i>Polychaeta</i> spp.: => 1 individual per m ² in in-fauna survey		Worm <i>Polychaeta</i> spp.: => 2 individuals per m ² recorded in in-fauna survey		

* Distinctive species identified from the Siu Ho Wan Site Trial, recorded at higher densities than from reference data collected from typical engineered shoreline.

**It should be noted that the species richness and density of the species indicators in the eco-shorelines might be similar to the reference site in the first 2-3 years of establishment. It is expected that the species richness and density in the eco-shoreline would be higher than the reference site after the establishment period of 2-3 years.

- 6.6.9. If the monitoring results of the eco-shoreline do not meet the indicators described in **Table 6.5**, the Monitoring Team (MT) should notify the CEDD, Environmental Team (ET), Independent Environmental Checker (IEC), Project Manager (PM) and Contractor. The MT should review the data as well as site conditions at the eco-shoreline survey site(s) to determine any potential reasons that the indicators of success have not been met. The MT should report the results of the investigation to CEDD, ET, IEC, PM and Contractor.

Appendix A

Implementation Programme for Eco-shoreline

Programme for Eco-shoreline

Locations of eco-shoreline	Start	Finish	2021			2022									2023													
			Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
Mangrove Eco-shoreline																												
ES1	Oct-22	Apr-23																										
ES3W	Dec-21	Apr-23																										
ES3E	May-22	Jun-23																										
Rocky Eco-shoreline																												
ES2W	Mar-22	Apr-23																										
ES2E	Sep-22	Apr-23																										
Vertical Eco-shoreline																												
VS1 & VS2	Apr-22	Dec-22																										
VS3 & VS4	Sep-22	Feb-23																										
VS6W	Apr-22	Aug-22																										
VS6E	Feb-22	Aug-22																										

Remarks:

Locations of eco-shoreline refer to Diagram 2.1

Appendix B

Environmental Mitigation Implementation Schedule – Eco-shoreline Implementation Plan

Environmental Mitigation Implementation Schedule – Eco-shoreline Implementation Plan

EIA Ref.	EM&A Log Ref.	Recommended Mitigation Measures	Objectives of the Recommended Measures & Main Concerns to address	Implementation Agent	Location	Implementation Stage	Implementation Plan Ref.
S9.8.4	EC14	Adopting Eco-shoreline design	To mitigate the impact of the marine loss	CEDD	Along future seawall	Construction phase	Section 2 and section 3
S9.11.2	EC26	Eco-shoreline and ichthyoplankton and juvenile fish monitoring	<ul style="list-style-type: none"> • Monitor the colonisation and establishment of fauna and/or flora, water quality, and recruitments of fisheries species • Analyze and report the monitoring works (monthly EM&A reports, progress reports, annual reports and final report) 	CEDD	Eco-shoreline at TCE reclamation	<ul style="list-style-type: none"> • For mangrove, rocky and vertical eco-shoreline, post-construction/operation phase, at low tide, twice in wet and dry seasons respectively, at least 3 years, and subject to review on monitoring extension • For ichthyoplankton and juvenile fish, post-construction/operation phase, during the spawning periods of marine fishes, on a monthly basis covering May to August, at least 3 years, and subject to review on monitoring extension 	Section 6
S10.9	F5	Follow the mitigation measure of eco-shoreline in ecology chapter for the construction and operation phases of the project.	To enhance the fisheries resources	CEDD	Eco-shorelines at TCE Reclamation	Construction phase and operation phase	Section 2, Section 3 and Section 6

Environmental Mitigation Implementation Schedule – Eco-shoreline Implementation Plan

S11.7 MM9	LV9	<p>Providing Natural Rock Material/ Planting for Artificial Seawall – There would be inevitable permanent losses of marine waters (seabed and water column), and direct impacts on existing artificial seawalls due to the reclamation. To minimize the impacts, the design of the future seawall like 'eco-shoreline' could be improved to provide high ecological functions and mitigate the impact of the loss. An 'eco-shoreline' is any shoreline which provides beneficial functions to the local ecosystem through a range of active or passive solutions, whilst providing coastal protection. By means of using natural rock materials for artificial seawall and considering to introduce a native vegetation buffer directly behind the top of seawalls as appropriate to create habitat, shelter and a source of food for benefiting both terrestrial and aquatic species along the foreshore, these measures can help to enhance the ecological functions and 'natural-look' of the shoreline, and the potential impacts will be mitigated.</p>	Mitigate the impacts on existing artificial seawalls	CEDD	Along future seawall	Construction Phase and Operation Phase	Section 2, Section 3 and Section 6
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