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10. FISHERIES IMPACT ASSESSMENT

10.1 Introduction

10.1.1.1 This section presents an assessment of the potential fisheries impacts associated with the construction and operation of the Project. The assessment was conducted in accordance with the criteria and guidelines set out in Annexes 9 and 17 of the Technical Memorandum on Environmental Impact Assessment (EIAO-TM) and the requirements set out in Clause 3.4.11 of the EIA Study Brief (No. ESB-360/2023).

10.2 Environmental Legislation, Standards, Guidelines and Criteria

10.2.1.1 Relevant regulations, legislation and guidelines for the assessment of fisheries impact include the following:

- Environmental Impact Assessment Ordinance (EIAO) (Cap. 499);
- Technical Memorandum on Environmental Impact Assessment Process (EIAO-TM) Annexes 9 and 17;
- Fisheries Protection Ordinance (Cap. 171) and its subsidiary legislation, the Fisheries Protection Regulations;
- Marine Fish Culture Ordinance (Cap. 353) and its subsidiary legislation; and
- Water Pollution Control Ordinance (WPCO) (Cap. 358) and its subsidiary regulations and statements.

10.2.1.2 Annex 17 of the EIAO-TM sets out the general approach and methodology for assessments of fisheries impacts, to allow a complete and objective identification, prediction and evaluation of the potential fisheries impacts. Annex 9 recommends the criteria that can be used for evaluating fisheries impacts.

10.2.1.3 Marine fish culture is protected and regulated by the Marine Fish Culture Ordinance (Cap. 353) which requires all marine fish culture activity to operate under licence in designated fish culture zones (FCZs).

10.2.1.4 WPCO (Cap. 358) aims to control water pollution in the waters of Hong Kong. According to the Ordinance and its subsidiary legislation, Hong Kong waters are divided into ten water control zones (WCZs). WCZs are designated with individual water quality objectives (WQOs) to promote the conservation and best use of those waters in the public interest. Corresponding statements of WQOs are stipulated for different water regimes (marine waters, inland waters, bathing beaches subzones, secondary contact recreation subzones and fish culture subzones) in each of the WCZs.

10.3 Assessment Methodology

10.3.1 Assessment Area

10.3.1.1 The assessment area for fisheries impact assessment follows that for water quality impact assessment, which includes the areas within 500 m from the Project boundary, the Junk Bay WCZ, Eastern Buffer WCZ and other potentially affected areas including part of Victoria Harbour WCZ, Port Shelter WCZ, Mirs Bay WCZ and Southern WCZ (see **Figure 10.1**). This assessment area shall be extended to include other areas if they are also found to be impacted by the construction or operation of the Project during the course of the EIA study.

10.3.2 Literature Review

10.3.2.1 A literature review was conducted to establish the fisheries baseline conditions (characterise the existing conditions within the assessment area, collect fisheries data, and identify fisheries practices, sites and species of potential fisheries importance) which may be affected by the Project. The literature review covered published literature, data, reports,

academic studies, consultancy studies, and previous EIA reports, including but not limited to the following:

- Latest annual report and website from Agriculture, Fisheries and Conservation Department (AFCD);
- Port Survey 2021 (AFCD, 2022);
- Report on Survey of Fisheries Resources in Hong Kong (2010-2015) (SCSFRI, 2017);
- Fisheries Resources and Fishing Operations in Hong Kong Waters (ERM, 1998);
- Provision of Consultancy Services for Updated Fisheries Survey for Tseung Kwan O (TKO) Desalination Plant – Final Report (WSD, 2017);
- Desalination Plant at Tseung Kwan O – Feasibility Study – EIA report (WSD, 2015);
- Cross Bay Link, Tseung Kwan O – Investigation – EIA report (CEDD, 2013a); and
- Tseung Kwan O – Lam Tin Tunnel (TKO-LTT) and Associated Works – Investigation – EIA report (CEDD, 2013b).

10.3.3 Fisheries Survey

10.3.3.1 Based on literature review, there is limited up-to-date information on the fisheries resources within and in the surrounding of Junk Bay. As such, fisheries surveys were conducted to fill the information gap on fisheries baseline information within the assessment area for the prediction and evaluation of fisheries impacts. Methodology of the fisheries survey is discussed in the following paragraphs.

10.3.3.2 Adult fish survey was conducted during daytime at nine locations (FS1 to FS9) and vessel survey was conducted at daytime at six locations (VS1 to VS6) (**Figure 10.2**). The programme of the fisheries survey is shown in **Table 10.1**. The adult fish surveys were carried out at daytime between February and March 2023 during the dry season, and between June and September 2023 during the wet season. Vessel surveys were carried out at daytime from 12pm to 6pm, between February 2023 to January 2024, covering the dry season, wet season, and transitional period.

Table 10.1 Survey Programme of the Fisheries Survey

Type of Survey	Frequency	Season	Survey Date
Adult Fish Survey	Three times during dry season – February to March 2023	Dry	14-15 Feb 2023
			27 Feb 2023
			15 Mar 2023
	Four times during wet season – June to September 2023	Wet	12 Jun 2023
			21 Jul 2023
			11 Aug 2023
			7 Sep 2023
Vessel Survey	Monthly from February 2023 to January 2024	Dry	27 Feb 2023
			15 Mar 2023
		Transitional Period	26 Apr 2023
			29 May 2023
		Wet	12 Jun 2023
			21 Jul 2023
			11 Aug 2023
			7 Sep 2023
		Transitional Period	27 Oct 2023
			20 Nov 2023
		Dry	27 Dec 2023
			8 Jan 2024

Adult Fish Survey

10.3.3.3 Two fishing methods, gill netting and cage trapping, were used to sample pelagic and demersal fisheries resources at each sampling location. Both methods are commonly used by local fishermen in Hong Kong.

10.3.3.4 For gill netting, six stationary bottom trammel gillnets were deployed at each location for three hours. Each net was 1.5 m in stretch depth, 30 m in length and comprised of three layers, with two 20 cm stretch mesh size sandwiching a 5 cm stretch mesh size. This sampling gear was selected for its ability to capture pelagic fish resources in a wide range of sizes and is commonly used in previous fisheries and EIA studies.

10.3.3.5 For cage trapping, two chains of cage traps were deployed to the sea bottom at each location for three hours, in which one chain comprised 20 rabbitfish cages (50-60 cm in diameter and 30- 40 cm in height, with a mesh size of 25 mm; each cage about 10 m apart); and one chain comprised 20 crab cages (60 cm in diameter and 28 cm in height, with a mesh size of 20 mm; each cage about 10 m apart). Bread or other suitable fish bait were used as bait for cage trapping. This sampling gear was selected for its ability to capture demersal fish and crustacean resources in a non-selective manner and is commonly used in previous fisheries and EIA studies.

10.3.3.6 All catches (fish, crustaceans and cephalopods, etc.) from the adult fish survey were washed by seawater, and recorded immediately, identified to species level as far as practicable. The specimens were analysed for species composition and diversity, abundance, size (total length, standard length and/or fork length as appropriate), biomass in weight, yield per unit effort (YPUE), catch per unit effort (CPUE) and estimated commercial value of fisheries species where applicable. Diversity of the fisheries resources was presented as species richness, Shannon-Weiner diversity (H'), and Pielou's evenness (J').

10.3.3.7 The following equations are used to calculate CPUE and YPUE:

$$\text{CPUE} = \frac{\text{No. of individuals}}{\text{Fishing time (hour)}}, \text{ where fishing time = 3 hours;}$$

$$\text{YPUE} = \frac{\text{Weight of fisheries resources (kg)}}{\text{Fishing time (hour)}}, \text{ where fishing time = 3 hours.}$$

10.3.3.8 Descriptive statistics for the measured parameters described above, including sum, mean value, and standard deviation, were analysed for the survey locations over the dry and wet seasons as appropriate. Other relevant data and information, including sampling time, weather conditions, sea conditions, tidal stage, as well as any special phenomena and activities around the survey locations that might have influenced the survey results were also recorded.

Vessel Survey for Fishing Activity

10.3.3.9 Vessel surveys were conducted to assess the level of fishing operations in the assessment area. All surveys were carried out between 12pm and 6pm. Visual observation of fishing operations was conducted over the marine waters within the visible range from the vessel survey location. Binoculars were used to aid the observation and increase the visual range as far as possible. Apart from the six vessel survey locations, cruising in the surrounding of the survey locations were also conducted to ensure all fishing operations within the concerned marine water were observed.

10.3.3.10 The detailed fishing operation information on both recreational and commercial fishing activities, including the types and operating locations of the fishing vessels, were collected as far as possible. Fishing operation method was also recorded where possible. The

location was recorded based upon GPS coordinates and position relative to the shoreline and marked on a map of the survey area.

10.4 Baseline Conditions

10.4.1 Literature Review

Physical Environment

10.4.1.1 The assessment area for the fisheries impact assessment covers the Junk Bay WCZ, Eastern Buffer WCZ and other potentially affected area including part of the Victoria Harbour WCZ, Port Shelter WCZ, Mirs Bay WCZ and Southern WCZ, which is the same as the study area for the water quality impact assessment. The Project sites are located in the Junk Bay WCZ and Eastern Buffer WCZ, within the eastern waters of Hong Kong. The water quality of both WCZs has improved noticeably with significant increase in dissolved oxygen (DO) level and decrease in nutrient and bacteria levels after the implementation of the Harbour Area Treatment Scheme (HATS) Stage 1 in 2001.

Fishing Operation

10.4.1.2 Trawl ban has been implemented in Hong Kong waters since 31 December 2012. After the trawl ban, fishing activities in Hong Kong waters are mainly conducted by sampans using multiple fishing gears and other smaller non-trawling fishing vessels (such as gill netters, long liners, purse seiners, etc.). Trawlers and other larger non-trawling vessels generally operate in the adjacent waters of South China Sea. AFCD Port Survey provides the most comprehensive information on capture fisheries in Hong Kong waters, including fishing operations and fisheries production. Based on the findings from the latest Port Survey in 2021, a moderate number of fishing vessels (>100-400 vessels per grid) operated in the waters around the project site. Elsewhere within the assessment area, a low level of fishing operation (>50-100 vessels per grid) was reported in Victoria Harbour, while a moderate to high level (>400-600 vessels) was reported in the waters around the Ninepin Group at the eastern edge of the assessment area (**Figure 10.3.1**). Among all the grids with varying levels of fishing operation in the assessment area, sampan was the dominant fishing vessel type (**Figures 10.3.2** and **10.3.3**; AFCD, 2022).

Fisheries Production and Fisheries Resources

10.4.1.3 The capture fisheries industry makes an important contribution to Hong Kong in maintaining a steady supply of fresh marine fish to local consumers. In 2023, it produced an estimated 87,000 tonnes of fisheries production valued at about $2.4 billion (AFCD, 2024a). From the results of AFCD's latest Port Survey, a low to moderate level of fisheries production (>50-200 kg/ha per grid) was recorded in the waters around the project site. Elsewhere within the assessment area, very low fisheries production (>0-50 kg/ha per grid) was reported in some parts of Victoria Harbour, while a moderate level of fisheries production (>200-300 kg/ha per grid) was reported in the waters around Ninepin Group at the eastern edge of the assessment area (**Figure 10.4**). Fish fry collection was found negligible in the Port Survey 2021 (AFCD, 2022).

10.4.1.4 A fisheries resources survey was conducted by AFCD to assess the effectiveness of the implementation of the trawl ban and other relevant fisheries management measures on the recovery of fisheries resources in Hong Kong waters. Two types of surveys including shrimp trawl surveys and stern trawl surveys were conducted in the south-eastern waters of Hong Kong, of which the assessment area falls in. Main commercial families of fisheries resources recorded from the shrimp trawl surveys include Leiognathidae, Platycephalidae, Sparidae, Portunidae, Sciaenidae, Polynemidae, Cynoglossidae, Penaeidae, Terapontidae and Synodontidae, while the main commercial catches from stern trawl surveys include Leiognathidae, Sparidae, Carangidae, Clupeidae, Engraulidae, Sciaenidae, Trichiuridae, Stromateidae, Nemipteridae and Synodontidae (SCSFRI, 2017).

10.4.1.5 Fisheries surveys were carried out pursuant to Condition 2.9 of the Environmental Permit No. EP-503/2015 of the TKO Desalination Plant at TKO 137 area. Adult fish surveys were undertaken between December 2015 and August 2016, covering the vicinity of the proposed submarine utilities around TKO 137 area and the outer Joss House Bay between the waters of Tung Lung Chau and Fat Tong Mun. The adult fish survey recorded a total 26,995 g of 723 individuals comprising 56 species from 33 families. Dominant species in terms of biomass and abundance were *Takifugu alboplumbeus* and *Evynnis cardinalis*, which were of low and moderate to high commercial value, respectively. The majority of adult fish species captured in the study area were of low commercial value, with some species of medium to high commercial values. It was therefore considered that the overall commercial value of adult fish resources in the Study Area was low and low to moderate (WSD, 2017).

10.4.1.6 Fish surveys were conducted as part of the ecological survey within the EIA studies of Cross Bay Link and TKO-LTT. For the Cross Bay Link project, direct field observation, active searching, fish cage-trapping and gill netting were carried out during the wet season of 2009 along the coastline of eastern Junk Bay. A low diversity of fauna was recorded in the fish surveys, including 11 species of fish, four species of crustacean and one species of other invertebrates. All were common species in Hong Kong. The most frequently recorded species was *Siganus canaliculatus* (CEDD, 2013a).

10.4.1.7 For the TKO-LTT project, direct field observation, active searching, net casting and cage-trapping were conducted depending on the substratum and water depth of the sampling sites, which covered intertidal, shallow estuarine, estuarine subtidal, and marine subtidal habitats along the western coastline of Junk Bay. A total of 12 fish species were recorded in the surveys between June and December 2009. Most of these species were found in coastal marine subtidal and intertidal areas. *Siganus canaliculatus* was the most dominant fish species observed in the coastal marine subtidal habitat, while *Bathygobius fuscus* was commonly recorded from intertidal rock pools. All recorded fish species are locally common and widespread in Hong Kong (CEDD, 2013b). However, the commercial values of the captured species were not specified in these two EIA studies (CEDD, 2013a; CEDD, 2013b).

Spawning and Nursery Grounds of Commercial Fisheries Resources

10.4.1.8 The consultancy paper “Fisheries Resources and Fishing Operations in Hong Kong Waters” identified important spawning and nursery grounds of fisheries resources in Hong Kong waters. The eastern waters (including Port Shelter) are identified as important spawning ground of commercial fisheries resources, including *Apogon quadrifasciatus*, *Parapristipoma trilineatum*, *Sebastiscus marmoratus*, *Trichiurus haumela*, *Upeneus sulphureus* and *Upeneus tragula*. Port Shelter is also identified as an important nursery area of commercial fisheries resources, including *Chrysophrys major*, *Rhabdosargus sarba*, *Sparus* spp., *Metapenaeopsis palmensis*, *Parapristipoma trilineatum*, *Epinephelus* fry and *Seriola purpurescens* (ERM, 1998). The recognised spawning grounds in the eastern water of Hong Kong is located at least 2.5 km east of the project site, respectively. The nursery area at Port Shelter is situated over 7.8 km northeast from the project site, on the other side of the Clear Water Bay Peninsula (**Figure 10.1**).

10.4.1.9 Besides adult fish surveys, juvenile fish and ichthyoplankton surveys were also conducted between December 2015 and August 2016 as one of the conditions of the Environmental Permit of the TKO Desalination Plant at TKO 137 area. In the juvenile fish survey, a total 519 g of 1,523 individuals comprising eight species from six families were recorded, with Engraulidae sp. being the dominant species in terms of biomass and abundance. For the ichthyoplankton survey, a total of 91 species from 42 families (including fish eggs and fish larvae) were recorded. The dominant species of fish egg and fish larvae were *Gerres oyena* and *Chromis notata*, respectively. Overall, the surveys indicated that the abundance and diversity of fish eggs and larvae were on the low side (with dominant species of low to no commercial value), and the abundance and diversity of juvenile fisheries resources

were very low within the study area. It was concluded that the study area, which covered the vicinity of the proposed submarine utilities around TKO 137 area and the outer Joss House Bay between the waters of Tung Lung Chau and Fat Tong Mun, did not appear to be an important spawning or nursery grounds for commercial fisheries, since there was a very weak relationship in recorded families between ichthyoplankton assemblages, adult fish and juvenile fish in the study area (WSD, 2017).

Artificial Reefs

10.4.1.10 An Artificial Reef (AR) project has been implemented in Hong Kong waters by AFCD since 1996 to enhance fisheries resource, restore destructed habitats, protect important nursery and spawning grounds and marine protected areas, and to improve the habitat quality of homogenous seabed. ARs are widely recognised for the ability to encourage growth and development of a great number and variety of marine organisms, which in turn provide food, shelter, and protection for fishes. The deployed ARs in Hong Kong waters are therefore regarded as fisheries sensitive resources. More than 600 units of ARs with a total volume about 180,000 m^3 have been deployed at various locations in Hong Kong waters, such as marine parks, important fish spawning and nursery grounds, and FCZs (AFCD, 2023).

10.4.1.11 The nearest AR deployment site is located at Outer Port Shelter, with the objective of preventing trawling and enhancing habitat quality and marine resources. Four types of ARs, consisting of boat with tyre, redundant pier, fender, and precast concrete module, with a total volume of 103,270 m^3 were deployed between 2001 and 2009. These ARs are located at least 5 km east from the project site (**Figure 10.1**).

Culture Fisheries

10.4.1.12 Marine fish culture involves rearing of marine fish from fry or fingerlings to marketable size in cages suspended by floating rafts, usually in sheltered coastal areas. The species cultured changed gradually over the recent years depending on the availability of imported fry, mainly from the Mainland, Taiwan, Thailand, Philippines, or Indonesia. Common species under culture include green grouper, brown-spotted grouper, giant grouper, Russell's snapper, mangrove snapper, gold lined seabream, and star snapper (AFCD, 2024b). Marine fish culture is protected and regulated by the Marine Fish Culture Ordinance (Cap. 353) which requires all marine fish culture activity to operate under licence in designated FCZs.

10.4.1.13 Currently, there are 28 FCZs occupying a total sea area of 650 ha with some 910 licensed operators. Majority of the licensed farms are small, family-based and consisting of one to two rafts with average total area of around 304 m^2. The estimated production in 2023 was about 499 tonnes valued at HK$54 million which catered approximately 2% of local demand for live marine fish (AFCD, 2024b). Within the assessment area, two FCZs were identified, namely Tung Lung Chau FCZ and Po Toi O FCZ, which are located more than 1.2 km southeast, and at least 6.1 km east from the project site, respectively (**Figure 10.1**).

10.4.2 Results from Adult Fish Survey

Overview

10.4.2.1 The adult fish surveys using gill netting and cage trapping were conducted at nine survey locations in the Junk Bay area during the dry season (February to March) and wet season (June to September) of 2023. A total of 1,682 individuals weighing 136.43 kg from 137 species of 55 families were collected during the survey period. Among all, 1,034 individuals of fishes weighing 102.86 kg from 97 species of 38 families, 616 individuals of crustaceans weighing 27.66 kg from 32 species of 12 families, and 32 individuals of other invertebrate species (including cuttlefish, squid, scallop and starfish) weighing 5.91 kg from eight

species of five families were recorded from the surveys. A full list of species recorded during the surveys is presented in **Appendix 10.1**.

10.4.2.2 The adult fish survey data (including fish and other fisheries species) in terms of total abundance, biomass and number of species are summarised in **Table 10.2**. The highest total biomass of fisheries resources was recorded in FS3, as contributed by a high biomass of *Mugil cephalus* with 132 individuals weighing 48.16 kg. The highest total abundance of fisheries resources was recorded in FS4, as contributed by a high abundance of the crabs *Charybdis (Charybdis) hellerii* and *Thalamita sima*, and the fishes *Neopomacentrus bankieri*, and *Siganus fuscescens*, with 91, 59, 62 and 48 individuals caught, respectively. FS2 recorded the highest total species richness. Conversely, the lowest total abundance and species richness were found in FS6, while FS7 had the lowest total biomass of fisheries resources.

Table 10.2 Total Abundance, Biomass and Number of Species Recorded from the Adult Fish Survey

Survey Location	Total Abundance (No. of Individuals)	Total Biomass (kg)	Total No. of Species
FS1	229	18.23	46
FS2	184	10.49	50
FS3	275	55.20	38
FS4	369	15.35	49
FS5	113	6.85	39
FS6	103	12.52	30
FS7	110	4.80	37
FS8	126	5.25	40
FS9	173	7.73	43
Overall	**1,682**	**136.43**	**137**

Commercial Value

10.4.2.3 The commercial value of fisheries resources was estimated by making reference to the data published on the Fish Marketing Organisation (FMO) website (FMO, 2024a), recent approved EIA reports and publication (e.g. Lai, 2023), FishBase, and prices of similar species. According to the annual report of FMO, the average price for fresh fish landed during 2022-2023 was 74-108 HK$/kg (FMO, 2024b). Therefore, species were grouped into high value (>108 HK$/kg), medium value (74-108 HK$/kg), and low value (<74 HK$/kg). The estimated commercial values of fisheries species recorded in the survey are presented in **Appendix 10.2**.

10.4.2.4 Among the 97 fish species recorded in the survey, 14 species are regarded as high value, one species is considered as medium to high value, 14 species are categorised as medium value, while the remaining 68 out of 97 species are considered as low-valued or non-commercially targeted species. Out of the 40 invertebrate species recorded in the survey, only 16 of them are considered commercially targeted, with nine out of 16 species considered of high value. Overall, although the recorded fisheries species consisted of catches with various commercial values, the catches were mainly comprised of low-valued and non-commercially targeted fisheries species which accounted for 78.5% of total abundance and 85.2% of total biomass.

Species Composition

10.4.2.5 The top dominant species of the Junk Bay area consisted of non-commercially targeted and low-valued fishes and crustaceans (e.g. *Mugil cephalus* and *Charybdis (Charybdis)*

hellerii) and some fishes and crustaceans of medium to high commercial value (e.g. *Epinephelus bruneus* and *Charybdis (Charybdis) feriata*). The top 10 dominant species recorded in the adult fish surveys, in terms of abundance and biomass, are summarised in **Table 10.3**. The full list of abundance and biomass of the recorded species are presented in **Appendix 10.1**.

10.4.2.6 The most dominant species ranked by abundance was the crab species *Charybdis (Charybdis) helleri*, which also ranked second in terms of biomass. This non-commercially targeted species contributed about 14.3% to the total abundance and 6.9% to the total biomass.

10.4.2.7 The most dominant species ranked by biomass was the fish species *Mugil cephalus*, which also ranked second in terms of abundance. This species, which is of low commercial value and only caught in the dry season survey, comprised nearly half (49.5%) of the total biomass and 10.6% of the total abundance.

10.4.2.8 Although species of medium to high commercial value were also recorded from the surveys, it is noted that the abundance and biomass of these species was generally low when compared to the total catches of the survey, accounting for about 21.5% of the total abundance and about 14.8% of the total biomass.

Table 10.3 Top Ten Dominant Species Recorded from the Adult Fish Survey

Group	Family	Species	Commer-cial Value	Abundance (No. of Individuals)	% of Total Abundance (Rank)	Biomass (kg)	% of Total Biomass (Rank)
Crustacean	Portunidae	*Charybdis (Charybdis) hellerii*	Nil	241	14.3% (1)	9.39	6.9% (2)
Fish	Mugilidae	*Mugil cephalus*	Low	178	10.6% (2)	67.55	49.5% (1)
Crustacean	Portunidae	*Thalamita sima*	Nil	108	6.4% (3)	3.52	2.6% (4)
Fish	Siganidae	*Siganus fuscescens*	Medium	91	5.4% (4)	2.96	2.2% (5)
Fish	Leiognathidae	*Leiognathus brevirostris*	Medium	85	5.1% (5)	1.88	1.4% (9)
Fish	Pomacentridae	*Neopomacentrus bankieri*	Nil	62	3.7% (6)	0.41	0.3% (-)
Crustacean	Portunidae	*Podophthalmus vigil*	Nil	54	3.2% (7)	4.14	3.0% (3)
Fish	Leiognathidae	*Leiognathus berbis*	Low	53	3.2% (8)	0.94	0.7% (-)
Fish	Nemipteridae	*Nemipterus japonicus*	Low	41	2.4% (9)	1.77	1.3% (-)
Crustacean	Portunidae	*Charybdis (Charybdis) anisodon*	Nil	39	2.3% (10)	1.15	0.8% (-)
Fish	Apogonidae	*Ostorhinchus fasciatus*	Low	39	2.3% (10)	0.42	0.3% (-)
Cephalopod	Sepiidae	*Sepia recurvirostra*	Low	13	0.8% (-)	2.72	2.0% (6)
Crustacean	Portunidae	*Charybdis (Charybdis) feriata*	High	8	0.5% (-)	2.15	1.6% (7)
Fish	Dorosomatidae	*Nematalosa japonica*	Low	24	1.4% (-)	1.97	1.4% (8)
Fish	Serranidae	*Epinephelus bruneus*	High	13	0.8% (-)	1.81	1.3% (10)

Spatial and Seasonal Variation

10.4.2.9 Throughout the whole survey, FS4 had the highest mean abundance and CPUE, while FS3 had the highest mean biomass and YPUE. The lowest mean abundance and CPUE was recorded in FS6, whereas FS7 had the lowest mean biomass and YPUE. The mean species richness was the highest in FS1, and lowest in FS6. For mean species diversity and species evenness, FS2 and FS5 recorded the highest values, respectively; whereas

FS7 and FS3 had the lowest values, respectively. Overall, the mean species diversity across the nine survey locations were considered to be low to moderate, with some unevenness observed in species distribution (**Table 10.4**).

10.4.2.10 **Table 10.5** presents the summary of fisheries resources at each location during the dry and wet seasons, respectively. Generally, the mean biomass of fisheries resources was higher in the dry season compared to the wet season (except at FS4, FS7, and FS8), primarily due to the higher biomass of fishes collected in the dry season (about 81.5 kg of fishes caught in the dry season compared to 21.4 kg of fishes in the wet season). On the contrary, the mean abundance was generally higher in the wet season than the dry season (except at FS3 and FS9), largely attributed to the difference in crustacean abundance between the two seasons, with the number of crustaceans caught in the wet season being at least five times more than that in the dry season (91 and 525 individuals caught in the dry and wet seasons, respectively). *Mugil cephalus*, a low-valued species, was the most dominant fish species in the dry season, while *Siganus fuscescens*, a medium-valued species, was the most dominant fish species in the wet season. For crustacean species, crab species *Podophthalmus vigil* was the most dominant in the dry season, while crab species *Charybdis (Charybdis) hellerii* was the most dominant in the wet season; both species are categorised as non-commercially targeted. Commercially important fish and crustacean species of medium to high values were more abundant in the wet season compared to the dry season. The mean species richness and diversity was generally higher in the wet season than the dry season, while there was no consistent seasonal pattern observed in the species evenness.

Table 10.4 Summary of Fisheries Resources at each Survey Location

Survey Location	Mean Abundance (No. of Individuals) (±S.D.)	Mean Biomass (kg) (±S.D.)	Mean CPUE (No. of Individuals/ hour) (±S.D.)	Mean YPUE (kg/hour) (±S.D.)	Mean Species Richness (S) (±S.D.)	Mean Species Diversity (H') (±S.D.)	Mean Species Evenness (J') (±S.D.)
FS1	32.71 ± 15.70	2.60 ± 4.14	10.90 ± 5.23	0.87 ± 1.38	12.43 ± 3.51	2.03 ± 0.22	0.83 ± 0.10
FS2	26.29 ± 8.64	1.50 ± 0.99	8.76 ± 2.88	0.50 ± 0.33	12.14 ± 5.43	2.08 ± 0.67	0.85 ± 0.13
FS3	39.29 ± 47.74	7.89 ± 18.44	13.10 ± 15.91	2.63 ± 6.15	9.43 ± 4.35	1.59 ± 0.74	0.76 ± 0.25
FS4	52.71 ± 41.74	2.19 ± 1.29	17.57 ± 13.91	0.73 ± 0.43	11.43 ± 1.90	1.91 ± 0.36	0.79 ± 0.15
FS5	16.14 ± 7.65	0.98 ± 0.35	5.38 ± 2.55	0.33 ± 0.12	8.86 ± 2.61	1.98 ± 0.23	0.93 ± 0.03
FS6	14.71 ± 7.27	1.79 ± 2.98	4.90 ± 2.42	0.60 ± 0.99	7.86 ± 3.80	1.77 ± 0.56	0.90 ± 0.13
FS7	15.71 ± 15.72	0.69 ± 0.76	5.24 ± 5.24	0.23 ± 0.25	8.00 ± 7.02	1.44 ± 0.93	0.86 ± 0.06
FS8	18.00 ± 12.19	0.75 ± 0.38	6.00 ± 4.06	0.25 ± 0.13	10.00 ± 5.32	1.92 ± 0.64	0.91 ± 0.07
FS9	24.71 ± 17.40	1.10 ± 0.54	8.24 ± 5.80	0.37 ± 0.18	10.86 ± 2.48	2.05 ± 0.33	0.87 ± 0.12
Overall	**26.70 ± 25.47**	**2.17 ± 6.35**	**8.90 ± 8.49**	**0.72 ± 2.12**	**10.11 ± 4.36**	**1.86 ± 0.57**	**0.85 ± 0.13**

Note: Mean values expressed as per survey.

Table 10.5 Summary of Fisheries Resources at each Survey Location <u>in each Season</u>

Survey Location	Season	Mean Abundance (No. of Individuals) (±S.D.)	Mean Biomass (kg) (±S.D.)	Mean CPUE (No. of Individuals/ hour) (±S.D.)	Mean YPUE (kg/hour) (±S.D.)	Mean Species Richness (S) (±S.D.)	Mean Species Diversity (H') (±S.D.)	Mean Species Evenness (J') (±S.D.)
FS1	Dry	25.33 ± 22.90	4.26 ± 6.65	8.44 ± 7.63	1.42 ± 2.22	11.00 ± 5.00	2.00 ± 0.26	0.88 ± 0.15
	Wet	38.25 ± 6.95	1.37 ± 0.35	12.75 ± 2.32	0.46 ± 0.12	13.50 ± 2.08	2.05 ± 0.22	0.79 ± 0.06
FS2	Dry	21.33 ± 6.43	2.15 ± 1.25	7.11 ± 2.14	0.72 ± 0.42	13.00 ± 3.61	2.38 ± 0.25	0.94 ± 0.04
	Wet	30.00 ± 8.87	1.01 ± 0.41	10.00 ± 2.96	0.34 ± 0.14	11.50 ± 7.00	1.85 ± 0.83	0.79 ± 0.13
FS3	Dry	53.33 ± 79.43	16.86 ± 28.44	17.78 ± 26.48	5.62 ± 9.48	6.00 ± 3.61	0.95 ± 0.46	0.65 ± 0.38
	Wet	28.75 ± 2.63	1.15 ± 0.12	9.58 ± 0.88	0.38 ± 0.04	12.00 ± 2.94	2.07 ± 0.47	0.83 ± 0.11
FS4	Dry	16.33 ± 2.25	1.08 ± 0.60	5.44 ± 0.84	0.36 ± 0.20	11.00 ± 2.65	2.24 ± 0.28	0.94 ± 0.03

	Wet	80.00 ± 34.13	3.03 ± 0.96	26.67 ± 11.38	1.01 ± 0.32	11.75 ± 1.50	1.66 ± 0.11	0.68 ± 0.06
FS5	Dry	13.67 ± 5.69	1.25 ± 0.13	4.56 ± 1.90	0.42 ± 0.04	9.33 ± 3.21	1.99 ± 0.22	0.91 ± 0.03
	Wet	18.00 ± 9.20	0.77 ± 0.32	6.00 ± 3.07	0.26 ± 0.11	8.50 ± 2.52	1.96 ± 0.27	0.94 ± 0.03
FS6	Dry	12.67 ± 11.24	3.17 ± 4.63	4.22 ± 3.75	1.06 ± 1.54	5.67 ± 2.52	1.45 ± 0.50	0.89 ± 0.18
	Wet	16.25 ± 3.77	0.76 ± 0.34	5.42 ± 1.26	0.25 ± 0.11	9.50 ± 4.04	2.00 ± 0.52	0.91 ± 0.11
FS7	Dry	3.67 ± 2.52	0.54 ± 0.79	1.22 ± 0.84	0.18 ± 0.26	2.33 ± 1.53	0.63 ± 0.67	0.89 ± 0.10
	Wet	24.75 ± 15.37	0.79 ± 0.83	8.25 ± 5.12	0.26 ± 0.28	12.25 ± 6.40	2.05 ± 0.53	0.85 ± 0.05
FS8	Dry	12.00 ± 13.23	0.68 ± 0.33	4.00 ± 4.41	0.23 ± 0.11	6.00 ± 4.00	1.43 ± 0.64	0.92 ± 0.11
	Wet	22.50 ± 10.85	0.80 ± 0.46	7.50 ± 3.62	0.27 ± 0.15	13.00 ± 4.24	2.29 ± 0.35	0.91 ± 0.05
FS9	Dry	29.33 ± 27.65	1.14 ± 0.87	9.78 ± 9.22	0.38 ± 0.29	10.67 ± 2.89	1.98 ± 0.17	0.85 ± 0.15
	Wet	21.25 ± 7.68	1.08 ± 0.25	7.08 ± 2.56	0.36 ± 0.08	11.00 ± 2.58	2.10 ± 0.44	0.88 ± 0.11
Overall	**Dry**	**20.85 ± 28.39**	**3.46 ± 9.60**	**6.95 ± 9.46**	**1.15 ± 3.20**	**8.33 ± 4.35**	**1.67 ± 0.67**	**0.87 ± 0.16**
	Wet	**31.08 ± 22.45**	**1.20 ± 0.82**	**10.36 ± 7.48**	**0.40 ± 0.27**	**11.44 ± 3.92**	**2.00 ± 0.44**	**0.84 ± 0.11**

Note: Mean values expressed as per survey.

10.4.3 Results from Vessel Survey

10.4.3.1 Between February 2023 and January 2024, a total of 95 vessels engaging in fishing activities were recorded, with almost all of them being sampans (92 out of 95 vessels). The locations of fishing vessels sighted in the surveys are presented in **Figure 10.5**, and detailed information on the recorded vessels is provided in **Appendix 10.3**. Fishing activities were recorded across the survey locations. The level of fishing activities recorded during the survey was considered to be low. There was an average of about eight vessels encountered per monthly survey. **Table 10.6** summarises the fishing activities observed during the vessel surveys. There were more fishing activities recorded in the dry season (43 vessels) compared to the transitional period one (12 vessels), wet season (19 vessels), and transitional period two (21 vessels).

10.4.3.2 Gill netting, long lining, hand lining and cage trapping are typical fishing methods adopted by local fishermen and were categorised as commercial fishing activities, while recreational fishing activities generally involve fishing by hand lining attached to a fishing rod. During observation, recreational hand lining and commercial hand lining were differentiated usually by the appearance of the fisher (sporty outfits or working outfits) and vessels used (outboard open sampans or fishing sampans). Among the recorded vessels with fishing activities, about half (52%) of the activities were categorised as commercial fishing (49 out of 95 vessels), while the other half (48%) were recreational fishing (46 out of 95 vessels). Most of the commercial fishing activities recorded were hand lining (32 out of 49 vessels). Commercial fishing activities were active during all seasons with the highest number of vessels recorded in the wet season (17 out of 49), while recreational fishing activities peaked in the dry season (31 out of 46 vessels) (**Table 10.6**).

Table 10.6 Summary of Fishing Activities in each Season

Type of Fishing Activity	Dry Season	Transitional Period One	Wet Season	Transitional Period Two	Overall
Commercial (hand lining, gill netting, cage trapping and long lining)	12	4	17	6	49
Recreational (hand lining)	31	8	2	5	46
Total No. of Vessels	**43**	**12**	**19**	**21**	**95**

Note: Dry season (February–March 2023, December 2023–January 2024); Transitional Period One (April–May 2023); Wet season (June–September 2023); and Transitional Period Two (October–November 2023).

10.4.4 Summary of Fisheries Baseline Conditions

10.4.4.1 Results of AFCD Port Survey 2021 indicated that the waters around the project site is of moderate usage by fishing vessels (>100-400 vessels; mainly sampans) and provides low to moderate level of capture fisheries production (>50-200 kg/ha). The ARs at Port Shelter and Po Toi O FCZ are all located at considerable distances from the Project (more than 5 km away from the project site). Tung Lung Chau FCZ and the spawning ground of commercial fisheries resources at eastern waters are situated about 1.2 km and 2.5 km from the project site, respectively.

10.4.4.2 Fisheries surveys conducted during the dry season (February to March 2023) and wet season (June to September 2023) using gill netting and cage trapping revealed that the catches were mostly comprised of low-valued and non-commercially targeted species, which accounted for 78.5% of total abundance and 85.2% of total biomass. Overall, species diversity at the nine survey locations were low to moderate, with some unevenness in species distribution. The vessel surveys conducted between February 2023 and January 2024 recorded an average of eight fishing vessels per monthly survey within and in the vicinity of the project site, with almost all of them being sampans. Half of the observed fishing activities were commercial (mostly using hand lining), while the other half were recreational (hand lining).

10.4.5 Fisheries Sensitive Receivers

10.4.5.1 Based on the review of the available information on the capture and culture fisheries of the waters in the vicinity of the proposed Project, the potential fisheries sensitive receivers that may be affected by the Project are identified as follows:

- Recognised spawning grounds of commercial fisheries resources at eastern waters (at least 2.5 km away from the proposed Project, respectively);
- Recognised nursery area of commercial fisheries resources at Port Shelter (at least 7.8 km away from the proposed Project, on the other side of the Clear Water Bay Peninsula);
- ARs at Outer Port Shelter (at least 5 km away from the proposed Project); and
- Tung Lung Chau FCZ and Po Toi O FCZ (at least 1.2 km and 6.1 km away from the proposed Project, respectively.

10.4.5.2 The locations of the sensitive receivers are shown in **Figure 10.1**. All potential fisheries sensitive receivers are located on the eastern side of the assessment area.

10.5 Impact Identification and Evaluation

10.5.1 Assessment Methodology

10.5.1.1 A review of baseline fisheries conditions from available literature and field surveys was conducted to establish the fisheries importance of the waters in the assessment area and its vicinity. Information from the water quality impact assessment (**Section 5**) was examined to assess potentially affected area by perturbations to water quality parameters. The potential fisheries impacts during the construction and operational phases of the Project were then assessed and evaluated, with reference to the guidelines in EIAO-TM Annex 9 and 17.

10.5.2 Identification of Potential Impacts during Construction Phase

10.5.2.1 The Project will involve two locations, namely TKO 137 and TKO 132, detailed in **Section 2** of this EIA report. The project site at TKO 137 would be developed into a new community primarily for housing purpose providing about 50,000 residential units, with ancillary facilities and supporting land uses (e.g. retail and other commercial facilities, government, institution and community uses, recreational and open space, as well as infrastructure). The proposed marine works associated with TKO 137 will include:

- Reclamation in the existing barging basin and along the shoreline; and
- Works associated with reclamation (e.g. removal of subtidal obstruction).

10.5.2.2 In order to make way for the housing development at TKO 137, land would be created through reclamation and slope-cutting off TKO 132 to accommodate five location-specific public facilities that all require marine frontage for daily operation. Other than the need to re-provide a public fill transfer facility (PFTF) and a concrete batching plant (CBP) from TKO 137, the land to be created off TKO 132 will be used to accommodate an important strategic Electricity Facilities (EFs), a construction waste handling facility (CWHF), and a refuse transfer station (RTS). The proposed marine works associated with TKO 132 will include:

- Reclamation;
- Works associated with reclamation (e.g. removal of subtidal obstruction); and
- Construction of marine viaducts to connect the reclaimed land to the existing Tseung Lam Highway.

10.5.2.3 The preliminary project layout is shown in **Figures 2.4 and 2.5** of **Section 2** and the indicative reclamation sequences are provided in **Table 2.21** and **Figures 2.8 and 2.9** of **Section 2**. The foundations of the reclamations at TKO 137 and TKO 132 will be constructed using a non-dredged ground treatment method, i.e. Deep Cement Mixing (DCM). The DCM method involves injecting controlled volumes of cement into the underlying materials while simultaneously mixing the cement with the in-situ materials to improve their strength.

10.5.2.4 The adoption of DCM would minimise the disturbance to the seabed from dredging activities. Nonetheless, some minor disturbance to the seabed would arise from the associated works, in particular, sediment removal would be carried out adjacent to the reclamation footprint during the construction stage to facilitate DCM. Such removal works would be short-term and temporary in nature.

10.5.2.5 Seawall will be built on top of the DCM foundation. Berthing areas are proposed at TKO 132 where vertical blockwork seawalls will be constructed to facilitate vessel berthing. The vertical seawall will typically be built by placing precast blockwork wall on top of the DCM columns. Sloping seawall will be adopted for the TKO 137 reclamation as well as along the northeast boundary of the TKO 132 reclamation. Rock fill will be used for constructing the sloping seawall with rock armour protection at the top. The proposed reclamation method at TKO 132 and TKO 137 will adopt an approach where seawalls will first be formed (above

the high-water mark) to partially enclose the filling activities. Public fill will be used to form the reclamation. Filling will be carried out behind the leading seawall of at least 200 m in length. Sand blanket laying will be carried out prior to the DCM operation.

10.5.2.6 Construction of marine viaducts connecting the TKO 132 development will involve installation of marine piles (as viaduct piers). There will be no open sea dredging or marine filling for the construction of these marine viaducts. The installation of marine piles will be of minor scale, with bored piles or equivalent system being adopted for the works.

10.5.2.7 No district cooling system is proposed under the Project. Construction of a new seawater intake is not necessary for the Project. The proposed Effluent Polishing Plant (EPP) at TKO 137 would involve seawall outfall only. The new EPP outfall, as well as other storm outfalls of the Project, will be located at the seawall of the proposed reclamation. No submarine intake or submarine outfall will be constructed under the Project. The effluent of the EPP will be diverted to the seawall via underground pipes / box culverts. Installation of the underground pipes, box culverts, and storm outfalls at TKO 137 and TKO 132 will not disturb the seabed or sediments. The installation works would be incorporated into the land-based construction works of the Project.

10.5.2.8 The potential fisheries impacts arising during the construction of the Project will include:

- Permanent and temporary loss of fishing ground and fisheries habitats due to the proposed reclamation works and piling works for the marine viaducts;
- Changes in water quality due to marine and land-based construction works; and
- Underwater sound generated from marine construction activities.

10.5.3 Evaluation of Potential Impacts during Construction Phase

Loss of Fishing Ground and Fisheries Habitats

10.5.3.1 The potential direct impacts on fisheries will include permanent and temporary loss of fishing ground and fisheries habitats. The loss of fishing ground refers to the area of water body that is available for fishing, while fisheries habitat refers to habitats that support the fisheries resources.

10.5.3.2 As discussed in **Section 9** of this EIA report, the total permanent loss of seabed (subtidal hard and soft substrate habitats) would be about 25 ha within TKO 137, and about 22 ha within TKO 132. Under a conservative approach, the total area of seabed loss is assumed as the total loss of fishing ground and fisheries habitat. This provides a conservative assumption as some marine areas would in fact still be available as fishing ground (e.g. marine waters above sloping seawall, within footprint of seabed loss), or as fisheries habitat (e.g. substratum along the seawall). Nonetheless, the permanent loss of fishing ground and fisheries habitat would be about 47 ha, under a conservative approach.

10.5.3.3 Temporary loss of fishing ground and fisheries habitats are also anticipated due to restricted access in the temporary works areas for the reclamation and piling works. Approximately 82 ha of fishing ground and fisheries habitat are expected to be temporarily lost, with the losses at TKO 137 and TKO 132 estimated being around 26 ha and 56 ha, respectively.

10.5.3.4 Based on the findings of the fisheries baseline, the fisheries production within the project boundary is low to moderate, primarily comprising species that are not commercially targeted or of low value. When compared to the 1,700 km^2 (approximately 170,000 ha) of total marine waters in Hong Kong (EPD, 2021) which are mostly available for fishing, the fishing ground and fisheries production loss caused by the Project is considered to be of insignificant proportion. Therefore, the potential impact of fishing ground and fisheries habitat loss during the construction phase is considered minor.

10.5.3.5 The waters around the project site are moderately used for fishing, with the Port Survey 2021 indicating that about 100-400 fishing vessels, primarily sampans, operate in the area.

Fishing vessels originally using the area of marine waters in the works area as part of their fishing ground might need to shift their operations to other locations/areas. The project will result in a permanent loss of approximately 47 ha and a temporary loss of around 82 ha of fishing grounds, which constitutes an insignificant proportion of the total marine waters in Hong Kong. Given that most of the existing fishing operations taking place in surrounding waters are predominantly conducted by sampans, which are small-sized and highly flexible, the potential impact on fishing operations is considered minor.

Changes in Water Quality

10.5.3.6 Marine construction works at TKO 137 and TKO 132, including DCM, seawall construction, underwater filling, sand blanket laying, and construction of marine viaducts, may disturb the seabed or water column and thereby impact water quality. These activities can generate sediment plume, increasing sediment suspension in the water column and leading to deterioration of water quality both on-site and off-site. The potential water quality impacts include elevated levels of suspended solids (SS) and turbidity, reduction of DO levels, and release of nutrients and/or contaminants into the nearby marine bodies. High SS levels can clog the gills of fishes and smother filter feeding marine organisms, while high turbidity can affect the foraging abilities of organisms relying on eye sights. Lower DO levels can affect stationary species, whilst mobile species might temporarily avoid the affected area. Consequently, there could be a temporary reduction in abundance of fisheries resources. Disturbance of seabed sediments might release nutrients and/or contaminants into the marine waters, potentially leading to adverse water quality impacts such as increased likelihood of algal bloom or accumulation of contaminants inside organisms, and causing lethal or sub-lethal effects to marine fauna (including fisheries resources) such as alteration of behaviour, reproduction failure and increase susceptibility to diseases. The potential indirect impacts on fisheries resources due to changes in water quality associated with the construction works were assessed.

Underwater Filling and Sand Blanket Laying

Elevation of Suspended Solids and Sediment Deposition

10.5.3.7 Quantitative water quality modelling was conducted in **Section 5** to simulate the loss of fines and dispersion of sediment load from the sand blanket laying, and marine filling works. Two worst-case scenarios, A1 and A2, were selected to model the SS levels in the marine environment during the construction phase. Scenario A1 represents the case with the largest overall sediment release in open waters before formation of any seawalls at TKO 137 and TKO 132 due to the sand blanket laying activities. Scenario A2 addresses the worst-case impact due to the underwater filing behind the leading seawall at both TKO 137 and TKO 132. The worst-case underwater filling work at TKO 137 would occur during Phase 1 of the reclamation. For the remaining phases of TKO 137 reclamation, the underwater filling would be fully surrounded by seawall and hence would not create water quality impact. At TKO 132, the reclamation work would proceed from northeast to southwest. The seawall construction would take place first to surround the reclamation site as far as practicable, confining the underwater filling work except for a 100-m gap for marine access. Scenario A2 considers the worst-case impact of underwater filling at TKO 132 before the southwest seawall is constructed.

10.5.3.8 The water quality modelling results in **Sections 5.8.2.3 and 5.8.2.4** indicated that under the unmitigated scenarios, the SS elevation and sedimentation at majority of the water sensitive receivers (WSRs) are predicted to be compliant with the corresponding assessment criteria, except around the proposed development at TKO 132. Elevated levels of SS as a result of these works are expected to be transient and localised to the proximity of active marine works areas. While the ARs at Outer Port Shelter are not specifically identified as WSRs in Section 5, as they are located at least 5 km away from the proposed Project, given their distance and the localised nature of the sediment plume, SS elevation and sedimentation are unlikely to impact the ARs.

10.5.3.9 The modelling results showed that with the implementation of mitigation measures such as deployment of silt curtains, the sediment plume and sedimentation rate at all the WSRs would be fully compliant with the relevant assessment criteria (**Section 5.8.2.8**). Therefore, unacceptable impacts to fisheries resources and habitats as a result of potential elevations of SS from the construction works are not expected to occur.

Oxygen Depletion

10.5.3.10 The DO depletion due to the release of sediment from the marine works was calculated and presented in **Section 5.8**. The findings showed that the predicted maximum DO depletions at all the WSRs are below 0.1 mg/L under the unmitigated scenarios and below 0.01 mg/L under the mitigated scenarios. The degree of DO depletion arising from this Project is considered minimal. Full DO compliances with the assessment criteria are predicted at all the WSRs during the construction phase (**Section 5.8.5**). Additionally, the ARs in Outer Port Shelter, which are not identified as WSRs, are not expected to experience any adverse impacts from the Project's construction activities due to their distance and the localised nature of the DO depletion exerted by sediment plume. Therefore, no unacceptable impacts to fisheries from the reduction of DO concentration are expected to occur.

Release of Nutrients, Metals and Micro-pollutants

10.5.3.11 A sediment elutriate test was conducted using sediment samples collected at the Project sites to identify the potential release of sediment-bound contaminants due to disturbance from the marine works. The elutriate samples were analysed for nutrients, heavy metals, trace organic pollutants and chlorinated pesticides. The modelling results showed that concentrations of all contaminants, including nitrogen nutrients, arsenic, copper and zinc, are predicted to be fully compliant with the assessment criteria at all WSRs (**Section 5.8.6.4**). Additionally, potential impacts on the ARs at Outer Port Shelter, which are not identified as WSRs, are not expected to occur due to their distance and the localised nature of potential contaminant dispersion as a result of seabed disturbance. Therefore, unacceptable fisheries impacts due to the potential release of nutrients, metals and micro-pollutants from disturbed sediments into the water column are not expected to occur.

Other Marine Construction Activities

10.5.3.12 The potential water quality impacts resulting from the DCM operation, seawall construction, and construction of marine viaducts were assessed qualitatively in **Section 5**. The primary concern arising from the DCM operation is the potential release of fines and cement slurry, and the possible thermal impact due to heat dissipation from the exothermic process of DCM. By deployment of silt curtain and placing a sand blanket layer on top of the DCM works areas before treatment, release of fines and cement slurry from the DCM operation would be negligible. Any heat dissipation from the exothermic process of DCM would largely occur within the materials immediately surrounding the DCM column, which is beneath the seabed. Any minor heat dissipation from the top of DCM columns would be absorbed by the sand blanket laid above them. Thermal impact due to DCM would be negligible. Therefore, no unacceptable impact is expected from the DCM works of this Project.

10.5.3.13 The seawalls at TKO 137 and TKO 132 would be constructed using blockwork wall, rock fill and/or rock armour. These materials contain no or negligible fines content, so no loss of fines is expected during the seawall construction. No adverse impact would arise from the seawall construction.

10.5.3.14 The construction of marine viaducts would involve installation of marine piers or piles, using bored piles or an equivalent system. There would be no open sea dredging for the construction of marine viaducts. All marine piers or piles would be bored inside a steel casing or other equivalent systems that can effectively contain wastewater and spoil generated from the pilling process. The steel casing would be inserted into the seabed by

vibratory action (such as using vibratory hammer), resulting in limited level of localised disturbance to bottom sediment, which would only be laterally displaced during the insertion process. After the installation of bored piles, the rest of the pile installation would be conducted in a dry environment within precast pier shell, thereby avoiding any direct water quality impact. Given the small scale of works (with no open dredging) and the provision of water quality mitigation measures for sediment control (such as installation of silt curtains) as recommended in **Section 5.11**, the potential release of fines and contaminants is expected to be limited. Therefore, no unacceptable impact is anticipated from the construction of marine viaducts.

10.5.3.15 Accidental leakage and spillage from marine barges could result in increase of SS and turbidity, or release of sediment-bound contaminants such as heavy metals and nutrients in marine waters. Nonetheless, with the good practices and mitigation measures to control accidental spillage as stated in **Section 5.11**, no adverse impacts on the fisheries resources are expected.

Land-based Construction Activities

10.5.3.16 Indirect impacts to fisheries resources, habitats and fishing operations may occur due to changes in water quality from land-based works. The potential water quality impacts arising from land-based works, including construction site runoff, wastewater from various construction activities, sewage effluent from construction workforce and accidental chemical spillage, can be controlled through the adoption of appropriate mitigation measures, and good site practices mentioned in **Section 5.12**, such as the provision of suitable site facilities. The potential water quality impacts arising from land-based works are therefore considered insignificant.

Underwater Sound

10.5.3.17 Intermittent underwater sound generated from construction activities such as construction vessel movement and marine piling works may cause potential disturbance to fisheries resources. Potential impacts on fishes due to underwater noise include physiological stress, avoidance, and injury (at high pressure levels). However, the level of impact depends on various factors, including background noise levels, the number of fish present, the species affected, the proximity of fish to the noise source, the attenuation properties of seabed sediments, and the hearing capabilities of the affected species.

10.5.3.18 Most marine invertebrates lack air-filled space and hence it is generally believed that noise have minimal physiological or behavioural impacts on them, except when they are within a few metres of the noise source. Therefore, the underwater sound generated by the marine works of this Project is anticipated to have a negligible impact on marine invertebrates.

10.5.3.19 Fish can detect underwater sound vibrations through the lateral line system and the inner ear for species with air-filled swim bladders. Anthropogenic underwater sounds associated with piling and marine work vessels for this Project exhibit major energy below 1,000 Hz and sound levels between 170 and 190 dB re 1 µPa at 1 m, which may be audible to most fish species (Richardson et al. 1995). Waters around the project site experience relatively high levels of existing marine traffic, especially at the vicinity of the existing barging basin at TKO 137, which is currently occupied for various barging operations with frequent vessel movements. Therefore, it is reasonable to assume that fishes in these waters are tolerant to a relatively high background level of underwater sound. During the peak construction period, it is estimated that the daily number of trips by marine works vessels would be about 22 and 23 round trips to the TKO 132 and TKO 137 work sites, respectively. The limited increase in the vessel activity associated with the construction of this Project is not expected to cause unacceptable impacts on the fisheries resources, and the potential impact of underwater noise is therefore considered negligible.

10.5.4 Identification of Potential Impacts during Operational Phase

10.5.4.1 A public sewerage system will be built to collect and convey all the sewage effluents generated from the Project area to the proposed EPP at TKO 137 for proper disposal. The EPP will treat the collected sewage to the secondary plus level (i.e. secondary treatment with 75% nitrogen removal and disinfection). Its treatment capacity has been designed to cater for the full development of TKO 137. The outfall of the EPP will be in the form of land-based underground box culvert for diverting the effluent from the EPP to the marine waters via the new man-made seawall of the Project development.

10.5.4.2 The TKO 132 development is proposed to accommodate public facilities that require marine frontage for daily operation, including the PFTF, CBP, EFs, CWHF and RTS. Wastewater will be generated from these facilities. A public sewerage system including a Sewage Pumping Station (SPS) and twin rising mains will be built to collect and convey all the sewage and wastewater generated at the proposed TKO 132 development (including those generated at the PFTF, CBP, CWHF and RTS) to the existing TKO Preliminary Treatment Works (PTW) and subsequently to the HATS for proper treatment and disposal. The existing TKO PTW and HATS system have been assessed to have sufficient capacity to accommodate the additional sewage flow from the RTS. No sewage and wastewater discharges are proposed at the TKO 132 development. For safe marine access to the CBP berthing facility at TKO 132, regular maintenance sediment removal will be required.

10.5.4.3 The potential fisheries impacts arising during the operation of the Project will include:

- Permanent loss of fishing ground and fisheries habitats due to the proposed reclamation and the placement of piles for marine viaducts;
- Changes in water quality due to sewage / wastewater generation, effluent discharge, surface runoff, accidental marine spillage from barges, and maintenance sediment removal; and
- Change of hydrodynamics induced by the footprint of the Project;
- Underwater sound due to increased vessel movements.

10.5.5 Evaluation of Potential Impacts during Operational Phase

Loss of Fishing Ground and Fisheries Habitats

10.5.5.1 The reclamation works, seawall construction and marine piling works of this Project will result in loss of fishing ground and fisheries habitats during the operational phase. As discussed under the construction phase impact (**Section 10.5.3**), there will be permanent loss of about 47 ha of fishing ground and fisheries habitat upon completion of the proposed land formation at TKO 137 and TKO 132 and the construction of marine viaducts at TKO 132. No further temporary loss (e.g. installation of silt curtain) would be expected during the operational phase. The loss constitutes an insignificant portion of the 1,700 km^2 (approximately 170,000 ha) of total Hong Kong marine waters (EPD, 2021) which are mostly available for fishing. Moreover, most existing fishing operations in surrounding waters are predominantly carried out by sampans that are small-sized and highly flexible, and the fisheries production within the Project boundary mainly consists of species that are not commercially targeted or are of low value. Therefore, the potential impacts on fisheries resources, habitats and fishing operations are anticipated to be minor.

Changes in Water Quality

Sewage / Wastewater Generation and Operation of Effluent Polishing Plant (EPP) at TKO 137

10.5.5.2 Potential indirect impacts to fisheries resources may arise from changes in water quality due to sewage / wastewater generation and effluent discharge and emergency discharge from the EPP. All sewage effluents generated in the proposed TKO 137 development, which would be mainly domestic in nature, would be collected by a public sewerage system

and conveyed to the proposed EPP for proper disposal. The effluent would be discharged into the open waters of Tathong Channel via the new man-made seawall. The large volume of the receiving marine waters and tidal current in Tathong Channel would dilute and disperse the effluent. The provision of secondary plus treatment level for the EPP would minimise residual pollutants and further safeguard water quality.

10.5.5.3 Emergency discharge of the EPP may occur in case of pump failure, electrical power supply interruption, or treatment unit failure. However, preventive design measures including dual power supply from two independent power supply sources from CLP, standby facilities for the main treatment units, standby equipment parts / accessories, and backup power supply systems using renewable energy sources and emergency generator, along with best management practices (BMP) like proactive maintenance, inspection and housekeeping measures, would ensure the reliability of the EPP operation. In the extremely remote event of power instability or accidental failure of treatment unit, backup power supply or standby treatment units would maintain the process and the treatment system restarting time would be less than two hours according to the normal practice of the Drainage Services Department. Interim bypass after the primary sewage treatment would be provided in the EPP to handle the emergency situation.

10.5.5.4 The water quality modelling results in **Section 5.10.5.1** indicated the water quality impacts caused by effluent discharges from the EPP are insignificant. The EPP discharges would not cause any water quality non-compliances under both normal operation and emergency situation. The degrees of water quality compliances are the same with or without the discharges.

10.5.5.5 Wastewater would also be generated during the operation of the refuse collection point, public transport interchange, green fuel station, ambulance depot and service reservoirs at TKO 137. Provided that the effluent and wastewater generated from these facilities are proper treated and disposed of in accordance with the WPCO requirements, and with the proper implementation of the design measures recommended in **Section 5.13**, no unacceptable water quality impact is expected from the operation of these facilities.

Sewage / Wastewater Generation and Operation of Sewage Pumping Station (SPS) at TKO 132

10.5.5.6 Wastewater and sewage would be generated from the public facilities (including the PFTF, CBP, CWHF and RTS) during the operation of the TKO 132 development. All wastewater and sewage would be diverted to the public sewerage system and then conveyed to the existing TKO PTW for proper disposal through the existing HATS. No treated or untreated wastewater / sewage would be discharged at TKO 132. Therefore, sewage and wastewater generation at TKO 132 would not cause any unacceptable water quality impact.

10.5.5.7 A new SPS is proposed at the TKO 132 development with a design capacity of 400m^3 per day to convey the sewage and wastewater to TKO PTW. Potential water quality impact may arise from emergency overflow / bypass of sewage due to pump failure, power supply failure, damage to pressure mains, or flooding. Emergency bypass culverts would be built to convey any emergency overflow to the southern Project boundary, which is the closest point to the open channel of Victoria Harbour, to enhance dispersion.

10.5.5.8 Based on past experiences, breakdown of SPS could be recovered in a matter of hours. Given the minor capacity of the proposed SPS, the quantity of any emergency discharge would be small. Such discharges would be immediately diluted by the marine waters, making any water quality impact transient and reversible. With the incorporation of precautionary and design measures mentioned in **Section 5.13** to prevent emergency situations, no long-term unacceptable water quality impacts are anticipated.

Non-point Source Surface Runoff at TKO 137 and TKO 132

10.5.5.9 Non-point source surface runoff containing contaminants from the paved area at TKO 137 to the adjacent marine waters is anticipated during rainfall events. The possible sources of non-point source pollution at TKO 137 would include a small amount of oil, grease and grit that may be deposited on the surfaces of the road network as well as a small amount of debris, refuse, dust from the roof of buildings and cleaning agents used for washing streets and building façade. With proper implementation of the stormwater control measures including BMP and blue-green infrastructure mentioned in **Section 5.13**, no unacceptable water quality impacts from the non-point source surface runoff are expected at TKO 137.

10.5.5.10 Contaminated wash-off may be generated from accidental spillage of materials or chemicals at the industrial facilities of TKO 132. If uncontrolled, the wash-off of the accidental spillage may increase the SS content in the receiving marine waters. To mitigate the risk, pollution sources or operational activities (e.g. material stockpile) at TKO 132 would be fully enclosed or covered within buildings to prevent contaminated runoff. For any uncovered areas or open space within the development area, perimeter drainage and runoff treatment devices would be provided to intercept and convey the first flush of potentially contaminated surface runoff and any dry weather flow to the public sewerage system. Containment measures such as stop-logs would be installed at suitable location(s) in the perimeter drainage system to contain any accidental spillage in open areas. With proper implementation of the storm water control measures, BMP for stormwater management, and the environmental management plan (EMP) proposed in **Section 5.13**, no unacceptable water quality impacts are anticipated from the non-point source surface runoff at TKO 132.

Accidental Marine Spillage from Barges at TKO 132

10.5.5.11 The daily operations of the facilities at TKO 132 would require marine delivery, unloading, and loading of fill, aggregate, sand, construction materials, and other materials with fines content, as well as municipal solid wastes and marine refuse. Accidental spillage of these materials could increase the SS levels in the marine waters. To prevent accidental spillage, enclosed conveyor system or sealed containers would be used to fully enclose the materials during the transfer to and from the barges. Sufficient free board and covering of the materials on the barges would be implemented to prevent overflow. Since there would be no lifting of these materials in open air during loading and unloading operations, accidental spillage is unlikely. With the proper implementation of the recommended mitigation measures and EMP outlined in **Section 5.13**, no accidental material spillable is expected during the operational phase.

Maintenance Sediment Removal at TKO 132

10.5.5.12 During the operational phase, maintenance sediment removal may be required once every five to 10 years (subject to site condition) to maintain sufficient clearance for safe marine access to the berthing area of the TKO 132 development. The sediment volume to be removed during each maintenance sediment removal event would be much smaller than that generated from the removal of obstruction or capital sediment removal during the construction phase, with an estimated sediment removal depth of about 0.5 m for navigation of vessels. The estimated sediment removal volume would be 10 times smaller than that generated from the removal of obstruction or capital sediment removal (700 m^3/day) with a sediment removal depth of 5 m. Thus, the potential water quality impacts on fisheries sensitive receivers due to the maintenance sediment removal at TKO 132 are considered much lower than those for the construction phase. With the implementation of mitigation measures proposed in **Section 5.13**, including the use of closed grab, restriction of working rates and deployment of silt curtain, potential impacts to fisheries would be reduced to within acceptable levels. Consequently, no unacceptable indirect impact on fisheries sensitive receivers from the maintenance sediment removal is anticipated.

Creation of Embayed Water and Marine Refuse Entrapment at TKO 132

10.5.5.13 Embayed water would form near the northern corner of the TKO 132 reclamation. Due to its embayment form, tidal flow velocity or flushing capacity is expected to be reduced, potentially leading to the entrapment of marine refuse and accumulation of pollutants. The embayed water may also increase oxygen demand in the slack water, increasing the risk of DO depletion. Floating refuse and debris from surface runoff, illegal dumping and littering from marine vessels and waterfront, and accidental spillage from daily operation of the public facilities may accumulate near TKO 132, particularly at the northern corner.

10.5.5.14 According to the water quality modelling results in **Section 5.10.4**, the predicted DO levels at the embayed water formed near the northern corner of the TKO 132 development would comply with the WQOs. Although water circulation at the northern corer would be limited, there are no major pollution sources in the surrounding area. Potential impacts from floating refuse accumulation could be mitigated through regular refuse scavenging. With the implementation of a regular refuse collection programme, the accumulation of pollutants and floating refuse is not anticipated.

Change of Hydrodynamics

10.5.5.15 The change in coastline configurations due to the proposed reclamations may affect the hydrodynamic regime and water quality patterns of the adjacent waters and hence a quantitative hydrodynamic modelling was conducted in **Section 5** to assess the overall hydrodynamic impacts. The modelling results in **Section 5.10.1** indicated that the reclamation works at TKO 137 and TKO 132 would not significantly alter the hydrodynamics regime. The tidal flow flushing through the key marine channels in the assessment area would not be diminished. The reclamations would cause no obvious changes in the tidal flow vectors and water quality patterns compared to baseline conditions. The degrees of water quality compliances remain the same with or without this Project (**Section 5.10.3**). Therefore, the Project would not cause any unacceptable fisheries impact due to change in local hydrodynamic regime and subsequent changes in water quality.

Underwater Sound

10.5.5.16 Vessel movements are expected for the day-to-day operation of the public facilities at TKO 132. The underwater sound characteristics of the vessels involved would be very similar to those currently present from existing marine traffic. Fish in these waters are habituated to the background levels of underwater sound, and the increase in vessel activity associated with the operation of this Project is not expected to result in unacceptable impacts on fisheries resources.

10.5.6 Impact Evaluation

10.5.6.1 From the information presented above, the fisheries impacts associated with the Project are not considered to be significant. An evaluation of the impacts according to Annex 9 of the EIAO-TM is presented in **Table 10.7**.

Table 10.7 Evaluation of Potential Fisheries Impacts during Construction and Operational Phases

Potential Impact	Source of Impact	Nature of Impact	Size of Affected Area	Loss of Fisheries Resources / Production	Destruction and Disturbance of Nursery and Spawning Grounds	Impact on Fishing Activity	Impact on Aquaculture Activity	Overall Impact Significance	Mitigation Measures Required
Construction Phase									
Direct loss of fishing ground and fisheries habitat	Land formation works, construction of seawalls, and piling works for marine viaducts.	Long-term permanent loss upon completion of land formation and seawall at TKO 137 and TKO 132, and pile structures of marine viaducts at TKO 132; Short-term temporary loss for the works areas at TKO 137 and TKO 132.	Total permanent loss of fishing grounds and fisheries habitat: about 47 ha; Temporary works areas: about 82 ha.	The Project works areas are of low to moderate level of fisheries production (>50-200 kg/ha), primarily comprising species that are not commercially targeted or of low value. The extent of affected area is relatively small and hence the impacts on fisheries resources/ production are considered minor.	The construction activities do not encroach on identified nursery and spawning grounds.	Moderate level of fishing operation (>100-400 vessels; mainly sampans which are small-sized and highly flexible); The loss of fishing ground is considered to be small when compared to the availability of fishing grounds in Hong Kong; The impact on fishing activity is hence considered minor.	No aquaculture activities at the Project area and hence no impact.	Minor	No
Changes in water quality	Marine construction works and land-based	Short-term and temporary	Localised to the immediate	Avoidance by fish is expected, and	Predicted changes in water quality	Impacts are localised with negligible	Water quality deterioration would be	Minor	No specific measures

Potential Impact	Source of Impact	Nature of Impact	Size of Affected Area	Loss of Fisheries Resources / Production	Destruction and Disturbance of Nursery and Spawning Grounds	Impact on Fishing Activity	Impact on Aquaculture Activity	Overall Impact Significance	Mitigation Measures Required
	construction works.		vicinity of the works areas.	negligible loss of fisheries resources/ production.	due to construction works are localised, and since spawning and nursery grounds are located far away, no unacceptable adverse impacts are expected.	impact on fishing operations.	localised around the works areas and hence no unacceptable impact on FCZs.		for fisheries are required. Water quality mitigation measures would further minimise impacts.
Underwater sound	Marine construction works	Short-term and temporary	Localised to sound-generating activities such as marine vessels and piling.	Avoidance and habituation by fish are expected, and negligible loss of fisheries resources/ production.	Spawning and nursery grounds are far away to be affected by underwater sound and hence no impact.	Underwater sound is expected to have negligible impact on fishing operations.	Aquaculture activities are far away to be affected by underwater sound and hence no impact.	Negligible	No
Operational Phase									
Direct loss of fishing ground and fisheries habitat	Land formation works, construction of seawalls, and piling works for marine viaducts.	Long-term permanent loss upon completion of land formation and seawalls at TKO 137 and TKO 132, and pile structures of	Total permanent loss of fishing grounds and fisheries habitat: about 47 ha	The Project works areas are of low to moderate level of fisheries production (>50-200 kg/ha),	The construction activities do not encroach on identified nursery and spawning grounds.	Moderate level of fishing operation (>100-400 vessels; mainly sampans which are	No aquaculture activities at the Project area and hence no impact.	Minor	No

Potential Impact	Source of Impact	Nature of Impact	Size of Affected Area	Loss of Fisheries Resources / Production	Destruction and Disturbance of Nursery and Spawning Grounds	Impact on Fishing Activity	Impact on Aquaculture Activity	Overall Impact Significance	Mitigation Measures Required
		marine viaducts at TKO 132.		primarily comprising species that are not commercially targeted or of low value. The extent of affected area is relatively small and hence no unacceptable impacts on fisheries resources/ production are expected.		small-sized and highly flexible); The permanent loss of fishing ground is considered to be small when compared to the availability of fishing grounds in Hong Kong; The impact on fishing activity is hence considered minor.			
Changes in water quality	Sewage / wastewater generation and operation of EPP at TKO 137 and SPS at TKO 132, surface runoff, and accidental marine spillage from barges, and creation of embayed water and marine refuse entrapment at TKO 132.	Long-term and permanent	Localised waters surrounding the proposed TKO 137 and TKO 132 developments.	Avoidance by fish is expected, and negligible loss of fisheries resources/ production.	Spawning and nursery grounds are located far away and hence no unacceptable adverse impacts are expected.	Impacts are localised with negligible impact on fishing operations.	Changes in water quality would be localised around the Project areas and hence no unacceptable impact on FCZs.	Minor	No specific measures for fisheries are required. Water quality mitigation measures would further minimise impacts.

Potential Impact	Source of Impact	Nature of Impact	Size of Affected Area	Loss of Fisheries Resources / Production	Destruction and Disturbance of Nursery and Spawning Grounds	Impact on Fishing Activity	Impact on Aquaculture Activity	Overall Impact Significance	Mitigation Measures Required
	Maintenance sediment removal at TKO 132	Short-term and temporary	Localised to the immediate vicinity of the berthing area at TKO 132.	Avoidance by fish is expected, and negligible loss of fisheries resources/ production.	No unacceptable adverse impacts are expected.	Impacts are localised with negligible impact on fishing operations.	No unacceptable adverse impacts are expected.	Minor	No specific measures for fisheries are required. Water quality mitigation measures would further minimise impacts.
Change in hydrodynamics	Fishing ground and fisheries habitats near the project site	Long-term and permanent	N/A	No unacceptable hydrodynamics impact and hence negligible loss of fisheries resources/ production.	Spawning and nursery grounds are located far away and hence negligible impact.	Change in hydrodynamics is expected to have negligible impact on fishing operations.	Aquaculture activities are located far away and hence negligible impact.	Minor	No
Underwater sound	Vessel movements	Long-term and permanent	Localised to sound-generating activities such as marine vessels.	Avoidance and habituation by fish are expected, and negligible loss of fisheries resources/ production.	Spawning and nursery grounds are far away to be affected by underwater sound and	Underwater sound is expected to have negligible impact on fishing operations.	Aquaculture activities are far away to be affected by underwater sound and	Negligible	No

Potential Impact	Source of Impact	Nature of Impact	Size of Affected Area	Loss of Fisheries Resources / Production	Destruction and Disturbance of Nursery and Spawning Grounds	Impact on Fishing Activity	Impact on Aquaculture Activity	Overall Impact Significance	Mitigation Measures Required
					hence no impact.		hence no impact.		

10.6 Cumulative Impacts

10.6.1.1 The projects that may cause cumulative impact on fisheries identified from the list of concurrent projects include the TKO Line Southern Extension (TKLSE). However, limited information is available on the exact alignment and construction details of the TKLSE. The only currently known information is that part of the TKLSE alignment would be located within the development area of TKO 137. The construction programme and details of TKLSE are currently not available, except that the alignment within development area of TKO 137 would be generally located underground. Detailed impacts of TKLSE will be assessed under a separate EIA study, which will take into account other concurrent marine construction activities and, where necessary, recommend mitigation measures to minimise potential impacts. With the implementation of mitigation measures recommended under this EIA study to minimise water quality impacts from this Project, potential cumulative impacts are not anticipated between the proposed development at TKO 137 and TKO 132, and other concurrent projects.

10.7 Mitigation of Adverse Environmental Impacts

10.7.1.1 In accordance with the guidelines in the EIAO-TM on fisheries impact assessment, the approach adopted in this EIA for mitigating impacts to fisheries includes:

- **Avoidance**: Potential impacts should be avoided to the maximum extent as practicable by adopting suitable alternatives;
- **Minimisation**: Unavoidable impacts should be minimised by taking appropriate and practicable measures such as confining works in specific area or season; and
- **Compensation**: When all possible mitigation measures have been exhausted and there are still significant residual impacts or when the impacts are permanent and irreversible, consideration shall be given to off-site compensation. It may include enhancement of fisheries resources and habitats elsewhere.

10.7.2 Considerations for Impact Avoidance

10.7.2.1 No FCZs will be directly impacted by the Project. Moreover, the Project is not located in waters of high levels of fishing operation or high fisheries production or fish fry collection. It is also away from other sites of fisheries importance such as ARs and spawning grounds and nursey area of commercial fisheries resources.

10.7.3 Considerations for Impact Minimisation

10.7.3.1 The preliminary design of the reclamation, as presented in the Project Profile, indicated that about 25 ha of land would be created at TKO 132. Following refinements in the engineering design, the extent of the proposed reclamation area at TKO 132 has been reduced to around 19 ha. This reduction would minimise the associated impacts on water quality and fisheries.

10.7.3.2 Some marine construction methods such as underwater blasting and percussive piling can have significant impacts on fisheries resources, and hence will be avoided in this Project. Although dredging is considered less harmful as underwater blasting, it still has the potential to cause destruction and disturbance to fisheries resources. Therefore, non-dredged reclamation methods, i.e. DCM for in-situ ground treatment, will be adopted whenever practicable. Utilising non-dredge methods instead of conventional seabed dredging will significantly decrease the release of suspended solids and contaminants into water bodies.

10.7.3.3 Water quality mitigation measures should be implemented during the construction phase. The mitigation measures cover the potential water quality impacts from marine and land-

based construction activities. With the implementation of the water quality mitigation measures stated in **Section 5**, no adverse fisheries impact is anticipated and no additional mitigation measure for fisheries is required during the construction phase.

10.7.3.4 Besides the adoption of the water quality mitigation measures to minimise the impacts due to creation of embayed water and marine refuse entrapment, sewage / wastewater generation and operation of EPP and SPS, non-point surface runoff, and accidental marine spillage from barges, no fisheries-specific mitigation measure is required during the operational phase of the Project.

10.7.4 Enhancement Measures

10.7.4.1 Enhancement measures, including eco-shoreline / ecological enhanced seawall and deployment of subtidal artificial structures, have been proposed in **Section 9** to improve the ecological functions of marine habitats adjacent to TKO 137 and TKO 132, which may also enhance the fisheries resources in the surrounding waters.

10.7.4.2 Ecological enhancement features (e.g. seawall enhanced with rough texture and irregular pattern) would be incorporated into suitable sections of the new vertical seawall along TKO 132. These features would create areas for establishment of intertidal fauna, and provide shade and refuges for marine organisms including juvenile fish. An eco-shoreline would be implemented along the sloping seawall of TKO 137, with a design focusing on providing subtidal hard substrates for coral colonisation. These structures could also support various intertidal and subtidal epifauna and pelagic fauna, such as providing shelters for juvenile fish and habitats for other marine species), thereby effectively enhancing both ecological functions and fisheries resources. During the detailed design stage, a comprehensive study and implementation programme will be submitted for the approval of relevant authority(ies) before commencement of reclamation works.

10.7.4.3 The deployment of subtidal artificial structures, including artificial reef (AR), has also been explored in **Section 9**. ARs are known to be effective in attracting and supporting large populations of fish by providing complex and hard-surface habitats in areas dominated by soft substrata. These ARs may provide shelters and promote the recruitment of fish larvae and juveniles, and ultimately enhance fisheries resources in the local waters. The feasibility of AR deployment will be future reviewed in later stage of the study. The detailed AR design and the corresponding implementation programme will be submitted for the approval of the authority(ies) before commencement of reclamation works.

10.8 Evaluation of Residual Impacts

10.8.1.1 Upon completion of the Project, there would be permanent loss of about 47 ha of fishing ground and fisheries habitat, constituting an insignificant portion of the total Hong Kong waters. With the implementation of the recommended water quality mitigation measures during the construction and operational phases, potential impacts on fisheries will be further minimised. No unacceptable residual fisheries impacts due to the proposed works are expected.

10.9 Environmental Monitoring and Audit Requirements

10.9.1.1 Since no unacceptable fisheries impacts have been predicted to occur during construction and operation of the Project, fisheries-specific monitoring is considered not necessary.

10.9.1.2 The water quality monitoring activities, designed to detect and mitigate impacts during the construction and operational phases, are also expected to protect against impacts to fisheries. Details of the water quality monitoring programme are provided in the standalone EM&A Manual.

10.10 Conclusion

10.10.1.1 The fisheries impact assessment was conducted based on the information gathered from literature review and the field surveys. The results show that the assessment area is utilised by moderate number of fishing vessels, predominantly sampans, with a fisheries production of low to moderate level. The production mainly comprises non-commercially targeted and low-valued species. Fisheries sensitive resources identified within the Assessment Area, including FCZs in Tung Lung Chau and Po Toi O, spawning grounds of commercial fisheries resources at eastern waters, nursery area of commercial fisheries resources at Port Shelter, and ARs at Outer Port Shelter, are located away from the Project site.

10.10.1.2 During the construction phase of the Project, impacts arising from the proposed reclamation at TKO 137 and TKO 132, as well as the construction of marine viaducts at TKO 132, will include the permanent loss (approximately 47 ha, under a conservative estimate) and temporary loss (about 82 ha) of fishing ground and fisheries habitats. Given that the affected area constitutes only a small proportion of the fishing ground and fisheries habitats in Hong Kong, which the fisheries operations primarily consist of small, flexible sampans, and the low to moderate fisheries production consisting mainly of non-commercial or low-valued species, the direct impacts on fisheries are considered to be minor. No direct impacts to the sites of fisheries importance are anticipated since the works areas will be far away from them. Changes in water quality associated with construction activities are not expected to result in unacceptable impacts on fisheries resources and habitats. Potential impacts of elevated level of underwater sound as a result of construction activities are also not expected to be unacceptable.

10.10.1.3 During the operational phase, there would be around 47 ha loss of fishing ground and fisheries habitats due to reclamation and the marine viaduct piles. However, the loss only constitutes an insignificant proportion of fishing ground and fisheries habitats in Hong Kong, and the direct impacts to capture fisheries due to loss of fishing ground and disruption of fisheries operation are expected to be minor. Indirect impacts related to changes in water quality from sewage / wastewater generation, effluent discharge, surface runoff, accidental marine spillage from barges, and maintenance sediment removal are expected to be of minor significance. The Project would not significantly alter the local hydrodynamics regime and hence the impact of change in hydrodynamics on fisheries is considered minor. Potential impacts of underwater sound due to vessel operation are not expected to be unacceptable.

10.10.1.4 With the adoption of non-dredged reclamation method such as DCM as far as practicable, as well as the implementation of adequate water quality mitigation measures such as installation of silt curtains, good site practices and BMP, alongside ecological enhancement measures such as eco-shoreline / ecological enhanced seawall, no adverse fisheries impacts are expected and hence no fisheries-specific mitigation measures are required during construction and operation. With the implementation of the recommended water quality mitigation measures during the construction and operational phases, potential impacts on fisheries will be further minimised. While no unacceptable fisheries impacts have been predicted to occur during construction and operation of the Project, fisheries-specific monitoring is considered not necessary.

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