8b. FISHERIES IMPACT (ARTIFICIAL ISLAND NEAR SKC)

8b.1 Introduction

8b.1.1.1 This section presents the potential fisheries impacts generated from the construction and operation of the IWMF at an artificial island near SKC, including the submarine cable laying works.

8b.1.1.2 Baseline condition for fisheries resources in the study area would be obtained from the latest relevant literature. Potential direct, indirect, residual and cumulative impacts on fisheries resources during the construction and operation phases of the Project would be identified and evaluated. Mitigation measures would be recommended where necessary.

8b.2 Environmental Legislation, Policies, Plans, Standards and Guidelines

8b.2.1.1 This fisheries impact assessment is conducted according to the criteria and guidelines set out in the Technical Memorandum on Environmental Impact Assessment Process (EIAO-TM) Annex 9 and Annex 17, in order to provide objective identification, prediction and evaluation of potential fisheries impacts arising from the Project. EIAO-TM Annex 17 sets out the methodology for assessment of fisheries impacts; and Annex 9 provides the evaluation criteria.

8b.2.1.2 Other local legislation that applies to fisheries and is relevant to this fisheries impact assessment includes the following:

- Fisheries Protection Ordinance (Cap. 171) – aims to promote the conservation of fish and other forms of aquatic life within the Hong Kong waters by regulating fishing practices to prevent detrimental activities to the fisheries industry. The Ordinance came into effect on 30 June 1997.
- Marine Fish Culture Ordinance (Cap. 353) – regulates and protects marine fish culture by designating areas of fish culture zone, granting license, prohibiting unauthorized vessels and any deposition of chemicals or other substance which are likely to cause injury to fish in a fish culture zone. The list of designated fish culture zones was last revised in January 2000.
- The Water Pollution Control Ordinance (Cap.358) – aims to protect and control water quality in Hong Kong. According to the Ordinance and its subsidiary legislation, Hong Kong waters are divided into ten water control zones (WCZ). Corresponding statements of Water Quality Objectives (WQO) 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 WCZ based on their beneficial uses.

8b.3 Study Area

8b.3.1.1 According to the Study Brief Section 3.7.6.2, the study area shall cover the Southern, Southern Supplementary, Second Southern Supplementary, North Western, North Western Supplementary, and Western Buffer Water control Zones, as designated under the Water Pollution Control Ordinance (Cap. 358, WPCO).

8b.3.1.2 After referring to the water quality impact assessment, potential adverse impact on water quality is predicted to be localized. Fisheries impact assessment for this study will therefore only cover the Southern Water Control Zone where the Project Site is located.

8b.4 Assessment Methodology

8b.4.1.1 Based on review of the findings of relevant studies and available information, sufficient baseline data on capture and culture fisheries are available from the latest Agriculture, Fisheries and Conservation Department (AFCD) Port Survey 2006, AFCD Annual Report 2001-2010, as well as other relevant information available in other reports and publications. No field surveys are therefore considered to be necessary.

8b.4.1.2 The impact assessment was prepared in accordance with the criteria and guidelines in Annexes 9 and 17 of the EIAO-TM. Results of water quality modelling (**Section 5b**) were adopted to assess the extent and severity of indirect impacts during the marine works. The water quality model was also used to formulate mitigation measures, if required.

8b.5 Description of the Environment

8b.5.1 Sites of Fisheries Importance

8b.5.1.1 The study area for this fisheries impact assessment is the same as that for the water quality impact assessment for this Project. Four FCZs and no oyster culture are present within the study area (**Figure 8b.1)**. A potential important spawning and nursery grounds for commercial fisheries are also identified with the study area. **Table 8b.1** presents the distance of FCZs from the Project Site:

Table 8b.1 Fisheries Sensitive Receivers within the Study Area

Fish Culture Zone	Approximate Distance from the Project Site (km)
Cheung Sha Wan	6
Lo Tik Wan	18
Sok Kwu Wan	22
Po Toi	27.5

8b.5.2 Capture Fisheries

8b.5.2.1 In 2010, the capture fishing industry landed approximately 168,000 tonnes of fisheries product valued at $2,100 million (AFCD, 2011a). The industry consists of about 3,900 fishing vessels and 8,200 fishermen. Fishing activities are mainly conducted in the waters of the continental shelf in South China Sea. The majority of the fishing vessels are manned by family members with the assistance of hired crew. Main fishing methods include trawling, long-lining, gill-netting and purse-seining, with the majority of the total catch obtained through trawling. Some recent data on local capture fisheries industry are summarized in **Table 8b.2**.

Table 8b.2 Recent Figures for Capture Fisheries in Hong Kong

Parameter	2010	2009	2008	2007	2006	2005	2004	2003	2002	2001
Fishing fleet size (No. of vessels)	3,900	3,700	3,800	4,000	3,950	4,150	4,300	4,600	4,470	5,100
Local fishermen engaged in capture fisheries	8.200	7,600	7,900	8,500	8,500	9,170	9,700	10,100	10,860	11,560
Production (thousand tonnes)	168	159	158.0	154.0	155.0	162.0	167.5	157.4	169.8	174.0
Value of produce (HK$ million)	2,100	2,000	1,780	1,530	1,600	1,600	1,600	1,500	1,600	1,700

Source: AFCD 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010 and 2011a

8b.5.2.2 The latest AFCD Port Survey 2006 (AFCD, 2011a) provides the most updated and detailed information on capture fisheries in Hong Kong waters, including both fishing operation and fisheries production (adult fish and fry). In general, the highest fisheries yields in Hong Kong were obtained in the eastern waters (e.g. Tolo Harbour, Crooked Haven, Port Shelter, and Po Toi) and the southern waters (e.g. Lamma Island, Cheung Chau, and Soko Islands), covering the study area.

8b.5.2.3 The fishing operation within the study area was supported by vessels of varying length. Vessels of less than 15 m in length were more frequently recorded operating around Soko Islands, Lamma Island, and Cheung Chau. Vessels exceeding 15 m in length were more frequently recorded at the southern part of the Southern WCZ. Shrimp trawler and hang trawler were the dominant type of fishing vessels, but other vessels such as purse seiner, sampan, pair trawler, and miscellaneous crafts were also found operating within the study area.

8b.5.2.4 The capture fisheries data in the study area is summarised in **Table 8b.3**

Table 8b.3 Summary of Capture Fisheries Data in the Study Area

Parameter	Shek Kwu Chau*	Along the Submarine Cable*	Cheung Sha	West Lamma Channel	Soko Islands	Cheung Chau	Lamma Island
No. of Vessels	50-400	10-100	10-50	100-400	100-400	100-400	100-700
Adult Fish Production in terms of Weight (kg/ha)	100-200	0-100	0-50	50-400	200-600	200-600	50-600
Fish Fry Production in terms of Density (tails/ha)	None reported	None reported	None reported	None reported	None reported	None reported	0-100
Fisheries Production (Adult and Fry) in terms of Value (HK$ /ha)	2,000-5,000	0-2,000	500-1,000	1,000-5,000	2,000-10,000	2,000-10,000	2,000-10,000

Source: Port Survey 2006 (AFCD, 2011a)
Note: * Works area

Operating Fishing Vessel

8b.5.2.5 The number of operating fishing vessels was considered to be moderate to high for Shek Kwu Chau (50-400), and low to moderate for the proposed submarine cable (0-100). The

amount of fishing vessels at Shek Kwu Chau is generally similar to the rest of the Southern WCZ.

Fisheries Production - Weight

8b.5.2.6 In terms of weight, adult fish production was low to moderate at Shek Kwu Chau (100-200 kg/ha), and low for the proposed submarine cable alignment (0-100 kg/ha). In comparison, the rest of the Southern WCZ is considered to have higher adult fish production (0-600 kg/ha) than the proposed works area.

Composition of Capture Fisheries

8b.5.2.7 The capture fisheries productions of the top 10 families within the study area are presented in **Table 8b.4**. Overall, the fisheries production at Shek Kwu Chau and the proposed submarine cable alignment is considered to be lower than the rest of the study area.

Table 8b.4 Fisheries Production (kg/ha) of Top Ten Families in the Study Area

Top Ten Fish Families	Shek Kwu Chau*	Along the Submarine Cable*	Cheung Sha	West Lamma Channel	Soko Islands	Cheung Chau	Lamma Island
Scad (Carangidae)	5-10	≤5	≤5	5-20	>60	≤5 to 60	≤5 to 40
Shrimp	40-60	≤5 to 10	≤5	≤5 to 40	20-40	10-60	≤5 to >60
Rabbitfish (Siganidae)	5-10	≤5 to 10	≤5	≤5 to 10	10-20	10-20	≤5 to 60
Squid	≤5	≤5	≤5	≤5 to 20	10-40	≤5 to 40	5-40
Croaker (Sciaenidae)	10-20	5-20	10-20	5-40	10-40	10-40	≤5 to 60
Crab	5-10	≤5 to 10	≤5	≤5 to 10	5-20	10-40	≤5 to 40
Mullet (Mugilidae)	≤5	≤5 to 10	≤5	≤5 to 20	20-60	5-20	≤5 to 20
Sardine (Clupeidae)	≤5	≤5	None reported	≤5 to 10	10-20	≤5 to 10	≤5 to 60
Seabream (Sparidae)	≤5	≤5 to 10	≤5	≤5 to 10	5-10	5-20	≤5 to 10
Anchovy (Engraulidae)	≤5	None reported	None reported	≤5 to 10	≤5	≤5 to 10	≤5 to 10

Source: Port Survey 2006 (AFCD, 2011a)
Note: *Works area

8b.5.2.8 The most common capture fisheries in Shek Kwu Chau was shrimp (40-60 kg/ha), followed by croaker (10-20 kg/ha); in which the proposed submarine cable alignment had low production (≤5-20 kg/ha). Other fisheries production in these two works areas was low in general.

8b.5.2.9 Within the rest of the study area, shrimp was also the most commonly captured fish. Moderate to high production of this species (up to 60 kg/ha) was recorded around Cheung Chau, Lamma Island, and the West Lamma Channel; whereas moderate production (20-40 kg/ha) of this species was recorded around Soko Islands. This species is of moderate commercial value.

8b.5.2.10 Low yield (5-10 kg/ha) of high-valued scad was reported at Shek Kwu Chau. Low yield (5-10 kg/ha) of other low and medium-valued species, including rabbitfish, croaker, and crab (5-20 kg/ha); as well as very low yield (≤5 kg/ha) of squid, mullet, sardine, seabream and anchovy were also reported.

Fisheries Production – Economic Value

8b.5.2.11 The fisheries production in terms of economic value was considered to be moderate to high at Shek Kwu Chau (HK$2,000-5,000), and low to moderate at the proposed submarine cable alignment (HK$0-2,000). The rest of the Southern WCZ has higher fisheries production in terms of economic value (up to 10000), where the highest overall fisheries value was recorded around Soko Islands, Lamma Island and Cheung Chau.

Fry Collection

8b.5.2.12 Fry collection in Hong Kong has reduced in scale in recent years. The latest interview studies reported that fry collection only occurs in a few areas (AFCD, 2011a). The highest fry collection activities mainly occurred at the northeast inshore waters at Three Fathoms Cove, Crooked Harbour, Double Haven and Long Harbour, which are all outside the study area. No fish fry production was reported at the most of the Southern WCZ (covering the Study Area), except Lamma Island (0-100 tails/ha).

Spawning and Nursery Ground for Commercial Fisheries Resources

8b.5.2.13 According to the "Fisheries Resources and Fishing Operations in Hong Kong Waters" (AFD, 1998), nursery ground of commercial fisheries resources was identified at Northeast Waters, Port Shelter, Lamma Island and South Lantau; whilst spawning ground of commercial fisheries resources were identified at Northeast Waters, Eastern Waters, Southeast Hong Kong in Mirs Bay, South Lamma, South Cheung Chau, Northeast Lantau, and South Lantau.

Nursery Ground

8b.5.2.14 The major commercial juvenile fish and crustacean species previously recorded in the nursery ground at South Lantau waters include *Oratosquilla anomala, Siganus oramin* and *Collichthys lucida* (AFD, 1998). During spring, autumn and winter, *Orgatosquilla anomala* was the dominant species; while *Collichthys lucida* and *Siganus oramin* were dominant during summer. Moreover, *Harpiosquilla harpax* were commonly recorded during winter, and Sciaenid fry was also frequently recorded near the Soko Islands during summer (*ibid.*).

Spawning Ground

8b.5.2.15 The major spawning fish species recorded in the spawning ground at southern waters (South Lantau, South Cheung Chau, South Lamma, and Southeast Hong Kong) include *Gymnothorax reevesi, Inegocia japonicus, Caranx kalla, Platycephalus indicus, Mylio macrocephalus, Nibea diacanthus, Johnius belengeri, Portunus pelagicus, Oratosquilla* spp.*, Solenocera crassicornis, Metapenaeus joyneri,* and *Leiognathus brevirostris* (AFD, 1998).

8b.5.2.16 The majority of the commercial fisheries species in Hong Kong spawn from June to September (*ibid.*). Some species in the southern waters, including *Platycephalus indicus*, spawn from February to April; *Caranx kalla* spawns around June; *Leiognathus brevirostris* and croakers spawn from May to December; and for most of the crustacean species, including *Metapenaeus joyneri,* spawn from April to November (*ibid.*).

8b.5.2.17 The south waters of Hong Kong, which covers the proposed Project Site at Shek Kwu Chau and submarine cable alignment, was previously identified as spawning and nursery ground. An ichthyoplankton and post-larvae survey was conducted over this area under *EIA-125/2006 Liquefied Natural Gas (LNG) Receiving Terminal and Associated Facilities: Part 2 South Soko* (CLP, 2006). Two of the sampling stations were located at the offshore waters at Shek Kwu Chau (SKC1 and SKC2). There were 40 fish families of the

fish larvae recorded. The area was dominated by Gobiidae and Blenniidae. Marked differences were found in fish family composition between wet and dry seasons: Ambassidae, Engraulidae, Gobiidae and Sciaenidae were abundant in wet season; whereas, Callionymidae, Gobiidae, Scorpaenidae and Syngnathidae in dry season. However, spatial difference in fish family composition was not apparent

8b.5.2.18 The survey results also revealed that the densities for fish larva (0.940 ± 1.067 to 2.498 ± 3.180 larva m^{-3})and eggs (0.335 ± 0.650 to 3.224 ± 5.356 egg m^{-3}) at all sampling stations were generally low; the degree of difference in densities between stations were small (CLP, 2006). Therefore, it was concluded that there was no observable difference in fish larvae and egg densities between the identified spawning and nursery grounds at southern waters of Hong Kong, and the waters at Western Lantau, which was not identified to be important spawning and nursery grounds (*ibid.*).

8b.5.2.19 Seasonal variation in fish larvae density was found in southern waters as the density decreased significantly after October (CLP, 2006). It also deduced that the peak spawning season was between July and September (*ibid)*.

Overall Findings on Capture Fisheries

8b.5.2.20 In terms of fisheries production and operation, the proposed works area is considered to be of low to moderate value, as the overall production is low to moderate, and that fisheries production is dominated by high yield of moderate-valued shrimp. In comparison, the rest of the study area have low to higher yield of fisheries production (in terms of weight and value), especially in the waters near Soko Islands, Cheung Chau, and Lamma Island.

8b.5.3 Culture Fisheries

8b.5.3.1 Marine culture fisheries included marine fish culture and oyster culture. Mariculture areas for marine fish included 26 Fish Culture Zones (FCZs) located in various sheltered coastal areas in Hong Kong waters, occupying about 209 ha of marine areas with about 1,035 licensed operators in 2010 (AFCD, 2011b). The majority of the licensed farms are small and family-based. They are often consisted of 1 to 2 fish rafts, with an averaged total area of about 280 m^2 (*ibid.*).

8b.5.3.2 Although no figures are available on the individual production of FCZ, it was estimated that marine culture fisheries production was about 1,512 tones in 2010, with a value of $118 million. Such production catered for about 9% of local demand for live marine fish (AFCD, 2011b). Recent figures on marine fish culture are presented in **Table 8b.5**:

Table 8b.5 Recent Figures on Hong Kong Marine Culture Fisheries Industry

Parameter	2010	2009	2008	2007	2006	2005	2004	2003	2002	2001
Licensed operator	1.035	1,050	1,060	1,070	1,078	1,092	1,125	1,155	1,240	1,370
Production (tonnes)	1,512	1,437	1,370	1,532	1,490	1,540	1,540	1,490	1,211	2,470
Value (HK$ million)	118	92	82	99	89	76	79	76	57	136

Source: AFCD 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010 and 2011b

8b.5.3.3 The variety of species cultured depends on the availability of imported fry. Commonly cultured marine species include green grouper, brown-spotted grouper, giant grouper, Russell's snapper, mangrove snapper, goldlined seabream, star snapper, and red drum (AFCD, 2011b).

8b.5.3.4 The nearest Cheung Sha Wan Fish Culture Zone (FCZ) is about 6 km to the northeast of Shek Kwu Chau. Lo Tik Wan FCZ, Sok Kwu Wan FCZ and Po Toi FCZ are located from 16 to 27.5 km away (**Figure 8b.1**).

8b.6 Identification, Prediction and Evaluation of Environmental Impacts

8b.6.1 Construction Phase

8b.6.1.1 The construction of the IWMF at an artificial island near SKC is scheduled to commence in 2013 and complete in 2018. The proposed marine construction works would involve reclamation, and construction of breakwater, cofferdam and berth at Shek Kwu Chau; laying of submarine cable between Shek Kwu Chau and Cheung Sha; and construction of a landing portal at Cheung Sha (**Figure 8b.1**). More details on construction method and programme are presented in **Section 2**.

8b.6.1.2 The following table summarizes the habitats to be directly affected under the Project:

Table 8b.6 Sizes of Works Areas for the IWMF an Artificial Island near SKC

Shek Kwu Chau		
Reclamation	7.9 ha	
Cofferdam	2 ha	
Breakwater	4.1 ha	
Berth	1.9 ha	
Embayment	15.1 ha	
Anti-scouring layer	1.5 ha	
Cheung Sha		
Landing portal	20 m^2	
Along submarine cable alignment		
Submarine cable trench	5.8 km long, 17,400 m^2	
Fisheries Resources to be Directly Affected	**Size**	**Duration**
Shek Kwu Chau		
Fishing ground	31 ha	Permanent
Fish spawning and nursery ground	15.9 ha	Permanent
Along submarine cable alignment		
Fishing ground	5.8 km long, 17,400 m^2	Temporary

Direct Impact

Permanent Loss of Fishing Ground

8b.6.1.3 Assuming that the total area enclosed within the breakwater would become permanently inaccessible for fishermen during and after the construction phase (**Figure 1.2**), no capture fishing activities could be carried out in these areas. The total area of fishing ground to be lost would therefore be about 31 ha, including the reclamation area and the embayment enclosed within the breakwater.

8b.6.1.4 Based on the Port Survey 2006 (AFCD, 2011a), the potentially affected area supported low to moderate fisheries production (100-200 kg/ha). The proposed works area constitutes an insignificant portion of the total fishing areas in Hong Kong. The loss of

fisheries production would be insignificant in comparison to the total fisheries production in Hong Kong. The impact of permanent loss of fishing ground due to this Project is considered to be acceptable.

8b.6.1.5 Overall, in view of the small size of the affected area, and insignificant loss of fisheries production, the potential impacts on capture fisheries production are considered to be acceptable under the Project.

Permanent Loss of Spawning and Nursery Ground

8b.6.1.6 The Project would permanently occupy a total area of 15.9 ha for reclamation, and cofferdam, breakwater and berth construction. While the footprint of works overlaps with the previously identified potential important fish spawning and nursery ground, a permanent loss of the 15.9 ha of Fish Spawning and Nursery Ground would be resulted.

8b.6.1.7 Considering that the 15.9 ha of loss would only account for an insignificant amount of area of the previously identified important fish spawning and nursery ground in the southern waters, the predicted loss of 15.9 ha is considered to be insignificant.

8b.6.1.8 In addition, the fisheries baseline surveys (ichthyoplankton and post-larvae) conducted under *EIA-125/2006 Liquefied Natural Gas (LNG) Receiving Terminal and Associated Facilities: Part 2 South Soko* (CLP, 2006) concluded that, the densities for fish larvae and eggs at all sampling stations, including two sampling stations around Shek Kwu Chau (SKC1 and SKC2), at south and west Lantau waters were generally low; and the degree of difference in densities between stations were small. Therefore, it was suggested that there was no observable difference in fish larvae and egg densities between the identified spawning and nursery grounds at southern waters of Hong Kong, and the waters at Western Lantau, which was not identified to be important spawning and nursery grounds (*ibid.*). Such study supports that the loss of 15.9 ha of marine habitat due to the Project would be insignificant.

Temporary Loss of Fishing Ground

8b.6.1.9 During the submarine cable laying process (for details please refer to **Section 2**), the subsea burying machine would create a trench of about 5.8 km long (17,400 m^2) by performing water jetting. The cable would be laid into the trench spontaneously. As a result, temporary occupation of fishing ground in the works area during the cable laying process is expected. Considering that the submarine cable laying operation would only last for about 20 working days, the temporary loss of fishing ground due to submarine cable laying works is considered to be insignificant.

Indirect Impact

Changes in Water Quality

8b.6.1.10 Potential indirect impacts on fisheries resources would include changes in water quality due to marine construction works, including filling for reclamation area, dredging for anti-scouring protection layer, and submarine cable laying process.

Elevation of Suspended Sediments (SS)

8b.6.1.11 The proposed marine works would temporarily elevate the SS level and create sediment plumes. Effects on fisheries resources could be lethal or sublethal through reduction in survivorship, growth rate, and reproductive potential due to stress incurred by the need to flush out deposited material constantly. High SS level may clog the gill structure of fish and cause physical damage and hinder transfer of oxygen. Fish egg and larval fish (fry) are more susceptible to deleterious impacts from sedimentation through smothering and

clogging of their respiratory systems. Adult fish are generally less sensitive to effects from SS.

8b.6.1.12 SS plume occurs naturally in the marine environment by wave action and vertical flux of water current. Fish has evolved behavioural adaptation to fluctuation in turbidity, such as clearing their gills by flushing water, or simply moving to less turbid waters.

Filling for reclamation area

8b.6.1.13 According to the water quality impact assessment (**Section 5b.7.3.12 – 5b.7.3.21**), unacceptable level of SS elevation was predicted during unmitigated scenario of filling works for reclamation area. Other than silt curtain, control on use of fill material for filling works are proposed to minimise SS elevation, as presented in **Table 5b.10** under **Section 5b**. With the implementation of the proposed measures to minimise SS elevation, compliance with the SS criterion of elevation from 30% of the ambient SS would be achieved. No significant adverse impact from SS elevation due to filling for reclamation area is therefore anticipated.

Dredging works for anti-scouring layer

8b.6.1.14 According to the sediment plume quantitative assessment in water quality impact assessment (**Section 5b.7.3.22 – 5b.7.3.30**), if unmitigated, the influence zone of SS elevation is relatively large during the dredging and filling activities for the IWMF. As shown in **Table 7b.44**, the level of SS elevation due to the dredging operation would reach 697 mg/L under unmitigated scenario, which is far above the assessment criteria of elevation of 30% of the ambient SS level.

8b.6.1.15 In order to mitigate the potential impacts from SS elevation, it is proposed to reduce the dredging rate for anti-scouring protection to the suggested level of 380 m^3/day, with no more than 15 grabs per hour using grab size of approximately 2 m^3 for anti-scouring protection layer construction (**Table 5b.12-5b.13**). The extent of dredging area has also been limited, as shown in **Figure 5b.4**.

8b.6.1.16 After the adoption of silt curtain, reduction of dredging rate, and limitation on extent of dredging works, compliance with the SS criterion of 30% elevation from the ambient SS (i.e. 10.7 mg/L during dry season and 8.4 mg/L during wet season) would be achieved. It is therefore considered that adverse impact due to SS elevation from the dredging operation would not be anticipated.

Submarine cable laying

8b.6.1.17 According to the water quality impact assessment (**Section 5b.7.4.1 – 5b.7.4.7**), no significant water quality impact is predicted for the submarine cable laying process.

Culture Fisheries

8b.6.1.18 As discussed, adverse water quality impacts due to SS elevation would not be anticipated. No adverse impacts on the nearest Fish Culture Zone, Cheung Sha Wan FCZ (~6 km away from works), due to SS elevation would be expected.

Capture Fisheries

8b.6.1.19 As discussed, adverse water quality impacts due to SS elevation would not be anticipated. No adverse impacts on capture fisheries due to SS elevation would be expected.

Spawning and Nursery Ground of Commercial Fisheries

8b.6.1.20 As discussed, adverse water quality impacts due to SS elevation would not be anticipated. No adverse impact on the potential important spawning and nursery ground of commercial fisheries due to SS elevation from the dredging operation would be anticipated.

Contaminant Release during Dredging Activities

8b.6.1.21 Dredging activities can cause the release of contaminants from marine sediments. Potential impacts on fisheries resources include the accumulation of contaminants in fish tissues, resulting in sub-lethal effects which may alter behaviour, reproduction and increase susceptibility to disease. Eggs, larvae and juveniles are particularly susceptible to the sub-lethal effects of contaminants, and elevated levels may lead to increased mortality. Bioaccumulation in commercially important fish species may ultimately impact human health. The potential impacts on marine fauna would depend on several factors including species tolerance, contaminant levels, water flow rate, etc.

8b.6.1.22 According to the sediment quality monitoring survey conducted by EPD in 2008 (EPD, 2009), the monitoring station closest to the Project Site, SS6, reflected no sediment contamination. Based on the sediment testing results collected under this study, the assessment indicated that unacceptable elevation of contaminant levels due to the proposed marine works would be unlikely. Significant impact regarding bioaccumulation of heavy metals and organochlorines in adult fish, as well as fish egg, larvae and juveniles are therefore not expected.

Decrease of Dissolved Oxygen (DO)

8b.6.1.23 When the increased SS concentration in water column combined with other factors, the DO in the water column will reduce. Elevated SS reduces light penetration and lowers the photosynthetic rate of phytoplankton, resulting in lowered oxygen production. Moreover, dredging activities disturb bottom sediments and cause the release of inorganic substances from the seabed into water column. The sudden release of inorganic substances may cause eutrophication and algal bloom. Oxidation of dead algae during decomposition may lead to further oxygen depletion within the water column. If the concentration of oxygen becomes too low, fish, especially those in early life stages, may be unable to tolerate such condition and suffer from hypoxia-induced mortality and stress, including reduced feeding and growth rate, as higher metabolic demand for oxygen are required for the growth at these developmental stages.

8b.6.1.24 According to the **Water Quality Impact Assessment** (**Section 5b**), no significant DO depletion was predicted under this Project even under unmitigated scenario. The dredging activities would cause a maximum DO depletion of less than 0.1 mg/L at the nearest sensitive receiver (located 15 m away from works). Full compliance with the WQO for depth-averaged DO was predicted. Hence, no adverse impacts on fisheries, including the potential important spawning and nursery ground for commercial fisheries, due to changes in DO level would be expected.

Impact on Livelihood of Fisheries Operators

Culture Fisheries Operators

8b.6.1.25 While the nearest Cheung Sha Wan FCZ is not expected to receive adverse impact from water quality, the livelihood of mariculture fish operators would not be affected by the Project.

Capture Fisheries Operators

8b.6.1.26 Considering that the fishing area to be permanently lost (31 ha) is small in comparison with the rest of the fishing area in Hong Kong, and that the fisheries production was considered to be low to moderate, potential impacts on capture fisheries operators due to the permanent lost is considered to be acceptable.

8b.6.1.27 The loss of fishing ground during construction phase would affect the local fishermen who habitually fish there. While fishing ground of similar quality is largely available in the vicinity, fishermen who habitually fish within and around the Project Site could utilise the waters in the vicinity of the Project Site, hence the livelihood of the fishermen is not expected to be significantly affected.

8b.6.1.28 During construction, marine works may result in deterioration in water quality. The fisheries resources in the vicinity of Project Site may be affected by deterioration in water quality, hence affecting the livelihood of the capture fishers operating in the area. Nevertheless, with the proper implementation of the mitigation measures proposed in **Section 5b**, no adverse impacts on capture fisheries due to deterioration in water quality would be expected. Capture fisheries operators are therefore not expected to receive significant adverse impact due to deterioration of water quality.

8b.6.2 Operation Phase

Changes in Water Quality

8b.6.2.1 Potential sources of water quality impact associated with the operation of the IWMF include:

Wastewater from Incineration Plant and Mechanical Treatment Plant

8b.6.2.2 The IWMF would have zero discharge of wastewater during operation. A wastewater treatment plant would be provided on-site to treat the wastewater generated from the IWMF (mainly human sewage). The treated effluent would be reused on-site (e.g. landscape irrigation, floor/vehicle washing).

Discharge of Saline Water from Desalination Plant at Seawall Outfall

8b.6.2.3 Approximately 1,520 m^3/day of saline water would be generated from the proposed desalination plant and discharged to the sea at the southern boundary of the proposed reclamation site (**Figure 5b.6** under **Water Quality Impact Assessment**). The discharge of concentrated saline water at ambient temperature at the proposed seawall outfall may increase the salinity of water in the nearby waters.

8b.6.2.4 The brine water drained from the desalination plant would be concentrated seawater (about 1.7-1.8 time more concentrated than the raw seawater). There would be no temperature elevation in the brine water discharge as compared to the ambient water temperature. No other biocides / anti-fouling chemicals (such as chlorine and C-treat-6) would be used for the proposed desalination plant. Instead, membrane would be backwashed frequently to prevent fouling problem. The backwash water, which contains chemical for cleansing the membrane filter, would be diverted to the onsite sewage treatment works.

8b.6.2.5 According to the detailed discussion in the **Water Quality Impact Assessment** (**Section 5b.7.6.8 – 5b.7.6.14**), the saline water to be discharged from the desalination plant would comply with effluent discharge standard (**Table 5b.12**). With the adoption of a conservative approach during quantitative assessment, the maximum predicted downstream influence distance of the saline water discharge is about 72 m away from

the outfall (**Table 5b.17**). Considering marine fishes usually have a higher salt tolerance than their freshwater counterparts, and that the discharge would only include saline water with no biocides / anti-fouling agents; potential adverse impact fisheries to the discharge of saline water would be minimal.

Impingement and Entrainment

8b.6.2.6 At the proposed water intake point for water supply at the desalination plant, the pulling force at the intake point may damage the local fisheries resources, due to impingement (physical collision with the screen at intake point) and entrainment (uptake of fisheries resources along with seawater).

8b.6.2.7 Although the rate of the water intake is slow (2,460 m^3/day), however, for the adult and juvenile fish species that could not resist the pulling force at the water intake point, impingement may occur at the intake screen, due to their larger body size. For the smaller sized fish, larvae and eggs, entrainment may occur due to the pulling force from water intake.

8b.6.2.8 Considering that the results presented in the fisheries baseline surveys (ichthyoplankton and post-larvae) (CLP, 2006) concluded that the densities for fish larvae and eggs at all sampling stations in South and West Lantau waters were generally low; and there was no observable difference in fish larvae and egg densities between the identified spawning and nursery grounds at southern waters of Hong Kong, and that at Western Lantau, which was not identified to be important spawning and nursery grounds (*ibid.*), it is therefore considered that impacts on local fisheries resources due to impingement and entrainment is acceptable.

Impact on Livelihood of Fisheries Operators

8b.6.2.9 The loss of fishing ground during operation phase within and around the Project Site would affect the local fishermen who habitually fish there. While fishing ground of similar quality is largely available in the vicinity, fishermen who habitually fish within and around the Project Site could utilise the waters in the vicinity of the Project Site, hence the livelihood of the fishermen is not expected to be significantly affected.

Obstruction of Fishing Activities due to Anti-scouring Layer

8b.6.2.10 Upon completion of the installation of anti-scouring layer at the foot of breakwater and cofferdam, the anti*scouring layer would not protrude above the seabed, and therefore no obstruction of fishing activities is predicted.

8b.6.3 Overall Impacts

8b.6.3.1 The overall evaluation of construction and operation phases impacts associated with the Project is summarized in **Table 8b.7** below.

Table 8b.7 Fisheries Impact Evaluation during Construction and Operation Phases

Criteria	Construction Phase Impact	Operation Phase Impact
Nature of impact	Direct loss of 31 ha of fishing ground, and 15.9 ha of spawning and nursery ground. Considering the works area has low to moderate fisheries production, and constitutes an insignificant portion of the total fishing area in Hong Kong waters, the impact would be permanent, irreversible but acceptable.	Permanent loss of 31 ha of fishing ground, and 15.9 ha of spawning and nursery ground. Considering the Project Site has low to moderate fisheries production, and constitutes an insignificant portion of the total fishing area in Hong Kong waters, the impact would be permanent, irreversible but acceptable.

Criteria	Construction Phase Impact	Operation Phase Impact
	Temporary loss of 17,400 m^2 of fishing ground would be resulted from the laying of submarine cable between Shek Kwu Chau and Cheung Sha. As the cable laying process would only last for about 20 working days, the temporary loss of fishing ground is considered to be insignificant. Indirect impact on fisheries resources include elevation in suspended sediment level, contaminants release during dredging, and decrease in DO. With the adoption of water quality control measures, compliance with the SS criterion of elevation from 30% of the ambient SS level would be achieved. As unacceptable elevation of contaminant levels, and decrease in DO due to the works would be unlikely; full compliance with the WQO is predicted. Indirect impacts on fisheries resources would be temporary and reversible in nature.	Indirect impact due to discharge of saline water would be diluted by large volume of water. The effect would be permanent though localised and reversible. No impact from wastewater should arise, as 'zero discharge policy' would be adopted. As the Project Site is located within an important commercial fisheries' spawning and nursery ground, uptake and damage of fisheries resources (including fish larvae and egg) may be resulted at the proposed intake point due to entrainment and impingement. As previously study demonstrated limited fish larvae and egg densities in South Lantau waters, with the incorporation of screens at the water intake point, impacts from impingement and entrainment would be permanent, localized and acceptable.
Size of affected area	Small. Loss of 31 ha of fishing ground, and 15.9 ha of spawning and nursery ground. Temporary loss of 17,400 m^2 of fishing ground. Elevation of SS would be mitigated by water quality control measures. Sediment plume is predicted to be localized.	Small. Permanent loss of 31 ha of fishing ground, and 15.9 ha of spawning and nursery ground. The volume of saline water discharge would be small, and the influence zone of saline discharge be negligible at 72 m downstream from the outfall. Potential impact on fisheries resources due to entrainment and impingement would be localised and small.
Loss of fisheries resources / production	Small. Permanent loss of an insignificant portion (31 ha) of the total fisheries production in Hong Kong, and temporary loss of 17,400 m^2 of fishing ground.	Small. Permanent loss of an insignificant portion (31 ha) of the total fisheries production in Hong Kong. Negligible loss of fisheries resources is expected due to impingement and entrainment at the water intake point. Provision of a screen at the water intake point would minimise the loss.
Destruction and disturbance of nursery and spawning grounds	Low impact. Permanent loss of 15.9 ha, and temporary disturbance on 17,400 m^2 of spawning and nursery grounds in southern Lantau waters.	Low impact. Permanent loss of 15.9 ha of spawning and nursery grounds in southern Lantau waters. Potential impact on loss of spawning and nursery fisheries resources due to

Criteria	Construction Phase Impact	Operation Phase Impact
		impingement and entrainment would be minimised with the implementation of a screen at intake point.
Impact on fishing activity	Low impact. The fishing ground in the vicinity of the IWMF supported a low to moderate number of vessels, and low to moderate production of fisheries in terms of weight and value. The size of fishing ground to be affected is insignificant in comparison with the total area of fisheries habitat and fishing ground in Hong Kong. The affected vessel could fish in other areas in nearby waters.	Low impact. The fishing ground in the vicinity of the IWMF supported a low to moderate number of vessels, and low to moderate production of fisheries in terms of weight and value. The size of fishing ground to be affected is insignificant in comparison with the total area of fisheries habitat and fishing ground in Hong Kong. The affected vessel could fish in other areas in nearby waters.
Impact on aquaculture activity	No adverse water quality impact on aquaculture activity is predicted at the nearest Cheung Sha Wan FCZ.	No impact on aquaculture activity is predicted.
Overall fisheries Impact	**Low**	**Low**

8b.7 Evaluation of Cumulative Environmental Impacts

8b.7.1.1 Two major projects may be carried out concurrently with the IWMF at the artificial island near SKC:

ESB-209/2009 – Outlying Islands Sewerage Stage 2 - South Lantau Sewerage Works (2013-2017)

Marine works

8b.7.1.2 The concurrent project would involve the construction of a Sewage Treatment Works (STW) at San Shek Wan. Although the STW building would be located outside the study area of the IWMF at Cheung Sha, nevertheless, its associated submarine outfall, which is approximately 800 m in length and 300 mm in diameter, would extend from the shore of San Shek Wan into the Southern Water Control Zone. The proposed submarine outfall of the concurrent project would require dredging works.

8b.7.1.3 While the tentative construction schedule for the IWMF at an artificial island near SKC is 2013 to 2018, there may be an overlapping period for the 2 projects. As the water quality impacts generated from the proposed reclamation and submarine cable installation works are predicted to be localized in the Water Quality Section, no significant cumulative impact on fisheries resources due to water quality would be anticipated.

ESB-187/2008 – Improvement of Fresh Water Supply to Cheung Chau (2010 – 2013)

Marine works

8b.7.1.4 This concurrent project would construct a submarine water main across Adamasta Channel, between Northern Channel of Cheung Chau and Chi Man Wan Peninsula, to replace the existing submarine water main. Works of the concurrent project that would overlap with the IWMF include the laying of submarine cable (~1400m in length and

~500mm in diameter) across Adamasta Channel within the Southern Water Control Zone.

8b.7.1.5 According to the tentative schedule of the concurrent project, which is 2010 to 2013, the submarine water main laying works may overlap with the construction phase for the IWMF at an artificial island near SKC (2013-2018). As the replacement works for submarine water main would be conducted by horizontal directional drilling through the bed rock, in which the seabed would not be disturbed; and that the water quality impacts generated from the IWMF marine works are predicted to be localized in the Water Quality section, no significant cumulative impact on fisheries resources due to water quality would be anticipated.

8b.8 Mitigation of Environmental Impacts

8b.8.1.1 Following EIAO-TM Annex 17, mitigation measures are discussed in this section to avoid, minimize, and compensate for the identified fisheries impacts. As the overall fisheries impact is considered to be low for construction and operation phases, no mitigation measure specifically for fisheries resources is recommended.

8b.8.1.2 In order to minimise environmental impacts during construction phase, alteration to the phasing of works, construction method, and layout plan of the IWMF at the artificial island near SKC have been made (**Section 2** for details). The total fishing ground to be permanently lost due to the project has been significantly reduced from ~50 ha to ~31 ha. By adopting the cellular cofferdam construction method, instead of the conventional seawall and breakwater construction method, SS elevation would be greatly reduced, minimising adverse impact on the health of fisheries resources. A more detailed construction programme is presented in **Table 2.5**.

8b.8.1.3 In order to minimise the risk of impingement and entrainment of fisheries resources (including fish, larvae and egg) through the intake point, provision of a screen at the water intake point for desalination plant would be essential.

8b.8.1.4 In order to minimize and control the water quality, no wastewater effluent, anti-fouling agent, heavy metals and other contaminants would be released during operation phase of the Project. Mitigation measures recommended in the water quality impact assessment during construction and operation would serve to protect fisheries resources from indirect impacts resulted from the Project.

8b.8.1.5 Some of the recommended mitigation measures include the following:

- Dredging rate of no greater than 380 m^3/day should be adopted to meet the Water Quality Objective;
- Dredging should be carried out by closed grab dredger (no more than 15 grabs per hour using grab size of approximately 2 m^3) to minimize release of sediment and other contaminants during dredging;
- Silt curtains should be deployed around works area to minimize the potential impact of elevated SS level and sedimentation from dredging;
- Temporary sanitary facilities should be employed on-site to handle sewage from the workforce;
- Barges should be loaded carefully to avoid splashing of material; and
- All barges should be fitted with tight bottom seals to prevent leakage of material during loading and transporting.

8b.8.1.6 More description on measures to mitigate water quality impact is presented in **Section 5b.8**.

8b.8.1.7 Artificial Reefs (ARs) are proposed to be deployed within the proposed marine park under this Project as an enhancement measure for the marine habitats. The creation of hard surfaces increases the complexity of marine habitats by offering various micro-habitats, and provides opportunities for marine organisms to develop within the AR, including fish. This enhancement feature would bring positive impacts to the previously identified important spawning and nursery ground for fisheries resources. More details are discussed in **Section 7b.7**.

8b.8.1.8 Release of fish fry has been proposed under this Project. The proposed deployment of ARs with various micro-habitats within the proposed marine park would provide shelter and nursery ground for the released fish fry. The frequency and quantity of fry to be released should be agreed by AFCD.

8b.9 Evaluation of Residual Environmental Impacts

8b.9.1.1 Residual impacts arised from the Project include the permanent loss of 31 ha of fishing ground, and 15.9 ha of spawning and nursery grounds of commercial fisheries resources. The areas of fishing, and spawning and nursery grounds to be lost are considered to be small, in comparison with the total area of fisheries habitat and fishing ground in Hong Kong. The residual impacts from this Project are therefore considered to be acceptable.

8b.10 Environmental Monitoring and Audit

8b.10.1.1 With the implementation of the mitigation measures for water quality, as recommended in the water quality impact assessment (**Section 5b.8**), no unacceptable fisheries impacts would be resulted from the Project. No monitoring programme for fisheries is recommended.

8b.11 Conclusion

8b.11.1.1 Permanent loss of 31 ha of fishing ground, and 15.9 ha of previously identified fisheries spawning and nursery ground is expected to arise due to the IWMF footprint. Temporary loss of 17,400 m^2 of fishing ground would be resulted from the laying process of submarine cable. Potential impact from impingement and entrainment of fisheries resources would be minimized by provision of screen at the seawater intake, in order to minimise the uptake of fisheries resources. Indirect impact on fisheries due to elevation in SS level would be temporary and localized. Mitigation measures such as adoption of silt curtain, reduced dredging rate, and phasing of marine works have been recommended, in order to minimise adverse impact on water quality, hence protecting fisheries resources.

8b.11.1.2 With the proper implementation of the recommended mitigation measures, potential impact on fisheries due to the proposed Project is considered to be acceptable.

8b.12 References

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