

## **8. FISHERIES IMPACT ASSESSMENT**

### **8.1 Introduction**

8.1.1 This section presents the findings of an assessment of potential impacts on existing capture and culture fisheries, including fisheries resources, fishing operations and fish culture activities, from the construction and operation of the proposed Project. It summarizes baseline information on fisheries production around Mirs Bay Water Control Zone (WCZ) and its vicinity gathered from literature review. The assessment of fisheries impacts is based on the Project Description (*Section 2*) and the findings of the Water Quality Assessment (*Section 5*).

### **8.2 Relevant Legislation & Assessment Criteria**

#### 8.2.1 Technical Memorandum

The criteria for evaluating fisheries impacts are stated in the *EIAO-TM Annex 17* of the EIAO-TM prescribes the general approach and methodology from assessing fisheries impacts caused by a project or proposal, to allow a complete and objective identification, prediction and evaluation of the potential impacts. *EIAO-TM Annex 9* recommends the criteria that are to be used for evaluation of fisheries impacts.

#### 8.2.2 Other Legislation

Other legislation which applies to fisheries includes:

- *Fisheries Protection Ordinance (Cap. 171)*, which provides for conservation of fish and other aquatic life, regulates fishing practices and prevents activities detrimental to the fishing industry.
- *Marine Fish Culture Ordinance (Cap. 353)*, which regulates and protects marine fish culture and other related activities and requires all marine fish culture activity to operate under license in designated Fish Culture Zones.
- *Water Pollution Control Ordinance (Cap. 358)*, which aims to control water pollution in Hong Kong waters. Water Control Zones (WCZs) are designated with individual water quality objectives to promote the conservation and best use of those waters in the public interest.
- *Environmental Impact Assessment Ordinance (Cap. 499)*, Section 5(7) – Environmental Impact Assessment Study Brief No. ESB-253/2012 Section 3.4.7 and Appendix G which outline the key fisheries impacts to be reviewed and assessed in the EIA Report.

### **8.3 Baseline Conditions & Fisheries Sensitive Receivers**

The Study Area for fisheries is the same as that for the Water Quality Impact Assessment (see *Section 5*) and includes other areas likely to be impacted by the Project, particularly area with significant fisheries resources and fishing activities, spawning and nursery grounds, and the Fish Culture Zones.

A desktop review of existing information on commercial fisheries resources and fishing operations in waters of the Study Area has been undertaken, and the most up-to-date information was obtained primarily from the Agriculture, Fisheries and Conservation Department (AFCD). For a detailed description of the physical and biological characteristics of the marine environment of the Study Area please refer to *Sections 5 and 7* respectively.

#### 8.3.1 Overview of Hong Kong Fisheries

Marine-based commercial fishing operations in Hong Kong are broadly classified into capture and culture fisheries.

*Capture Fisheries*

Capture fisheries is primarily concentrated in the waters of Hong Kong, the Pearl River Estuary and the adjacent continental shelf of the South and East China Seas <sup>(1)</sup>. The AFCD reported that in 2014 an estimated 160,789 tonnes of fish was produced, which was equivalent to an economic value of about HK\$2,530 million <sup>(2)</sup>. In addition, 9,400 local fishermen with approximately 4,500 vessels were servicing in the fishing industry <sup>(3)</sup>. Most fishing vessels are manned by family members with the assistance of hired crew. The major fishing methods include trawling, long-lining, gill-netting and purse-seining with the majority of the total catch obtained through trawling. Recent data on local capture fisheries industry are summarized in *Table 8.1*.

**Table 8.1 – Hong Kong Capture Fisheries Industry Summary Statistics 2002 – 2014 (source: AFCD)**

Year	Fishing fleet size (no. of vessels)	No. of Local fishermen engaged in capture	Production (tonnes)	Value of capture produce (HK \$M)
2002	4,770	10,860	169,790	1,600
2003	4,630	10,130	157,440	1,600
2004	4,330	9,770	167,540	1,600
2005	4,150	9,170	162,000	1,600
2006	3,950	8,500	155,000	1,600
2007	4,000	8,500	154,000	1,530
2008	3,800	7,900	158,000	1,780
2009	3,700	7,600	159,000	2,000
2010	3,900	8,200	168,000	2,100
2011	4,026	8,500	170,720	2,358
2012	3,992	8,800	155,230	2,317
2013	3,988	8,800	170,129	2,338
2014	4,500	8,800	160,789	2,530

Based on the latest data from AFCD Port Survey 2006, the highest fisheries production (600 to 1,000 kg ha<sup>-1</sup>) in Hong Kong was recorded in the vicinity of the eastern and northeastern coasts including Ninepin Island Group, Po Toi and Tap Mun <sup>(4)</sup> and these areas also recorded the highest number of fishing vessels. The top 10 families captured in Hong Kong waters were: Scad (Carangidae), shrimp, rabbitfish (Siganidae), squid, croaker (Sciaenidae), crab, mullet (Mugilidae), sardine (Clupeidae), seabream (Sparidae) and anchovy (Engraulidae).

Previous studies indicated that fry collection has become very limited throughout Hong Kong waters <sup>(5)</sup>. Fish fry production was concentrated in the eastern waters,

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<sup>(1)</sup> Sumaila, U. R., Cheung, W. and I. Teh (2007) Rebuilding Hong Kong's Marine Fisheries: An Evaluation of Management Options. Fisheries Centre Research Reports 15 (3). pp.112.  
<sup>(2)</sup> AFCD (2015), available on: [https://www.afcd.gov.hk/english/fisheries/fish\\_cap/fish\\_cap.html](https://www.afcd.gov.hk/english/fisheries/fish_cap/fish_cap.html)  
<sup>(3)</sup> *Ibid.*  
<sup>(4)</sup> *Ibid.*  
<sup>(5)</sup> ERM (1998). Study of Fisheries Resources and Fishing Operations in Hong Kong Waters, AFD.

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although a minor production was also reported in the East Lamma Channel and Po Toi.

To promote the sustainable development of fishing industry and to conserve fisheries resources in Hong Kong waters, AFCD has implemented a number of fisheries management and conservation measures. On 31 December 2012, an outright trawling ban was put into effect in an attempt to restore the seabed and the depleted fisheries resources <sup>(6)</sup>. To complement the trawl ban and bring local fisheries industry back to a sustainable path, the government seeks to implement other fisheries management measures through legislative amendments to the Fisheries Protection Ordinance (Cap. 171). These measures include:

1. Setting up a registration system for local fishing vessels;
2. Limiting new entrants and maintaining an appropriate level of fishing effort;
3. Restricting fishing activities of non-fishing vessels and prohibiting fishing activities of non-local fishing vessels;
4. Designation of fisheries protection areas;
5. Habitat enhancement and restoration (i.e. artificial reefs); and
6. Fish restocking exercises.

Since 1999, Mainland Authorities (The Bureau of Fisheries Management and Fishin Port Superintendence of the Ministry of Agriculture in the Mainland) have implemented a fishing moratorium for South China Sea fishing grounds for about 2.5 months during mid-summer (between 16 May to 1 August). The moratorium prohibits fishing activity by the Hong Kong fleet outside of Hong Kong waters using trawl net, purse-seine, hang trawl and cage trapping in order to conserve fisheries resources and promote sustainable development of the fishing industry <sup>(7)</sup>.

#### *Culture Fisheries*

Marine fish culture operations occur at 26 Fish Culture Zones (FCZs) which altogether occupy about 209 ha of Hong Kong waters with some 968 licensed operators. They involve rearing of marine fish from fry or fingerlings to marketable size in cages suspended by floating rafts usually in sheltered coastal areas/embayments. Most licensed fish farms are typically small scale, family-based operations comprising only one or two rafts with average total area of about 290 m<sup>2</sup>.

With effect from June 2002, the marine fish culture licence is transferable. The existing moratorium for FCZs has been reviewed and the following new measures are proposed to promote the sustainable development of the local fisheries industry, including <sup>(8)</sup>:

1. Issue new marine fish culture licences in three FCZs (i.e. O Pui Tong, Wong Wan and Sham Wan FCZs) with approximately 30 new marine fish culture license to be issued at the initial stage;

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<sup>(6)</sup> *Ibid.*

<sup>(7)</sup> AFCD (2000). Information Note on Fishing Moratorium in the South China Sea. Paper presented in Legislative Council Panel on Health Services.

<sup>(8)</sup> AFCD (2013). Marine Fish Culture in Hong Kong. Paper presented in Legislative Council Panel on Food Safety and Environmental Hygiene

2. Expand the existing FCZ at Yim Tin Tsai to rearrange and spread out the existing rafts within the expanded zone with no net increase in the total licensed raft area;
3. Identify any potential sites for designation of new FCZs; and,
4. Impose licensing conditions and provide appropriate support to encourage the mariculture industry to adopt new technologies and management practices.

In 2014, the marine fish culture industry produced about 1,255 tonnes of fish valued at HK\$115 million which accounts for about 6 % of local demand for live marine fish. The fish species commonly cultured in FCZs are of high commercial value including the green grouper (*Epinephelus coioides*), brown-spotted grouper (*Epinephelus chlorostigma*), giant grouper (*Epinephelus lanceolatus*), Russell's snapper (*Lutjanus russellii*), mangrove snapper (*Lutjanus argentimaculatus*), goldlined seabream (*Rhabdosargus sarba*) and star snapper (*Lutjanus stellatus*). Some recent figures on the local marine culture fisheries are presented in *Table 8.2* below.

**Table 8.2 – Marine Culture Fisheries Summary Statistics 2002 – 2014 (source: AFCD)**

Year	Licensed Mariculturists	Production (tonnes)	Value (HK\$ million)
2002	1,237	1,210	57
2003	1,157	1,490	76
2004	1,125	1,540	79
2005	1,104	1,540	76
2006	1,081	1,490	89
2007	1,072	1,530	99
2008	1,060	1,370	82
2009	1,050	1,437	92
2010	1,035	1,512	118
2011	1,010	1,185	94
2012	1,008	1,299	117
2013	987	1,005	94
2014	968	1,255	115

### 8.3.2 Capture Fisheries in the Study Area

#### *Fishing Operations*

The area and number of vessels operating in the Study Area during 2005 are presented in [Figure 8.1](#). It should be noted that trawling was still allowed at time when the Port Survey was conducted in 2005. Small numbers of fishing vessels (10 – 100 vessels), mostly sampans and purse seiners, operated in waters around the proposed STKSTW expansion and submarine outfall in 2005. Elsewhere within the Study Area, moderate number of vessels (100 – 400 vessels) were recorded near Ap Chau, Kat O, Yan Chau Tong, Lai Chi Wo and Wong Wan. The vessels, which are less than 15 m in length, are the major type of fishing operation vessels in northeastern waters.

#### *Fishing Production*

The level of fisheries production in the waters around Sha Tau Kok Area in 2005 is presented in [Figures 8.2](#) and [8.3](#).

Data from the AFCD Port Survey 2006 indicated that fisheries production in waters around the submarine outfall of the proposed STKSTW ranged 0 – 100 kg ha<sup>-1</sup> for adult fish ([Figure 8.2](#)) accounting for HK\$ 1,000 – 5,000 ha<sup>-1</sup> in value ([Figure 8.3](#)). Key fish families recorded by Port Survey 2006 include Siganidae (Rabbitfish), Engraulidae (Anchovy), Sciaenidae (Croaker) and Sparidae (Seabream).

In comparison to other areas of the Hong Kong fishing ground, fisheries production in the waters around Sha Tau Kok Area is low. Other areas of high fisheries production include areas around Cheung Chau, Lamma Island, the Ninepin Island Group, the Soko Islands, the Po Toi Island Group and Tap Mun.

#### *Fish Fry Production*

As presented in [Figure 8.4](#), there is no record of fish fry catches within the direct footprint of the submarine outfall pipelines. Other areas of fish fry production outside of the direct footprint of submarine outfall pipeline area include the Po Toi Island Group, Port Shelter and Tap Mun.

### 8.3.3 Culture Fisheries in the Study Area

Six AFCD designated Fish Culture Zones (FCZs) are located in the northeastern part of Hong Kong in the Mirs Bay in the vicinity of the Study Area ([Figure 8.5](#)):

1. Sha Tau Kok FCZ (1.17 km from the diffuser of the proposed submarine outfall);
2. Ap Chau FCZ (3.25 km from the diffuser of the proposed submarine outfall);
3. Kat O FCZ (5.17 km from the diffuser of the proposed submarine outfall);
4. O Pui Tong FCZ (6.29 km from the diffuser of the proposed submarine outfall);
5. Sai Lau Kong FCZ (5.17 km from the diffuser of the proposed submarine outfall);
6. Wong Wan FCZ (8.08 km from the diffuser of the proposed submarine outfall).

There are no pond culture resources and activities in the northeastern part of Hong Kong where the Project is located.

### 8.3.4 Spawning Areas

The northeast waters were identified in 1998 as fisheries spawning grounds for high value commercial species ([Figure 8.5](#))<sup>(9)</sup>. The key species recorded spawning in the northeast waters include *Leiognathus brevirostris* (shortnose ponyfish), *Konosirus punctatus* (gizzard shad) and *Metapenaeopsis palmensis* (southern velvet prawn). The recognized spawning grounds at the northeast waters are located > 2 km east of the proposed submarine outfall.

### 8.3.5 Nursery Areas

Nursery areas in Hong Kong waters that are important habitat area for a number of commercial juvenile fish and crustacean species have been previously identified along northeast waters, across southern waters from Lantau Island to Lamma Island and within Port Shelter waters<sup>(10)</sup>, whilst no nursery ground was identified within the direct footprint of the submarine outfall of the proposed STKSTW ([Figure 8.5](#)). The identified nursery grounds are located > 2 km east of the proposed submarine outfall.

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<sup>(9)</sup> ERM (1998) Fisheries Resources and Fishing Operations in Hong Kong waters.  
<sup>(10)</sup> *Ibid.*

### 8.3.6 Artificial Reef Deployment

The AFCD has been undertaking a programme to enhance existing marine habitats and fisheries resources through the siting, construction and deployment of artificial reefs (ARs) since 1996. Generally ARs provide hard bottom, high profile habitat in areas without natural cover and may potentially act as fish enhancement devices. The Yan Chau Tong Marine Park and O Pui Tong ARs were deployed with the key objective of enhancing the marine habitat quality and fisheries resources ([Figure 8.5](#)). A total of 19,820 m<sup>3</sup> consisting of boat, tyre, concrete-coated tyre, quarry rock, pre-cast concrete and biofilter core have been deployed on the seabed from 1998 to 2003 in Yan Chau Tong Marine Park. For O Pui Tong, a total of 4 units with volume of 200 m<sup>3</sup> tyre modules were deployed in 2000. They are located at least 5.88 km away from the proposed submarine outfall.

### 8.3.7 Sensitive Receivers

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

- Fish Culture Zones at Sha Tau Kok, Ap Chau, Kat O, O Pui Tong, Sai Lau Kong and Wong Wan (at least 1.17 km away from the diffuser of the proposed submarine outfall);
- Recognized spawning and nursery ground of commercial fisheries resources at northeast waters (at least 2 km away from the diffuser of the proposed submarine outfall); and
- Artificial reefs at Yan Chau Tong Marine Park and O Pui Tong (at least 5.88 km away from the diffuser of the proposed submarine outfall).

The locations of the sensitive receivers are shown in [Figure 8.5](#).

### 8.3.8 Fisheries Importance

Based on the baseline information provided above, the importance of the fisheries within the Study Area is evaluated. The fishing areas within and in the vicinity of the Project's footprint are considered to be of low to moderate commercial value. Also considering the small size of these areas at Starling Inlet (464 ha), the Project Area is considered as of low importance to the Hong Kong fishing industry.

According to *Annex 9* of the *EIAO-TM*, spawning and nursery grounds can be regarded as an important habitat type as they are critical to the regeneration and long-term survival of many organisms and their populations. However, no spawning and nursery area has been identified within the footprint of the proposed submarine outfall of the Project. The closest recognized spawning area is located at least 2 km east of the Project site. The closest artificial reefs are also over 5 km from the Project site. Considering the separation distances between the Project and these fisheries sensitive receivers, it is considered that the Project Area is of low importance to fisheries resources.

The waters surrounding the Project's footprint and its vicinity support mariculture activities with six designated FCZs located in northeast waters. The closest FCZ is about 1 km away from the diffuser of the proposed submarine outfall. It is considered that the Project Area is of moderate importance to culture fisheries.

Results from the review indicate that fisheries importance of the Project Area and its vicinity is low when compared to other waters of Hong Kong. Therefore, it is considered that further fisheries field surveys around the Project area are not

necessary for the impact assessment given the small scale of the marine construction works with temporary loss of 1 ha fisheries habitat and fishing ground.

#### **8.4 Assessment Methodology**

A desktop literature review of baseline fisheries conditions was conducted for the purpose of establishing the fisheries importance of the waters in the vicinity of the proposed expansion of STKSTW at Sha Tau Kok. Information from the water quality impact assessment (*Section 5*) was examined to refine the size of the Study Area as that is potentially affected by perturbations to water quality parameters. This area, refined to within 7 km from the Project facilities, became the main focus for this fisheries impact assessment. The importance of potentially impacted fisheries resources and fishing operations, and aquaculture activity within this area was studied. The potential impacts due to the construction and operation of the Project were then assessed (with reference to the *EIAO-TM Annex 17*) and the impacts evaluated (with reference to the criteria in *EIAO-TM Annex 9*).

#### **8.5 Potential Impacts & Impact Assessment on Fisheries Resources**

##### **8.5.1 Construction Phase**

- Direct disturbances of fisheries habitat, fishing ground, fishing operations and aquaculture activity; and,
- Perturbations to key water quality parameters.

##### *Disturbance to fisheries habitat, fishing ground, fishing operations and aquaculture activity*

Direct impacts to fisheries resources, habitats and fishing operations include disturbance caused by marine construction works (i.e. the construction of discharge outfall and the construction of diffusers).

As trenchless construction technique (i.e. HDD) will be used for the construction of submarine discharge outfall which does not require dredging along the submarine outfall alignment, it is anticipated that seabed sediments would not be disturbed and disturbance to fisheries habitat and fishing ground is hence not expected.

The submarine outfall diffuser will be installed within the cofferdam to be constructed at Starling Inlet. It is expected to cause temporary loss of approximately 1 ha of fisheries habitat and fishing ground which will last for approximately 27 months (September 2018 – November 2020), including the works area for work vessels. In addition, there will be 0.042 ha permanent loss of fishing ground due to the construction of the diffuser erected above the seabed and the loss of fishing ground has been minimised using HDD method for the construction of submarine outfall. Owing to the very small area of the fisheries habitat and fishing ground lost to the marine construction works when compared to the 464 ha sea area at Starling Inlet and due to its low fisheries importance, unacceptable impacts to local fisheries resources, habitats and fishing operations are not expected. Fisheries resources are expected to return to the area following the cessation of marine construction activities. Issuance of Marine Department Notice or other notification is expected to reduce the risk of collision of increased marine traffic and fishing vessels to within acceptable levels.

##### *Perturbations to key water quality parameters*

Indirect impacts to fisheries resources, habitats and fishing operations during the construction phase are primarily associated with the suspension of sediments due to the marine works. Potential impacts to water quality from sediment release due to the installation of sheetpiles (and removal after the completion) for cofferdam

installation at submarine outfall, decommissioning of existing submarine outfall, vessel discharges and land-based site runoff from construction workforce as described in the water quality impact assessment in *Section 5*. Potential impacts to water quality from sediment release are as follows:

- Increased concentrations of suspended solids (SS);
- Decreased dissolved oxygen (DO) concentrations;
- An increase in nutrient concentrations in the water column; and
- Elevation of heavy metals and micro-organic pollutants.

During construction period, discharges and runoff from the site, particularly during excavation and backfilling works, will contain SS which could be a source of water pollution. Drill cuttings (rock debris from drill hole) would be separated from used HDD drilling fluid and be disposed of as fill material onsite while used drilling fluid would be reconditioned (if required) and be reused as far as practicable. Spent drilling fluid which is no longer fit for reuse would be dewatered and disposed at landfill. Uncontrolled disposal of debris and rubbish such as packaging, construction materials and refuse and spillages of chemicals stored on-site, such as drilling fluid, oil, diesel and solvents would also result in contamination of construction site runoff. However, it is anticipated that no unacceptable water quality impacts would arise from the land-based works if standard site practices and mitigation measures, described in *Section 5.9.4*, are in place and properly implemented.

Sediment or SS could be lethal or sublethal to fish and other fisheries resources through reduction in survivorship, growth rate and reproductive potential due to stress incurred by the need to constantly flush out deposited material. High SS level may clog 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 burial and clogging of their respiratory systems. Adult fish are more likely to move away when they detect certain SS level and therefore less sensitive to effects from SS.

Increase in SS in water column combining with a number of other physical or biotic factors would reduce DO in water column. Elevated SS reduces light penetration, lowers the photosynthetic rate of phytoplankton and eventually would lower the rate of oxygen production in water column. Also, the release of inorganic substances from the sediments may cause eutrophication and algal bloom. Oxidation of dead algae may use up some of the oxygen in the water. If oxygen levels are depleted to low levels, fish, especially those in early life stages may be unable to tolerate such conditions and suffer hypoxia-induced mortality and / or stress including reduced feeding and growth rate.

Sediment-bounded nitrogenous compounds could also be released into the water column and result in an increase of nutrients (total inorganic nitrogen - TIN and unionized ammonia - UIA). High levels of nutrients may potentially cause rapid increase in phytoplankton population, on occasions to the point that an algal bloom occurs. An intense algal bloom can cause sharp decrease in the levels of DO. This decrease in DO would initially occur in the surface water, and then spread to deeper water as dead algae fall through the water column and decompose on the seabed.

Aside from the effects of SS, DO and nutrient release on the water column, the Project works have the potential for release of heavy metals and micro-organic pollutants which may impact fisheries in terms of:

- accumulation of contaminants in the tissue of fish and invertebrates resulting in sublethal effects which may affect behaviour, reproduction and increasing susceptibility to disease; and;
- increased mortality, and sub lethal effects to, eggs, larvae and juvenile species, as these are particularly sensitive to elevated contaminant concentrations.

According to the water quality impact assessment in *Section 5*, sediment release due to the installation of sheetpiles (and removal after the completion) for cofferdam installation at submarine outfall, decommissioning of existing submarine outfall, vessel discharges and surface runoff from land-based construction activities near the coastal waters would not cause any significant change in sediment, SS, organic and inorganic water pollutants. It is also predicted that the construction of submarine outfall diffuser under this Project would be in compliance with the corresponding SS, DO, TIN and UIA criteria of WQO. Therefore, it is unlikely to cause unacceptable impact on the aquatic environment from an ecotoxicological point of view. Moreover, all important fisheries resources, such as fish spawning and nursery grounds, FCZs, and artificial reefs are at large distances (> 1km) away from the proposed works area. With the implementation of mitigation measures proposed in water quality impact assessment in *Section 5*, such as the use of silt removal facilities, and effective site drainage would minimize any impacts to the marine environment resulting from land-based construction activities. No unacceptable impact associated with water quality change is expected on fisheries resources during the construction phase.

#### 8.5.2 Operation Phase

As the cofferdam will be removed after the completion of proposed submarine outfall construction, permanent loss of fishing ground will be limited to the location of the submarine outfall diffuser erected above the seabed, which is of 0.042 ha size. There will be no loss of habitat in the water column. From the evaluation of the productivity and value of the local fisheries in Section 8.3, the affected area is considered as of low fisheries importance. Overall, the very small size and low fisheries importance of the affected area suggest that unacceptable impacts to fisheries caused by permanent loss of fishing ground are not expected to occur. The potential impact of the operational phase of the Project on the fisheries of the Study Area would be the change in the hydrodynamic regime and water quality due to the operation of TSTP (interim scenario) and the expanded STKSTW (operation scenario).

Based on the TSTP design, there would not be a net increase in pollution loading from the operation of the TSTP as compared with the operation of the STKSTW at present. Therefore, it is predicted that the TSTP operation would not result in the change in levels of TIN, UIA, SS, DO and *E. coli* for the Sha Tau Kok FCZ (420 m away from the diffuser of the existing submarine outfall). All other important fisheries resources, such as fish spawning and nursery grounds, FCZs, and artificial reefs are at large distances (> 2 km) away from the outfall, and no unacceptable change in water quality is predicted at these sensitive receivers. With the operation of the expanded STKSTW, treated effluent would be discharged at the proposed new submarine outfall located further away from the Sha Tau Kok FCZ at the opening of the Starling Inlet embayment which favours the effluent dispersion and material exchange. Although there is an increase in effluent flow rate (1,660 m<sup>3</sup>/day to 10,000 m<sup>3</sup>/day), it is predicted that the levels of DO, TIN, UIA, SS and *E. coli* would comply to the WQO criteria at STKFCZ (1.17 km away from the diffuser of the new submarine outfall) and all other sensitive receivers (> 2 km away from the diffuser of the new submarine outfall). There would be no unacceptable impact from the operation of the expanded STKSTW on the fisheries resources and fishing operations.

Therefore, the impact due to discharge of treated effluent under both interim and operation scenarios on fisheries resources is considered acceptable.

As discussed in *Section 5.8*, precautionary measures have been taken into account in the design and initial commissioning of the TSTP and expanded STKSTW to minimize the risk of discharge of untreated or incompletely-treated sewage into the marine water of Starling Inlet under emergency situation. In the event that such situation occurs, it is predicted that the change in levels of DO, SS, UIA and *E. coli* is localised around the safety outlet of the TSTP and expanded STKSTW after a 2-hour emergency discharge. The change in levels of DO, SS, UIA and *E. coli* at the FCZs, including the nearest Sha Tau Kok FCZ, is limited and would not result in unacceptable change in levels of DO, SS, UIA and *E. coli* at the FCZs. No unacceptable impact to the aquaculture activities at the FCZs is thus expected from such emergency situation. In addition, it is predicted that the water quality would recover to ambient levels within a short period of time (3 to 10 days) after such emergency discharge (see *Section 5*). Therefore, the impact from the emergency discharge of the TSTP and the expanded STKSTW on fisheries resources is considered to be temporary and insignificant. Given the unlikely occurrence of emergency discharge with the application of the precautionary measures and the temporary change in water quality after an emergency discharge, there would be no unacceptable impact from such situation on the fisheries resources and fishing operations.

## **8.6 Impact Evaluation**

From the information presented above, the fisheries impact associated with the Project is not considered to be significant. An evaluation of the impacts accordingly to *Annex 9* of the *EIAO-TM* is presented below.

### **8.6.1 Nature of Impact**

Permanent impacts are predicted to occur as a result of the loss of fishing ground in the 0.042 ha area to be used for installation of submarine outfall diffuser. Temporary disturbance to fishing grounds in the Project's marine works area is expected. Temporary and localized impacts to pelagic and demersal fisheries resources as a result of perturbations to water quality are predicted to occur only in the immediate vicinity of the works area.

### **8.6.2 Size of Affected Area**

The construction and operation of the Project is predicted to result in the permanent loss of approximately 0.042 ha of fishing ground on the seabed only. In addition, the construction of the Project is predicted to result in the temporary loss of approximately 1 ha of fisheries habitat and fishing ground, including the works area for work vessels. This loss is considered to be insignificant for local fishery resources and fishing operations given the very small size of fisheries habitat and fishing ground loss and low fisheries importance in these waters.

### **8.6.3 Loss of Fisheries Resources/Production**

The value of the fisheries resources/ production of the marine waters around the submarine utilities is low in comparison to other waters in Hong Kong. The area affected is very small.

### **8.6.4 Destruction and Disturbance of Nursery and Spawning Grounds**

No important spawning or nursery grounds have been identified within the Project Area. The recognized spawning and nursery grounds at Mirs Bay lie at least 2 km from the proposed Project. As the water quality modelling results have indicated

that impacts to water quality are predicted to be localised and short-term, impacts to the identified nursery and spawning grounds are not expected to occur.

8.6.5 Impact on Fishing Activity

Due to the small size of the affected area and the low fisheries importance, impacts on fishing activity are expected to be negligible.

8.6.6 Impact on Aquaculture Activity

No unacceptable impact has been identified on the FCZs as SS elevations, DO depletion as well as nutrient and contaminant release from marine construction works for cofferdam installation at submarine outfall would be minimal. The closest FCZ is Sha Tau Kok FCZ which is located at least 420 m from the diffuser of the existing submarine outfall for TSTP or 1 km from the diffuser of the proposed submarine outfall for expanded STKSTW, and no unacceptable change in water quality would be predicted from the operation of the TSTP and expanded STKSTW, including the presence of emergency discharge situation. Therefore, no unacceptable impact on aquaculture activity is expected.

**8.7 Mitigation Measures**

In accordance with the guidelines in the *EIAO-TM Annex 17* on fisheries impact assessment, the policy adopted in this EIA for mitigating impacts to fisheries, are:

- **Avoidance:** Potential impacts should be avoided to the maximum extent 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, restoration (and possibly enhancement) of disturbed fisheries resources and habitats as well as establishing a communication plan to relevant stakeholders regarding emergency discharge situation at STKSTW;
- **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 compensation. It may include enhancement of fisheries resources and habitats elsewhere.

Construction impacts to fisheries resources, habitats and fishing operations have largely been avoided (i.e. important spawning and nursery area of commercial fisheries resources, fish culture zones, artificial reefs) and reduced through proper planning and design of the works, in particular those associated with the marine construction activities for the submarine outfall (e.g. adoption of trenchless method to avoid the needs of dredging and backfilling along the submarine outfall alignment such that the seabed and aquatic ecosystem are not disturbed, location of the outfall diffuser to allow better mixing, and optimisation of project construction schedule). The main works have been designed to confirm compliance with the assessment criteria at sensitive receivers and control water quality impacts to within acceptable levels and water quality mitigation measures will be implemented to further avoid/reduce potential impacts (see *Section 5*). These measures are expected to control and reduce potential impacts to fisheries resources as well, and no fisheries-specific mitigation measures or compensation are thus required during construction.

No significant impacts to fisheries resources and fishing operations is expected to occur during the operation phase of the Project. Compliance with the relevant discharge standards to control water quality impacts to within acceptable levels is also expected to control impacts to fisheries resources. As a good practice, it is recommended to establish a communication plan as a precautionary approach to

inform the mariculturists, relevant stakeholders (e.g. Sha Tau Kok District Rural Committee) and relevant government departments (e.g. AFCD, EPD, MD) of the emergency discharge situation at STKSTW such that appropriate response actions can be formulated.

### **8.8 Residual Impacts**

Impacts to fisheries resources, habitats and fishing operations during construction and operation phase are considered to be within acceptable level. As the cofferdam will be removed after the completion of proposed submarine outfall construction, permanent loss of fishing ground will be limited to the location of the diffuser erected above the seabed, which is of 0.042 ha size. The magnitude of residual impact is considered to be within acceptable levels given the small size and low fisheries importance of the area being lost.

### **8.9 Cumulative Impacts**

Information from publicly available sources suggested that the construction/implementation programmes of the major projects listed in *Section 2.10* would coincide with the construction of the Project. In particular, the sediment removal project at Sha Tau Kok FCZ, Boat Shelter and Approach Channel (tentative without confirmed programme) could be the concurrent marine construction works that involves dredging operation inside Starling Inlet which is scheduled to commence in the 1st half of 2017 for completion in the 1st half of 2018 tentatively, which would potentially be concurrent with the marine construction period under this Project. During the dredging operation, the fish rafts of the Sha Tau Kok FCZ would be relocated to two proposed temporary relocation zones <sup>(11)</sup>. One of the relocation zones is about 800 m east to the existing Sha Tau Kok FCZ (FCZ7 shown in [Figure 8.5](#)) and the other would be about 250 m south to the existing Sha Tau Kok FCZ (FCZ8 shown in [Figure 8.5](#)). Under the interim scenario of the TSTP operation, as the two relocation sites are located further away from the existing outfall of the existing STKSTW/TSTP, higher mean and 10<sup>th</sup>-percentile DO levels as well as lower TIN, UIA SS, *E. coli* levels are predicted. No exceedance in WQO criteria would be predicted from the operation of the TSTP.

The fisheries impact assessment has considered the cumulative effects of different activities of this Project on fisheries resources and fishing operations. The worst-case scenarios of concurrent construction of all Project facilities have been assessed in the Water Quality Impact Assessment (*Section 5*) and thus the cumulative impacts of this specific Project have been accounted for. As discussed in *Section 5*, the cumulative impacts of the various project-specific construction activities are not predicted to cause unacceptable impacts to water quality. Consequently, unacceptable cumulative impacts to fisheries resources are not expected to occur.

Given that no operational impacts on fisheries resources are anticipated from this project, operational cumulative impacts with other developments in and around Starling Inlet are not predicted to occur.

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<sup>(11)</sup> CEDD (2008). Project Profile for Sediment Removal at Sha Tau Kok Fish Culture Zone, Boat Shelter and Approach Channel. Submitted under EIAO with Application No. ESB-186/2008.

## **8.10 Environmental Monitoring & Audit**

As no unacceptable impacts have been predicted to occur during the construction and operation of this Project, monitoring of fisheries resources during these project phases is not considered necessary.

Monitoring activities designed to detect and mitigate any unacceptable impacts to water quality during construction phase are also expected to serve to protect against unacceptable impacts to fisheries. The details of the water quality monitoring programme are presented in the *EM&A Manual* attached to this EIA.

## **8.11 Conclusions**

A literature review of baseline information on commercial fisheries resources and fishing operations surrounding the waters of the proposed Project has been undertaken. Results from the review indicate that fisheries importance of the Project Area and its vicinity is low when compared to other waters of Hong Kong. Sensitive receivers including spawning ground, nursery ground, artificial reefs and Fish Culture Zone areas have been identified; however, the assessment of water quality impacts demonstrated that these areas will not be significantly affected.

During construction of the Project, direct impacts arising from the proposed marine works include temporary loss of approximately 1 ha of fisheries habitat and fishing ground. Given the small size of the fishing ground and temporal nature (within 27 months) of the marine works, no significant direct impacts on fishing operations are expected to occur. Indirect impacts to fisheries resources related to perturbations to key water quality parameters are also expected to be insignificant as the predicted changes in water quality are short term and localised to immediate vicinity of the works area. Marine construction works have been designed to reduce potential impacts on the water quality which will, in turn, reduce impacts on fisheries resources. No fisheries-specific mitigation measures are required during construction.

There will be loss of 0.042 ha of fishing ground during operation due to the installation of diffuser erected above the seabed. Given the small size and low fisheries importance of the area being lost, unacceptable operational phase impacts to fisheries resources and fishing operations are not expected to occur. Unacceptable impacts from discharge of treated sewage are not anticipated to occur. Compliance with the relevant discharge standards to control water quality impacts to within acceptable levels is also expected to control impacts to fisheries resources. As a good practice, it is recommended to establish a communication plan as a precautionary approach to inform the mariculturists, relevant stakeholders (e.g. Sha Tau Kok District Rural Committee) and relevant government departments (e.g. AFCD, EPD, MD) of the emergency discharge situation at STKSTW such that appropriate response actions can be formulated.

All of the potential construction and operational fisheries impacts identified are deemed acceptable.