

5. FISHERIES

5.1 Introduction

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 associated with the construction and operation of the proposed Project with the available Project information to-date.

5.2 Legislative Requirements and Evaluation Criteria

5.2.1 Technical Memorandum

The criteria for evaluating fisheries impacts are stated in the *Technical Memorandum on Environmental Impact Assessment Process (EIAO-TM)*. *Annex 17* of the *EIAO-TM* prescribes the general approach and methodology for the assessment of fisheries impacts deriving from 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 evaluating fisheries impacts.

5.2.2 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 licence in designated FCZs;
- *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; and
- *Environmental Impact Assessment Ordinance (Cap. 499)*, the Study Brief Section 3.4.5 and Appendix D which outline the key fisheries impacts to be reviewed and assessed in the EIA report.

5.3 Baseline Conditions

5.3.1 Assessment Area

In accordance with Clause 3.4.5.2 of the Study Brief, the Assessment Area for fisheries impact assessment (**Figure A1.1 of Appendix 5A**) shall be the same as the assessment area for Water Quality Impact Assessment covering the Mirs Bay Water Control Zone (WCZ) and the Tolo Harbour and Channel WCZ. Detailed description of the physical and biological characteristics of the marine environment of the Assessment Area is provided in **Section 3** and **Section 4** respectively.

5.3.2 Summary of Existing Conditions

A literature review was conducted to review the baseline fisheries conditions within the Assessment Area and to identify information gaps to determine whether field surveys are required to provide sufficient information for the fisheries impact assessment. Findings of the literature review are presented in **Sections 5.3.2.1 to 5.3.2.6**.

5.3.2.1 Overview of Hong Kong Fisheries

Commercial fishing operations in Hong Kong are broadly identified into culture and capture fisheries. Marine-based culture fishery operations occur at 26 FCZs which altogether occupy about 209 ha of Hong Kong waters with some 920 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. Fish farms are typically small scale operations comprising only one or two rafts with an average total size of about 304 m² ⁽⁵⁸⁾.

With effect from June 2002, the marine fish culture licence is transferable. The existing moratorium for FCZs has been reviewed and was partially lifted in 2013 to launch a pilot scheme for the issuance of new marine fish culture licenses (MFCLs). Ten MFCLs were issued in three FCZs with surplus carrying capacity, including the O Pui Tong, Wong Wan and Sham Wan FCZs, in which four licences remained valid, with three at Wong Wan FCZ and one at Sham Wan FCZ by the end of 2018 ⁽⁵⁹⁾.

In 2021, the marine fish culture industry produced about 332 tonnes of fish valued at HK\$34 million which accounts for about 2% of local demand for live marine fish ⁽⁶⁰⁾. Some recent figures on the local marine culture fisheries are presented in **Table 5.1**.

Table 5.1 Marine Culture Fisheries Summary Statistics 2008-2021 (Source: AFCD)

AFCD Estimate	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Licensed Mariculturists	1,050	1,035	1,010	1,008	987	968	969	949	938	931	923	925	920
Production (tonnes)	1,437	1,512	1,185	1,299	1,005	1,255	1,219	1,031	1,004	850	889	687	332
Value (HK\$ million)	92	118	94	117	94	115	105	86	78	71	72	52	34

Capture fisheries is vastly distributed in the waters of Hong Kong, the Pearl River Estuary and the adjacent continental shelf of the South and East China Seas ⁽⁶¹⁾. AFCD reported that in 2021 an estimated 112,000 tonnes of fish was produced, which was equivalent to an economic value of about HK\$2.8 billion. Also, 10,510 local fishermen with approximately 5,170 vessels were servicing in the fishing industry ⁽⁶²⁾. The major fishing methods consist of long-lining, gill-netting and purse-seining.

In 2016-17, AFCD carried out the latest round of port survey to collect the updated data of distribution of fishing operations and production for 2016. According to the survey results, the highest fisheries production of 400 to 600 kg ha⁻¹ in Hong Kong was recorded in the vicinity of the south of Cheung Chau and Shek Kwu Chau ⁽⁶³⁾. The highest number of fishing vessels were distributed around Soko Islands, Shek Kwu Chau, Cheung Chau, west of Lamma, northwest of Ninepin Island, Tap Mun and Wong Chuk Kok Tsui. Mullet (*Mugilidae*), sardine / shad (*Clupeidae*), scad / jack (*Carangidae*), seabream (*Sparidae*), croaker (*Sciaenidae*), squid, crab, rabbitfish (*Siganidae*), shrimp and flathead (*Platycephalidae*) were the top 10 families captured in Hong Kong waters.

(58) AFCD (2021) Marine fish culture, pond fish culture and oyster culture.

(59) Legislative Council Panel on Food Safety and Environmental Hygiene (2019) Development of Mariculture.

(60) AFCD (2021) *Op. cit.*

(61) Sumaila UR, Cheung WWL and Teh L (2007) Rebuilding Hong Kong's Marine Fisheries: An Evaluation of Management Options. Fisheries Centre Research Reports 15 (3). pp.112.

(62) AFCD (2021) Capture Fisheries Overview.

(63) AFCD (2017) Port Survey 2016/17.

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, trawling (including pair, stern, shrimp and hang trawling) was prohibited to restore the seabed and the decreased fisheries resources⁽⁶⁴⁾. Other fisheries management practises are implemented to supplement the ban, including:

- Setting up a registration system for local fishing vessels;
- Limiting new entrants to control the fishing effort;
- Restricting fishing activities of non-fishing vessels and prohibiting fishing activities of non-local fishing vessels;
- Designating fisheries protection areas;
- Habitat enhancement and restoration (i.e. artificial reefs); and
- Fish restocking trials.

Since 1999, Mainland Authorities have implemented a fishing moratorium for the South China Sea fishing ground. In 2022, the revised fishing moratorium has extended from 1 May to 16 August. The moratorium prohibits all fishing operations except lining by the Hong Kong fleet outside of Hong Kong waters and also banning on the operation of fish collectors⁽⁶⁵⁾ in order to conserve fisheries resources and promote sustainable development of the fishing industry⁽⁶⁶⁾.

5.3.2.2 Culture Fisheries of the Assessment Area

Three FCZs are located within the Assessment Area and their separation distances from the Project site are presented in **Table 5.2**. The FCZs in the vicinity of the Project site are Tap Mun FCZ, Kau Lau Wan FCZ and Sham Wan FCZ located over 1 km (by sea distance) away. There are no fish ponds or oyster farms identified in the northeastern part of Hong Kong waters (**Figure 5.1**).

Table 5.2 Distances between the FCZs in the Assessment Area and the Proposed FCZ at Mirs Bay

Fish Culture Zone	Shortest Separation Sea Distance (km)
Tap Mun	2.1
Kau Lau Wan	1.4
Sham Wan	4.0

5.3.2.3 Capture Fisheries of the Assessment Area

Trawling has been banned in Hong Kong waters since 31 December 2012. Apart from historical data, only some published information after the trawl ban was available for review.

The most systematic information on commercial fishing operation and fisheries production of the Assessment Area was obtained primarily from the AFCD Port Survey 2016/17 (**Figures 5.2 to Figure 5.3**). The survey was conducted from 2015 to 2016 through a comprehensive interview survey of local fishermen by AFCD⁽⁶⁷⁾. The survey achieved a sampling rate of about 36% which included

(64) AFCD (2020). *Op. Cit.*

(65) Refers to the fisheries ancillary vessels which are used to gather catch from fishing vessels, and operate either in Hong Kong waters or further afield.

(66) AFCD (2020) Proposed Injection into the Fishing Moratorium Loan Scheme. Paper presented in Legislative Council Panel on Food Safety and Environmental Hygiene.

(67) AFCD (2017) *Op. cit.*

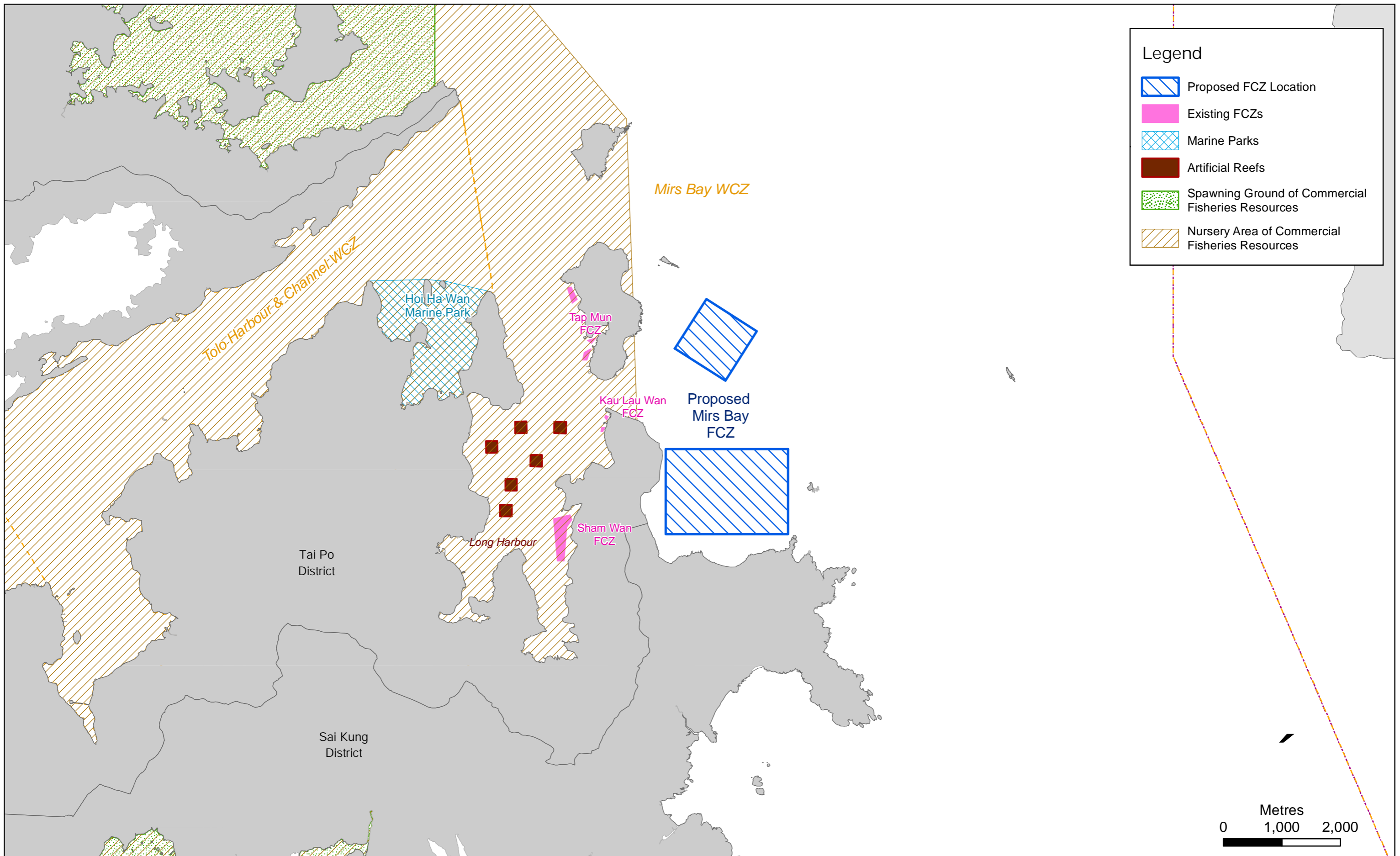


Figure 5.1

Fisheries Sensitive Receivers in the Assessment Area

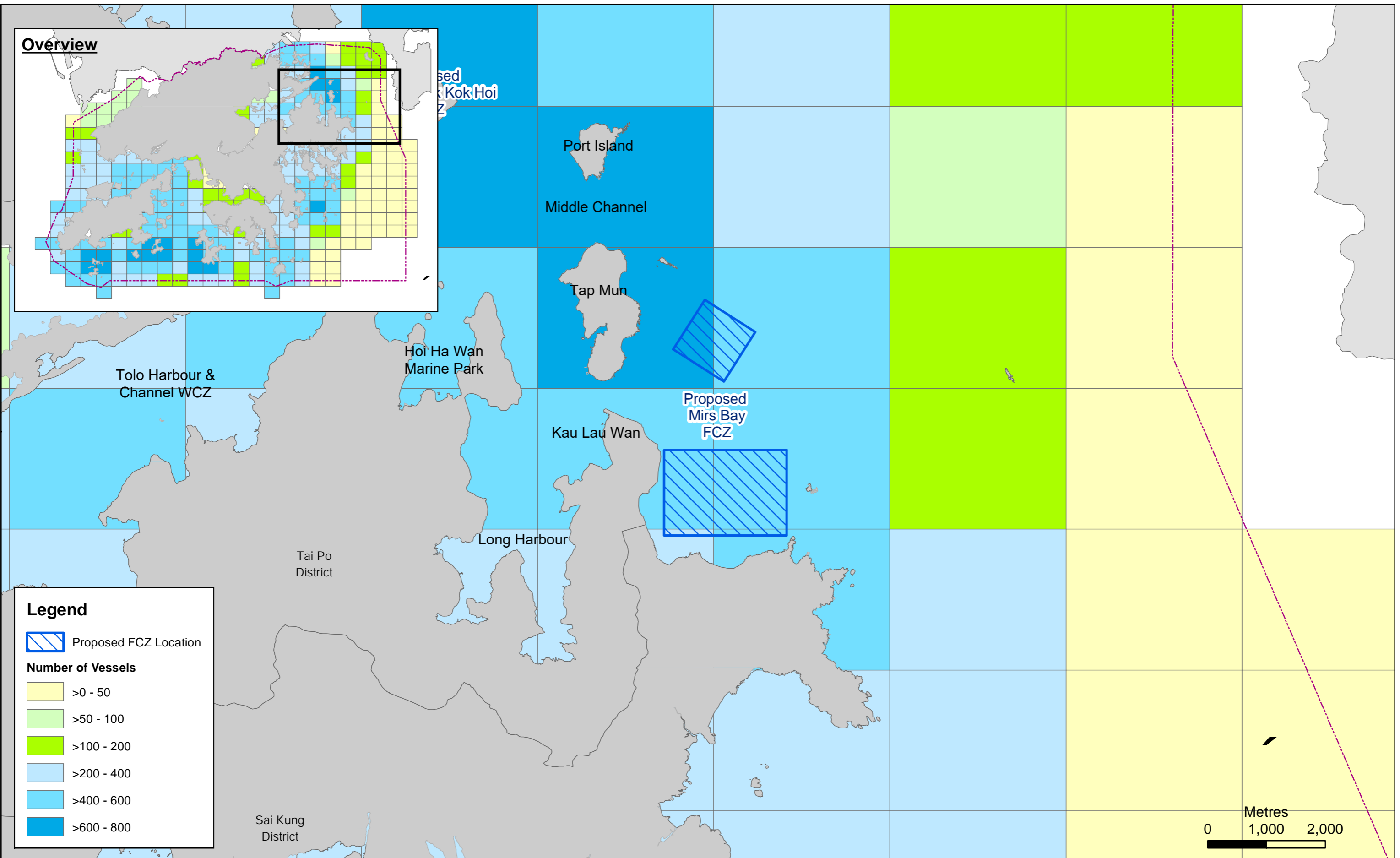


Figure 5.2

Distribution of Fishing Operations (All Vessels) in Northeastern Hong Kong Waters as recorded in AFCD Port Survey 2016/17

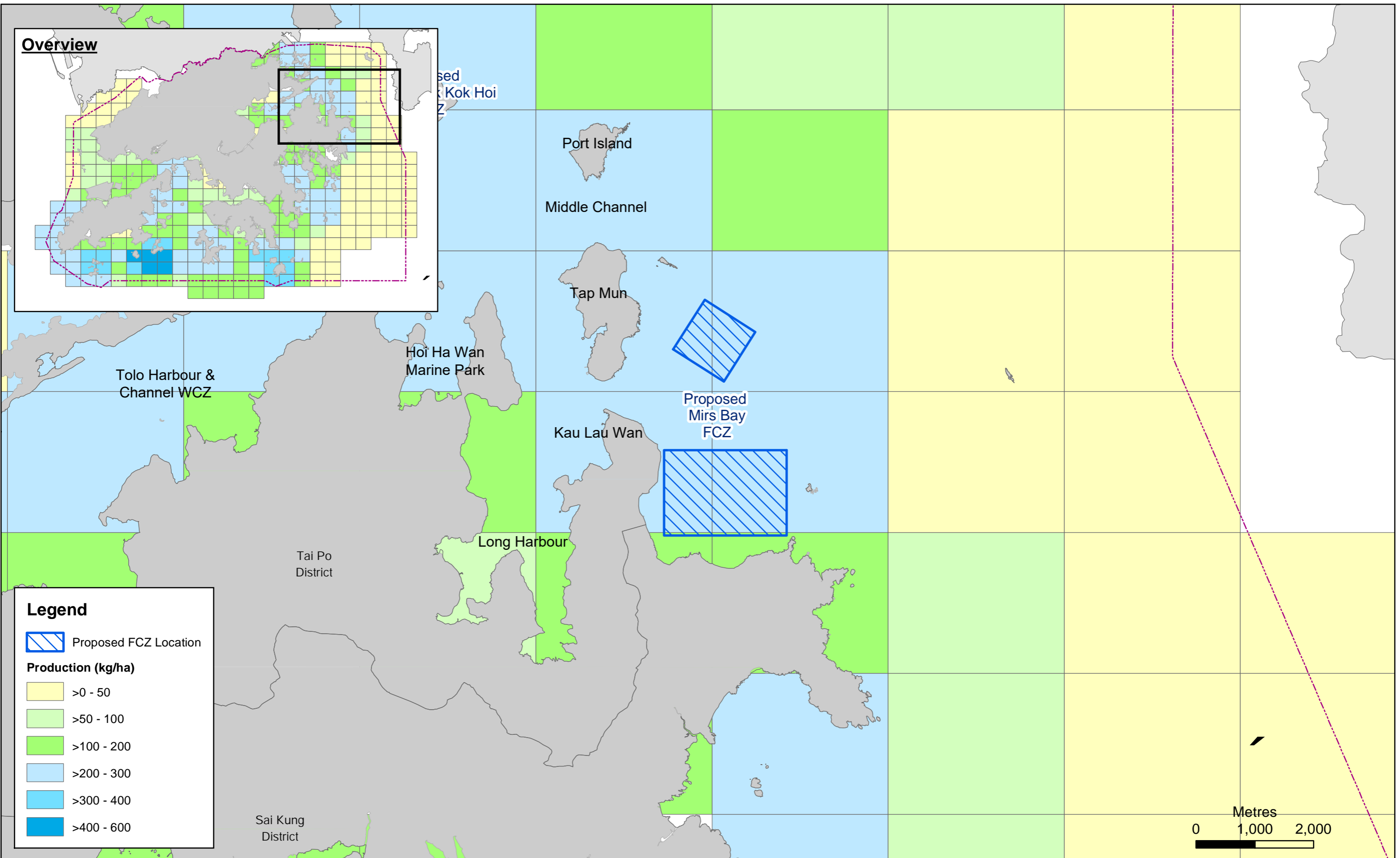


Figure 5.3

Distribution of Fisheries Production (All Vessels) in Northeastern Hong Kong Waters as recorded in AFCD Port Survey 2016/17

various fishing vessels from different homeports. Apart from the Port Survey, other recently approved EIA and fisheries studies undertaken in the Assessment Area have also been reviewed.

Fishing Operations

Data from AFCD Port Survey 2016/17 indicated that the majority of vessels that operated throughout the Assessment Area were sampans and other vessels including gill netter, long liner, purse seine etc. were present in smaller numbers. The data indicated that the areas within and in the vicinity of the Project site has a range of low to high levels (>200-400 vessels, >400-600 vessels and >600-800 vessels) of fishing operations (**Figure 5.2**). Moderate to high levels of fishing operation (>400-600 vessels and >600-800 vessels) were recorded in other areas around the coastline of Kau Lau Wan, Middle Channel, the majority of Long Harbour and Tap Mun. Similarly, areas within Hoi Ha Wan Marine Park (HHWMP) also supported moderate to high level of fisheries operation (>400-600 vessels). Under the Marine Parks and Marine Reserves (Amendment) Regulation 2019 which came into effect on 1 April 2020, commercial fishing would be banned and eventually phase out in HHWMP to protect coral communities and enhance the overall fisheries resources in Hong Kong ⁽⁶⁸⁾. A transitional period of two years is provided under the ban which new fishing permits will no longer be granted and existing fishing permits will not be renewed for HHWMP.

Fisheries Production

Fisheries production of the Assessment Area in terms of weight as reported in the AFCD Port Survey 2016/17 is presented in **Figure 5.3**. Results showed that fisheries production within and in the vicinity of the Project site has low to moderate (>100-200 to >200-300 kg/ha) fisheries production. Low level of fisheries production (>0-50 kg/ha) was noted at offshore areas of northeastern waters.

Fisheries Resources

Historically, Tolo Harbour was found to consist of fish assemblages of moderate species richness with low diversity identified ⁽⁶⁹⁾. It was recorded that the majority of fish assemblages was fast growing but with low commercial value thriving in heavily eutrophic waters. The species captured that were considered of medium commercial value were sea breams, rock fish and chicken grunt ⁽⁷⁰⁾. For south-west Mirs Bay, it was found to consist of fish assemblages of high diversity and species evenness which corresponded to the location of the Project site ⁽⁷¹⁾. However, the lowest species evenness was recorded at north-west Mirs Bay which was attributed to the majority of the catch consisting of Ponyfish (*Leiognathus brevirostris*).

A more recent review of the fisheries resources data could be referred to the monitoring of local fisheries resources from 2010-2015 initiated by AFCD with the implementation of the trawl ban in 2012. Demersal fisheries surveys were conducted using stern and shrimp trawlers across four areas in Hong Kong waters and the results showed that there were signs of recovery of fisheries resources. In the northeastern waters relevant to this Assessment Area, it was reported that the abundance and biomass of seabreams (Sparidae) and hairtails (Trichiuridae), and the abundance of threadfin breams

(68) AFCD (2020) Marine Park Permit.

(69) Leung AWY (1997) The epibenthic ichthyofauna of Tolo Harbour and Hong Kong's Northeastern waters: a long term record of change. In: The Marine Flora and Fauna of Hong Kong and Southern China IV, Proceedings of the Eighth International Marine Biological Workshop 1995, B Morton (ed), pp. 463-487, Hong Kong University Press, Hong Kong.

(70) ERM (2003). The Proposed Submarine Gas Pipeline From Cheng Tou Jiao Liquefied Natural Gas Receiving Terminal, Shenzhen to Tai Po Gas Production Plant, Hong Kong. EIA Study (EIA-089/2003). Prepared for The Hong Kong and China Gas Company Limited.

(71) Leung AWY (1997) *Op. cit.*

(Nemipteridae) had increased ⁽⁷²⁾. The main commercial fisheries resources (ranked based on the biomass of each family) found in the northeastern waters of Hong Kong ⁽⁷³⁾ are summarised in **Table 5.3** below. Overall, the northeastern waters generally supported fish families of low commercial value, such as Ponyfish (*Leiognathus* sp.), with some commercially important families recorded in the area, such as swimming crabs (Portunidae), seabreams (Sparidae), flatheads (Platycephalidae) of lower biomass ranking.

A study on Marine Parks and Marine Reserve fisheries resources in 2016 showed that the abundant fishes in HHWMP included both fishes of low and moderate commercial values ⁽⁷⁴⁾. The most abundant species in HHWMP was pearl-spotted spinefoot (*Siganus canaliculatus*) which was of low commercial value. Other abundant species in HHWMP included rice-paddy eel (*Pisodonophis boro*), Japanese golden thread (*Nemipterus japonicus*), red pargo (*Pagrus major*), threadfin porgy (*Evynnis cardinalis*) and black bream (*Acanthopagrus schlegelii*). Among the abundant species, threadfin porgy, Japanese golden thread, red pargo and black bream were commercially important. It should be noted that HHWMP are at some distance from the Project site (>3 km).

Table 5.3 Main Commercial Families of Fisheries Resources in Northeastern Hong Kong Waters from Fishery Surveys (Source: AFCD Hong Kong Fisheries Resources Monitoring Report (2010-2015))

Rank	Main Commercial Families from Shrimp Trawl Surveys	Main Commercial Families from Stern Trawl Surveys	Main Commercial Families from Purse-Seine Surveys
1	Leiognathidae	Leiognathidae	Clupeidae
2	Platycephalidae	Clupeidae	Carangidae
3	Portunidae	Sparidae	Engraulidae
4	Clupeidae	Carangidae	Scombridae
5	Sparidae	Polynemidae	Sphyraenidae
6	Gerreidae	Trichiuridae	/
7	Synodontidae	Siganidae	
8	Squillidae	Synodontidae	
9	Sciaenidae	Sciaenidae	
10	Soleidae	Nemipteridae	

5.3.2.4 Spawning Ground

The northeastern Hong Kong waters were previously identified in 1998 as fisheries spawning grounds for various fish species ⁽⁷⁵⁾. In Hong Kong, spawning period differs among fisheries species with the majority of commercial species aggregate and spawn in the open waters during June to September. Some fish species, including flathead (*Platycephalus indicus*) and shad (*Clupanodon (Konosirus) punctatus*), spawn in late winter / early spring (i.e. February to April) and a few are known to spawn in January. Shrimp scad (*Alepes djedaba*) spawns in early summer (around June) whilst pony fish (*Leiognathus brevirostris*) and croakers were found to be reproductive throughout most of the year from May to December. The spawning period of most of the crustacean species was found to be from April to November, with spawning concentrated between June and August.

(72) South China Sea Fisheries Research Institute (2017) Report on Survey of Fisheries Resources in Hong Kong (2010-2015). Prepared for AFCD.

(73) South China Sea Fisheries Research Institute (2017) Main Commercial Families of Fisheries Resources in Hong Kong. Prepared for AFCD.

(74) Country and Marine Parks Board Marine Parks Committee (2020) Fisheries Resources Surveys at Existing and Proposed Marine Parks, and Cape D'Aguiar Marine Reserve – Results and Conclusion.

(75) ERM (1998) Fisheries Resources and Fishing Operations in Hong Kong Waters, Final Executive Summary, for Agriculture, Fisheries and Conservation Department.

Field surveys were conducted in Tolo Channel and Long Harbour from May 2016 to May 2017 to investigate the abundance, composition and distribution of the ichthyoplankton, zooplankton, juvenile fish and crustacean ⁽⁷⁶⁾. The study recognised the areas as spawning ground and nursery area which supported a diverse assemblage of fisheries resource. The ichthyoplanktons of several commercially important species, such as rockfish (*Sebastiscus marmoratus*), seabreams (*Acanthopagrus schlegelii*, *Sparidae* spp.), grunt (*Parapristipoma trilineatum*), shad (*Nematolosa japonica*) and flatheads (*Inegocia japonica*, *Platycephalus indicus*), were recorded in the surveys.

The recognised spawning ground is located at ~5.9 km from the Project site (i.e. beyond the Assessment Area), covering Wong Chuk Kok Hoi and extends to the northeastern waters (**Figure 5.1**). The Project site is located out of this recognised spawning ground of the northeastern waters (**Figure 5.1**).

5.3.2.5 Nursery Area

The waters in Tolo Channel and northeastern Mirs Bay was identified as important nursery areas for high commercial value species in 1998, which extends approximately 10 km from Wong Chuk Kok Hoi, covering waters at Tolo Harbour, Tap Mun, Port Island and Long Harbour (**Figure 5.1**). This recognised nursery area is an important habitat for commercial species, namely red pargo (*Pagrus major*) and the goldlined seabream (*Rhabdosargus sarba*) ⁽⁷⁷⁾. The fish fry of *Pagrus major* have been found to be most abundant during February and March, whereas juveniles of other commercial species were found abundantly from July to August. A juvenile fish survey conducted between 2013 and 2014 identified HHWMP as one of the nursery areas and the dominant species, such as silverstriped round herring (*Spratelloides gracilis*), is of low commercial value ⁽⁷⁸⁾. The Project site is located out of this recognised nursery area at ~0.7 km away (**Figure 5.1**).

As mentioned in **Section 5.3.2.4**, Tolo Channel and Long Harbour were also recognised by a study conducted between 2016 and 2017 as nursery area which supported a diverse assemblage of fisheries resource ⁽⁷⁹⁾, with some commercially important families such as barracuda (*Sphyraena flavicauda*), jack mackerel (*Trachurus japonicus*), rabbitfish (*Siganus fuscescens*) and seabreams (*Acanthopagrus schlegelii*, *Rhabdosargus sarba*, *Evynnis cardinalis*, *Pagrus major*) were recorded in the area ⁽⁸⁰⁾.

5.3.2.6 Artificial Reef Deployment

An Artificial Reef (AR) program has been implemented in Hong Kong's waters by AFCD since 1996 as an effort to enhance fisheries resource whilst promoting biodiversity ⁽⁸¹⁾. ARs are recognised worldwide as having 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. Therefore, the ARs are considered to be fisheries sensitive receivers. There has been a total of 673 units of ARs with a total volume of over 179,200 m³ ⁽⁸²⁾ deployed in Hong Kong waters, the location of all ARs deployed is recorded by the Hong Kong Artificial Reef Project.

(76) State Key Laboratory of Marine Pollution, City University of Hong Kong (2018) Provision of Survey Services of Ichthyoplankton, Zooplankton and Juvenile Fish and Crustacean in the Potential Fisheries Protection Areas. Final Executive Summary, for Agriculture, Fisheries and Conservation Department.

(77) ERM (1998) *Op. cit.*

(78) Leung PTY, Mak S, Ip J, Yau C, Lai V and Leung KMY (2014) Survey of Juvenile Fish Resources at the Three Marine Parks at Northeast Hong Kong. Prepared for Agriculture, Fisheries and Conservation Department, HKSAR Government.

(79) State Key Laboratory of Marine Pollution, City University of Hong Kong (2018) *Op. Cit.*

(80) State Key Laboratory of Marine Pollution, City University of Hong Kong (2018) *Op. Cit.*

(81) AFCD (2021) Conservation of Fisheries Resources.

(82) AFCD (2021) *Op. Cit.*

There are two AR deployment sites within the Assessment Area, including HHWMP and Long Harbour (**Figure 5.1**). No AR has been deployed within the Project site. The nearest AR from the Project site would be those deployed at Long Harbour (~2.3 km from the Project site), followed by those deployed at HHWMP (~4.5 km from the Project site). A total of 6 and 7 units of ARs with a total volume of 33,420 m³ and 9,530 m³ ARs were deployed in Long Harbour from 2002-2004 and in HHWMP from 1998-2003 respectively, to provide hard, bottom, high profile habitat in areas without natural cover and act as biofilters to enhance habitat quality and marine resources ⁽⁸³⁾.

5.3.3 Fisheries Importance

Based on the baseline information reviewed, low to high levels of fishing operation with low to moderate levels of fisheries production were reported at the Project site, and similar levels of fisheries operation and production were also reported elsewhere in the broad Assessment Area, which indicates the Project site does not represent a unique fishing ground. The Assessment Area including the Project site also supported fisheries resources that are mainly with low commercial value, and areas that support fisheries of higher commercial value, such as HHWMP (~4.5 km from the Project site), is located at some distance from the Project site. ARs which are key fisheries habitats are also at some distances (>2.3 km from the Project site) from the Project site.

Annex 9 of the *EIAO-TM* states that spawning ground and nursery area can be regarded as important habitats to fisheries. The Project site is located out of the recognised spawning ground and nursery area in northeastern Hong Kong waters. Identified nursery habitats, such as rocky reefs at HHWMP, are again located at some distances from the Project Site. The potential for the Project site and its immediate vicinity to function as a unique and important spawning ground and nursery area is relatively low.

5.3.4 Fisheries 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 potential sensitive receivers that may be affected by the Project activities (i.e. distances are shown by sea distance) are identified as follows:

- Recognised spawning ground and nursery area of commercial fisheries resources in northeastern waters which are located at ~5.9 km and ~0.7 km from the Project site respectively;
- FCZs at Tap Mun (located at ~2.1 km northwest of Project site), Kau Lau Wan (located at ~1.4 km west of Project site) and Sham Wan (located at ~4.0 km southwest of Project site);
- A total of 33,420 m³ ARs were deployed in Long Harbour (located at >2.3 km west of the Project site); and
- Hoi Ha Wan Marine Park (located at ~4.5 km west of the Project site) and 9,530 m³ of ARs deployed within.

The locations of the sensitive receivers are shown in **Figure 5.1**.

5.4 Assessment Methodology

A review of baseline fisheries conditions from available literature was conducted for the purpose of establishing the fisheries importance of the waters in the Assessment Area and its vicinity. Information from the water quality impact assessment has been examined to assess potentially affected area by perturbations to water quality parameters.

The potential impacts due to the construction and operation of the Project were then identified and evaluated (with reference to the *EIAO-TM Annex 17* guidelines and the criteria in *EIAO-TM Annex 9*).

(83) AFCD (2021) Hong Kong Artificial Reef Project.

5.5 Potential Impacts and Impact Assessment

5.5.1 Construction Phase

The construction of the proposed Project will mainly involve the setup of fish farm structures, including fish rafts / cages, auxiliary facilities and mooring system. No dredging works is required during the construction phase.

The scale of construction work on-site is relatively small. Main components of the rafts / cages are manufactured off-site and will be towed to the Project site using tug boat. On-site assembly and anchoring of the fish rafts / cages will be assisted by a small number of marine vessels such as sampans and small speed boats for up to a few trips per day. Anchoring of these vessels might be required. No heavy construction plant would be used. Fish rafts / cages and auxiliary facilities, such as storage space and shelters, would be positioned by anchor lines attaching to the anchorage points on the seabed. Use of winch might be required during the assembly and anchorage of fish rafts / cages. All construction activities shall be conducted during daylight hours.

Potential impacts to fisheries resources and fishing operations arising from these works may be divided into those related to:

- Disturbances of fisheries habitat (including spawning ground and nursery area) and loss of access to fishing grounds; and
- Underwater sound from marine construction activities and marine vessels.

5.5.1.1 Habitat Disturbance and Loss of Access to Fishing Grounds

Direct impacts to fisheries resources, habitats and fishing operations include disturbance caused by assembly and installation activities on-site. The installation of fish farm structures are expected to be completed within a few weeks for each fish raft, and would cause temporary disturbance to fisheries habitat and loss of access to potential fishing grounds with an area of approximately 410 ha. Fish farm structures, such as fish cages will occupy a section of the water column and the disturbance of seabed due to the anchorage of fish farm structures will be confined to a thin surface layer (<0.5 m) within a small area. It should be noted that only a small number of vessels will be used and the frequency / trip of these vessels would also be relatively low. No disturbance to the identified fisheries sensitive receivers, including Tap Mun FCZ (~2.1 km from the Project site), Kau Lau Wan FCZ (~1.4 km from the Project site), Sham Wan FCZ (~4.0 km from the Project site), and ARs of Long Harbour and HHWMP (~2.3 km and ~4.5 km from the Project site respectively) is expected.

In the context of the size of fisheries habitats and fishing ground available in the vicinity, the size of the area affected would be small. Considering the temporary nature of the disturbance (a few weeks for each fish raft / cage), impacts are considered to be of minor significance and unacceptable impacts on fisheries resources, habitats and fishing activities are not expected. Fisheries resources are expected to return to the area following the cessation of fish farm construction activities.

Construction activities, such as during the assembly of fish raft, would generate noise, glare and dust which may affect fisheries resources. Potential impacts, mostly to fish species, would have temporary avoidance of areas in the vicinity of works area or close to the source of disturbance. Considering the temporary nature of the construction works, impacts from the generation of noise, glare and dust on fisheries habitats are considered negligible, and unacceptable impacts on the fisheries resources are not anticipated. Major lighting sources will be pointed inward and downwards to avoid disturbance to wildlife, unacceptable impacts on the fisheries resources are not anticipated.

5.5.1.2 Underwater Sound

Intermittent sounds, which occur during assembly and installation activities on-site and marine vessel movement, may have an impact on fisheries resources. Potential effects of increased underwater sound include physiological stress, avoidance and injury (at high pressure levels). The level of impact

is however dependent upon background sound, number and type of species affected, proximity of organism to the sound source, attenuation properties of seabed sediments and hearing capabilities of the species affected, etc..

Most marine invertebrates do not possess air-filled space and thus it is generally considered that sound would have limited physiological or behavioural effects on marine invertebrates, except if they are located within a few metres of the sound source. Therefore, underwater sound generated from marine works is expected to have negligible impact on marine invertebrates in the Assessment Area.

The impact of underwater sound generation from construction activities on fish is highly depended upon the hearing capabilities of the different species present in the area, with the hearing specialists being of greatest concern. The significance of these effects is dependent upon the proximity of fish to the sound source. Considering that a small number of marine vessels would be present temporarily at the Project site during fish farm construction, fish species that are sensitive to the generation of sound are likely to instinctively avoid the area once works commence and would be temporarily displaced to other areas where similar habitat conditions are present. Fisheries resources are expected to return to the area following the cessation of fish farm construction activities.

Waters within the Assessment Area and its vicinity is subject to a range of low to high levels of marine traffic by similar types of vessels. It is reasonable to assume that fish are habituated to low to high background levels of underwater sound, and a small increase in vessel activity associated with the construction of this Project is not anticipated to result in unacceptable impacts on fisheries resources. Overall, the fisheries sensitive receivers, including Tap Mun FCZ, (~2.1 km from the Project site), Kau Lau Wan FCZ (~1.4 km from the Project site), Sham Wan FCZ (~4.0 km from the Project site), and ARs in of Long Harbour and HHWMP (~2.3 km and ~4.5 km from the Project site respectively), are located at some distances from the Project site and unacceptable impacts on these fisheries sensitive receivers are not expected.

5.5.2 Operation Phase

Mariculture activities, such as management of fish raft / cages and fish stocks within the Project site will be undertaken during operational phase. Limited numbers of small power generators will be used on fish rafts to support daily mariculture activities. The transportation of fish stocks, fish feed, fish raft equipment and workforce as well as occasional visitors will make use of small marine vessels such as sampans and speed boats for a few trips a day. No maintenance dredging or sediment removal is anticipated during FCZ operation. All operation activities shall be conducted during daylight hours. The potential impacts on fisheries of the Assessment Area include:

- Changes in fisheries habitats and loss of access to fishing grounds;
- Temporary relocation of rafts under typhoons or algal blooms;
- Underwater sound from daily operations and marine vessels;
- Perturbations to key water quality parameters during fish farm operation, including fish feed wastage and fish excretion; and
- Fish diseases.

5.5.2.1 Changes in Fisheries Habitat and Loss of Access to Fishing Grounds

As discussed in **Section 5.5.1.1**, the fish farm structures will not fully occupy all of the Project site area but mainly a section of the water column and a small area of seabed confined to a thin surface layer (<0.5 m). Although the Project site covers some areas of Mirs Bay, majority of fisheries resources found in and around the vicinity of the Project site are of low commercial value. The impacts on fisheries resources and fisheries habitat are considered to be of minor significance and unacceptable impacts are not expected.

Fish farm structures would provide hard substrate that could be colonised by a variety of marine organisms. Although periodic cleaning will be implemented as part of the fish farm management practice to maintain good aquaculture environment, regular cleaning activities will be mainly applied to fish cages / nets, while the majority of the fish farm structures, such as the main framework of the fish raft, auxiliary facilities and mooring system will remain intact most of the time. There is considerable knowledge in Hong Kong and elsewhere on the colonisation of marine structures with species such as seaweeds, crustaceans, octocorals, bivalves, amphipods, anemones, bryozoans and more mobile fauna including crabs. Colonisation of these structures could attract fish and marine invertebrates into the area. Overall, the structures of the fish farm are expected to result in potential positive effect on fisheries resources and habitats of the waters within and in the vicinity of the Project site.

All the fish rafts / cages will be floating with permeable nets to allow water exchanges with the marine environment. Consequently, it is predicted that no unacceptable changes in hydrodynamics will occur.

While the fishing activities in the Project site range from low to high levels, the area lost for fishing activities (410 ha) is considered to be moderate compared to the availability of fishing grounds elsewhere in northeastern Hong Kong waters available for fishing activities. Overall, the impacts on fishing activities are considered to be of moderate significance. The Assessment Area including the Project site supported fisheries resources that are mainly with low commercial value, and areas that support fisheries of higher commercial value, such as HHWMP, is located at some distance from the Project site. Considering that suitable fishing grounds outside of the Project site can allow similar fishing activities to take place, unacceptable impacts on fishing activity are not expected.

Operational activities, such as cleaning of fish cages and the use of lighting, would generate noise, glare and dust which may affect fisheries resources. Potential impact, mostly to fish species, would have temporary avoidance of areas in the vicinity of the operational area or close to the source of disturbance. Considering the temporary nature of the cleaning activities, impacts from the generation of noise, glare and dust on fisheries resources are considered negligible, and unacceptable impacts on the fisheries resources are not anticipated. Major lighting sources will be pointed inward and downwards to avoid disturbance to wildlife, unacceptable impacts on the fisheries resources are not anticipated.

5.5.2.2 Temporary Relocation of Fish Rafts / Cages

In general, relocation of fish rafts adopting advanced mariculture technologies are not necessary under adverse weather (e.g. typhoon) given the framework of fish cages would use weather-resistant and durable materials (e.g. HDPE cages, steel truss cages). For other potential circumstances (e.g. red tide event, outbreak of fish disease), the licensees will review the need of fish raft relocation and propose the fish raft relocation plan as necessary for agreement with AFCD on a case-by-case basis, depending on the type of algal bloom (any toxicity to fish), expected duration of such circumstances, feasibility for early harvesting of fish stock, feasibility of implementing onsite control measures etc. In case fish raft relocation is considered necessary, the fish rafts will be relocated away from the areas of circumstances, avoid marine fairways and utilities and at some distance away from ecological and fisheries sensitive receivers (e.g. about 200 m away from established coral communities) to minimise potential impacts to these sensitive receivers. Such relocation will be temporary (e.g. a few weeks) and the fish rafts will return to the Project site upon the cease of the circumstances. The mobilisation of the fish rafts will cause temporary disturbance to fisheries habitat. Increased operation of marine vessels will occur due to the towing of fish rafts to the new location, and the re-anchoring of fish rafts will cause temporary disturbance to the water column and seabed. The corresponding impacts would be similar to those occurred in the construction phase (**Section 5.5.1**). Overall, impacts are considered to be of minor significance and unacceptable impacts on fisheries resources, habitats and fishing activities are not expected.

5.5.2.3 Underwater Sound

Operation of the fish farm would produce underwater sound from the management of fish rafts / cages and fish stocks, and operation of marine vessels. The daily operations of small marine vessels, such as sampans or speed boats would be temporary which the underwater sound characteristics of these vessels are similar to the operations at Tap Mun FCZ, Kau Lau Wan FCZ, Sham Wan FCZ and marine traffic at the vicinity of ferry routes nearby. Fish in these waters are habituated to the background level of underwater sound, and a small increase in mariculture and vessel activities associated with the operation of this Project are not anticipated to result in unacceptable impacts on fisheries.

5.5.2.4 Changes in Water Quality

Mariculture activities would result in an increase in water quality pollutants primarily from fish feed, feed wastage, fish excretion and dead fish. The increase in pollution load would affect the water quality in the receiving waters and the potential impacts on fisheries are as follows:

- Suspended solids (SS) dispersion;
- Dissolved oxygen (DO) depletion; and
- Elevated nutrient levels.

The use and storage of chemicals, such as pharmaceuticals for fish and those used for equipment maintenance will be limited on site and stored at secured locations, discharge of water containing such chemicals is not expected from daily operations. Human activities, such as the removal of fouling organisms on fish net / cages and the generation of sewage by the staff on site will be limited. The dislodged biomass will not be constituted as additional pollution load by feeding on the original pollution source at the fish farm, and automated / remote operation of mariculture activities is expected for the new FCZ with minimal manual labour required. Water quality impacts as a result from chemical and sewage discharge from the Project site are therefore not anticipated, and mainly impacts from fish feed, feed wastage, fish excretion and dead fish are discussed below.

To estimate the impacts on fisheries sensitive receivers of the Assessment Area, computer modelling of changes in water quality were conducted under two scenarios:

- Baseline scenario, which covered the “without-project” condition in 2023, including pollution loading from existing FCZs (including Tap Mun FCZ (~2.1 km from the Project site), Kau Lau Wan FCZ (~1.4 km from the Project site) and Sham Wan FCZ (~4.0 km from the Project site)); and
- Project scenario, which took into account the additional pollution load from the mariculture activities at the Project site, as well as the other nearby proposed new fish culture zones at Outer Tap Mun and Wong Chuk Kok Hoi (each at their carrying capacity).

Relevant assessment criteria, i.e. Water Quality Objectives (WQOs) in the Mirs Bay and Tolo Harbour and Channel WCZs, were then used to assess potential impacts on fisheries.

Suspended Solids (SS)

Fish farm operation are expected to generate SS within the water column as a result of fish feed, fish feed wastage and fish excretion, contributing to an increase in sediment deposition in close proximity of the Project site.

Fluxes of SS naturally occur in the marine environment and as a result, fish have evolved behavioural adaptations to tolerate changes in SS load (e.g. clearing their gills by flushing water over them). Beyond the Project site, dispersion will cause a rapid decrease in the suspended solids concentrations. Compared to adult fish, larvae and post-juvenile fish are relatively more susceptible to variations in SS concentrations as their sensory system is less developed. Adult fish are more

likely to move away from area of disturbance when they detect sufficiently elevated SS concentrations and therefore are unlikely to be significantly impacted.

The SS level at which fish move into clearer water is defined as the tolerance threshold which varies among species and different stages of the life cycle. If SS levels exceed tolerance thresholds and the fish are not able to move away from the affected area, the fish are likely to become stressed, injured and may eventually die. The rate, timing and duration of SS elevations influence the type and extent of impacts upon fish and potentially crustaceans.

Findings from literature reviews indicated that lethal responses had not been reported in adult fish at SS values below 125 mg/L ⁽⁸⁴⁾ and that sub-lethal effects were only observed when levels exceeded 90 mg/L ⁽⁸⁵⁾. However, as part of a study for AFCD, *Consultancy Study on Fisheries and Marine Ecological Criteria for Impact Assessment* guideline values have been identified for fisheries and selected marine ecological sensitive receivers based on international marine water quality guidelines for the protection of ecosystems ⁽⁸⁶⁾. The AFCD study recommends a maximum SS concentration of 50 mg/L (based on half of the no observable effect concentrations). However, the study cautioned that site-specific data should be considered in environmental assessments on a case-by-case basis. In order to provide a more conservative assessment (i.e. with a lower tolerance criterion), the relevant WQOs for SS elevation are adopted instead in this study as the assessment criteria for fisheries sensitive receivers.

The water quality modelling results have indicated that at all fisheries sensitive receivers, SS elevations as a result of fish farm operation are predicted to be compliant with the relevant WQOs for both wet and dry seasons. SS elevations are expected to be temporary in nature and localised to the Project site. With the fish farm standing stock kept within the Project site's maximum carrying capacity and the use of pellet feed within fish farms, potential impacts to fisheries will well managed. The Project site is not located within the recognised spawning ground and nursery area in northeastern Hong Kong waters. Areas which supported fisheries of higher commercial value, such as HHWMP which are at some distance away from the Project site. As such, unacceptable impacts from fish farm operation on fisheries resources and habitats (including spawning ground or nursery area) due to potential elevations of SS are not expected to occur.

Dissolved Oxygen (DO)

The relationships between SS and DO are complex, with elevated SS in the water column together with a number of other factors to reduce DO concentrations. Elevated SS (and turbidity) reduces light penetration, lowers the rate of photosynthesis by phytoplankton (i.e. primary productivity) and thus lowers the rate of oxygen production in the water column. Furthermore, the decomposition of organic matter in fish feed, fish excretion and dead fish in the water column may consume DO in the receiving waters. The resulting overall DO depletion has the potential to cause an adverse effect on the eggs and larvae of fish and crustaceans, as at these stages of development high levels of oxygen in the water are required for growth to support high metabolic growth rates.

The water quality modelling results have indicated that DO depletion associated with fish farm operation are predicted to be low and remain compliant with the relevant WQO DO criteria at all fisheries sensitive receivers in the vicinity of the Project Site. Beyond the immediate vicinity of the Project Site, no unacceptable change in dissolved oxygen level is predicted at other fisheries sensitive receivers in both baseline and project scenarios. Overall, there is limited change in the

(84) References cited in BCL (1994) *Marine Ecology of the Ninepin Islands* including Peddicord R and McFarland V (1996) *Effects of suspended dredged material on the commercial crab, Cancer magister*. in PA Krenkel, J Harrison and JC Burdick (Eds) *Dredging and its Environmental Effects*. Proc. Speciality Conference. American Society of Engineers.

(85) Alabaster JS & Lloyd R (1984) *Water Quality Criteria for Freshwater Fisheries*. Butterworths, London.

(86) City University of Hong Kong (2001) *Consultancy Study on Fisheries and Marine Ecological Criteria for Impact Assessment*. Prepared for AFCD.

predicted DO levels at baseline and project scenarios and unacceptable impacts to fisheries are not expected to occur.

Nutrients

High levels of nutrients released from fish feeds, fish excretion and dead fish to the water column may potentially cause rapid increases in phytoplankton population, on occasions to the point that an algal bloom occurs. An intense bloom of algae can lead to sharp decreases in the levels of DO. This decrease will initially occur in the surface water, and then spread to deeper waters as dead algae fall through the water column and decompose on the seabed. Anoxic conditions may result if DO concentrations are already low or are not replenished. As discussed above, reduced levels of DO can impact the eggs and larvae of fish and crustaceans which require high levels of oxygen for development. Significantly low levels of DO may also result in fish mortality.

The water quality modelling results have indicated that the levels of nutrients as a result of fish farm operation are expected to be low in general within the Assessment Area. Predicted levels of unionized ammonia and Total Inorganic Nitrogen (TIN) at the Project site and all fisheries sensitive receivers are below the assessment criterion. Overall, the increased levels of nutrients in the water column as a result of fish farm operation are considered to be of minor significance and unacceptable impacts to fisheries are not expected to occur.

Chlorophyll-a

Chlorophyll-a is a photosynthetic pigment of phytoplankton and is commonly used as a direct indicator of algal biomass. As mentioned above, increased levels of phytoplankton due to nutrients released from fish farms could potentially trigger algal blooms, in which could reduce DO levels in the water column and result in fish mortality.

The water quality modelling results have indicated that the levels of chlorophyll-a vary spatially across the Assessment Area and are generally higher at the surface level and areas with shallower water depth. The predicted change of chlorophyll-a levels between baseline and project scenarios at the Project site and all other fisheries sensitive receivers within the Assessment Area is limited and below the corresponding assessment criterion. Therefore, fish farm operation is not expected to result in significant increase of chlorophyll-a and unacceptable impacts to fisheries are not expected to occur.

5.5.2.5 Fish Diseases

Fishes are kept in close proximity at individual cages in fish farms compared to the open marine waters which will increase the chance of disease transmission once developed.

It is expected that good mariculture practices shall be implemented by the fish farmers and preventive measures such as quarantine newly stocked fish / fry, using uncontaminated fish feed, regular monitoring and control of fish density, etc., as specified in **Appendix 2A**. As mentioned in **Section 5.5.2.4**, if the use of pharmaceuticals for fish is required, it will be limited on site and stored at secured locations, discharge of such chemicals is not expected from daily operations. Mariculturists at the Project site would be required to strictly observe the requirement under *Cap. 529 Veterinary Surgeons Registration Ordinance* and have strict control on prescription drugs, therefore, adverse impacts on fisheries are not anticipated. The implementation of the fish health surveillance program would also be vital to maintain the health of these maricultured fish species in the new FCZ ⁽⁸⁷⁾, therefore, AFCD has implemented the Fish Health Inspection Programme by conducting regular visits to fish farms, to identify early outbreaks of fish diseases and advice on good mariculture practices and prevention measures to fish farmers as specified in **Appendix 2A** ⁽⁸⁸⁾. Unacceptable impacts on fisheries are expected to be minor.

(87) Chong R, Bousfield B, Brown R (2011) *Op. cit.*

(88) AFCD (2021) Technical Support and Financial Assistance.

5.6 Impact Evaluation

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 5.4**.

Table 5.4 Evaluation of Fisheries Impacts in accordance with the Criteria described in Annex 9 of the EIAO-TM

Potential 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
<i>Construction Phase</i>								
Habitat disturbances and loss of access to fishing grounds	Temporary and short term (a few weeks) in the active works area.	Loss of access to fishing grounds would cover the whole Project site (410 ha).	Project site is of low to moderate levels of fisheries production and the majority of fisheries resources is of low commercial value. Considering that the impacts are temporary, impacts on fisheries resources / production is minor.	The Project site is located out of the recognised spawning ground and nursery area. No destructive constructing method are used. The magnitude of disturbance is considered to be low.	Low to high fishing operations have been recorded at the Project site Considering the temporary nature of construction impact, the impacts on fishing activities are considered to be of minor significance	No adverse impact is expected on Tap Mun FCZ, Kau Lau Wan FCZ and Sham Wan FCZ located over 1 km from the Project site.	Minor	No
Underwater sound from marine construction activities and marine vessels	Temporary and short term (a few weeks) in the active works area.	Localised to sound-generating activities, e.g. assembly of fish rafts, installation of mooring	Avoidance and habituation by fish are expected. Loss of fisheries resources / production are considered negligible.	Underwater sound is expected to have negligible impact on spawning ground and nursery area.	Underwater sound is expected to have negligible impact on fishing operations.	No adverse impact is expected on Tap Mun, Kau Lau Wan FCZ and Sham Wan FCZ located over 1 km from the Project site.	Minor	No

Potential 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
		system, marine vessels.						
<i>Operation Phase</i>								
Change in fisheries habitat and loss of access to fishing grounds	Long term over Project operation but reversible.	Loss of access to fishing grounds would cover the whole Project Site (410ha)	The fish farm structures only occupy a section of the water column and a small area of seabed confined to a thin surface layer. Considering that the majority of fisheries resources is of low commercial value in the Project site, impacts on fisheries resources / production is minor. Potential positive effect on fisheries resources due to the colonisation of marine organisms on fish farm structures is expected.	The Project site is not located within the recognised spawning ground and nursery area, therefore no direct impact on nursery area and spawning ground is expected. Fish farm structures may potentially provide spawning and nursery habitats.	Impacts are localised with moderate impact on fishing operations. Fishing activities are not allowed at the fish farm structures. Nevertheless, suitable fishing grounds outside of these structures can allow similar fishing activities to take place. Therefore, unacceptable impacts on fishing activity are not expected.	No adverse impact is expected on Tap Mun, Kau Lau Wan FCZ and Sham Wan FCZ located over 1 km from the Project site. The proposed FCZs would provide more fisheries resources to the local and global fisheries market.	Minor	No

Potential 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
Temporary relocation of fish rafts / cages	Temporary.	Localised to the immediate vicinity of the area of fish rafts / cages relocation.	Avoidance by fish is expected, and negligible loss of fisheries resources when re-anchoring occurs.	Impacts are localised with negligible impact on nursery and spawning grounds when re-anchoring occurs.	Impacts are localised with negligible impact on fishing operations when re-anchoring occurs.	Impact is variable depending on the location in which the fish rafts / cages will be relocated (i.e. distance with other existing FCZs). Considering that the impact is temporary and the rafts / cages shall be relocated back into the Project site afterwards, impacts are localised with negligible or low impact.	Minor	No
Underwater sound from marine vessels and daily operations	Long term over Project operation but reversible.	Localised to the immediate vicinity of the sound-generating activities e.g. maintenance of	Avoidance and habituation of fish is expected. Loss of fisheries resources or production are considered negligible.	Underwater sound is expected to have negligible impact on spawning ground and nursery area.	Underwater sound is expected to have negligible impact on fishing operations.	Daily fish farm operations and marine traffic present at the Tap Mun FCZ, Kau Lau Wan FCZ, Sham Wan FCZ and Tap	Minor	No

Potential 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
		the fish rafts / cages and marine vessel movement.				Mun pier. Small increase of underwater sound from the Project site is expected to have no unacceptable impact.		
Changes in water quality due to fish farm operational activities	Long term over Project operation but reversible.	Localised to the immediate vicinity of the fish farm.	Water quality compliance expected with no unacceptable impact.	Water quality compliance expected with no unacceptable impact.	Impacts are localised with negligible impact on fishing operations.	No unacceptable water quality impact expected at FCZs.	Minor	Water quality mitigation measures would further reduce impacts.
Fish diseases	Infrequent outbreaks. Occur when source of pathogens / stressors are present.	Specific fish rafts / cages or waters in the vicinity of the Project site.	Magnitude of impact would depend on the type of disease induced. Proper treatment will be implemented at the infected sites, therefore the magnitude of impact is considered to be low.	Magnitude of impact would depend on the type of disease induced. Proper treatment is implemented at the infected sites, therefore the magnitude of impact is	Impacts are localised with negligible impact on fishing operations.	Good mariculture practices will be implemented, therefore, impact on fish stock will be minor.	Minor	No

Potential 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
				considered to be low.				

5.7 Cumulative Impacts

As there are no other existing or committed non-FCZ projects identified in the vicinity of the Project site, the *Water Quality Impact Assessment* conducted is based on the worst-case scenarios of concurrent operation of all existing and planned FCZs as sources of pollution. It is expected that all FCZs will be operated within the maximum carrying capacity and therefore, unacceptable impacts to water quality are not anticipated. Consequently, unacceptable cumulative impacts to fisheries resources are not predicted to occur.

Potential operational impacts presented in **Section 5.5.2** were examined to evaluate potential cumulative impacts with other operations / developments in the northeastern Hong Kong waters. Outcomes of this evaluation, excluding the impact on water quality are summarised as follows:

- **Change of Fisheries Habitat and Loss of Access to Fishing Grounds:** The change of fisheries habitat and loss of access to fishing grounds in the context of fisheries operation would be approximately 600 ha in total, including the Project site (410 ha), the proposed Outer Tap Mun FCZ (55 ha), the proposed Wong Chuk Kok Hoi FCZ (35 ha) and the proposed Po Toi (Southeast) FCZ (100 ha). Although the fishing areas affected covers a certain extent of Hong Kong waters, loss of fisheries resources and habitats due to all the proposed FCZs would be minimal. Furthermore, the provision of the proposed FCZs would support more mariculture operations in Hong Kong and thus providing more mariculture production for local and global consumption. Considering that the overall impact of the Project is minor, and it is unlikely that the construction and operation of the Project and the other proposed FCZs would exert an unacceptable cumulative effect on fisheries.
- **Changes in Water Quality:** No marine works or other major source of pollution is expected from the construction phase of the Project, therefore, no unacceptable cumulative impact during the construction phase is expected. Water quality modelling results for the operation phase, including the pollution loading from existing and other proposed FCZs (i.e. Wong Chuk Kok Hoi FCZ and Outer Tap Mun FCZ) also showed that no unacceptable cumulative impact during the operation phase is expected.
- **Underwater Sound:** This Project is located at ~1.4 km from Kau Lau Wan FCZ, ~2.1 km away from Tap Mun FCZ and ~4.0 km away from Sham Wan FCZ, and >1.5 km away from other planned FCZs. For this Project, mainly small marine vessels e.g. sampans and speed boats operated by fishermen would be used during FCZ operation. The underwater acoustic profiles generated by works vessels of this Project would therefore be similar to the daily operations of the Tap Mun FCZ, Kau Lau Wan FCZ, Sham Wan FCZ and nearby ferry routes. Cumulative effects of works vessels operational sound, if any, are anticipated to be negligible. It is not expected to result in significant cumulative impact to the fisheries resources within the Assessment Area.
- **Marine Traffic:** This Project is located at sufficient distance from other FCZs in the vicinity. It is expected to involve a relatively small number of small marine vessels, such as sampans and speed boats that travel to and from the Project site during daily operations. Given that existing marine traffic is present within Outer Tap Mun near Tap Mun FCZ and Tap Mun pier and that the waters off northeastern Hong Kong have moderate levels of existing marine traffic, such as the ferry route between Ma Liu Shui to Lai Chi Wo / Kat O and Ma Liu Shui to Tap Mun, the cumulative effects of marine traffic disturbance to the nearby fishing operations are anticipated to be negligible.

5.8 Mitigation Measures

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

- **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; 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.

To summarise, this assessment of impacts demonstrates that impacts will largely be avoided and minimised during the construction and operation of the proposed Project, particularly to the key fisheries sensitive receivers, such as the spawning ground and nursery area of the northeastern waters of Hong Kong, marine parks, ARs and nearby FCZs.

Impacts to fisheries have largely been avoided and minimised through proper planning and design of the works. The Project site is selected to be far from HHHMP, such that impact to the marine park is avoided. The construction work of the FCZ is properly designed such that no dredging work is required. To minimise the impacts to the vicinity of the Project site, it is designed to have minimal construction work on site. The scale of construction work on-site is relatively small, and the number of vessels operating concurrently are limited to a small number. The installation time of fish farm structures is minimised and is expected to be completed within a few weeks for each fish raft which would only cause temporary disturbance to fisheries habitat and fishing ground. Main components of the rafts / cages are manufactured off-site and will be towed to the Project site using tug boat. On-site assembly and anchoring of the fish rafts / cages will be assisted by a small number of marine vessels such as sampans and small speed boats for up to a few trips per day. No heavy construction plant would be used. To minimise the impact on fisheries resources, the fish farm is designed to occupy minimal space which will only occupy a thin surface layer (<0.5 m) within a small area.

These designs are expected to control and reduce potential impacts to fisheries resources, and no fisheries-specific mitigation measures are thus required during construction.

The mitigation measures designed to mitigate water quality impacts and proper fish farm management designated to mitigate marine ecological impacts shall be adopted. No fisheries-specific mitigation measures are thus required during operation.

5.9 Residual impacts

Taking into consideration the impact assessments in the previous sections and with effective implementation of the proposed mitigation measures, the significance of residual impacts on fisheries resources including sensitive receivers such as Tap Mun FCZ, Kau Lau Wan FCZ, Sham Wan FCZ and other ARs in the vicinity have been evaluated. Residual impacts occurring as a result of the proposed Project have been determined and are discussed as follows:

- 410 ha of fisheries habitat and fishing grounds will be affected during operation of the FCZ. While the design of fish farm will only occupy a section of the water column and a small area of seabed. With low commercial value for the majority of fisheries resources found in and around the vicinity of the Project site and considering that suitable fishing grounds outside of the Project Site can allow similar fishing activities to take place, the impact due to the change in fisheries habitat and loss of access to fishing grounds is considered to be of acceptable. Furthermore, with the implementation of the proposed mitigation measures, the potential impact on fisheries will be further minimised. No unacceptable residual fisheries impacts during the construction and operation of the Project are therefore anticipated.
- In addition, the establishment of the proposed FCZ would have positive effects on fisheries resources. While the proposed FCZ would provide more fisheries resources to the local and

global fisheries market, the fish farm structures would also provide artificial substrates, which could form habitat and shelter for juveniles or adult fisheries resources. Besides, the reduced fishing pressure may also have potential positive effect on fisheries resources within and adjacent to the Project site.

5.10 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.

5.11 Summary and Conclusions

A review of baseline information on commercial fisheries resources, habitats and fishing operations surrounding the waters of the proposed Project from available literature has been conducted. Results of the review indicated that although low to high levels of fishing operation with low to moderate levels of fisheries production were reported at the Project site, similar levels of fisheries operation and production were also reported elsewhere in the broad Assessment Area. Recent studies suggested that the northeastern waters supported fisheries resources that are mainly with low commercial value, with some commercially important families recorded in the area. It remains as important spawning ground and nursery area for fisheries resources. HHWMP which supported fish families with higher commercial values is located at some distance away from the Project site. Within the Assessment Area, fisheries sensitive receivers, including spawning ground, nursery area, marine parks, ARs and existing FCZs have been identified. Based on the information reviewed, the Project site does not represent a unique fishing ground, spawning ground and nursery area for fisheries resources.

During the construction of the Project, direct impacts arising from the proposed marine works include disturbance to fisheries habitats and the loss of access to potential fishing grounds (~410 ha). Considering the temporary nature of the disturbance and the majority of fisheries resources found in and around the vicinity of the Project site are of low commercial value, unacceptable impacts on fisheries are not expected. Low to high fishing operations have been recorded at the Project site. Considering the temporary nature of construction impact, the impacts on fishing activity are considered to be of minor significance. Impact of elevated levels of underwater sound as a result of construction activities are considered acceptable with the presence of existing underwater sound from the nearby Tap Mun FCZ, Kau Lau Wan FCZ, Sham Wan FCZ and ferry routes. No fisheries-specific mitigation measures are required during FCZ construction.

During FCZ operation, there will be 410 ha loss of access to fishing grounds. The structures mainly occupy a section of the water column and a small area of seabed confined to a thin surface layer (<0.5 m). The presence of fish farm structures will also provide hard substrates that could be colonised by a variety of marine organisms and bringing potential positive effect on fisheries resources. Although the area affected is considered moderate in the context of surrounding similar habitat, the majority of fisheries resources found in and around the vicinity of the Project site are of low commercial value, unacceptable impacts on fisheries are not expected. Impacts on fishing activity are localized with moderate impact on fishing operation as fishing activities are not allowed inside fish farm structures. Considering that suitable fishing grounds outside of these structures can allow similar fishing activities to take place, unacceptable impacts on fishing activity are not expected. Potential impacts of elevated levels of underwater sound generated from the marine vessels in the vicinity of the Project site are considered acceptable with the presence of existing underwater sound from the nearby Tap Mun FCZ, Kau Lau Wan FCZ, Sham Wan FCZ and ferry routes. Temporary relocation of fish rafts may occur over a short time, therefore, unacceptable impacts are not anticipated. Impacts of changes in water quality arising from FCZ operation are predicted to be largely confined in the vicinity of the Project site within the maximum carrying capacity. No unacceptable change in water quality is predicted at all fisheries sensitive receivers in both baseline and project scenarios. The management of fish health will be conducted regularly to prevent fish disease outbreaks, including the Fish Health

Inspection Programme to be conducted regularly by AFCD and the implementation of good mariculture practices by fish farm owners. No fisheries-specific mitigation measures are required during FCZ operation.

Overall, no unacceptable impacts to fisheries are expected to occur. All of the potential construction and operational fisheries impacts identified are deemed acceptable.