

## 5. FISHERIES IMPACT ASSESSMENT

### 5.1 Introduction

This *Section* presents the findings of an assessment of potential impacts on capture and culture fisheries associated with the construction and operation activities of the Project.

### 5.2 Legislative Requirements and Evaluation Criteria

#### 5.2.1 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 for 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.

#### 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 license in designated Fish Culture Zones (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)*, *Clause 3.4.5* and *Appendix D* of the EIA Study Brief (ESB-328/2019) 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* of the EIA Study Brief, the Assessment Area for fisheries impact assessment is the same as that for water quality impact assessment, covering the area within the Southern WCZ and Western Buffer WCZ. Detailed description of the physical and biological characteristics of the marine environment of the Assessment Area are provided in **Sections 3** and **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 detail in **Annex 5A**.

Some of the baseline information was collected very recently in 2016-2018 and is considered to be up-to-date and representative of the existing conditions in the Assessment Area (**Figure 1.3 of Annex 5B**). Therefore, no information gap within the Assessment Area is identified. Despite this, to better understand the fisheries resources and fishing operations within and in the vicinity of the Study Area, field surveys at selected locations within and in the vicinity of the Study Area where potential impact

could occur were conducted between February and May 2021 to update the latest fisheries baseline in these locations. The methodology for the surveys is presented in **Annex 5B**. Detailed survey findings are presented in detail in **Annexes 5C to 5E**.

The information from desktop review and field surveys collectively suggested that:

- According to the AFCD Port Survey 2016/17 data, the Study Area falls within an area with moderate to high (>400-600 vessels) level of fishing operations. The Study Area provides low to moderate level of capture fisheries production (>100-300 kg/ha).
- Fisheries surveys conducted from February to May 2021 showed that the catches were generally comprised of low to moderate commercial value fisheries species which accounted for about 75% of total biomass and 65% of total abundance. Some fisheries species of medium to high commercial value were recorded, including prawns, mantis shrimps, porgy and flounder.
- The level of ichthyoplankton and fish post-larvae resources of the Assessment Area varied greatly over time and was low in general with species of low to medium commercial value;
- Vessel surveys recorded an average of four fishing vessels/day operation in the waters within and in the vicinity of the Study Area. The fishing activities were generally undertaken using P4/7 vessels (sampan) and small fishing boats.

### 5.3.3 Fisheries Importance

Based on the information reviewed, the importance of the fisheries within the Assessment Area is evaluated. Findings from the desktop review and field surveys indicated that the Study Area support low to moderate level of capture fisheries production with generally species of low to medium commercial value.

According to *EIAO-TM Annex 9*, spawning grounds and nursery area 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. The Study Area is located within the recognised spawning ground and nursery area of commercial fisheries resources. It is, however, important to note that the densities of ichthyoplankton and fish post-larvae resources varied across seasons at the three surveyed sites from the fisheries surveys. The level of ichthyoplankton and fish post-larvae resources of the Assessment Area was low in general with mainly low to moderate value commercial species, which indicates that the potential for the Assessment Area to function as important spawning grounds and nursery area is not high.

The waters within the Project's footprint and its vicinity also do not support mariculture activities. The nearest FCZs are located more than 6.9 km (by sea) from the Project.

### 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 are identified as follows:

- Recognised spawning ground and nursery area of commercial fisheries resources in southern waters located within the Project;
- FCZs at Cheung Sha Wan (~ 6.9 km away from the Project), Lo Tik Wan (~ 7.0 km away from the Project), Sok Kwu Wan (~ 8.8 km away from the Project) and Ma Wan (~ 14.3 km away from the Project); and
- Artificial reefs within Lo Tik Wan FCZ (located ~ 8.9 km from the Project).

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

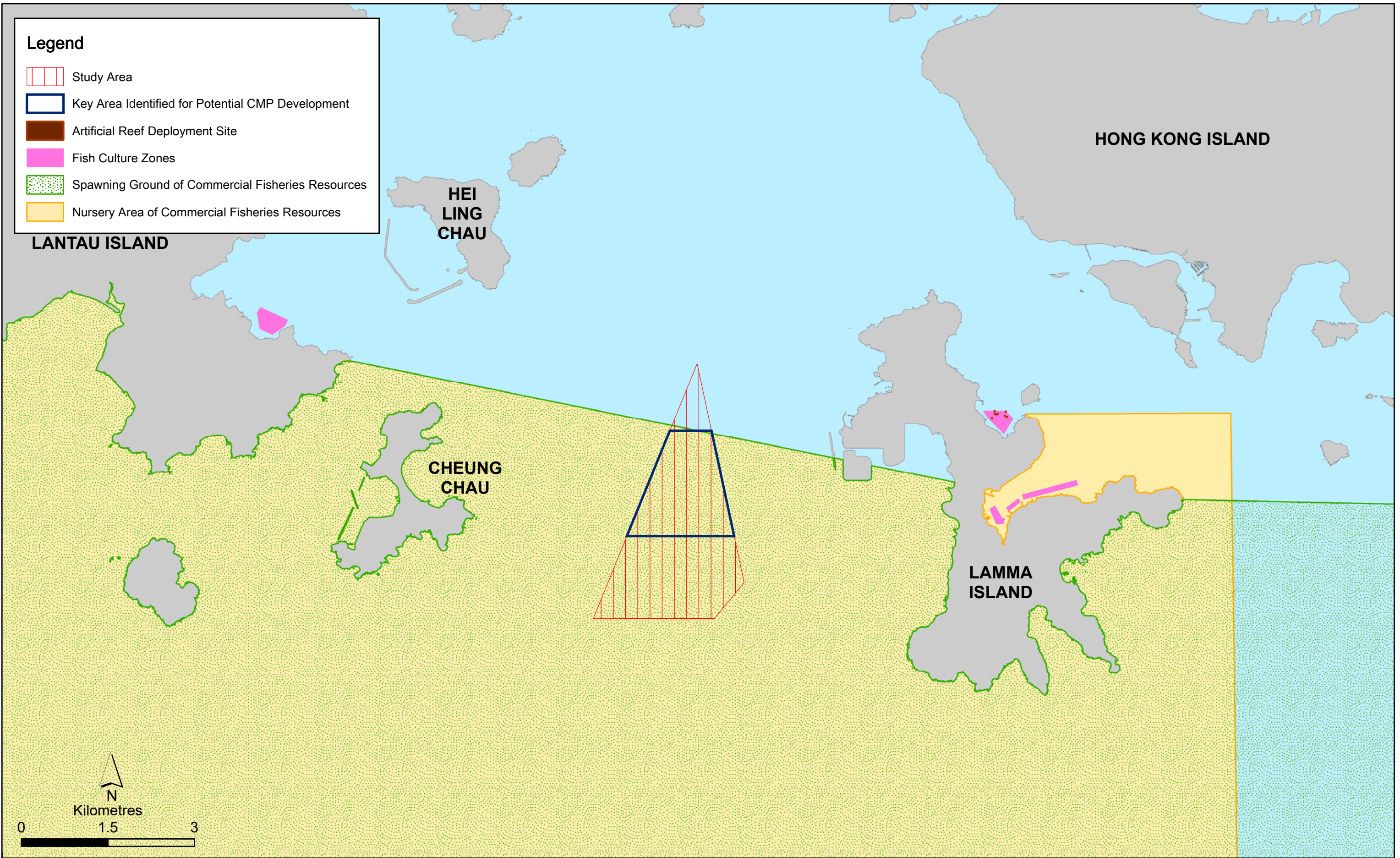


Figure 5.1

Fisheries Sensitive Receivers

## 5.4 Assessment Methodology

A review of baseline fisheries conditions from available literature and field surveys 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 (**Section 3**) was examined to assess potentially affected area by perturbations to water quality parameters.

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

## 5.5 Potential Impacts and Impact Assessment

The key construction and operation activities of the Project are discussed in **Section 2.6.4**. Potential sources of impacts to fisheries resources and fishing operations arising from the Project may occur during both construction and operation activities, including:

### Construction activities:

- Dredging of the seabed for the formation of CMP

### Operation activities:

- Disposal of contaminated sediment in the formed CMP
- Capping of the exhausted CMP with uncontaminated sediment up to the original seabed level

Note that the construction activities (dredging) could overlap with operation activities (backfilling and capping) to maintain uninterrupted disposal service of the proposed WL Facility. The following key issues to fisheries have been assessed and discussed in the following sections:

- Direct disturbances of fisheries habitat and fishing ground;
- Perturbations to key water quality parameters from marine construction and operation activities; and
- Underwater sound generated from marine construction activities.

### 5.5.1 Habitat Disturbance & Loss of Access to Fishing Ground

Direct impacts to fisheries resources, habitats (including spawning ground and nursery area) and fishing operations include disturbance caused by the dredging, disposal and capping works of the Project during construction and operation. The construction and operation activities are expected to cause temporary loss of access to potential fishing ground of up to 120 ha at the active CMP(s) within the Key Area at any one time. It should be noted that a relatively small number of works vessels (e.g. up to two dredgers, some tugs/ supporting vessels, some hopper barges for sediment handling at any one time) will occupy the active CMP areas, and the frequency/ trip of works vessels would also be relatively low in general depending on the sediment disposal demand. It is expected that the disturbance to fisheries habitats will be temporary at discrete work locations of the active CMPs. Each CMP will be constructed and operated sequentially and will be capped with 3 m layer of uncontaminated sediments to keep the contaminated material beyond the reach of bioturbation and to protect it against storm erosion. The work rates for dredging, backfilling and capping works will be controlled and a maximum of two grab dredgers or one TSHD will be used for the formation of CMP at any one time. The dredging works for formation of CMP will not be continuous throughout the service lifetime of the WL Facility and the schedule could be adjusted in view of the actual sediment disposal demand and the interface with other concurrent activities / projects to minimise potential environmental impacts. The disposal activity is expected to have a much lower working rate throughout the service lifetime of the WL Facility with reference to the estimated annual average

disposal demand of 0.6 Mm<sup>3</sup> (equivalent to ~1,650 m<sup>3</sup>/day) while the working rate of capping activity could also be controlled depending on the availability of uncontaminated sediment.

Once dredging, backfilling and capping works for a CMP of the Project are completed, the seabed and hydrodynamic regime is expected to restore to their original condition. A review of long term environmental monitoring within and around the capped pits at South Brothers has shown that there is an increasing trend of macrobenthos infauna in terms of biomass over time at the capped pits and the faunal diversity at the capped pits also appears to increase over time and the majority of the infauna species identified were polychaetes, crustaceans and bivalves, which were similar to the species found in the adjacent reference stations in North Lantau waters in a relatively short period of time (about 2 years following the completion of capping works)<sup>(55)</sup>. This demonstrates that recolonisation of benthos occurs and the habitats are expected to return to pre-dredged conditions.

Considering the temporary and reversible nature of the disturbance, small extent of the area at any one time which is of low to moderate fisheries production and moderate to high level of fishing operation, impacts are considered to be of minor to moderate significance. Safety / precautionary measures such as issuance of Marine Department Notice or other notifications is expected to reduce the risk of collision of increased marine traffic and fishing vessels to within acceptable levels. During construction and operation of the CMPs, works area will be established within and in the vicinity of the active CMP(s) within Key Area only to minimize the actual extent of fisheries habitats and fishing ground affected at any one time. Fisheries resources are expected to return to the area following the cessation of dredging, backfilling and capping works. Overall, unacceptable impacts on fisheries are not expected.

## 5.5.2 Change in Water Quality

Indirect impacts to fisheries resources, habitats (including spawning ground and nursery area) and fishing operations during the construction and operation activities of the Project include sediment release associated with the dredging, backfilling and capping works. Potential impacts to water quality from sediment release due to the construction and operation activities of the Project are described in the water quality impact assessment (**Section 3**). These potential impacts are as follows:

- Suspended solids (SS) dispersion and sedimentation;
- Dissolved oxygen (DO) depletion;
- Release of sediment-bounded contaminants into the water column; and
- Release of sediment-bounded nutrients into the water column.

### 5.5.2.1 Suspended Solids (SS)

Dredging, backfilling and capping works are expected to generate SS within the water column and result in increased sediment deposition in close proximity of the works areas. The modelling works have analysed SS dispersion from concurrent dredging, backfilling and capping works of the CMPs (**Section 3.7.1**).

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). Concentrations of SS generated by the dredging, backfilling and capping works are expected to be greater, particularly in the Key Area. Beyond the active works areas of the proposed CMPs, dispersion could be expected so there is a rapid decline in the SS 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

(55) ERM (2019). Quarterly EM&A Report for Contaminated Mud Pits to the East of Sha Chau and the South of The Brothers – October to December 2018. Submitted under Agreement No. CE 63/2016 (EP)

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, fishes are susceptible to be stressed, injured and may eventually die. The rate, timing and duration of SS elevations affect the type and significance 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  $125 \text{ mg L}^{-1}$  (56) and that sub-lethal effects were only observed when levels exceeded  $90 \text{ mg L}^{-1}$  (57). In the *Consultancy Study on Fisheries and Marine Ecological Criteria for Impact Assessment* by AFCD, guideline values have been identified for fisheries and selected marine ecological sensitive receivers. The values are based on international marine water quality guidelines for the protection of ecosystems (58). The AFCD study recommends a maximum SS concentration of  $50 \text{ mg L}^{-1}$  (based on half of the No Observable Effect Concentrations). This criterion has been adopted in previous approved EIA Reports. 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 WQOs for SS elevation are adopted in this study as the assessment criteria for fisheries sensitive receivers.

As discussed in *Section 3.7.1*, the water quality modelling results have indicated that at all fisheries sensitive receivers, SS elevations as a result of the proposed dredging, backfilling and capping works are predicted to be compliant with the relevant WQOs for both wet and dry seasons (**Table 3.13**). The maximum SS elevation at sensitive receivers was predicted to be  $1.1 \text{ mg/L}$  while the maximum SS elevation at the nearby FCZs was predicted to be  $0.2 \text{ mg/L}$ . Elevated levels of SS as a result of these works are expected to be temporary in nature and localised to the proximity of active works areas of the proposed CMPs. With the implementation of mitigation measures proposed in the water quality impact assessment in **Section 3.8**, such as the use of cage-type silt curtain for dredging works by grab dredgers, control of working rates for dredging, backfilling and capping works, potential impacts to fisheries would be further reduced. Also, although larvae and post-juvenile fish are more likely to be impacted as they may not be able to detect and avoid areas with elevated levels of SS, the Project area only contributed to <1% of the recognized nursery area and spawning ground for commercial fisheries resources in Hong Kong waters, and the level of ichthyoplankton and fish post-larvae resources of the Assessment Area varied greatly over time and was low in general. Therefore, unacceptable impacts from dredging, backfilling and capping works on fisheries resources and habitats (including spawning ground and nursery area) are not anticipated.

### 5.5.2.2 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 potential release of sediment contaminants into the water column may consume the 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.

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- (56) 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.
- (57) Alabaster JS & Lloyd R (1984) *Water Quality Criteria for Freshwater Fisheries*. Butterworths, London
- (58) City University of Hong Kong (2001). Agreement No. CE 62/98, *Consultancy Study on Fisheries and Marine Ecological Criteria for Impact Assessment*, AFCD, Final Report July 2001.

The results of the water quality assessment have indicated that elevated levels of SS as a result of dredging, backfilling and capping works are expected to be temporary in nature and localised to the proximity of active works areas of the proposed CMPs. DO depletion associated with dredging, backfilling and capping works are predicted to be very low (~0.03 mg/L, see **Section 3.7.1.2**) and remain compliant with the relevant WQO DO criteria at all fisheries sensitive receivers for both wet and dry seasons. Therefore, impacts are considered to be of minor significance and no unacceptable impacts to fisheries from the reduction of DO concentration are expected to occur.

### 5.5.2.3 Contaminant Release

The potential for release of contaminants from disturbed sediments has been assessed in **Section 3.7.1.3**. Sediment samples collected within the Study Area indicated low levels of sediment contamination within the Project Site. Therefore, risk of release of sediment-bounded contaminant from dredging works of the Project is minimal and impact to fisheries resources due to potential contaminant release is not expected. On the other hand, the contamination levels of sediments for backfilling of the Project could vary and sediment-bounded contaminants from backfilling is more likely to be released. As a conservative approach in the water quality modelling, it is assumed that concentration of all sediment-bounded contaminants are at the corresponding UCEL and release of sediment-bounded contaminants is instantaneous and 100% loss from the entrained sediment. In reality, the release of sediment-bounded contaminants takes time and generally cannot reach its completion (see **Section 3.7**). The modelling results showed that all the levels of contaminants of concern at sensitive receivers are within the corresponding assessment criteria. Unacceptable water quality impacts due to the potential release of heavy metals and organic pollutants from disturbed sediments into the water column are not expected to occur. An assessment on bioaccumulation was also conducted for this study and the results showed that the increase in contaminant concentrations in fisheries resources is insignificant (see **Section 8**). In addition, with reference to the long-term environmental monitoring data from ESC CMPs, the concentrations of contaminants for tissues/ whole body samples of fisheries resources (including pelagic fish, molluscs, predatory crabs, predatory fish and predatory shrimps) collected between reference area (i.e. away from CMPs) and impact area (i.e. closer to the CMPs) were found to be similar over the years <sup>(59)</sup>, indicating there is no evidence of adverse impact to fisheries resources collected near the CMP area due to the potential release of sediment-bounded contaminant. Therefore, impacts on fisheries resources due to bioaccumulation of released contaminants from disturbed sediments are not expected to occur.

### 5.5.2.4 Nutrients

High levels of nutrients (total inorganic nitrogen and ammonia) released from disturbed sediments to the water column may potentially cause rapid increase in phytoplankton population, on occasions to the point that an algal bloom occurs. An intense algal bloom can cause decrease in the levels of DO. This decrease 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.

The water quality modelling results have indicated that elevated levels of SS as a result of dredging, backfilling and capping works are expected to be temporary in nature and localised to the proximity of active works areas of the proposed CMPs. The predicted change is well below 1% of the corresponding WQO and is considered inconsequential at all fisheries sensitive receivers for both wet and dry seasons (see **Section 3.7.1.4**). Impacts are considered to be of minor significance and unacceptable impacts to fisheries are thus not expected to occur.

### 5.5.2.5 Summary

In summary, predicted levels of SS, DO, contaminant and nutrient concentrations as a result of dredging, backfilling and capping works of this Project are anticipated to be in compliance with the

(59) ERM (2021). Annual Risk Assessment Report for the Contaminated Mud Pits to the East of Sha Chau - April 2020 to March 2021. Submitted under Agreement No. CE 63/2016 (EP).

relevant assessment criteria. Impacts are considered to be of minor significance. Impacts are localised with negligible impact on fishing activity. Unacceptable indirect water quality impacts from sediment release on fisheries resources, habitats, fisheries sensitive receivers and fishing activity are not expected to occur.

### 5.5.3 Underwater Sound

Intermittent sounds, which occur during construction and operation activities such as dredging 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 of fish present, type of species affected, proximity of fish 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.

Fish, however, can detect underwater sound vibrations through two ways, the lateral line system and the inner ear for species containing air-filled swim bladders. Anthropogenic underwater sounds associated with vessels for this Project, such as barges, tug boats, dredgers, etc., exhibit major energy below 1,000 Hz and sound levels of between 170 and 190 dB re 1  $\mu$ Pa at 1 m and may be audible to most fish species<sup>(60)</sup>. Waters within the Assessment Area and its vicinity is subject to relatively high levels of marine traffic by similar types of vessels; therefore it is reasonable to assume that fish in these waters are habituated to a relatively high background level of underwater sound, and a small increase in vessel activity associated with the construction and operation of this Project is not anticipated to result in unacceptable impacts on fisheries resources, and hence is expected to have negligible impact on fishing activity.

## 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 5.1**.

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(60) Richardson WJ, Greene CRG, Malme CI, Thomson DH (1995) *Marine Mammals and Noise*. Academic Press, San Diego, 576 pp



**Table 5.1 Evaluation of Fisheries Impacts in accordance to the Criteria described in Annex 9 of 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
Direct disturbances of fisheries habitat and loss of access to fishing ground	Temporary and reversible.	A total of ~235 ha. Up to 120 ha at active CMP(s) within the Key Area at any one time during dredging, backfilling and capping operations.	The Project area is of low to moderate fisheries production. Fisheries resources are expected to return to the area following the cessation of dredging, backfilling and capping works. Considering the temporary and reversible nature of the disturbance, impacts on loss of fisheries resources / production are considered minor.	Although the Project is located within recognised spawning ground and nursery area, the level of ichthyoplankton and fish post-larvae was generally low. Impacts on destruction and disturbance of nursery and spawning grounds are considered minor.	The Project area falls within an area with moderate to high level of fishing operation. Considering the temporary and reversible nature of the disturbance, as well as the minimisation of works area to active CMP(s) within Key Area only, impacts on fishing activity are considered minor to moderate.	No aquaculture activities in the Project works areas and hence no impact.	Minor to Moderate	Yes; minimise works area to active CMP(s) within Key Area only. Issue Marine Department Notice or other notifications as safety / precautionary measures
Perturbations to key water quality parameters from marine construction and operation activities	Temporary and reversible.	Localized to the immediate vicinity of the active works areas of the proposed CMPs.	Avoidance by fish is expected, and negligible loss of fisheries resources or production.	Water quality compliance expected with minor impact.	Impacts are localised with negligible impact on fishing activity.	Water quality compliance at FCZs expected with no unacceptable impact.	Minor	No, water quality mitigation measures would further reduce impacts ( <b>Section 3.8</b> )
Underwater sound	Temporary and reversible.	Localized to the immediate vicinity of the active works areas of the proposed CMPs.	Avoidance and habituation by fish are expected, and negligible loss of fisheries resources or production.	Underwater sound is expected to have negligible impact on spawning ground and nursery area.	Underwater sound is expected to have negligible impact on fishing activity.	Aquaculture activities are too remote to be affected by underwater sound and hence no impact.	Minor	No

## 5.7 Cumulative Impacts

The fisheries impact assessment has considered the cumulative effects of different activities of this Project on fisheries resources, habitats and fishing operations. The water quality impact assessment (**Section 3**) was based on the worst-case scenarios of concurrent construction and operation activities of this Project as well as relevant concurrent projects (see **Annex 3A** for the detailed consideration) and thus has also incorporated potential cumulative impacts. The cumulative impacts of the various construction and operation activities of this Project and other relevant concurrent projects have been demonstrated in **Section 3.9** as not causing unacceptable impacts to water quality. Consequently, unacceptable cumulative impacts to fisheries resources are not predicted to occur.

Information from publicly available sources suggested the major projects that may coincide with the construction/ implementation programmes of this Project (**Section 2.8** and **Annex 2A**). Potential cumulative impacts were evaluated with other existing and planned major development in the Assessment Area, in particular South of Cheung Chau Open Sea Sediment Disposal Area, Improvement Dredging for Lamma Power Station Navigation Channel and Development of an Offshore Wind Farm in Hong Kong and the Artificial Islands in the Central Waters located within a few kilometres from the Project. Outcomes of this evaluation are summarised as follows:

- **Habitat Loss and Disturbance and Loss of Access to Fishing Grounds:** the extent of disturbance of the Project is expected to be small, temporary and confined to localised works areas at the active CMP(s) of the Key Area (up to ~120 ha of loss of fishing ground at any one time for dredging, backfilling and capping activities). The South of Cheung Chau Open Sea Sediment Disposal Area is expected to result in a temporary disturbance of a maximum of 600 ha seabed habitat at any one time, though the seabed disturbance is expected to be confined in particular areas where disposal activities would occur. The Improvement Dredging for Lamma Power Station Navigation Channel is expected to result in a temporary disturbance of 262 ha seabed habitat and loss of access to fishing ground. The Development of an Offshore Wind Farm in Hong Kong is expected to result in a permanent loss of 0.16 ha seabed habitat and permanent loss of access to ~700 ha fishing ground. The severity of such cumulative habitat loss is expected to be significantly reduced to acceptable levels by mitigation measures proposed as part of the EIAs for the Improvement Dredging for Lamma Power Station Navigation Channel and Development of an Offshore Wind Farm in Hong Kong. Considering the temporary nature and relatively small size (up to ~120 ha of loss of fishing ground at any one time for dredging, backfilling and capping activities) of the Project, it is not expected to exert an unacceptable cumulative effect. On the other hand, the development of the Artificial Islands in the Central Waters are expected to result in a permanent loss of ~1,000 ha seabed. The KYCAI development is currently in early planning stage and effective and feasible mitigation measures, including compensation measures, will be investigated under the CW Study to address the permanent loss of seabed due to the proposed development <sup>(61)</sup>. The acceptability of residual cumulative impacts on fisheries from the said concurrent projects will largely depend on the environmental acceptability of the reclamation of KYCAI and the HKI-NEL Link in the Central Waters.
- **Underwater Sound:** the Project is located at sufficient distance from other projects and only a relatively small number of slow-moving works vessels would be used for the Project. Given the similarity in underwater acoustic profiles generated by works vessels of this Project and other projects (e.g. by the use of large vessels generating low-frequency sound), cumulative effects of works vessels operational sound, if any, are anticipated to be negligible.

(61) Subject to further investigation on the details of the proposed KYCAI development under the CW Study, the detailed cumulative impacts to fisheries due to habitat loss and disturbance and loss of access to fishing grounds, increase in underwater sound and increase in marine traffic, if any, will be addressed under the EIAs for the CW Study.

- **Marine Traffic:** this Project is located at sufficient distance from other projects in the vicinity. It is expected to involve a relatively small number of works vessels at any one time at the works areas of the proposed CMPs, and the frequency/ trip of vessel would also be low. Given the waters off southern Hong Kong have some levels of existing marine traffic, the cumulative effects of marine traffic disturbance to the nearby fishing operations, if any, are anticipated to be negligible.

Other projects either do not have a marine element or are at more than a few kilometres from this Project, and so no unacceptable cumulative impact on disturbance to fisheries resources, habitats (including spawning or nursery grounds) and fishing operation is expected.

## 5.8 Mitigation Measures

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

- **Avoidance:** Potential impacts should be avoided to the maximum extent 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.

Impacts to fisheries resources, habitats and fishing operations have largely been avoided (i.e. avoid areas of high fisheries importance through site selection) and reduced through proper planning and design of the CMPs (e.g. CMPs to be developed within Key Area, CMPs to be constructed and operated sequentially, no more than three pits will be active (dredging / backfilling / capping) at any one time and works area within and in the vicinity of the active pit(s) only). Issuance of Marine Department Notice or other notifications is expected to reduce the risk of collision of increased marine traffic and fishing vessels to within acceptable levels as safety / precautionary measures. During construction and operation of the CMPs, works area will be established within and in the vicinity of the active CMP(s) within Key Area only to minimize the actual extent of fisheries habitats and fishing ground affected at any one time. Appropriate notification, communications, site protection and marking would be adopted to reduce navigation risks with fishing vessels. The construction and operation activities have been designed (e.g. appropriate work rates for dredging, backfilling and capping) to confirm compliance with the assessment criteria at sensitive receivers and control water quality impacts to within acceptable levels and water quality mitigation measures (e.g. deployment of cage-type silt curtain during dredging works by grab dredgers, good site practices) will be implemented to further avoid/reduce potential impacts (see **Section 3**). These measures are expected to control and reduce potential impacts to fisheries resources as well, and no other fisheries-specific mitigation measures are thus required during construction and operation of the Project.

## 5.9 Residual Impacts

Recolonisation of benthos is expected after capping of the CMPs and the habitats are expected to return to pre-dredged conditions. Fisheries resources are expected to return to the area following the cessation of dredging, backfilling and capping works. With the implementation of water quality mitigation measures during construction and operation activities of the Project, potential impacts on fisheries habitats and resources will be further minimised. No adverse residual fisheries impacts due to the dredging, backfilling and capping works of the Project are expected.

## 5.10 Environmental Monitoring and Audit

While no unacceptable impacts have been predicted to occur during construction and operation of the Project, monitoring of fisheries resources and biomonitoring programme are recommended to address stakeholders' concerns on the level of fisheries resources and contamination of seafood in the vicinity of the Project. The details of the fisheries resources monitoring and biomonitoring programme will be presented in the EM&A Manual attached to this EIA Report.

In addition, monitoring activities designed to detect and mitigate impacts to water quality during construction and operation activities are also expected to serve to protect against impacts to fisheries. The details of the water quality monitoring programme will be presented in the EM&A Manual attached to this EIA Report.

## 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 and field surveys has been undertaken. Results from the review indicate that the Study Area falls within an area with moderate to high level of fishing operations and provides low to moderate capture fisheries production. Sensitive receivers, including spawning ground and nursery area of commercial fisheries resources in southern waters, FCZs in Sok Kwu Wan, Lo Tik Wan, Cheung Sha Wan and Ma Wan, and artificial reefs in the Lo Tik Wan FCZ have been identified, and the water quality impact assessment demonstrated that these sensitive receivers would not be affected unacceptably.

During construction and operation activities of the Project, direct impacts arising from the proposed dredging, backfilling and capping works include temporary disturbance to fisheries habitats and loss of access to potential fishing ground within an area of approximately Key Area. Considering the temporary and reversible nature of the disturbance, small extent of the area at any one time which is of low to moderate fisheries production and moderate to high level of fishing operation, impacts are considered to be of minor to moderate significance and unacceptable impacts on the fisheries resources, habitats and fishing activities are not expected. Indirect impacts to fisheries resources related to perturbations to key water quality parameters from construction and operation activities are expected to be insignificant as the predicted changes in water quality are temporary, localised to immediate vicinity of the active works areas of the proposed CMPs and in compliance with the corresponding WQOs and assessment criteria. Potential impacts of elevated levels of underwater sound as a result of construction and operation activities are also not expected to be unacceptable. The construction and operation of the Project have been designed to reduce potential impacts on water quality which will, in turn, reduce impacts on fisheries resources. Water quality mitigation measures (e.g. deployment of cage-type silt curtain during dredging works by grab dredgers, good site practices) will be implemented to further avoid/reduce potential impacts. Safety / precautionary measures such as issuance of Marine Department Notice or other notifications is expected to reduce the risk of collision of increased marine traffic and fishing vessels to within acceptable levels. During construction and operation of the CMPs, works area will be established within and in the vicinity of the active CMP(s) within Key Area only to minimize the actual extent of fisheries habitats and fishing ground affected at any one time.

No unacceptable impacts to fisheries are expected to occur. All of the potential construction and operational fisheries impacts identified are deemed acceptable. Recolonisation of benthos is expected after capping of the CMPs and the habitats are expected to return to pre-dredged conditions. Fisheries resources are expected to return to the area following the cessation of dredging, backfilling and capping works.