

TRANSPORT AND HOUSING BUREAU  
GOVERNMENT SECRETARIAT  
Port, Maritime and Logistics Development Unit

# Ecological, Fisheries and Water Quality Impact Assessment Study for the Proposed Port Development at Northwest Lantau

*Executive Summary*

14 September 2007

**Environmental Resources Management**

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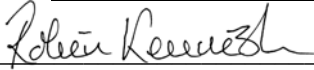


Transport and Housing Bureau

Ecological, Fisheries and Water  
Quality Impact Assessment Study  
for the Proposed Port Development  
at Northwest Lantau:

*Executive Summary*

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For and on behalf of Environmental Resources Management
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## CONTENTS

1	<i>INTRODUCTION</i>	1
2	<i>KEY INFORMATION ON EXISTING ENVIRONMENTAL CONDITIONS</i>	2
2.1	<i>INTRODUCTION</i>	2
2.2	<i>WATER QUALITY</i>	2
2.3	<i>MARINE ECOLOGY</i>	2
2.4	<i>FISHERIES RESOURCES AND FISHING OPERATIONS</i>	4
3	<i>IMPACT ASSESSMENT SUMMARY</i>	5
3.1	<i>WATER QUALITY</i>	5
3.2	<i>MARINE ECOLOGY - CHINESE WHITE DOLPHINS</i>	7
3.3	<i>MARINE ECOLOGY - OTHER MARINE ECOLOGICAL RESOURCES</i>	9
3.4	<i>FISHERIES</i>	10
4	<i>CONCLUSIONS</i>	12
4.1	<i>OVERALL ACCEPTABILITY OF ANY ADVERSE WATER QUALITY, FISHERIES AND ECOLOGICAL IMPACTS</i>	12
4.2	<i>CONDITIONS AND REQUIREMENTS FOR THE DETAILED DESIGN, CONSTRUCTION AND OPERATION OF THE PROJECT</i>	15
4.3	<i>OVERALL ACCEPTABILITY HAVING REGARD TO AND IN LIGHT OF TECHNICAL CONSTRAINTS, COST AND ACCEPTABILITY OF THE IMPACT AND PROPOSED MITIGATION MEASURES</i>	15
4.4	<i>ACCEPTABILITY OF RESIDUAL IMPACTS AFTER THE IMPLEMENTATION OF PROPOSED MITIGATION MEASURES</i>	18

**ERM-Hong Kong, Ltd** (ERM) was commissioned by the Port, Maritime and Logistics Development Unit (PMLDU) of the Transport and Housing Bureau (THB) to undertake the study entitled *Ecological, Fisheries and Water Quality Impact Assessment Study for the Proposed Port Development at Northwest Lantau* (the Study).

The Study arose as a recommendation (under Clause 10 of ACE Paper 2/2005) from the consultancy study on Hong Kong Port – Master Plan 2020 (HKP2020). That study concluded that it was not possible, with the information available at that stage, to determine whether or not the environmental impact of the Northwest Lantau option can meet the necessary regulatory requirements, in light of the particular concerns related to potential impacts to the Chinese White Dolphin.

The Study has aimed to provide the HKSARG with information on the acceptability of residual impacts from the construction and operation of the proposed port at Northwest Lantau. The assessment is focused upon impacts to water quality, fisheries and marine ecological resources with a special focus on impacts to the Chinese White Dolphin population. A key feature of the Study is the extensive field data collected through a 12-month field survey programme of dolphin abundance and distribution in Hong Kong and Mainland waters as well as water quality modelling simulations, which have provided essential data for undertaking the assessment. It is important to note that the Study is based on a conceptual engineering design for the proposed port at Northwest Lantau.

The detailed findings of the Study are presented in a *Final Report* which in turn draws from extensive results and assessments presented in a series of *Working Papers*. This *Executive Summary* is intended to provide an overview of the key Study findings, and presents the main conclusions and recommendations of the Study in order to assist the HKSARG in its deliberation on the way forward.

2.1 INTRODUCTION

The Study is focussed on assessing impacts to Water Quality, Marine Ecology and Fisheries sensitive receivers and hence this section on existing environmental conditions is focussed on these three topic areas.

2.2 WATER QUALITY

The proposed container terminal would be situated in Hong Kong's northwestern waters within the Pearl River Estuary. The environmental conditions of the area show distinct seasonality as a result of the seasonal influx of freshwater from the Pearl River. The estuarine influence is especially pronounced in the wet summer months when the freshwater flows are the greatest and with prominent strong salinity and temperature stratification. During the winter months water conditions are more typical of the ocean.

In the area surrounding the proposed container terminal site, the water quality is influenced to a degree by effluent discharges from sewage treatment works, such as those at Siu Ho Wan and Pillar Point. EPD routine water quality monitoring data, for the period 1996 to 2006, indicate an increasing trend for suspended solids and Unionised Ammonia. A decreasing trend for dissolved oxygen (DO) was reported from 1996 to 2003, increasing afterwards. The water quality parameters generally comply with the statutory criteria (ie the Water Quality Objectives) aside from Total Inorganic Nitrogen (TIN), and Unionised Ammonia at some locations. It was noted from reviewing the data for suspended solids that the range of values recorded is high (up to 81 mg L<sup>-1</sup>) near the container terminal site.

2.3 MARINE ECOLOGY

2.3.1 Chinese White Dolphins

For this Study, twelve months of marine mammal surveys in both West Lantau and Mainland waters of the Pearl River Estuary have been completed. The survey data were combined with the Government's long-term dolphin monitoring data to examine various aspects of the population biology of the Chinese White Dolphin population in the Pearl River Estuary.

Results from various analyses under this Study suggested that the stretch of waters along the western coast of Lantau represented a very important habitat to the dolphins compared with other areas of the Pearl River Estuary and Hong Kong. Some key points include:

- The dolphin encounter rate was much higher in West Lantau than in all other survey areas, indicating that West Lantau was the area most regularly used by dolphins (*Figure 2.1*).
- West Lantau was one of the areas which were consistently utilized by dolphins in all four seasons and were important to dolphins year-round (*Figure 2.2*). Other areas used year-round by dolphins but to a lower extent included South Lingding Bay, Northwest Lantau (ie West of the Chek Lap Kok Platform), Macau, Central Lingding Bay, Northeast Lantau, Southwest Lantau, Deep Bay and East Lantau.
- West Lantau had the highest densities of dolphins, which were up to 2.9 times higher than South Lingding Bay, the area with the 2<sup>nd</sup> highest dolphin density (*Figures 2.3 – 2.5*).
- West Lantau had the highest occurrence of young calves (encounter rate of 5.3 young calves per 100 km of survey effort) among all survey areas (< 1.9 in all other areas). West Lantau should thus be viewed as one of the more important areas for young calves.
- Dolphins sighted in West Lantau had the highest occurrence of feeding (encounter rate of 4.36) and socializing (encounter rate of 1.61) activities among all survey areas (< 2.13 and < 0.36 respectively in all other areas). West Lantau should thus be viewed as one of the more important areas for feeding and socializing.
- Photo-identification showed that individuals from other survey areas used West Lantau as part of their home range. This supports the finding that West Lantau is one of the more important dolphin habitats in the Pearl River Estuary.

Based on the methodology defined in *Annexes 8 and 16* of the Technical Memorandum under the Environmental Impact Assessment Ordinance (*EIAO-TM*), the ecological importance of marine waters off West Lantau around the proposed port development site for marine mammals is **high**.

### 2.3.2 *Other Ecological Resources*

The ecological profile of marine habitats along the West Lantau coast was examined through a desktop study and field surveys, including horseshoe crab surveys to determine the presence of any nursery beaches.

As an artificial island, the proposed port development site footprint would lie off the coast of West Lantau and therefore would not directly impact intertidal hard or soft bottom habitats, or subtidal hard bottom habitats that fringe Lantau's coast. The area that would be directly impacted by the proposed development is muddy seabed, which supports subtidal soft bottom benthic assemblages. The ecological importance of this potentially directly impacted marine habitat is evaluated as **low** but with ecological linkage (via the foodchain) to high value dolphin habitat.

As part of this Study, fisheries surveys have been conducted off the Tai O coast and in the neighbouring waters of Northwest and Southwest Lantau.

Analysis of shrimp trawl, hang trawl and gill-net survey data did not reveal any significant differences in catch sizes between Tai O and any of the other surveyed locations off West Lantau. Also, there were no clear patterns in catch sizes between the different survey months, but community structure did vary with time. Fish post larvae and ichthyoplankton surveys provided no strong evidence that West Lantau waters are more important fish spawning or nursery areas than other surveyed areas in Hong Kong.

Fishing operations in West Lantau are dominated by sampan vessels (> 50 %, using gill nets and hand lines), and are generally more concentrated off the Tai O coast owing to the heavier use of this area by small-scale fishermen.

Using the assessment methodology defined in *Annexes 9 and 17* of the *EIAO-TM*, it was determined that the waters off West Lantau are of **low to moderate** importance to the Hong Kong fishery. The areas were of higher importance to the small-scale fishermen based along the West Lantau coast.

### 3.1 WATER QUALITY

A water quality impact assessment has been carried out to identify and evaluate the potential hydrodynamic and water quality impacts arising from the construction and operation of the proposed Port development.

#### 3.1.1 Construction Phase

Two construction options have been reviewed and the associated construction works have been investigated. One option requires extensive piling activities (fully piled). If bored piling is adopted, this may involve discharging untreated piling water into the surrounding marine water, and adequate mitigation measures are required in controlling the discharge to avoid adverse environmental impacts. The other option which requires reduced piling coupled with dredging and backfilling along the seawall would result in the resuspension of sediments and associated water quality impacts. For both options, dredging will be required at the proposed approach channel and container berth which extends into mainland waters. This would elevate the SS levels in marine waters.

As the proposed dredging sites are situated in two water quality and ecological sensitive areas, ie West Lantau and the Pearl River Estuary Chinese White Dolphin Nature Reserve, a mixing zone will unavoidably occur <sup>(1)</sup>. Based on the model predictions, the mixing zone will be approximately 4.2 km<sup>2</sup> (near the seabed) in size assuming that silt curtains are not used for mitigation. With the installation of silt curtains to reduce the extent of SS dispersion, there would still be residual impacts over a sizeable area (approximately 3.8 km<sup>2</sup>, assuming that deployment of silt curtains around the grab dredgers gives a maximum 75% SS reduction).

Residual water quality impacts to sensitive areas have been examined. The magnitude of the adverse water quality impacts was considered low since predicted SS elevations would not be expected to have direct biologically significant impacts to the dolphins. These water quality impacts would occur during the dredging and backfilling works in the construction phase, and would cease once works are completed.

A cumulative water quality impact assessment has been conducted and the potential concurrent projects during the construction phase have been identified. It has been assumed in the study that an artificial island for the Hong Kong Zhuhai Macau Bridge (HZMB) Hong Kong Boundary Crossing Facilities (BCF) would be located at San Shek Wan. The cumulative water quality impacts associated with the construction works for the HZMB without

(1) A mixing zone is a region of a waterbody where water quality criteria can be exceeded. The WQOs must be met at the boundary of the mixing zone.

any mitigation measures would be adverse in terms of magnitude and extent. Non-compliances of the water quality objectives would occur along the western coast of Lantau and the mixing zone would be up to 33 km<sup>2</sup> in size (near the seabed) if no mitigation measures are deployed. Note that the cumulative assessment was carried out with a highly conservative set of assumptions such as the consideration of unmitigated scenarios, maximum dredging and filling rates and all works occurring concurrently. It should also be noted that the Hong Kong BCF preferred site location had not been determined at the time of writing and was under study for the ongoing HZMB Hong Kong BCF Site Selection Study - Feasibility Study. With effective mitigation measures, the cumulative impacts could be reduced. Further assessment is required to assess the effectiveness of mitigation measures and to determine compliance with standards.

### 3.1.2 *Operation Phase*

After construction, the presence of the Port may result in a change in the hydrodynamic regime and hence an impact assessment, with the aid of mathematical modelling, has been carried out to address these impacts.

From the modelling results, it is concluded that there would be a significant change in flow patterns and water quality in close proximity to the Port. These changes would mainly be found in an area within approximately 5 km of the Port, and would diminish with distance. Of the two construction options, the reclamation option would result in more significant changes to hydrodynamics and water quality than the fully piled option.

The impact of the proposed Port development on the dispersion of effluents from the Tai O Sewage Treatment Works (STW) was also addressed. Modelling results show that the physical presence of the Port leads to the accumulation of pollutants at San Shek Wan and Yi O. Should this Project be pursued, further investigation will be required to determine whether the situation can be rectified using options such as upgrading the treatment level of the STW and relocating the outfall discharge to minimise the effect of the Port on dispersion.

Water quality impacts due to port operations, such as vessel discharges, surface runoff and oil spillage have been assessed. It is expected that no adverse impacts would arise, provided that adequate precautionary measures are implemented.

Generally, the maintenance dredging works would pose water quality impacts of a lower magnitude and smaller scale than those associated with the construction phase dredging. The frequency and duration of maintenance dredging should be quantified in the detailed environmental impact assessment as more engineering design data become available.

An assessment of the potential impacts to the Chinese White Dolphins and other marine ecological resources was undertaken. The assessment addressed the potential construction and operation phase impacts of the proposed port development at Northwest Lantau.

### 3.2.1

#### *Construction Phase*

The impact assessment was conducted with reference to the two preliminary design options:

- *Option 1* involving construction of a 245 ha platform on a fully piled structure;
- *Option 2* involving a combination of mostly reclamation and some piles.

The assessment also took into account the dredging works for the approach channel, berthing area and for *Option 2*, the seawall foundations around the perimeter of the reclamation footprint. The overall duration of the proposed construction phase works was assumed to take about 10 years.

For both Options, habitat loss was identified as the **most significant** issue for dolphins. Under both options, 245 ha of marine waters will be permanently lost that are important to dolphins for a variety of reasons. As described in *Section 2.3.1*, West Lantau waters are important for dolphin feeding, nursing and socialising activities and have the highest densities of dolphins when compared to the other areas surveyed in the Pearl River Estuary and Hong Kong waters. The permanent loss of this valuable habitat at West Lantau waters, which was found to surpass the importance of any of other survey area in the Pearl River Estuary, has the potential to result in adverse impacts to dolphins. This permanent habitat loss will be in addition to the disturbance of 480 ha of seabed due to dredging of the approach channel and berthing areas, most of which would occur within the existing Pearl River Estuary Chinese White Dolphin National Nature Reserve in Mainland waters.

Affected dolphins would be expected to disperse to other areas of their home range in the Pearl River Estuary (c. 16,000 km<sup>2</sup>). The distribution and home ranges of dolphins would therefore be altered so that dolphins from both Hong Kong and Mainland waters, that currently use this area as important part of their home ranges for feeding, socialising and nursing would have to adjust to the loss.

In a monitoring study of the Chinese White Dolphin in Hong Kong, it was found that dolphins have returned and are using the waters near the Chek Lap Kok airport after the construction phase which involved extensive marine work of a similar nature to that proposed for the Port development <sup>(1)</sup>.

(1) Jefferson, T. A. (ed.). 2005. Monitoring of Indo-Pacific humpback dolphins (*Sousa chinensis*) in Hong Kong waters – data analysis: final report. Unpublished report submitted to the Hong Kong Agriculture, Fisheries and Conservation Department.

Furthermore, there is residual uncertainty as to whether the displacement of dolphins from waters around the periphery of the Port footprint would be permanent or temporary. In addition to the potential for an altered distribution and home ranges as dolphins adjust to the presence of the Port, there is a risk that the loss of such important marine mammal habitat may have broader implications on the dolphin population as a whole and affect the carrying capacity of the Pearl River Estuary for dolphins. There is a potential risk that the Port may lead to a reduction in the size of the Chinese White Dolphin population.

Disturbance and the risk of vessel strike due to presence and movement of construction vessels was assessed and it was concluded that the presence of works vessels would not necessarily adversely impact marine mammals. When construction works are underway, if substantial numbers of works vessels were gathered in one location, there is an increased likelihood that dolphins would avoid the area until the vessels have left. Sounds generated by dredging operations are not expected to acoustically interfere with dolphins to a significant degree.

The potential impact of disturbance to the seafloor due to dredging works and the effects on dolphin's prey resources were assessed. Elevations in SS associated with dredging (both *Options 1 & 2*), reclamation and backfilling works (*Option 2* only) for the Port development are not anticipated to cause direct adverse impacts on dolphins but indirect impacts may occur. There are large natural fluctuations in ambient suspended sediment in West Lantau waters which can sometimes reach high levels ( $> 80 \text{ mg L}^{-1}$ ). The water quality assessment has indicated the dredging would also contribute large area exceedances in SS levels. Although estuarine organisms including fisheries resources can tolerate high SS concentrations to a degree, there is potential for these tolerances to be exceeded on occasion when ambient suspended sediment levels are also high. Furthermore, the potentially large size of the sediment plume and the disturbance of 480 ha of seabed are reasons to predict there is the potential for wide-scale changes in dolphins' prey distribution to occur during the construction phase. As West Lantau is known to be important feeding habitat, such changes in prey distribution could have significant implications to the dolphins.

Percussive pile driving works produce high-intensity underwater sound and may result in the interruption of the dolphins' normal activities, and would be another reason for the short- or long-term displacement from the impacted areas around the project site. The scale and duration of the piling works for the proposed Port development would be considerable involving many thousands of piles and requiring, for *Option 1* up to 10 years to complete (*Option 1*: 10 years; *Option 2*: 2 years) and would involve many piling barges.

The propagation of high-intensity impulsive sounds associated with percussive piling works can be reduced by employing a bubble jacket/curtain; however, the impacts to dolphins would be greater if large numbers of piles are installed concurrently. Taking into account the importance of West Lantau waters to dolphins, the expected magnitude of impacts due to large

scale concurrent piling works for both Options and the long duration of this activity particularly for *Option 1*, the percussive piling works, would probably also lead to the medium to long-term avoidance of the area by dolphins.

As set out above, there are a number of sources of impact which would contribute to dolphins avoiding the area beyond the additional significant large scale loss of important habitat. The significance of this avoidance and habitat loss to the population as a whole is worthy of further assessment as there may be habitats that provide the equivalent ecological function elsewhere in Hong Kong or in the Pearl River Estuary.

### 3.2.2 *Operation Phase*

Increased vessel traffic during the Port operation was identified as having the potential to affect Chinese White Dolphins, which may need to change their diving and surfacing patterns to avoid being hit by large vessels. Although, vessel activity may result in behavioural change, it should be noted that the slow speed of the vessels in and around the Port would generally reduce the chances of collision and thus reduce the significance of the overall impacts. As noted in *Section 2.3.1*, this area is notable for the relatively higher densities of young calves which are considered more vulnerable than older animals.

With the operation of this major port facility, it is expected that there will be substantial increases in vessel traffic levels in the West Lantau area above existing levels both due to ship arrivals and due to Port fleet movements. The Port would also be in operation on a 24 hour permanent basis. It is expected that the frequent passing of vessels off West Lantau would mean that mothers with calves would be more likely avoid the shipping approaches to the Port. It should be noted that the shipping lanes in the western waters of Hong Kong such as the Urmston Road support relatively high density of sightings of dolphins, albeit not mother with calves. Consequently, it is not expected that all dolphins will avoid the waters around the Port but mothers with calves can reasonably be expected to do so.

Impacts associated with maintenance dredging will be similar but of a lower magnitude than those discussed for the construction phase.

## 3.3 *MARINE ECOLOGY - OTHER MARINE ECOLOGICAL RESOURCES*

### 3.3.1 *Construction Phase*

Habitat loss will be confined to areas off the coast consisting of subtidal soft bottom habitat. No direct impact to intertidal habitats, including horseshoe crab nursery beaches would occur. The scale of permanent habitat loss required for *Option 2* (combination of piling and reclamation) is considerably greater and therefore of higher magnitude than that for *Option 1* (fully piled). The loss of seabed and the associated benthic assemblages would be about 245 ha for *Option 2* and 4.8 ha for *Option 1*. Although not physically lost, the assessment of *Option 1* identified negative impacts to marine waters due to shading effect of the platform. The total loss of 245 ha of subtidal soft bottom

habitat due to *Option 2* was assessed as a significant impact on the marine ecology of West Lantau since there would be large scale loss of habitat for benthic organisms, which are a source of food for demersal (bottom-dwelling) fish such as croakers, Sciaenidae, which in turn, in addition to pelagic fish (eg engraulids, clupeids and trichiurids), are known to be important prey for dolphins.

Dredging for the approach channel and container vessels berthing area would disturb 480 ha of seabed. The assessment concluded that the direct impact on the subtidal soft bottom habitat will be temporary in nature and the disturbed seabed will eventually be available for recolonisation by benthic fauna. Although, the habitat loss would be reversible, impacts would recur periodically due to maintenance dredging.

### 3.3.2 *Operation Phase*

The hydrodynamic modelling work has demonstrated that under *Option 1* (fully piled) water flows would pass largely unhindered under the platform. The modelling results for *Option 2* (combination of reclamation and piling) indicated that the horseshoe crab nursery beaches at Yi O and Sham Wat may be indirectly impacted by reductions in water quality. A 10% decrease in dissolved oxygen was predicted at Yi O, while *E. coli* levels were predicted increase by 40% at Sham Wat.

## 3.4 *FISHERIES*

### 3.4.1 *Construction Phase*

For both *Options 1* and *2*, the loss of fishing area was assessed as amounting to 245 ha. The loss of this area, which is of low to moderate importance, will impact fishers that habitually fish West Lantau waters. It is expected that the loss of this area would mean that affected fishers would have to relocate to other fishing areas. The loss of these marine waters, although unlikely to cause a noticeable reduction in overall Hong Kong fish catches, is expected to affect some small scale local fishermen.

Under *Option 1*, loss of fishing resources will be of lower magnitude than *Option 2* since the majority of marine waters and seabed under the platform would be preserved. As fishers would not be able to access the waters under the platform, the fisheries resources (either mature or juvenile fishes and crustaceans) underneath it may be preserved to a certain extent, and may contribute to nearby waters. Although this may be considered to have a positive effect, it is considered relatively minor.

Dredging of the approach channel and container vessels berthing area would have a long construction period (3 years) and therefore would be likely to result in significant impacts on the existing fishing operations of the area.

According to the water quality assessment of the dredging works, the mixing zone would generally be confined to the immediate vicinity of the dredging

site. Organisms in these habitats are considered to be adapted to tolerate naturally-occurring episodes of elevated suspended sediment conditions. Nevertheless, at times when ambient suspended levels naturally reach high levels, the elevations in SS due to dredging may be above tolerable levels. There is potential for adverse water quality impacts on fisheries resources in the direct vicinity of the dredging works. In addition, disturbance of the seabed as a result of dredging and other works has the potential to cause certain fisheries resources to migrate to other waters.

### 3.4.2 *Operation Phase*

Using hydrodynamic modelling, it was predicted that *Option 1* (fully piled option) will result in minimal change to the hydrodynamic conditions around the Port. In contrast, it was predicted that under *Option 2* (Combined reclamation and piled option), water flows and sedimentation would be significantly altered off Yi O due to the blocking effect of the newly reclaimed land on currents passing along the West Lantau coast. It is considered that these changes may influence the distribution of fisheries resources off the Yi O headland since the eddies, where fish tend to congregate, would be weakened.

The findings and impact assessment of this Study are intended to contribute to deliberation by the Government on the following.

- The overall acceptability of any adverse water quality, fisheries and ecological impacts;
- The conditions and requirements for the detailed design, construction and operation of the Project;
- The overall acceptability having regard to and in light of technical constraints, cost and acceptability of the impact and proposed mitigation measures; and
- The acceptability of residual impacts after the implementation of proposed mitigation measures.

#### 4.1 *OVERALL ACCEPTABILITY OF ANY ADVERSE WATER QUALITY, FISHERIES AND ECOLOGICAL IMPACTS*

The overall water quality, fisheries and ecological impacts due to the Port development at Northwest Lantau are summarised as follows:

*Table 4.1 Summary of Overall Impacts to Water Quality*

<b>Project phase</b>	<b>Impact Summary</b>
Construction	<ul style="list-style-type: none"> <li>• Quantitative modelling of the potential water quality impacts associated with dredging activities indicate the potential for large area exceedances of SS concentrations above water quality standards in the bed layer over the course of the dredging works.</li> <li>• Potentially concurrent projects during the construction phase have been identified. A cumulative assessment of the port plus the HZMB Hong Kong Boundary Crossing Facilities (BCF), would have potentially adverse construction phase impacts under worse case conservative construction design assumptions. Non-compliances with WQOs were predicted to occur at sensitive receivers along the western coast of Lantau and the mixing zone could be up to 33 km<sup>2</sup> in size. It should also be noted that the Hong Kong BCF preferred site location has not yet been determined and is being studied under the current HZMB Hong Kong BCF Site Selection Study - Feasibility Study.</li> </ul>

Project phase	Impact Summary
Operation	<ul style="list-style-type: none"> <li>It was concluded that there would be a significant change in flow patterns and water quality in the close proximity of the Port under <i>Option 2</i>. Of the two construction options, the reclamation option would result in more significant impacts than the fully piled option. The assessment of <i>Option 2</i> indicated that the water quality of Yi O bay and Sham Wat Wan may be adversely affected, specifically reduction in DO and an elevation in <i>E. coli</i> respectively, as a result of an impairment in the dispersion of treated sewage effluent from the Tai O STW.</li> </ul>

**Table 4.2** *Summary of Overall Impacts to Marine Ecology*

Project phase	Impact Summary
Construction	<ul style="list-style-type: none"> <li>Permanent and temporary habitat loss: <ul style="list-style-type: none"> <li><u><i>Option 1</i></u>: Approximately 4.8 ha of subtidal soft bottom habitat due to installation of piles will be permanently lost. Directly affected infaunal and epifaunal assemblages consist of a variety of common and widespread species which are well-represented in Hong Kong. Chinese White Dolphin utilisation of the sea area underneath the platform is considered uncertain and unlikely.</li> <li><u><i>Option 2</i></u>: Permanent and irreversible loss of 245 ha subtidal soft bottom habitat and sea area which has been identified as important to the Chinese White Dolphin.</li> <li><u>Approach Channel and Container Berthing Area</u>: The approach channel and container berthing area are located to the west of the Port and within the Pearl River Estuary Chinese White Dolphin National Nature Reserve in Mainland Waters. An area of about 480 ha will be dredged during the construction phase which may last for approximately 3 years. Such large scale and prolonged dredging activities may influence the distribution and activities of Chinese White Dolphin utilising these waters.</li> </ul> </li> <li>The scale of piling works for the proposed Port development would be considerably greater than that for other recent projects in Hong Kong. From a marine mammal assessment perspective, the proposed scale and duration of piling works is a significant matter, particularly if the percussive piling method was adopted. 27,000 piles and 2,300 piles are required for the <i>Option 1</i> and <i>Option 2</i> respectively. It is also noted that from the preliminary works schedule, piling works would be a long-term activity spanning several years and could involve up to 26 piling barges. The underwater sounds emanating from the percussive piling works may be dampened through the use of a bubble jacket/curtain but impacts to Chinese White Dolphins are predicted to be potentially adverse due to the prolonged duration and large scale of the piling activities, and taking into account the importance of West Lantau waters to dolphins.</li> <li>Quantitative modelling of the potential water quality impacts associated with dredging activities indicate the potential for large area exceedances of SS concentrations above water quality standards in the bed layer over the course of the dredging works, which may adversely affect the distribution of dolphin prey resources in the affected area.</li> </ul>

Project phase	Impact Summary
Operation	<ul style="list-style-type: none"> <li>During the operation phase, the Port will be in permanent operation on a 24 hour basis. Due to increases in marine traffic and related disturbances, there is the possibility that operation of the Port at West Lantau would lead to the avoidance of this area by mothers with calves. Given that information available to date indicates that this is one of the more important, nursing, feeding and socialising areas in Hong Kong waters and the Pearl River Estuary this has the potential to have population wide consequences if no suitable replacement habitat is available.</li> </ul>

**Table 4.3** *Summary of Overall Impacts to Fisheries*

Project phase	Impact Summary
Construction & Operation	<ul style="list-style-type: none"> <li>Disturbance of the seabed due to dredging activities and consequent indirect water quality impacts may cause low levels of disturbance to fisheries resources.</li> <li>The loss of 245 ha of low to moderate importance fishing ground for both options, although unlikely to cause a noticeable reduction in overall Hong Kong fish catches, but it is expected to adversely affect some small scale local fishers.</li> </ul>

The guiding principle for ecological assessment emphasises that areas and/or habitats of ecological importance shall be conserved as far as possible. *Annex 16* of the *EIAO-TM* sets out the general policy for mitigating impacts on important habitats and wildlife. Proposed ecological mitigation measures for ecology, should, in accordance with this guiding principle, follow, in order of priority:

- **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 constraints on the intensity of works operations (eg dredging rates) or timing of works operations; and
- **Compensation:** The loss of important species and habitats may be provided for elsewhere as compensation. Enhancement and other conservation measures should always be considered whenever possible.

According to *Annex 16* of the *EIAO-TM*, any project that is likely to result in adverse ecological impacts in areas of ecological importance shall not normally be permitted unless:

- the project is necessary;
- it has been proven that no other practical and reasonable alternatives are available; and,

- adequate on-site and/or off-site mitigation measures are to be employed.

In this preliminary assessment using conservative assumptions for the proposed design for the Port and the associated construction methods, it is predicted that there is the potential to cause adverse ecological impacts. It should be noted that this finding does not take into consideration the positive effect associated with the utilisation of mitigation measures. It is important under the *EIAO* for the proponent to demonstrate there is a need for the project, that no other practical and reasonable alternatives are available and that effective mitigation measures have been adopted.

It should be noted that in addition to Northwest Lantau, Southwest Tsing Yi was also considered as one of the potential locations for the proposed container terminal in the Study on Hong Kong Port- Master Plan 2020 (HKP 2020). According to the findings of the HKP 2020, development at this location would, however, incur substantial land resumption and reprovisioning costs, and is also likely to result in severe waste management, water quality and decontamination problems. No firm conclusion can be reached at this stage given the uncertainty on the feasibility of mitigation measures for the Northwest Lantau option, which is recommended to be the subject for further study.

#### **4.2** *CONDITIONS AND REQUIREMENTS FOR THE DETAILED DESIGN, CONSTRUCTION AND OPERATION OF THE PROJECT*

Should the Government decide to pursue the project at the proposed site in Northwest Lantau, optimization of the design and construction methods will need to be undertaken as there is the potential for adverse residual impacts.

Due to the ecological importance of parts of the Northwest Lantau area, it is expected that the construction programme will need to take into account the following constraints, which have been recommended in recent EIA studies that cover the West and Northwest Lantau areas:

- Avoidance where practicable of percussive pile driving and dredging activities during the Chinese White Dolphin peak calving season, ie March through August; and
- Restrict percussive pile driving and dredging activities to a daily maximum of 12 hours with daylight operations avoiding generation of underwater sounds at night time.

#### **4.3** *OVERALL ACCEPTABILITY HAVING REGARD TO AND IN LIGHT OF TECHNICAL CONSTRAINTS, COST AND ACCEPTABILITY OF THE IMPACT AND PROPOSED MITIGATION MEASURES*

To mitigate the various potential impacts to Chinese White Dolphin, a number of mitigation measures have been considered in the study. Given the potential adverse impacts associated with the project particularly due to large scale habitat loss, it is apparent that mitigation measures would need to be

effective on a scale that has not previously been achieved in Hong Kong. The feasibility and effectiveness of such far reaching mitigation measures requires further examination. The series of mitigation measures that are proposed for further study are as follows.

- Relocation of the Port development site to reduce impacts to a high dolphin density habitat - This measure would involve moving the location of the Port further north or to another suitable location, to an area where dolphin density is comparatively lower. This measure would allow permanent habitat loss to be avoided in areas with higher value and may also reduce the scale of any necessary mitigation. The measure may require a longer approach channel, which would traverse important dolphin habitat and may increase the volume of dredged material generated. Furthermore, the possible interaction between the Port and the HZMB project would need to be examined.
- Reduction of size of platform / reclamation - It would be necessary to explore means to optimise the size of the Port development to minimise habitat loss. Any reduction in terminal size would reduce the amount of permanent habitat loss and the scale of additional mitigation needed.
- Deployment of artificial reefs - Artificial reefs are typically deployed to enhance marine areas and would be intended to bolster feeding resources for dolphins. The performance of artificial reefs in Hong Kong western waters may be hampered by high sedimentation rates and subsidence. To be effective, artificial reefs would need to be designed to overcome these issues.
- No take zone / trawler exclusion zone - Placing restrictions on fisheries may be a way to enhance the productivity of remaining marine waters by increasing prey availability for dolphins, and minimising disturbance to the seabed. Areas designated as no take zones would be those in which all fishing activities would be prohibited, whereas trawler ban zones would prohibit only demersal (bottom) trawling and hang trawling. Although fishing restrictions may have benefits to the fishing industry in the longer term through promoting the recovery of fish stocks, they are likely to be perceived as controversial and, there would need to be consultation with the local fishers.
- Total fishing ban - A total fishing ban refers to prohibiting all fishing activities across major parts of West Lantau. A major ban on fishing activities would enhance prey availability for dolphins by removing competition from fishers and allowing the recovery of fish stocks, as well as allowing recovery of benthic communities in the absence of high levels of disturbance. A fishing ban would also remove a source of potential injury and dolphin mortality. Such a measure would have major implications on the fishing industry and the concerned fishers would need to be consulted.

- Ship speed restriction zone – A speed restriction zone is a measure whereby all vessels would be subject to speed restrictions (<10 knots) within a designated area. Speed restrictions would provide a means to lower the risk of vessel strike on dolphins. Such a measure, which would mean significant restrictions on existing and future marine traffic on West Lantau, would require extensive public consultation and any restriction on vessel speeds near to the Port may need to be negotiated with the shipping industry and other sectors.
- Expansion of Marine Park areas or Nature Reserve – The *Marine Parks Ordinance* provides an existing mechanism for designation of areas where activities, such as fishing and restrictions on vessel speed, may be imposed. Expansion of existing Marine Parks, designation of new Marine Parks or Reserves within Hong Kong would require the identification of suitable areas for expansion and confirmation that the measures would be feasible in compensating for habitat loss. The focus of investigation would probably be the Lung Kwu Chau and Sha Chau Marine Park and the potential Fan Lau Marine Park. Further investigation may also include exploring the expansion of the Pearl River Estuary Chinese White Dolphin Nature Reserve. There would need to be extensive public consultation especially with the fishing and shipping industries in Hong Kong. Liaison with the relevant authorities in the Central Government regarding the issue of the Pearl River Estuary Chinese White Dolphin Nature Reserve would be necessary.

In general, any measures which are required to reduce impacts to water quality (including provision of silt curtains, controlling dredging rates etc) and which contribute to good construction practices (including control vessel speeds, provision of bubble jacket/curtain) will also serve to protect against indirect impacts to capture fisheries and ecological resources.

Although not implemented specifically to mitigate for the loss of fishing grounds, provision of 19.5 km of rubble mound seawalls on the edges of the proposed Port reclamation (only for *Option 2*) would provide habitat for more diverse and abundant ecological assemblages than are currently present on the existing flat muddy seabed and has the potential to provide habitat and shelter for juveniles or adult fisheries resources. However, such fisheries and ecological mitigation measures still can only partially mitigate the loss of important Chinese White Dolphin habitats.

As part of the further study, it is considered that if this site option is pursued then it will be necessary to develop an integrated mitigation strategy through combining different mitigation measures.

The further investigation of mitigation measures will need to examine their potential effectiveness and feasibility and will need to address issues such as the scale of mitigation needed and possibility for implementation given there could be major implications on the fishing operators and other stakeholders.

The identified key residual impact occurring during the construction phase is the permanent loss of approximately 245 ha of seabed associated with the Port development (for both Options). The loss of this area of important Chinese White Dolphin habitat is potentially detrimental to the population of Chinese White Dolphins in Hong Kong. Although a number of potential mitigation measures have been identified, it is uncertain at this stage whether measures to offset large scale habitat loss are practicable or would be sufficient to reduce residual impacts to acceptable levels according to the *EIAO-TM* requirement.

Should this option be pursued further and taken to a more detailed stage of engineering design and feasibility study the following further investigations would be beneficial:

- Engineering studies to further optimize the size and scale of reclamation required for the Port and to optimise construction methods in light of the findings of this study;
- Further investigation (including empirical studies) of the feasibility of the mitigation strategy;
- Determination of whether other suitable locations for the Port are available in western waters of Hong Kong that are less important habitat for dolphins;
- Further surveys in Mainland waters to better understand the distribution of key habitats with a view to identifying other important areas of dolphin habitat; and,
- Extension of the surveys in Mainland water to the southwest of Macau to determine whether the population of Chinese White Dolphin extends further into the west of the Pearl River Estuary.

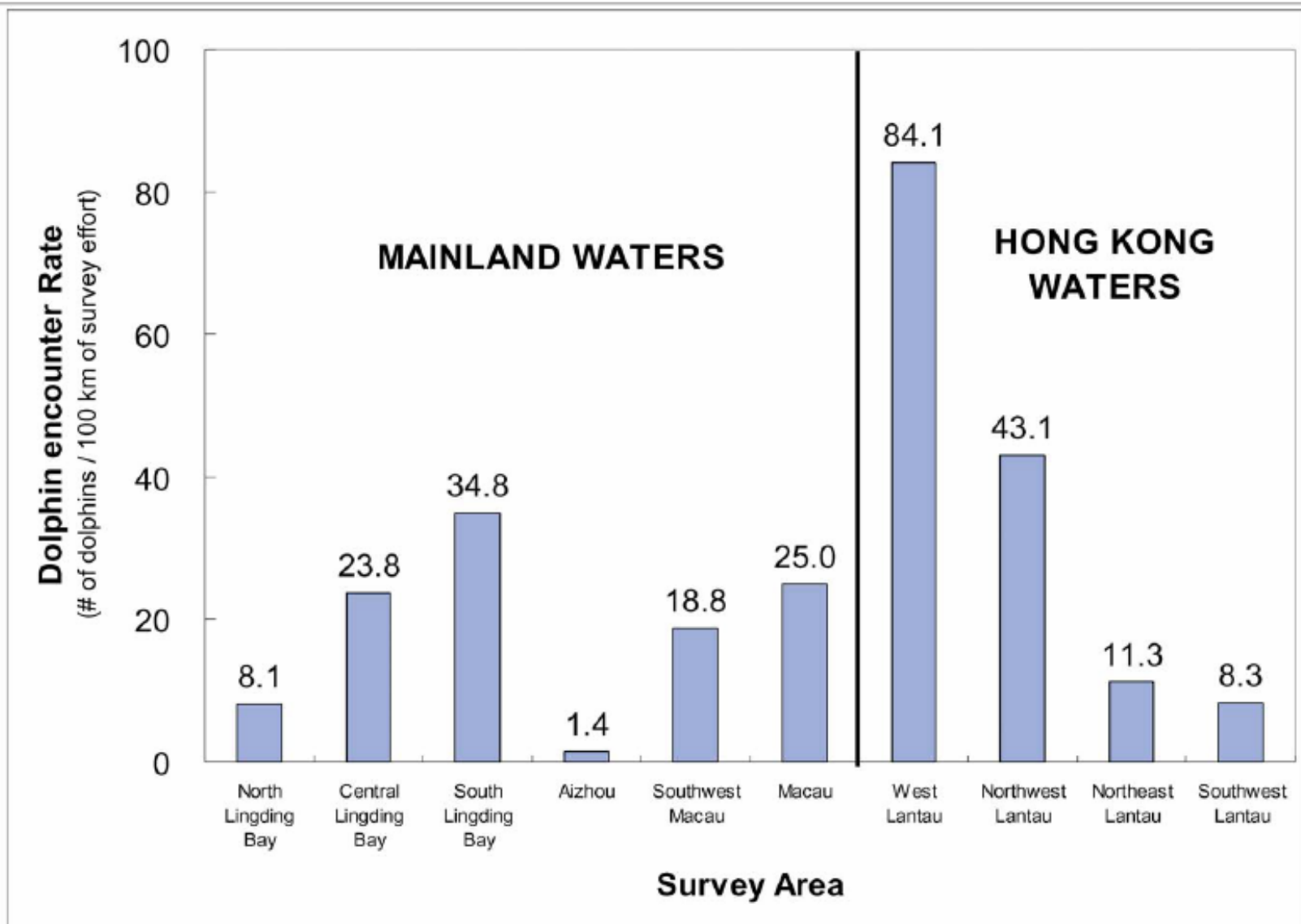


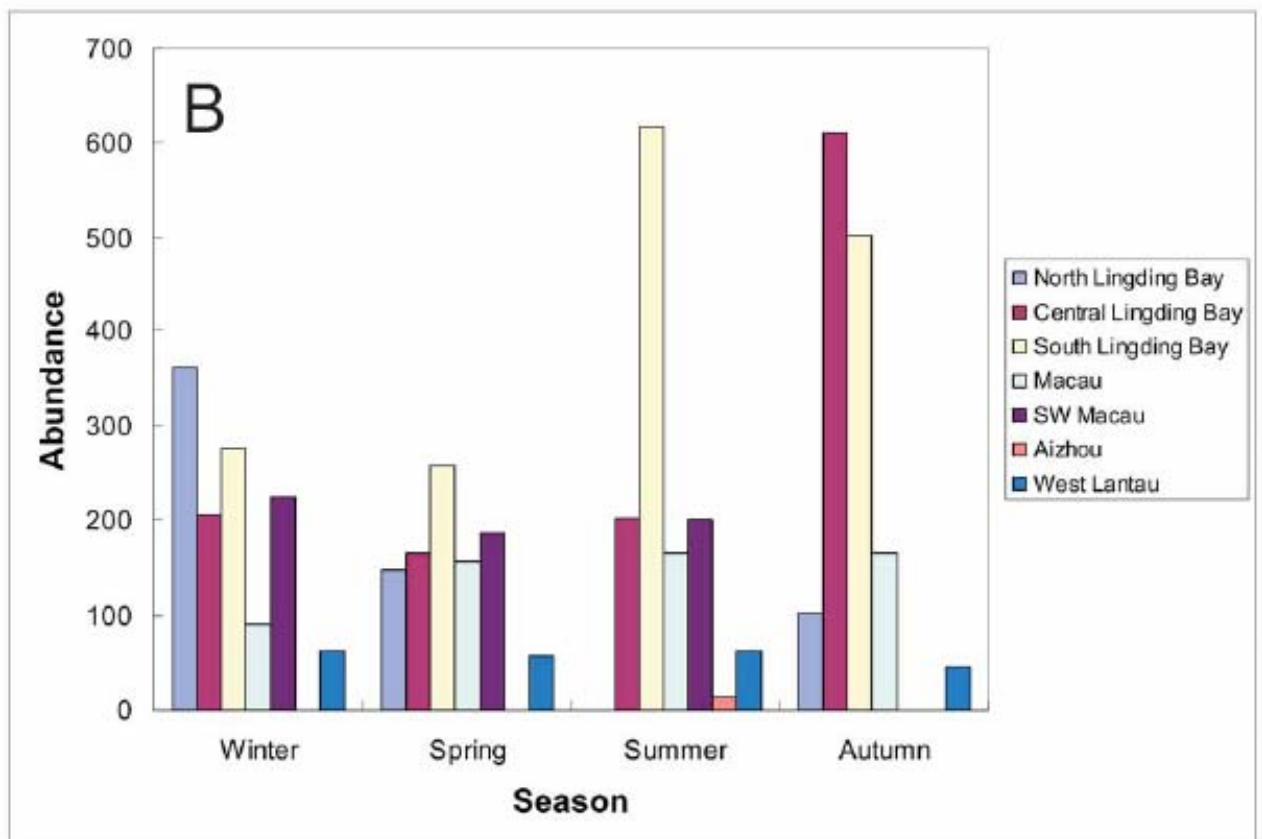
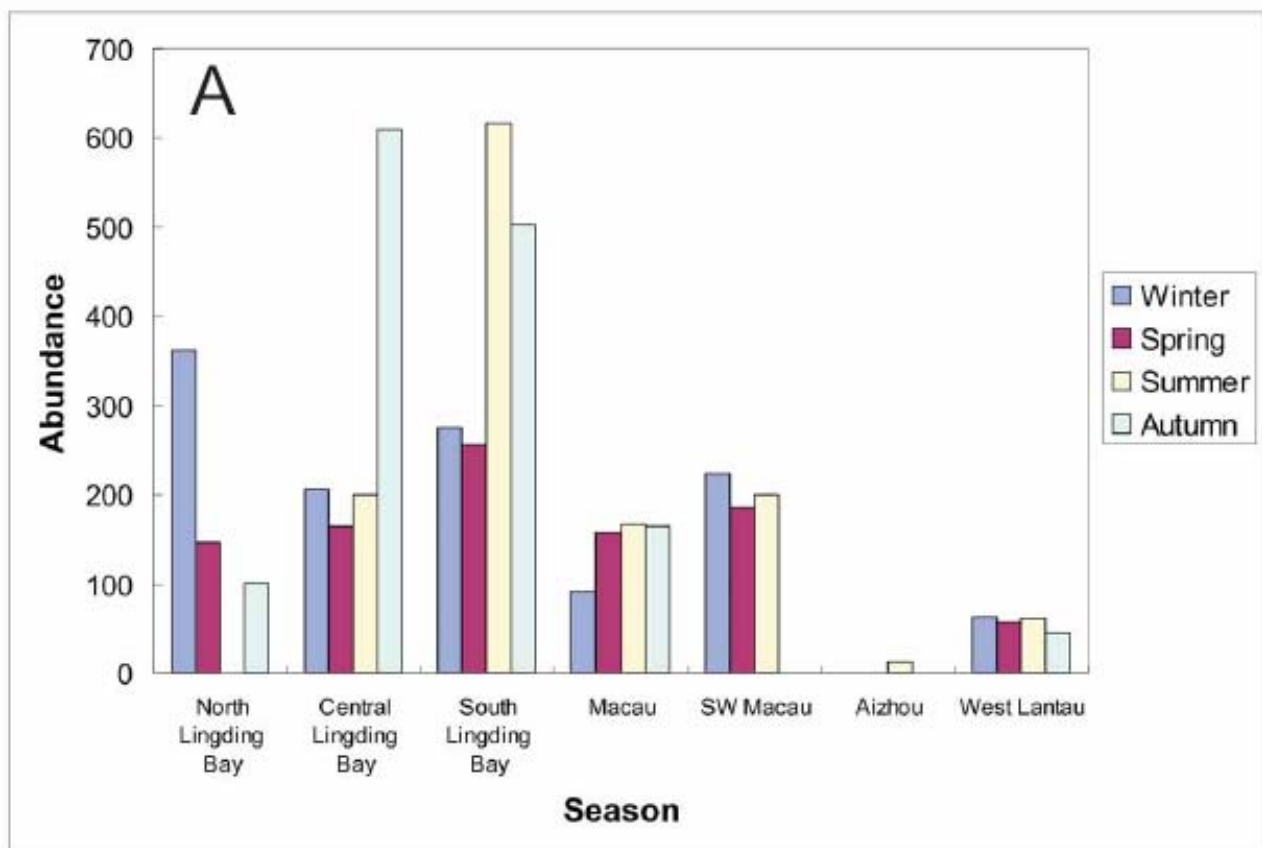
Figure 2.1

Comparison of Dolphin Encounter Rates in Different Survey Areas in Mainland and Hong Kong Waters of the Pearl River Estuary (February 2006 - January 2007)

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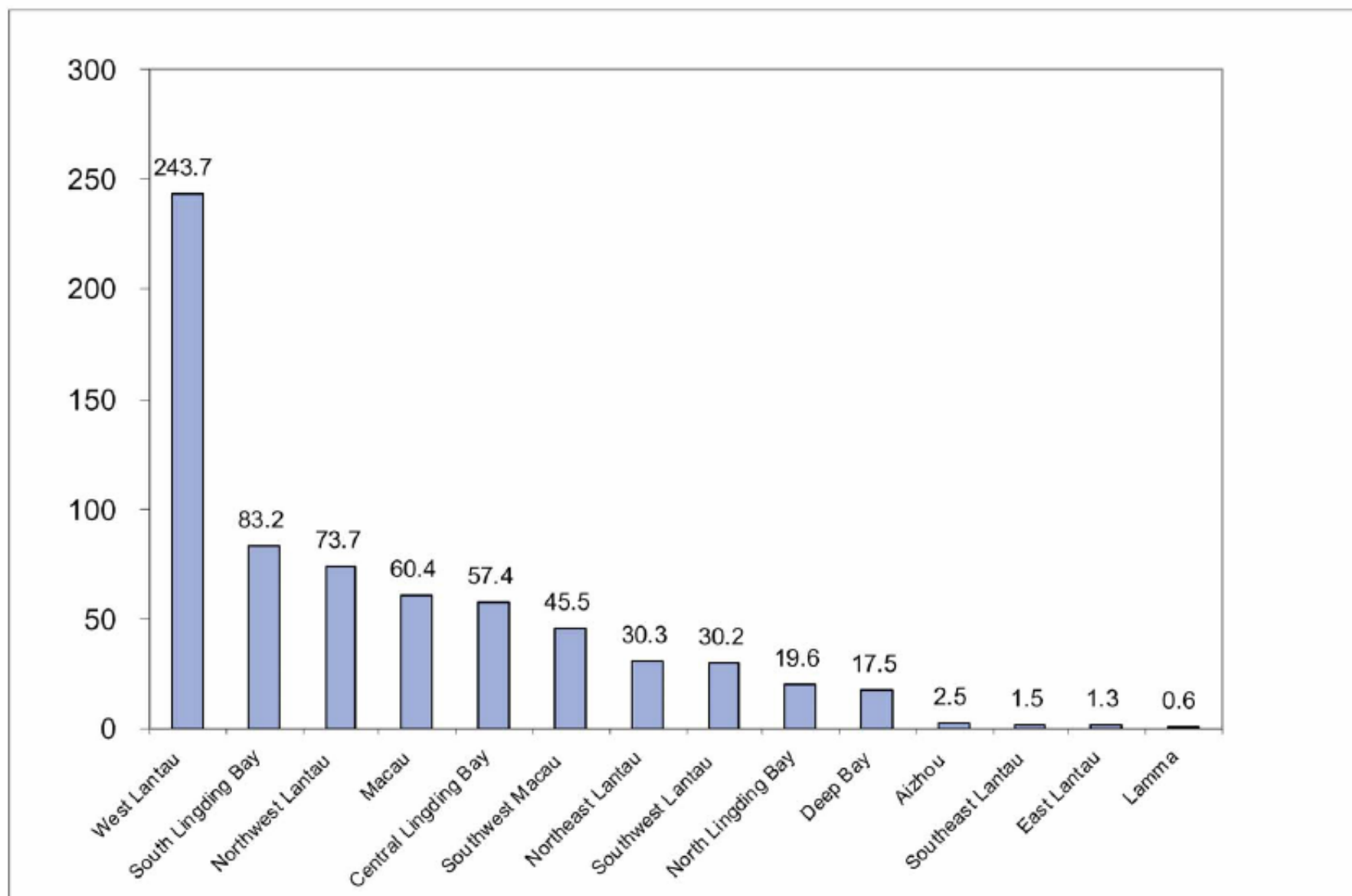




**Figure 2.2**

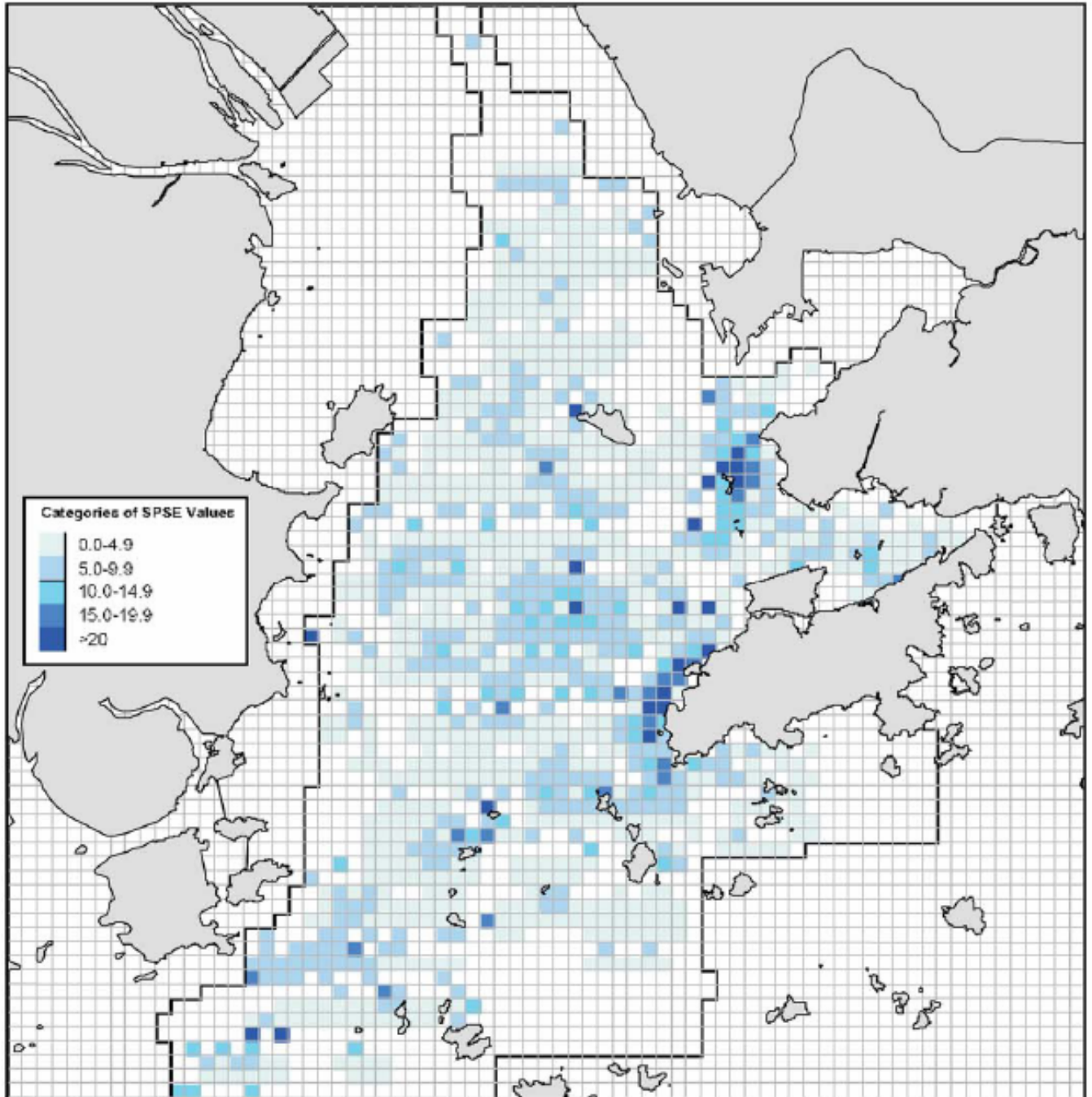
- A. Seasonal Variation in Abundance Estimates of Chinese White Dolphins in Each of the Seven Survey Areas in Hong Kong and Mainland Waters
- B. Comparison of Abundance Estimates of Chinese White Dolphins Among Different Survey Areas in Four Seasons

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**Figure 2.3**

Comparison of Density Estimates in Different Survey Areas of Hong Kong and Mainland Waters of the Pearl River Estuary, Using Line-transect Analysis



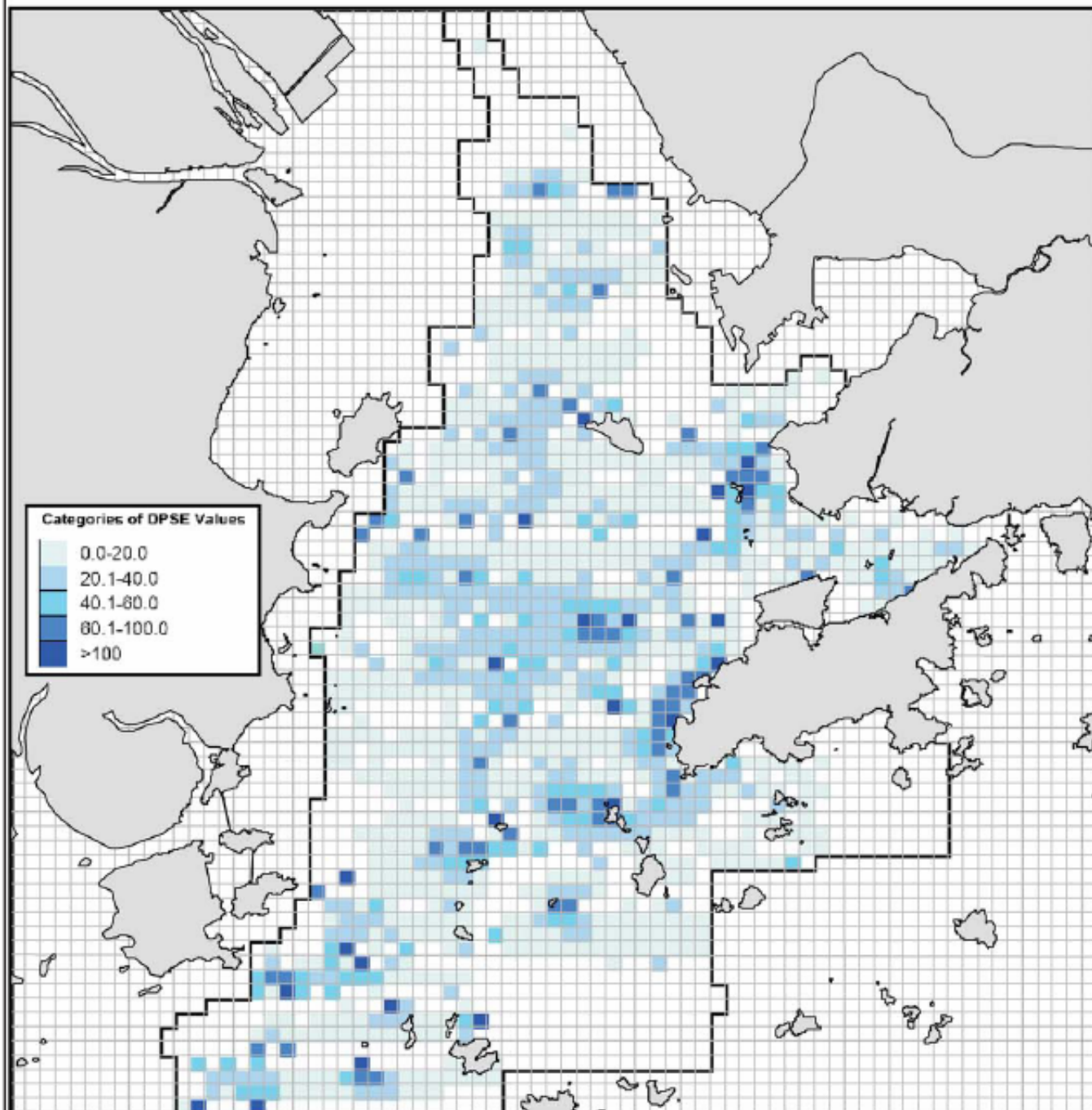
**Figure 2.4**

Sighting Density of Chinese White Dolphins with Corrected Survey Effort per km<sup>2</sup> in the Pearl River Estuary, Using On-effort Survey Data from 2005-07 (SPSE Values in Legend Represent No. of On-effort Dolphin Sightings per 100 Units of Survey Effort)

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**Figure 2.5**

Density of Chinese White Dolphins with Corrected Survey Effort per km<sup>2</sup> in the Pearl River Estuary, Using On-effort Survey Data from 2005-07 (DPSE Values in Legend Represent No. of On-effort Dolphin Sightings per 100 Units of Survey Effort)

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