Appendix C

Operational Phase Dolphin Monitoring Survey

CONTRACT NO. HY/2012/08
Hong Kong-Zhuhai-Macao Bridge Tuen Mun – Chek Lap Kok Link (Northern Connection Sub-sea Tunnel Section)
Post-Construction Dolphin Monitoring

8th Quarterly Progress Report (March-May 2022)
submitted to Dragages – Bouygues Joint Venture & ERM Hong Kong Ltd.

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1. Introduction

1.1. As part of the Hong Kong-Zhuhai-Macao Bridge (HZMB), the Tuen Mun-Chek Lap Kok Link (TMCLKL) is a designated project under the Environmental Impact Assessment Ordinance (EIAO). The Environmental Impact Assessment (EIA) Report and Environmental Monitoring and Audit (EM&A) Manual (EIA Register No.: AEIAR-146/2009) for the project were approved by the Director of Environmental Protection in October 2009 and the Environmental Permit No. EP-354/2009 (EP) was issued in November 2009. The EP has been subject to several variations and the current one is EP No. EP-354/2009/D.

1.2. The TMCLKL was constructed under two works contracts namely Contract No. HY/2012/07 (Southern Connection Viaduct Section) and Contract No. HY/2012/08 (North Connection Sub-sea Tunnel Section). In accordance with the EP, the Contractors of Contract No. HY/2012/07 and Contract No. HY/2012/08 have separately employed their own Environmental Team (ET) and ET Leader to conduct construction phase monitoring of Chinese White Dolphin (CWD) in the North Lantau (NL) waters, which included the Northeast Lantau (NEL) and Northwest Lantau (NWL) survey areas, following the requirements specified in the EM&A Manual and the relevant contract specifications of the two contracts.

1.3. In accordance with Section 6.1 of the EM&A Manual and the EP, an ecological monitoring and audit programme is needed to monitor potential impacts through construction and operation activities of TMCLKL. The construction and post-construction (operational) EM&A objectives are to ensure that the ecological contract works and construction mitigation procedures recommended in the EIA are carried out as specified and are effective. Post-construction phase EM&A will comprise the audit of the measures as appropriate. In order for such monitoring to be effective, it needs to be divided into three phases: pre-disturbance (i.e. baseline phase), the entire period of disturbance (i.e. construction phase) and post-disturbance after the completion

of construction works (i.e. post-construction phase). Survey techniques must be held constant from phase to phase, and survey equipment and personnel should ideally be the same as well.

1.4. The main objective of the current assignment commissioned by the Highways Department is to conduct the post-construction monitoring of CWD in NL waters in compliance with the requirements stipulated in the EM&A Manual and the EP for the TMCLKL works. Such monitoring should be conducted for two years upon the completion of all marine-based construction activities for the TMCLKL according to the EM&A Manual, which were completed in May 2020. From June 2020 to August 2021, 15 months of post-construction dolphin monitoring had been carried out by the ET / ET Leader appointed under Contract No. HY/2012/08, while the remaining nine months of post-construction dolphin monitoring will be completed under this assignment, from September 2021 to May 2022.

1.5. In August 2021, the ERM Hong Kong (ERMHK) Limited has been appointed as the Consultant responsible for the nine months of post-construction monitoring of CWD in NL waters for the TMCLKL. Subsequently, the Hong Kong Cetacean Research Project (HKCRP) has been appointed by ERMHK to collaborate and undertake the dolphin monitoring tasks to conduct systematic line-transect vessel surveys.

1.6. The present quarterly progress report is submitted to the Contractor under the TMCLKL post-construction phase dolphin monitoring programme, which summarizes the results of survey findings during the period of March to May 2022.

2. Monitoring Methodology

2.1. Vessel-based Line-transect Survey

2.1.1. According to the requirement of the updated EM&A manual, dolphin monitoring programme should cover all transect lines in NEL and NWL survey areas (see Figure 1) twice per month throughout the entire construction and post-construction monitoring period. The co-ordinates of all transect lines are shown in Table 1.

Table 1 Co-ordinates of transect lines conducted by TMCLKL08 project

Line No.		Easting	Northing		Line No.		Easting	Northing
1	Start Point	804671	815456		13	Start Point	816506	819480
1	End Point	804671	831404		13	End Point	816506	824859
2	Start Point	805476	820800		14	Start Point	817537	820220
2	End Point	805476	826654		14	End Point	817537	824613
3	Start Point	806464	821150		15	Start Point	818568	820735
3	End Point	806464	822911		15	End Point	818568	824433

4	Start Point	807518	821500		16	Start Point	819532	821420
4	End Point	807518	829230		16	End Point	819532	824209
5	Start Point	808504	821850		17	Start Point	820451	822125
5	End Point	808504	828602		17	End Point	820451	823671
6	Start Point	809490	822150		18	Start Point	821504	822371
6	End Point	809490	825352		18	End Point	821504	823761
7	Start Point	810499	822000		19	Start Point	822513	823268
7	End Point	810499	824613		19	End Point	822513	824321
8	Start Point	811508	821123		20	Start Point	823477	823402
8	End Point	811508	824254		20	End Point	823477	824613
9	Start Point	812516	821303		21	Start Point	805476	827081
9	End Point	812516	824254		21	End Point	805476	830562
10	Start Point	813525	821176		22	Start Point	806464	824033
10	End Point	813525	824657		22	End Point	806464	829598
11	Start Point	814556	818853		23	Start Point	814559	821739
11	End Point	814556	820992		23	End Point	814559	824768
12	Start Point	815542	818807		24	Start Point	805476	815900
12	End Point	815542	824882		24	End Point	805476	819100

2.1.2. The TMCLKL08 survey team used standard line-transect methods (Buckland et al. 2001) to conduct the systematic vessel surveys, and followed the same technique of data collection that has been adopted over the last 22 years of marine mammal monitoring surveys in Hong Kong developed by HKCRP (see Hung 2020). For each monitoring vessel survey, a 15-m inboard vessel with an open upper deck (about 4.5 m above water surface) was used to make observations from the flying bridge area.

2.1.3. Two experienced observers (a data recorder and a primary observer) made up the on-effort survey team, and the survey vessel transited different transect lines at a constant speed of 13-15 km per hour. The data recorder searched with unaided eyes and filled out the datasheets, while the primary observer searched for dolphins and porpoises continuously through 7 x 50 *Fujinon* marine binoculars. Both observers searched the sea ahead of the vessel, between 270^{o} and 90^{o} (in relation to the bow, which is defined as 0^{o}). One to two additional experienced observers were available on the boat to work in shift (i.e. rotate every 30 minutes) in order to minimize fatigue of the survey team members. All observers were experienced in small cetacean survey techniques and identifying local cetacean species.

2.1.4. During on-effort survey periods, the survey team recorded effort data including time, positions (latitude and longitude), weather conditions (Beaufort sea state and visibility), and distance traveled in each series (a continuous period of search effort) with the assistance of a handheld GPS (*Garmin eTrex Legend*).

2.1.5. Data including time, position and vessel speed were also automatically and continuously logged by handheld GPS throughout the entire survey for subsequent review.

2.1.6. When dolphins were sighted, the survey team would end the survey effort, and immediately record the initial sighting distance and angle of the dolphin group from the survey vessel, as well as the sighting time and position. Then the research vessel was diverted from its course to approach the animals for species identification, group size estimation, assessment of group composition, and behavioural observations. The perpendicular distance (PSD) of the dolphin group to the transect line was later calculated from the initial sighting distance and angle.

2.1.7. Survey effort being conducted along the parallel transect lines that were perpendicular to the coastlines (as indicated in Figure 1) was labeled as "primary" survey effort, while the survey effort conducted along the connecting lines between parallel lines was labeled as "secondary" survey effort. According to HKCRP long-term dolphin monitoring data, encounter rates of Chinese white dolphins deduced from effort and sighting data collected along primary and secondary lines were similar in NEL and NWL survey areas. Therefore, both primary and secondary survey effort were presented as on-effort survey effort in this report.

2.2. Photo-identification Work

2.2.1. When a group of Chinese White Dolphins were sighted during the line-transect survey, the TMCLKL08 survey team would end effort and approach the group slowly from the side and behind to take photographs of them. Every attempt was made to photograph every dolphin in the group, and even photograph both sides of the dolphins, since the colouration and markings on both sides may not be symmetrical.

2.2.2. A professional digital camera (*Canon* EOS 7D model), equipped with long telephoto lenses (100-400 mm zoom), were available on board for researchers to take sharp, close-up photographs of dolphins as they surfaced. The images were shot at the highest available resolution and stored on Compact Flash memory cards for downloading onto a computer.

2.2.3. All digital images taken in the field were first examined, and those containing potentially identifiable individuals were sorted out. These photographs would then be examined in greater detail, and were carefully compared to the existing Chinese White Dolphin photo-identification catalogue maintained by HKCRP since 1995.

2.2.4. Chinese White Dolphins can be identified by their natural markings, such as nicks, cuts, scars and deformities on their dorsal fin and body, and their unique spotting patterns were also used as secondary identifying features (Jefferson 2000).

2.2.5. All photographs of each individual were then compiled and arranged in chronological order, with data including the date and location first identified (initial sighting), re-sightings, associated dolphins, distinctive features, and age classes entered into a computer database.

2.3. Data Analysis

2.3.1. Distribution Analysis – The line-transect survey data was integrated with the Geographic Information System (GIS) in order to visualize and interpret different spatial and temporal patterns of dolphin distribution using sighting positions. Location data of dolphin groups were plotted on map layers of Hong Kong using a desktop GIS (ArcView© 3.1) to examine their distribution patterns in details. The dataset was also stratified into different subsets to examine distribution patterns of dolphin groups with different categories of group sizes, young calves and activities.

2.3.2. Encounter rate analysis – Encounter rates of Chinese white dolphins (number of on-effort sightings per 100 km of survey effort, and total number of dolphins sighted on-effort per 100 km of survey effort) were calculated in NEL and NWL survey areas in relation to the amount of survey effort conducted during each month of monitoring survey. Only data collect under Beaufort 3 or below condition would be used for the encounter rate analyses. Dolphin encounter rates were calculated in two ways for comparisons with the HZMB baseline monitoring results as well as to AFCD long-term marine mammal monitoring results.

Firstly, for the comparison with the HZMB baseline monitoring results, the encounter rates were calculated using primary survey effort alone. The average encounter rate of sightings (STG) and average encounter rate of dolphins (ANI) were deduced based on the encounter rates from six events during the present quarter (i.e. six sets of line-transect surveys in North Lantau), which was also compared with the one deduced from the six events during the baseline period (i.e. six sets of line-transect surveys in North Lantau).

Secondly, the encounter rates were calculated using both primary and secondary survey effort collected under Beaufort 3 or below condition as in AFCD long-term monitoring study. The encounter rate of sightings and dolphins were deduced by dividing the total number of on-effort sightings (STG) and total number of dolphins (ANI) by the amount of survey effort for the present quarterly period.

2.3.3. Quantitative grid analysis on habitat use – To conduct quantitative grid analysis of habitat use, positions of on-effort sightings of Chinese White Dolphins collected during the quarterly monitoring period were plotted onto 1-km^2 grids among NWL and NEL survey areas on GIS. Sighting densities (number of on-effort sightings per km^2) and dolphin densities (total number of dolphins from on-effort sightings per km^2) were then calculated for each 1 km by 1 km grid with the aid of GIS.

Sighting density grids and dolphin density grids were then further normalized with the amount of survey effort conducted within each grid. The total amount of survey effort spent on each grid was calculated by examining the survey coverage on each line-transect survey to determine how many times the grid was surveyed during the study period. For example, when the survey boat traversed through a specific grid 50 times, 50 units of survey effort were counted for that grid. With the amount of survey effort calculated for each grid, the sighting density and dolphin density of each grid were then normalized (i.e. divided by the unit of survey effort).

The newly-derived unit for sighting density was termed SPSE, representing the number of on-effort **s**ightings **p**er 100 units of **s**urvey **e**ffort. In addition, the derived unit for actual dolphin density was termed DPSE, representing the number of **d**olphins **p**er 100 units of **s**urvey **e**ffort. Among the 1-km^2 grids that were partially covered by land, the percentage of sea area was calculated using GIS tools, and their SPSE and DPSE values were adjusted accordingly. The following formulae were used to estimate SPSE and DPSE in each 1-km^2 grid within the study area:

$$SPSE = ((S / E) \times 100) / SA\%$$
$$DPSE = ((D / E) \times 100) / SA\%$$

where S = total number of on-effort sightings
D = total number of dolphins from on-effort sightings
E = total number of units of survey effort
SA% = percentage of sea area

2.3.4. Behavioural analysis – When dolphins were sighted during vessel surveys, their behaviour was observed. Different activities were categorized (i.e. feeding, socializing, traveling, and milling/resting) and recorded on sighting datasheets. This data was then input into a separate database with sighting information, which can be used to determine the distribution of behavioural data with a desktop GIS. Distribution of sightings of dolphins engaged in different activities and behaviours would then be plotted on GIS and carefully examined to identify important areas for different activities of the dolphins.

2.3.5. Ranging pattern analysis – Location data of individual dolphins that occurred during the 3-month post-construction phase monitoring period were obtained from the dolphin sighting database and photo-identification catalogue. To deduce home ranges for individual dolphins using the fixed kernel methods, the program Animal Movement Analyst Extension, was loaded as an extension with ArcView© 3.1 along with another extension Spatial Analyst 2.0. Using the fixed kernel method, the program calculated kernel density estimates based on all sighting positions, and provided an active interface to display kernel density plots. The kernel estimator then calculated and displayed the overall ranging area at 95% UD level.

3. Monitoring Results

3.1. Summary of survey effort and dolphin sightings

3.1.1. During the period of March to May 2022, six sets of systematic line-transect vessel surveys were conducted under the TMCLKL08 post-construction dolphin monitoring works to cover all transect lines in NWL and NEL survey areas twice per month.

3.1.2. From these TMCLKL08 surveys, a total of 838.31 km of survey effort was collected, with 100% of the total survey effort being conducted under favourable weather conditions (i.e. Beaufort Sea State 3 or below with good visibility). Among the two areas, 327.00 km and 511.31 km of survey effort were conducted in NEL and NWL survey areas respectively.

3.1.3. The total survey effort conducted on primary lines was 580.29 km, while the effort on secondary lines was 258.02 km. Survey effort conducted on both primary and secondary lines were considered to be on-effort survey data. A summary table of the survey effort is shown in Appendix I.

3.1.4. During the six sets of TMCLKL08 monitoring surveys conducted between March and May 2022, no Chinese White Dolphin was sighted at all, which was the second time with no sighting for the whole quarter since HZMB monitoring began in 2012 (the first time was in the quarter of June-August 2021).

3.2. Encounter rate

3.2.1. During the present quarterly period, the encounter rates of Chinese White Dolphins deduced from the survey effort and on-effort sighting data from the primary transect lines under favourable conditions (Beaufort 3 or below) for each set of the TMCLKL08 surveys in NEL and NWL are shown in Table 2. The average encounter rates deduced from the six sets of surveys were also compared with the ones deduced from the baseline monitoring period (September-November 2011) (Table 3).

Table 2. Dolphin encounter rates (sightings per 100 km of survey effort) during March-May 2022

SURVEY AREA	DOLPHIN MONITORING DATES	Encounter rate (STG) (no. of on-effort dolphin sightings per 100 km of survey effort)	Encounter rate (ANI) (no. of dolphins from all on-effort sightings per 100 km of survey effort)
		Primary Lines Only	Primary Lines Only
Northeast Lantau	Set 1 (8 & 11 Mar 2022)	0.00	0.00
	Set 2 (14 & 15 Mar 2022)	0.00	0.00
	Set 3 (12 & 13 Apr 2022)	0.00	0.00
	Set 4 (21 & 25 Apr 2022)	0.00	0.00
	Set 5 (3 & 5 May 2022)	0.00	0.00
	Set 6 (17 & 19 May 2022)	0.00	0.00
Northwest Lantau	Set 1 (8 & 11 Mar 2022)	0.00	0.00
	Set 2 (14 & 15 Mar 2022)	0.00	0.00
	Set 3 (12 & 13 Apr 2022)	0.00	0.00
	Set 4 (21 & 25 Apr 2022)	0.00	0.00
	Set 5 (3 & 5 May 2022)	0.00	0.00
	Set 6 (17 & 19 May 2022)	0.00	0.00

Table 3. Comparison of average dolphin encounter rates from the present post-construction monitoring period (March-May 2022) and baseline monitoring period (September-November 2011) (Note: encounter rates deduced from the baseline monitoring period have been recalculated based only on survey effort and on-effort sighting data made along the primary transect lines under favourable conditions; ± denotes the standard deviation of the average encounter rates)

	Encounter rate (STG) (no. of on-effort dolphin sightings per 100 km of survey effort)		**Encounter rate (ANI)** (no. of dolphins from all on-effort sightings per 100 km of survey effort)	
	March – May 2022	**September – November 2011**	**March – May 2022**	**September – November 2011**
Northeast Lantau	0.0	6.00 ± 5.05	0.0	22.19 ± 26.81
Northwest Lantau	0.0	9.85 ± 5.85	0.0	44.66 ± 29.85

3.3.2. To facilitate the comparison with the AFCD long-term monitoring results, the encounter rates were also calculated for the present quarter using both primary and secondary survey effort. The encounter rates of sightings (STG) and dolphins (ANI) in NWL and NEL were all nil for this quarter with no dolphin being sighted.

3.3.3 In NEL, the average dolphin encounter rates (both STG and ANI) in the present quarterly post-construction monitoring period were both zero with no on-effort sighting being made, and such complete absence of dolphins in NEL have been consistently recorded during the same spring quarters throughout the HKLR03/TMCLKL08 dolphin monitoring in the past eight consecutive years (Table 4).

Table 4. Comparison of average dolphin encounter rates in Northeast Lantau survey area from the same spring quarters of HKLR03/TMCLKL08 impact and post-construction monitoring periods since 2013 and the baseline monitoring period (September-November 2011) (Note: encounter rates deduced from the baseline monitoring period have been recalculated based only on survey effort and on-effort sighting data made along the primary transect lines under favourable conditions; ± denotes the standard deviation of the average encounter rates)

	Encounter rate (STG) (no. of on-effort dolphin sightings per 100 km of survey effort)	**Encounter rate (ANI)** (no. of dolphins from all on-effort sightings per 100 km of survey effort)
September-November 2011 (Baseline)	6.00 ± 5.05	22.19 ± 26.81
March-May 2013 (Impact)	0.42 ± 1.03	0.42 ± 1.03
March-May 2014 (Impact)	0.00	0.00
March-May 2015 (Impact)	0.00	0.00
March-May 2016 (Impact)	0.00	0.00
March-May 2017 (Impact)	0.00	0.00
March-May 2018 (Impact)	0.00	0.00
March-May 2019 (Impact)	0.00	0.00
March-May 2020 (Impact)	0.00	0.00
March-May 2021 (Post-Construction)	0.00	0.00
March-May 2022 (Post-Construction)	0.00	0.00

3.3.4. Furthermore, the average dolphin encounter rates (STG and ANI) in NWL during the present quarterly period were both nil with no sighting being made at all. Such complete absence of dolphins in North Lantau waters throughout the entire quarter was recorded for the second time since all HZMB dolphin monitoring began in 2012, indicating a dramatic decline in dolphin usage of this survey area since the baseline period in 2011.

3.3.5. When comparing among the past ten spring quarters in 2013-22, both quarterly counter rates in STG and ANI remained consistently low since 2015, and reached the lowest ever level in 2022 (Table 5). Such dramatic and continuous drop in dolphin occurrence in NWL since the spring period in 2015 raises serious concerns as there has been no sign of recovery in dolphin occurrence in North Lantau waters at all.

Table 5. Comparison of average dolphin encounter rates in Northwest Lantau survey area from the same spring quarters of HKLR03/TMCLKL08 impact and post-construction monitoring periods since 2013 and the baseline monitoring period (September November 2011) (Note: encounter rates deduced from the baseline monitoring period have been recalculated based only on survey effort and on-effort sighting data made along the primary transect lines under favourable conditions; ± denotes the standard deviation of the average encounter rates)

	Encounter rate (STG) (no. of on-effort dolphin sightings per 100 km of survey effort)	**Encounter rate (ANI)** (no. of dolphins from all on-effort sightings per 100 km of survey effort)
September-November 2011 (Baseline)	9.85 ± 5.85	44.66 ± 29.85
March-May 2013 (Impact)	7.75 ± 3.96	24.23 ± 18.05
March-May 2014 (Impact)	6.51 ± 3.34	19.14 ± 7.19
March-May 2015 (Impact)	0.47 ± 0.73	2.36 ± 4.07
March-May 2016 (Impact)	0.98 ± 1.10	4.78 ± 6.85
March-May 2017 (Impact)	0.93 ± 1.03	5.25 ± 9.53
March-May 2018 (Impact)	2.88 ± 4.81	11.12 ± 22.46
March-May 2019 (Impact)	1.13 ± 1.39	2.54 ± 3.00
March-May 2020 (Impact)	0.56 ± 0.86	0.56 ± 0.86
March-May 2021 (Post-Construction)	1.13 ± 1.37	3.44 ± 4.26
March-May 2022 (Post-Construction)	0.00	0.00

3.3.6. A two-way ANOVA with repeated measures and unequal sample size was conducted to examine whether there were any significant differences in the average encounter rates between the baseline and HKLR03/TMCLKL08 monitoring periods. The two variables that were examined included the two periods (baseline and impact/post-construction phases) and two locations (NEL and NWL).

3.3.8. For the comparison between the baseline period and the cumulative quarters of the HKLR03/TMCLKL08 monitoring period (i.e. the 35 quarters of the impact and post-construction phases being assessed), the p-values for the differences in average dolphin encounter rates of STG and ANI were both 0.000000. Even if the alpha value is set at 0.00001, significant differences were still detected in both the average dolphin encounter rates of STG and ANI (i.e. between the cumulative periods and the locations).

3.3.9. As indicated in both dolphin distribution patterns and encounter rates, dolphin usage has been significantly and dramatically reduced in both NEL and NWL survey areas during the present quarterly period, and such low occurrence of dolphins has also been consistently documented throughout the HKLR03/TMCLKL08 monitoring period.

3.3.10. Even though all marine works associated with the HZMB construction have already been completed for two years, and the Brothers Marine Park has been established as a compensation measure for the permanent habitat loss in association with the HZMB reclamation works since late 2016, apparently there has still been no sign of recovery of

dolphin usage in North Lantau waters at all. On the contrary, such usage has continued to diminish to a near-absence level.

4. References

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Appendix I. TMCLKL08 Survey Effort Database (March-May 2022)

(Abbreviations: BEAU = Beaufort Sea State; P = Primary Line Effort; S = Secondary Line Effort)

DATE	AREA	BEAU	EFFORT	SEASON	VESSEL	TYPE	P/S
8-Mar-22	NW LANTAU	2	20.79	SPRING	STANDARD36826	TMCLKL	P
8-Mar-22	NW LANTAU	3	5.50	SPRING	STANDARD36826	TMCLKL	P
8-Mar-22	NW LANTAU	2	9.11	SPRING	STANDARD36826	TMCLKL	S
8-Mar-22	NE LANTAU	2	7.98	SPRING	STANDARD36826	TMCLKL	P
8-Mar-22	NE LANTAU	3	10.90	SPRING	STANDARD36826	TMCLKL	P
8-Mar-22	NE LANTAU	2	4.22	SPRING	STANDARD36826	TMCLKL	S
8-Mar-22	NE LANTAU	3	6.40	SPRING	STANDARD36826	TMCLKL	S
11-Mar-22	NW LANTAU	2	28.90	SPRING	STANDARD36826	TMCLKL	P
11-Mar-22	NW LANTAU	3	6.30	SPRING	STANDARD36826	TMCLKL	P
11-Mar-22	NW LANTAU	2	8.90	SPRING	STANDARD36826	TMCLKL	S
11-Mar-22	NW LANTAU	3	4.60	SPRING	STANDARD36826	TMCLKL	S
11-Mar-22	NE LANTAU	2	16.52	SPRING	STANDARD36826	TMCLKL	P
11-Mar-22	NE LANTAU	2	9.08	SPRING	STANDARD36826	TMCLKL	S
14-Mar-22	NW LANTAU	2	26.50	SPRING	STANDARD36826	TMCLKL	P
14-Mar-22	NW LANTAU	2	9.50	SPRING	STANDARD36826	TMCLKL	S
14-Mar-22	NE LANTAU	2	18.38	SPRING	STANDARD36826	TMCLKL	P
14-Mar-22	NE LANTAU	2	10.92	SPRING	STANDARD36826	TMCLKL	S
15-Mar-22	NW LANTAU	2	34.30	SPRING	STANDARD36826	TMCLKL	P
15-Mar-22	NW LANTAU	3	1.30	SPRING	STANDARD36826	TMCLKL	P
15-Mar-22	NW LANTAU	2	13.00	SPRING	STANDARD36826	TMCLKL	S
15-Mar-22	NE LANTAU	2	15.31	SPRING	STANDARD36826	TMCLKL	P
15-Mar-22	NE LANTAU	2	9.89	SPRING	STANDARD36826	TMCLKL	S
12-Apr-22	NW LANTAU	2	36.20	SPRING	STANDARD36826	TMCLKL	P
12-Apr-22	NW LANTAU	2	13.10	SPRING	STANDARD36826	TMCLKL	S
12-Apr-22	NE LANTAU	2	13.65	SPRING	STANDARD36826	TMCLKL	P
12-Apr-22	NE LANTAU	3	1.50	SPRING	STANDARD36826	TMCLKL	P
12-Apr-22	NE LANTAU	2	9.95	SPRING	STANDARD36826	TMCLKL	S
13-Apr-22	NW LANTAU	2	26.55	SPRING	STANDARD36826	TMCLKL	P
13-Apr-22	NW LANTAU	2	10.25	SPRING	STANDARD36826	TMCLKL	S
13-Apr-22	NE LANTAU	2	19.84	SPRING	STANDARD36826	TMCLKL	P
13-Apr-22	NE LANTAU	2	9.46	SPRING	STANDARD36826	TMCLKL	S
21-Apr-22	NW LANTAU	2	36.80	SPRING	STANDARD36826	TMCLKL	P
21-Apr-22	NW LANTAU	2	11.60	SPRING	STANDARD36826	TMCLKL	S
21-Apr-22	NE LANTAU	2	16.33	SPRING	STANDARD36826	TMCLKL	P
21-Apr-22	NE LANTAU	2	9.07	SPRING	STANDARD36826	TMCLKL	S
25-Apr-22	NW LANTAU	2	22.55	SPRING	STANDARD36826	TMCLKL	P
25-Apr-22	NW LANTAU	3	2.90	SPRING	STANDARD36826	TMCLKL	P
25-Apr-22	NW LANTAU	2	6.63	SPRING	STANDARD36826	TMCLKL	S
25-Apr-22	NW LANTAU	3	3.82	SPRING	STANDARD36826	TMCLKL	S
25-Apr-22	NE LANTAU	2	14.73	SPRING	STANDARD36826	TMCLKL	P
25-Apr-22	NE LANTAU	3	3.58	SPRING	STANDARD36826	TMCLKL	P
25-Apr-22	NE LANTAU	2	9.66	SPRING	STANDARD36826	TMCLKL	S
25-Apr-22	NE LANTAU	3	0.43	SPRING	STANDARD36826	TMCLKL	S
3-May-22	NW LANTAU	2	18.19	SPRING	STANDARD36826	TMCLKL	P
3-May-22	NW LANTAU	3	8.05	SPRING	STANDARD36826	TMCLKL	P
3-May-22	NW LANTAU	2	8.96	SPRING	STANDARD36826	TMCLKL	S
3-May-22	NW LANTAU	3	1.30	SPRING	STANDARD36826	TMCLKL	S
3-May-22	NE LANTAU	2	18.33	SPRING	STANDARD36826	TMCLKL	P
3-May-22	NE LANTAU	2	10.67	SPRING	STANDARD36826	TMCLKL	S
5-May-22	NW LANTAU	2	22.38	SPRING	STANDARD140232	TMCLKL	P
5-May-22	NW LANTAU	3	13.82	SPRING	STANDARD140232	TMCLKL	P

Appendix I. (cont'd)

(Abbreviations: BEAU = Beaufort Sea State; P = Primary Line Effort; S = Secondary Line Effort)

DATE	AREA	BEAU	EFFORT	SEASON	VESSEL	TYPE	P/S
5-May-22	NW LANTAU	2	8.60	SPRING	STANDARD140232	TMCLKL	S
5-May-22	NW LANTAU	3	5.10	SPRING	STANDARD140232	TMCLKL	S
5-May-22	NE LANTAU	2	6.01	SPRING	STANDARD140232	TMCLKL	P
5-May-22	NE LANTAU	3	9.43	SPRING	STANDARD140232	TMCLKL	P
5-May-22	NE LANTAU	2	7.06	SPRING	STANDARD140232	TMCLKL	S
5-May-22	NE LANTAU	3	2.70	SPRING	STANDARD140232	TMCLKL	S
17-May-22	NW LANTAU	2	20.06	SPRING	STANDARD138716	TMCLKL	P
17-May-22	NW LANTAU	3	6.73	SPRING	STANDARD138716	TMCLKL	P
17-May-22	NW LANTAU	2	7.30	SPRING	STANDARD138716	TMCLKL	S
17-May-22	NW LANTAU	3	2.51	SPRING	STANDARD138716	TMCLKL	S
17-May-22	NE LANTAU	2	15.98	SPRING	STANDARD138716	TMCLKL	P
17-May-22	NE LANTAU	3	2.78	SPRING	STANDARD138716	TMCLKL	P
17-May-22	NE LANTAU	2	10.09	SPRING	STANDARD138716	TMCLKL	S
17-May-22	NE LANTAU	3	1.05	SPRING	STANDARD138716	TMCLKL	S
19-May-22	NW LANTAU	1	5.80	SPRING	STANDARD138716	TMCLKL	P
19-May-22	NW LANTAU	2	26.30	SPRING	STANDARD138716	TMCLKL	P
19-May-22	NW LANTAU	3	3.21	SPRING	STANDARD138716	TMCLKL	P
19-May-22	NW LANTAU	2	13.90	SPRING	STANDARD138716	TMCLKL	S
19-May-22	NE LANTAU	2	14.41	SPRING	STANDARD138716	TMCLKL	P
19-May-22	NE LANTAU	3	1.50	SPRING	STANDARD138716	TMCLKL	P
19-May-22	NE LANTAU	2	8.08	SPRING	STANDARD138716	TMCLKL	S
19-May-22	NE LANTAU	3	1.11	SPRING	STANDARD138716	TMCLKL	S

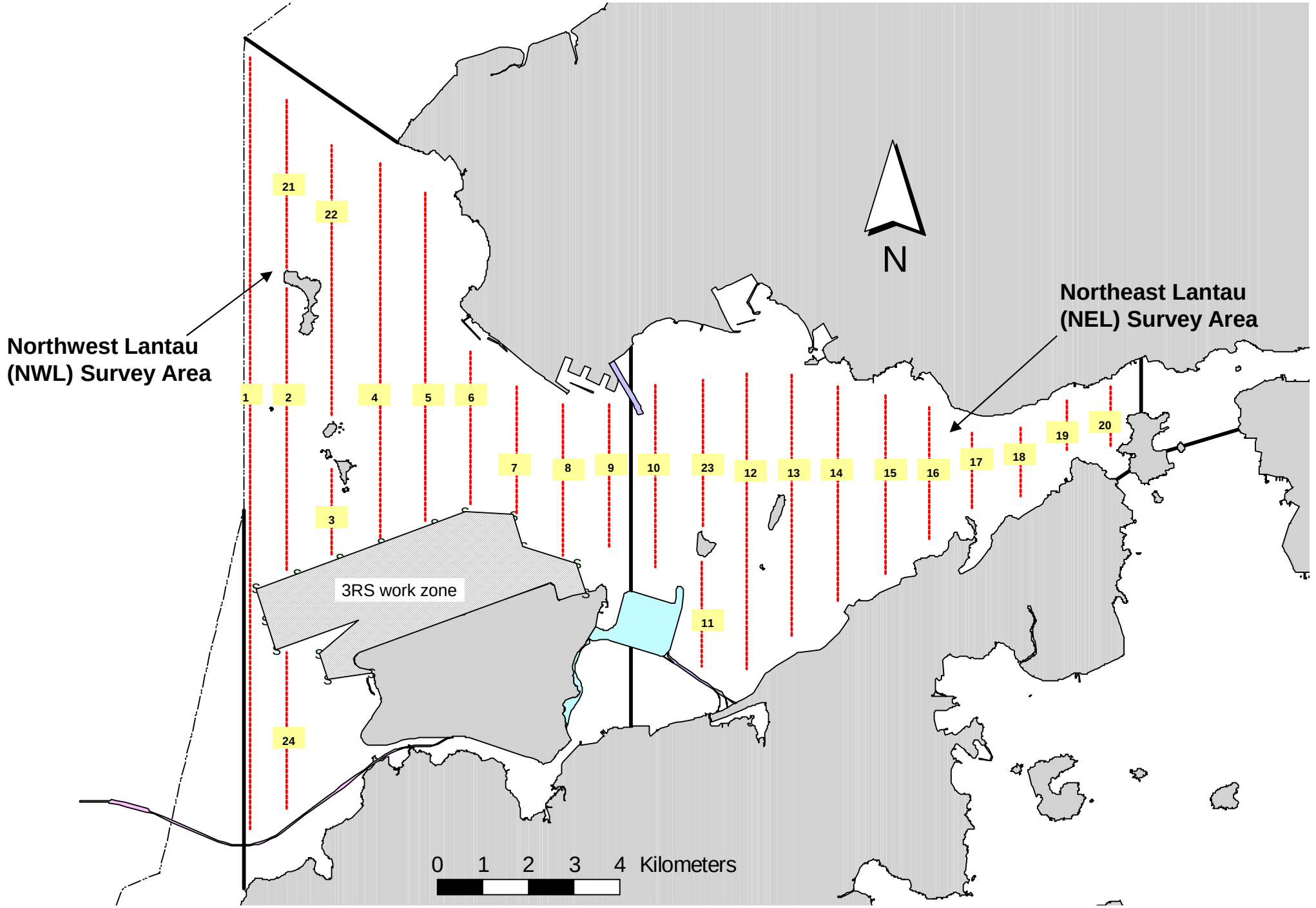

Figure 1. Transect Line Layout in Northwest and Northeast Lantau Survey Areas