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Expansion of Hong Kong International Airport into a Three-Runway System (“3RS”)

Update on the Implementation of Marine Ecology Mitigation and Enhancement Measures in association with the 3RS Project

PURPOSE

This paper presents an update to Members on progress with implementing marine ecology mitigation and enhancement measures for the 3RS Project in 2018.

BACKGROUND

2. The 3RS Environmental Impact Assessment (“EIA”) proposed a broad range of mitigation measures intended to avoid, minimise and compensate for the potential impact on Chinese White Dolphins (“CWD”) and marine ecology during the construction and operational phases of the 3RS Project. A Marine Ecology and Fisheries Enhancement Strategy (“MEFES”) was also recommended, intended to enhance marine ecology (including CWD) and fisheries resources.

3. Key 3RS Project construction activities during 2018 of relevance to marine ecology and CWDs were reclamation works, including deep cement mixing (DCM) works, prefabricated vertical drain (PVD) installation, marine filling, seawall construction, and laying of sand blankets. The Airport Authority Hong Kong (“AAHK”) has implemented all required marine ecology mitigation and enhancement measures in conjunction with these work activities over the period, with details regularly updated on a dedicated website¹.

¹ <http://env.threerunwaysystem.com/en/index.html>

4. AAHK has also regularly updated the Advisory Council on the Environment (“ACE”) on progress with implementing key commitments since 2015, including the 3RS marine park proposal and the marine ecology and fisheries enhancement measures directly funded by AAHK.

MITIGATION MEASURES DURING THE CONSTRUCTION PHASE

5. Construction phase mitigation measures intended to minimise potential disturbance to CWDs include implementation of Dolphin Exclusion Zones around potentially noisy marine works activities, SkyPier high speed ferries route diversion and speed restrictions, advance seawall construction / silt curtain deployment prior to marine filling, acoustic decoupling for noisy equipment on marine vessels and a range of other good site practices designed to minimise day to day impacts on marine ecology and the marine environment.

6. AAHK voluntarily set up a Marine Traffic Control Centre (“MTCC”) and Marine Surveillance System (“MSS”) since the commencement of marine works to ensure the proper management of construction marine traffic. AAHK conducts real-time monitoring of all construction vessel activities in order to ensure marine traffic impacts are minimised, for example enforcing a 10-knot speed limit within works areas and CWD hotspots, ensuring vessels do not encroach into specified no-entry areas, follow designated routes and only use designated marine works access gates. The Environmental Team (“ET”) regularly monitors and reviews data collected by the MTCC / MSS to check construction marine traffic compliance with the requirements, with non-compliance incidents followed up effectively and timely. Training is provided to all construction vessel skippers on the specific vessel operation requirements and controls in and around the 3RS marine works area. The Independent Environmental Checker (“IEC”) performs routine audits on compliance aspects and confirms that on-site construction vessels are being properly managed.

7. The ET has been conducting regular and ad-hoc inspections to check compliance of all implemented mitigation measures with requirements outlined in the Environmental Permit (“EP”) and Updated Environmental Monitoring and Audit Manual of the 3RS Project. Any observations relating to non-compliance have been followed up promptly with the involvement of the ET, the IEC and relevant construction contractors. Overall, recommended mitigation and enhancement measures have been effectively implemented over the period to the satisfaction of the IEC and the relevant authorities.

CHINESE WHITE DOLPHIN MONITORING IN 2018

8. AAHK has continued to monitor CWD abundance, movement and behaviour over the period with the overall aim being to ensure any impacts from the 3RS Project construction works are not having any unacceptable, adverse impact on CWDs during different works phases. CWD monitoring results for 2018 (both vessel-based and land-based surveys) show that CWD use of Hong Kong waters appears to be stable in West Lantau, where important habitats remain near Tai O, Peaked Hill and Fan Lau. Monitoring data shows there has been some apparent shifting in areas used by CWD, from Southwest Lantau to North Lantau waters with data continuing to show that waters around Lung Kwu Chau remain an important year-round foraging area for CWDs. It is notable that CWD sightings were also made by vessel surveys around The Brothers in the Northeast Lantau area during the period, indicating that CWDs may have returned to Northeast Lantau waters during the year, after a notable period of absence. During the year, all recommended precautionary and mitigation measures for CWDs have been implemented in accordance with requirements and appear to be effective. A full summary and all key findings from the 2018 CWD monitoring effort is presented in **Annex 1** of this paper.

MARINE ECOLOGY ENHANCEMENT FUND AND FISHERIES ENHANCEMENT FUND UNDER THE MEFES

9. Since the setting up of a Marine Ecology Enhancement Fund (“MEEF”) and a Fisheries Enhancement Fund (“FEF”) with a total budget of HK\$400 million in late 2016, over HK\$18 million was granted from the MEEF and FEF (“the Funds”) to 16 projects for years 2017/18 and 2018/19. Details of the funded projects, including the reports of those completed projects, can be found at the dedicated websites².

10. Funded projects are generally managed and conducted by universities, research groups, or associations from the fisheries industry. AAHK is active in publicising and promoting the Funds to encourage continuing and high-quality funding applications, with a fund sharing session on funded project findings held in March 2019, with wide-ranging participation and good attendance.

² MEEF funded projects: http://env.threerunwaysystem.com/en/meef/meef_projects.html
FEF funded projects: http://env.threerunwaysystem.com/en/fef/fef_projects.html

ENHANCEMENT MEASURES DIRECTLY FUNDED BY AAHK UNDER MEFES

11. AAHK is directly funding and implementing several marine ecology and fisheries enhancement measures in Lantau waters on a voluntary basis. These include:

- (i) Eco-enhancement designs for sections of the 3RS seawalls, including sloping seawall blocks and vertical seawall panels designed with rough surfaces, pits, holes and rock pools to facilitate and promote colonisation of epifauna and to increase microhabitat complexity as well as offering refuge for marine organisms. A number of eco-seawall blocks have already been installed with several hundred blocks of varied designs are now under fabrication for installation during 2019, as seawall construction continues;
- (ii) A pilot trial on fish fry restocking is underway with around 12,000 fish fingerlings of commercially important species, including green groupers, yellowfin seabream and black seabream, are being released in May 2019 and then tentatively in September 2019 near the existing Hong Kong International Airport (“HKIA”) seawall within the vessel-restricted Hong Kong International Airport Approach Area to ensure better protection of released fish. Pre- and post-release monitoring surveys using a mixture of cage-trapping, hand-lining, baited remote underwater video monitoring and acoustic telemetry surveys are being conducted to monitor restocking effectiveness; and
- (iii) Preparatory work for a pilot test on artificial reef (“AR”) deployment and the required gazettal under the Foreshore and Sea-bed (Reclamations) Ordinance is in progress. The pilot test is intended to evaluate the effectiveness of placing different arrays of AR structures in the North Lantau marine environment to determine ecological value, prior to potential deployment of similar structures within the proposed 3RS Marine Park. The pilot test would commence in 2020 (subject to the gazettal under the Foreshore and Sea-bed (Reclamations) Ordinance and statutory authorisation).

PROPOSED MARINE PARK

12. The 3RS EIA Report requires AAHK to advance the preparation work for the designation of an approximately 2,400 hectares marine park in North Lantau waters,

with designation to tie in with the full operation of the 3RS in 2024. The new marine park is intended to provide linkage between the Sha Chau and Lung Kwu Chau Marine Park and The Brothers Marine Park in North Lantau waters, and will result in over 4,400 hectares of linked marine protected area near HKIA.

13. AAHK has continued to work with AFCD in the preparatory work for the designation of the 3RS Marine Park, taking into account progress and development of other committed marine parks in western Hong Kong waters. As part of the preparatory work, a set of goals supported by a multi-pronged management plan are under development to ensure the effective management of the marine park. In addition, AAHK has continued with the consultation with relevant stakeholders during 2018 and the first half of 2019, including the Marine Parks Committee (“MPC”), government departments, the marine industry via the Marine Department’s consultative and advisory committees, and subsea utility owners/operators, to solicit views on the preliminary design and management plan for the 3RS Marine Park. Further consultation with other relevant stakeholders including green groups, the fishery sector, local communities, professionals, and the ACE are planned in late 2019 / early 2020.

STAKEHOLDER ENGAGEMENT

14. AAHK continues to actively engage key stakeholders, for example through meetings with Community and Professional Liaison Groups made up of representatives from HKIA’s neighbouring districts as well as well-qualified professionals and experts with an interest in the 3RS Project. Stakeholder engagement provides a platform for facilitating communications and information sharing on all environmental issues related to the 3RS Project.

15. AAHK strives to be highly transparent in its works and the dedicated project website provides the general public with up to date information on the 3RS Project, including environmental monitoring and audit data and results, updated plans and submissions in accordance with requirements in the EP and sharing of the materials presented at liaison group meetings, as well as sharing details and updates on the status and operation of the Funds.

WAY FORWARD

16. AAHK will continue to implement all marine ecology mitigation and enhancement measures for the 3RS Project to ensure full compliance with the EP and EIA Ordinance requirements. AAHK will continue to proactively engage with relevant stakeholders on the 3RS Project and on environmental matters through the established engagement platforms, including the project liaison groups, the dedicated 3RS website and with the use of other stakeholder engagement events as required.

Airport Authority Hong Kong

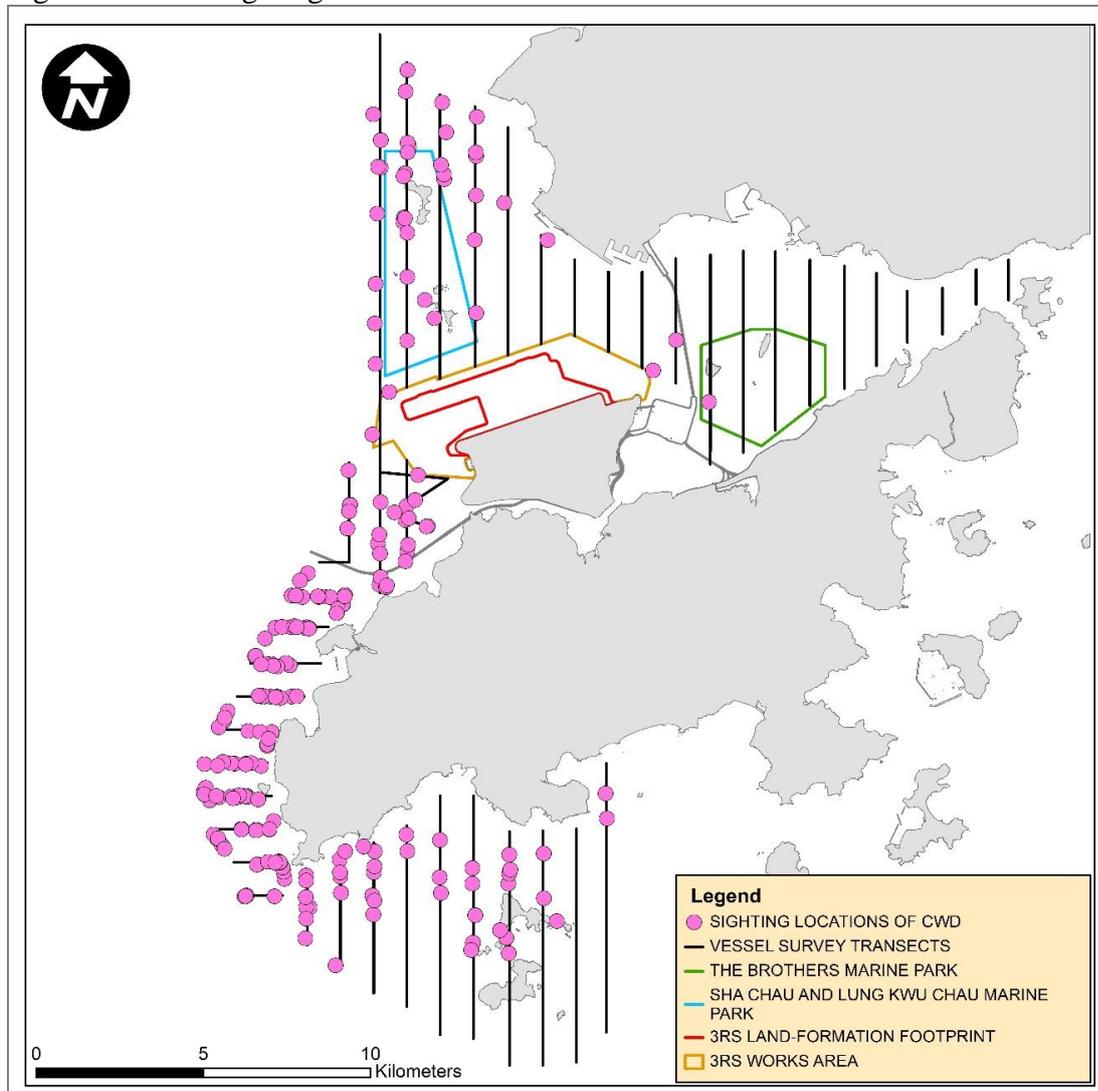
July 2019

CWD VESSEL LINE-TRANSECT MONITORING FINDINGS

1. Small vessel line-transect surveys provided data for estimating density and abundance and for other assessments making use of line-transect distance-sampling methodologies. The surveys involved small vessel line-transect data collection that is designed to be consistent with previous surveys undertaken by the AFCD for their long-term monitoring work on small cetaceans in Hong Kong. Surveys were designed to provide systematic, quantitative measurements of density, abundance and habitat use.

2. CWD monitoring data were collected by conducting vessel line-transect surveys in Northeast Lantau (NEL), Deep Bay (DB), Northwest Lantau (NWL), Airport West (AW), West Lantau (WL) and Southwest Lantau (SWL) areas at a frequency of two surveys per month. Sightings in 2018 are summarised in **Figure 1**.

Figure 1: CWD Sightings Distribution in 2018



3. Quantitative grid analysis on habitat use was conducted using the 3-year 3RS sighting data-set. Sightings Per 100 units of Sighting Effort (SPSE) and Dolphins Per 100 units of Sighting Effort (DPSE) values were calculated for all grids in all survey areas (see **Figure 2** and **Figure 3**) with reference to the methodology adopted in AFCD Marine Mammal Monitoring Reports. The grid analysis findings revealed that NWL area was being more heavily used by CWDs in 2018 than the past year and the important habitat with high dolphin densities slightly shifted particularly to southwest off Lung Kwu Chau (LKC), whilst waters between Sham Wat and the 3RS works area have become more important as increased usage by CWDs was observed in 2018. The important dolphin habitats in WL with high dolphin densities were near Tai O, Peaked Hill and Fan Lau. In SWL, waters around Fan Lau Tung Wan remain an important habitat, however, there was an overall decrease of dolphin usage from Shek Pik to Lo Kei Wan and Shui Hau, as well as offshore waters around the Soko Islands.

4. Density and abundance estimations were conducted from the 3RS CWD monitoring data using the program Distance, involving the same basic methods as in previous analyses. The estimate of overall abundance for 2018 was 77 dolphins, which is slightly up from last year (71 dolphins in 2017), with the associated precision (CV) of 18.9%, which indicates a reasonable level of precision (**Table 1**; the lower the CV the higher the precision). The higher abundance estimated this year is partly due to the fact that size-bias corrected average group size was higher in 2018, and also may be influenced by different behaviours of dolphins that may also affect their sightability. It is important to emphasise that abundance fluctuations in one year do not necessarily mean the population has increased or reflect the long-term trend, and dolphins move around among the various areas across the Pearl River Estuary region from year to year. The area with the highest abundance was WL, while NWL had higher numbers of dolphins than SWL. NEL for the first time in several years registered dolphin sightings. Seasonal analysis showed that the 2018 seasonal range is 61 (lowest in winter) to 99 dolphins (highest in summer), and this indicates that, despite the overall reduction in the average number of dolphins using Hong Kong waters in recent years, there are quite a number of dolphins still present in Hong Kong, in particular during the summer months.

5. Within NWL waters, dolphins are mostly found around the Castle Peak and LKC areas. The 2018 estimate for NWL was 22 dolphins (see **Table 1**), which is substantially higher than the past years (14 to 15 dolphins) and preliminary analyses suggests that dolphin numbers in NWL may have remained stable or possibly may even have increased since 2017.

6. One of the concerns expressed in the EIA was the potential impacts on the CWD travel areas between the existing airport and the Sha Chau and Lung Kwu Chau Marine Park (SCLKCMP). During the construction phase, ongoing monitoring efforts show that dolphins are still using these travel areas, as movements between WL and NWL have been documented from the re-sighting of CWD individuals.

Figure 2: SPSE and DPSE of CWDs with Corrected Survey Effort per km² from 3RS monitoring (Upper Left: SPSE in 2017, Lower Left: DPSE in 2017, Upper Right: SPSE in 2018, Lower Right: DPSE in 2018)

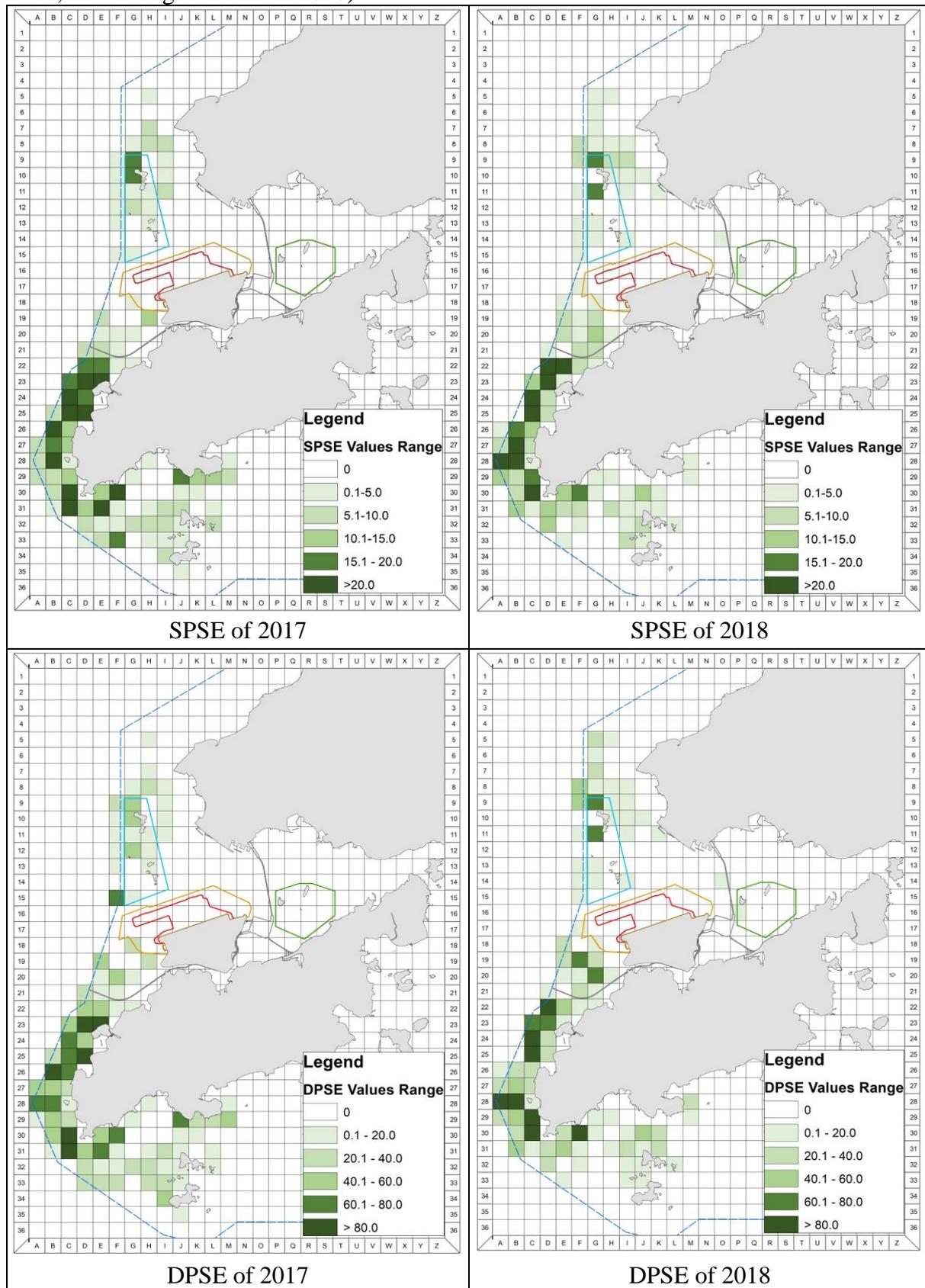


Figure 3: Cumulative SPSE and DPSE of CWDs with Corrected Survey Effort per km² (December 2015 to December 2018)

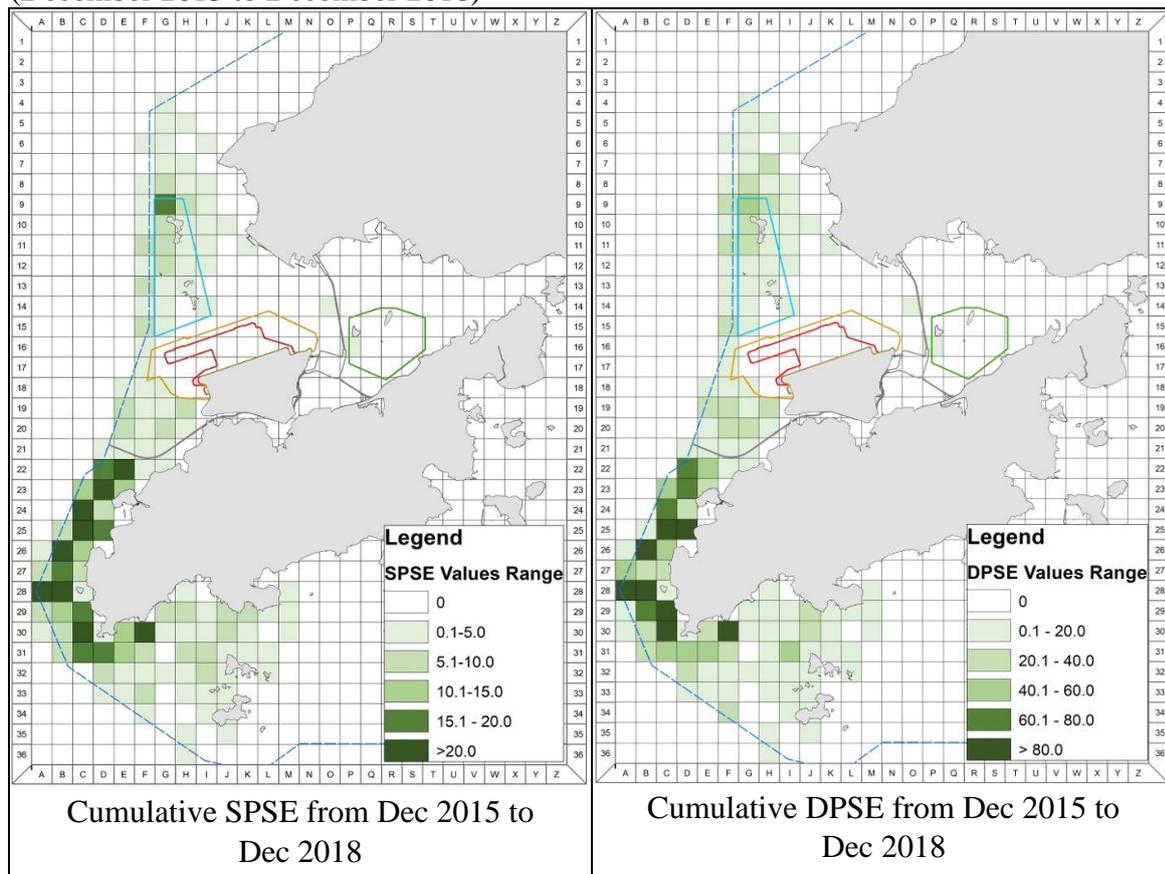


Table 1: CWD Line Transects Parameters and Estimates of Density and Abundance for Western Hong Kong based on 3RS data (2018)

Time Period	Stratum	No. of Sightings	Trackline		Abundance	95% CI	
			Average Group Size*	Detection Prob. - g(0) [#]		Density (no./100km ²)	(Abund.) %CV
Jan-Dec 2018	AW	5	2.8	1.0	43.05	2	1-5 45.0
Jan-Dec 2018	DB	2	2.8	1.0	4.51	1	1-2 19.7
Jan-Dec 2018	NEL	2	2.8	1.0	2.94	2	0-6 73.2
Jan-Dec 2018	NWL	46	2.8	1.0	24.85	22	13-36 25.6
Jan-Dec 2018	SWL	40	2.8	1.0	22.23	15	8-27 31.1
Jan-Dec 2018	WL	107	2.8	1.0	137.68	38	25-59 22.0
Jan-Dec 2018 Pooled[^]		202	2.8	1.0	29.13	77	53-112 18.9

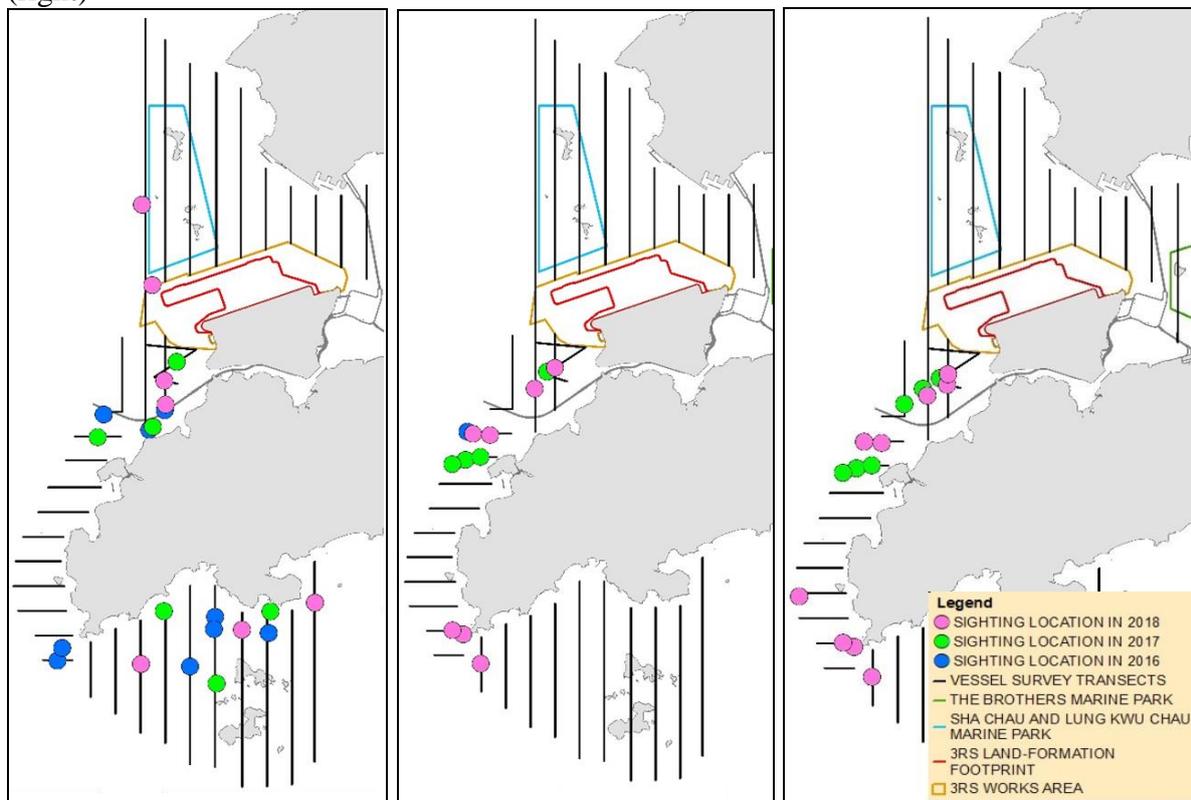
[^] Pooled abundance not including Airport West (AW). Note that the pooled estimates do not necessarily add up to the sum of the individual stratum estimates, as these are computed separately.

* Size-bias corrected average group size (determined by the linear regression method in the program Distance)

[#] From Jefferson (2000)

7. Photo-identification (photo-ID) data are collected during vessel surveys, and the purpose of photo-ID in Hong Kong CWD monitoring is to provide home range and life history information on individual dolphins. In the 2018 monitoring period, the photo-ID work associated with the 3RS vessel surveys identified a total of 158 CWD individuals grouped into three photo ‘catalogues’, namely North Lantau (NL), WL and South Lantau (SL), according to their first sighting locations. 97 CWDs were sighted more than once (61.4%) and 63 of the 158 identified individuals (39.9%) showed cross-area movement between different survey areas. Several individuals were re-sighted in WL, NWL (including AW) and SWL survey areas (**Figure 4**). Amongst the 97 re-sighted individuals, 32 were sighted five times or more, indicating there were quite a number of individuals that continued their frequent use of Lantau waters in 2018.

Figure 4: Sighting Locations of WLMM027 (left), WLMM060 (middle) and WLMM071 (right)



CWD LAND-BASED THEODOLITE TRACKING SURVEY FINDINGS

8. The result of land-based theodolite tracking surveys with plots of first sightings of all the tracked CWD groups in 2018 at LKC are summarised in **Figure 5**. A total of 167 CWD groups were sighted in 2018 from LKC during essentially the same survey effort as in the previous two years. Overall, CWDs were observed more than expected by statistical chance during the dry season (November-May), and less than expected during the wet season. Based on theodolite data, the waters off LKC remain an important foraging area for CWDs throughout the year. Foraging and travelling were observed most frequently (52.0% and 38%, respectively) off LKC (**Figure 6**).

Figure 5: Plots of First Sightings of All CWD Groups recorded from Lung Kwu Chau in 2018

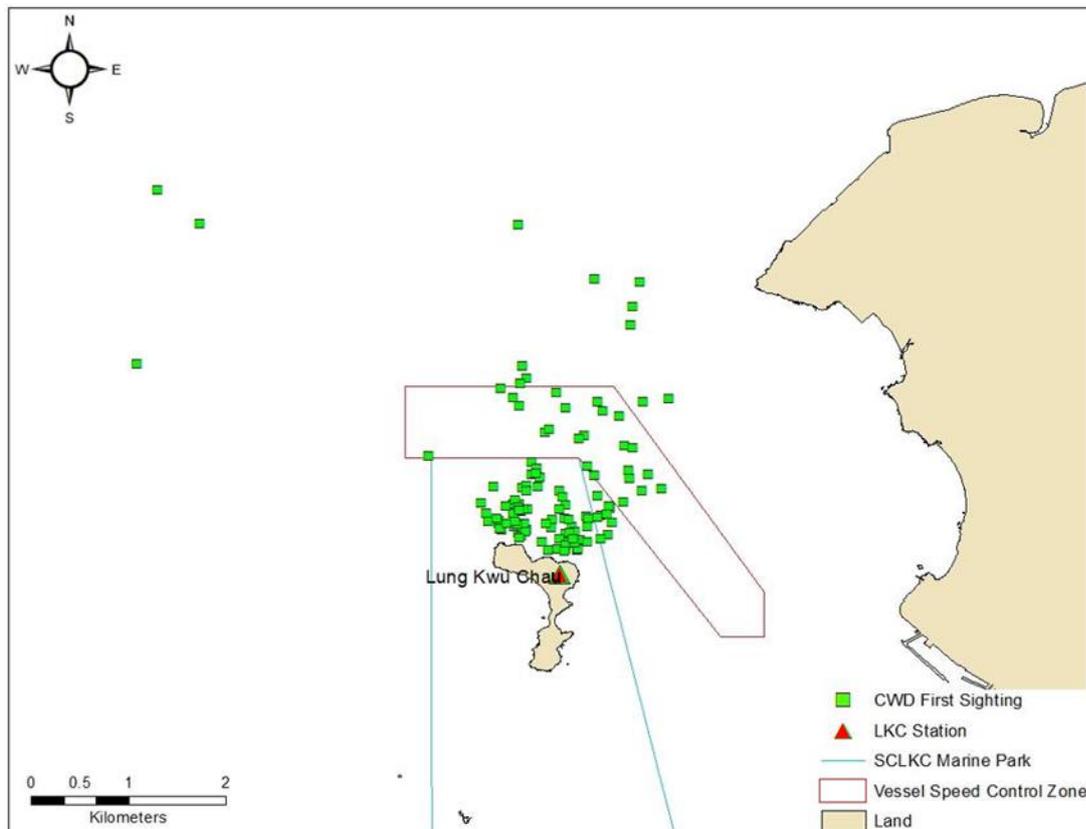
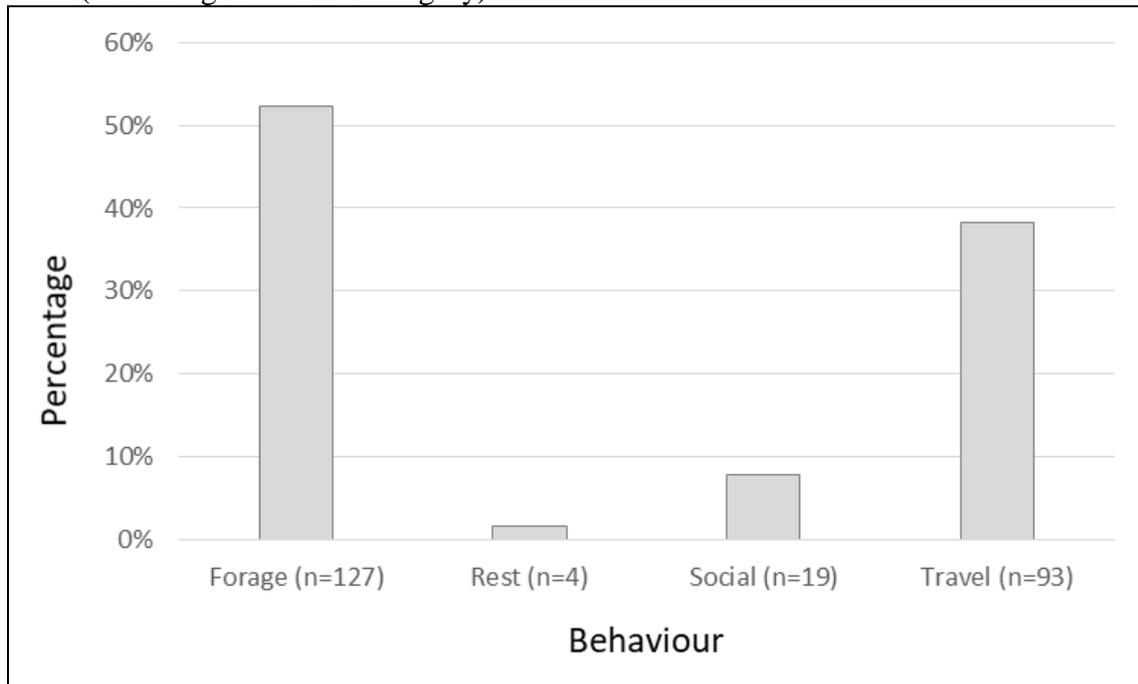
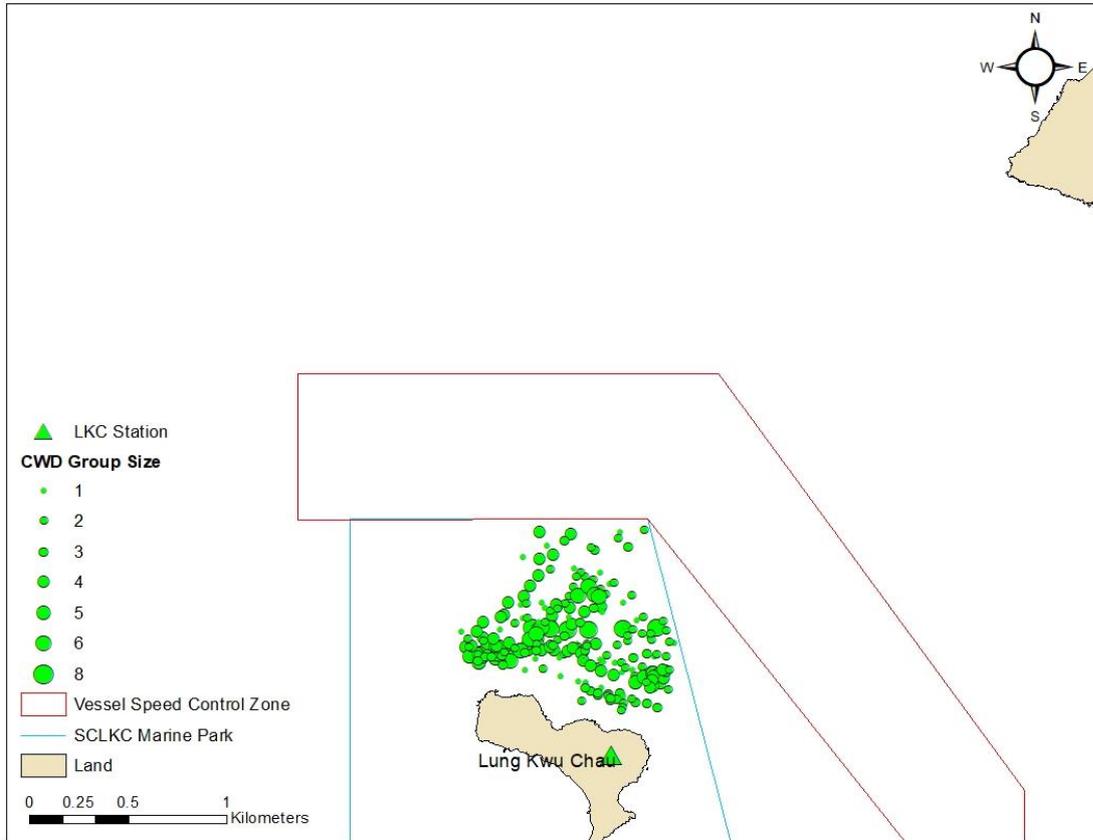


Figure 6: Bar chart showing percentages of CWD Behavioural States off Lung Kwu Chau in 2018 (excluding Unknown Category)

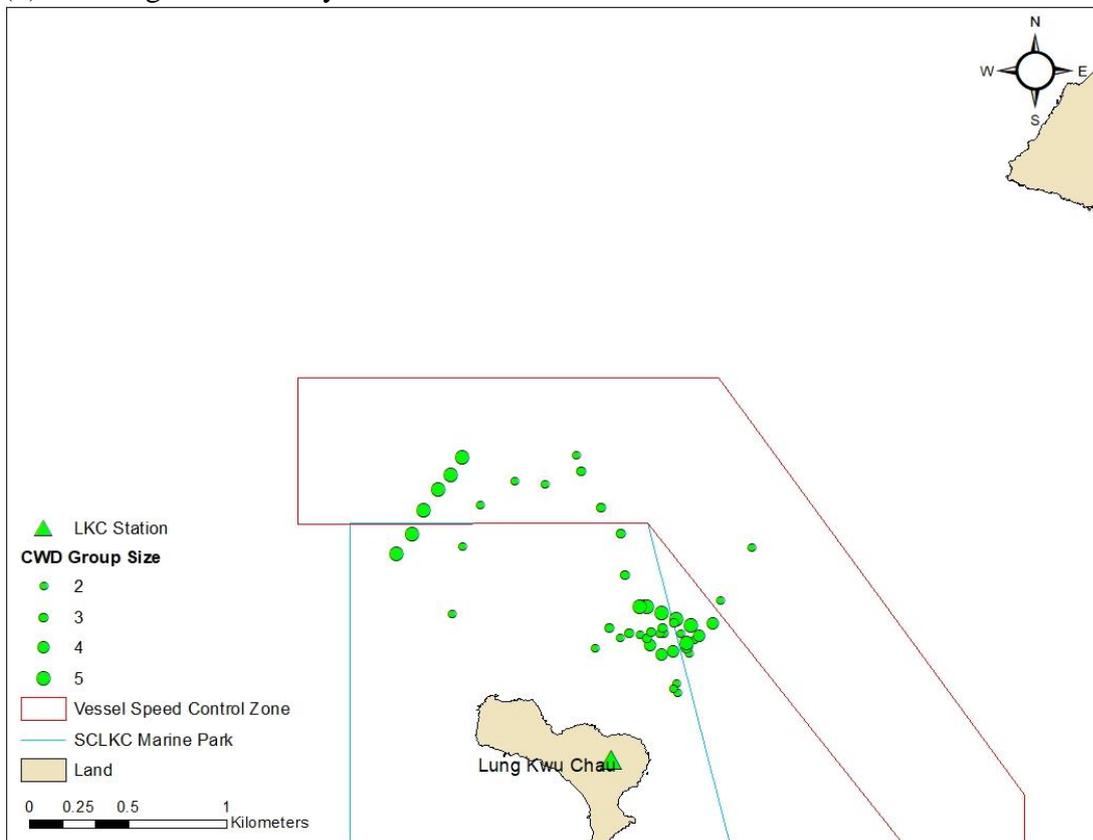


9. In 2018, the mean group size of CWDs off LKC was 3.26, ranging from 1 to 8 dolphins (**Table 2**). The Kruskal-Wallis and Dunn post hoc tests showed that the mean group size was significantly larger outside the SCLKCMP boundary than inside it (see **Figure 7 (a) to (c)** for the plots of CWD positions relative to group sizes within; crossing and outside the boundary of SCLKCMP), and this group size pattern was similar to the findings observed in 2017. Vessels were recorded within 500 meters of focal CWD groups off LKC on 102 occasions, including high speed ferries (HSF) travelling at restricted speeds (≤ 15 knots) on 48 occasions, HSF travelling at normal speeds (>15 knots) on 12 occasions, and other vessels (e.g., fishing and government vessels) on 42 occasions (**Table 2**). The group size of CWDs within 500 m of HSF under restricted speeds (≤ 15 knots) was 3.75, HSF under normal speeds (>15 knots) was 4.50, and group size by other vessel type was 3.43. CWD group size with no vessels within 500 m was 3.12 (**Table 2**). The Kruskal-Wallis and Dunn post hoc tests showed that CWD mean group size was higher in the presence of HSF under normal or restricted speeds than when no boats were present. Regarding CWD movement patterns (swimming speed, reorientation rate and linearity) relative to vessel type present, a basic one-way ANOVA showed no significant differences, however, sample size was low for each vessel type present. These findings differ from results in 2017, in which reorientation rate and linearity varied significantly in the presence of different vessel types.

Figure 7: Plots of CWD Short-track Positions (Standardised Segments) relative to Group Size tracked from LKC in 2018
 (a) Within SCLKCMP



(b) Crossing the boundary of SCLKCMP



(c) Outside SCLKCMP

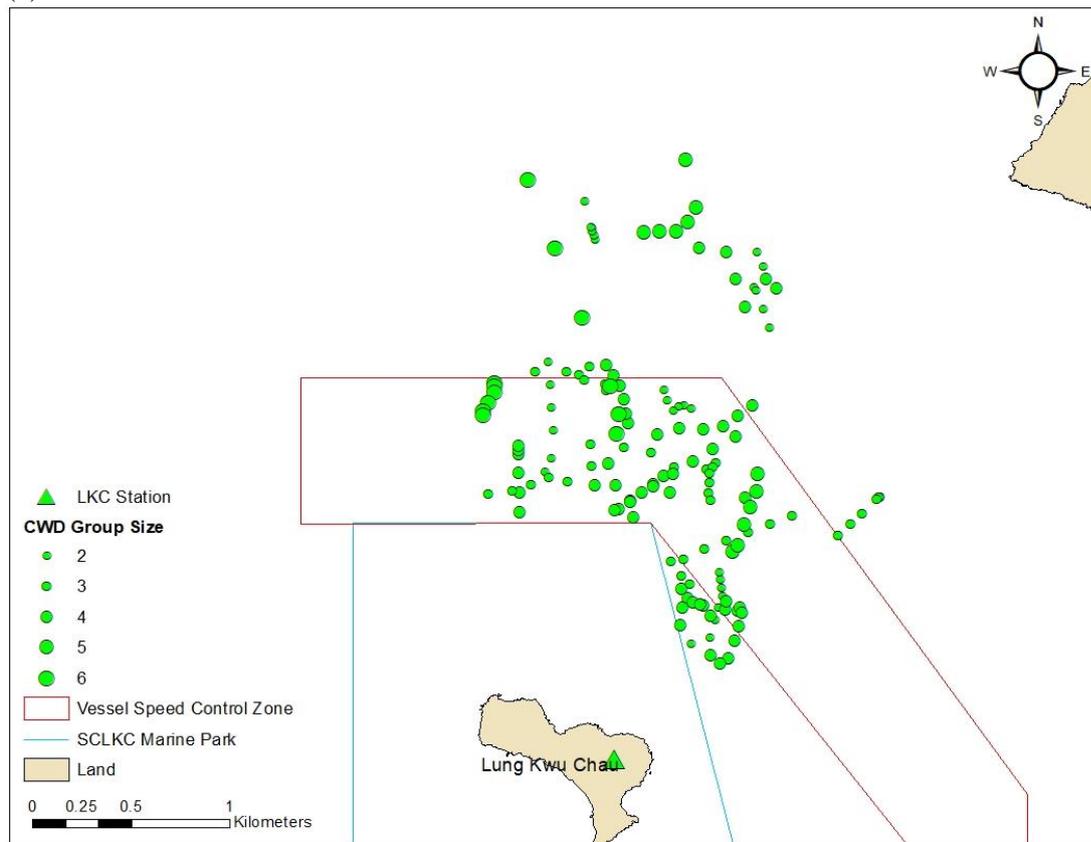


Table 2: CWD Focal Group Size off LKC in 2018 Summary (Standardised Segments)

Station	Sample Size	Minimum No. of Individuals	Maximum No. of Individuals	Mean Group Size	Standard Deviation
Lung Kwu Chau Total	432	1	8	3.26	1.50
Inside SCLKCMP boundary	229	1	8	3.05	1.72
Crossing SCLKCMP boundary	48	2	5	3.25	1.21
Outside SCLKCMP boundary	155	2	6	3.57	1.13
No boats present	330	1	8	3.12	1.58
HSF travelling at normal speed (>15 knots) within 500 m	12	4	5	4.50	0.52
HSF travelling at restricted speed (≤15 knots) within 500 m	48	2	6	3.75	1.10
Other boats within 500 m	42	2	5	3.43	1.06

CWD PASSIVE ACOUSTIC MONITORING FINDINGS

10. The results of passive acoustic monitoring (PAM) with dolphin detections in 2018 at south of Sha Chau, i.e. waters between HKIA and SCLKCMP are summarised in **Table 3**. Dolphins were detected on 123 of 281 days with recording effort (44%). Clicks were the predominant type of dolphin signal detected, and the diurnal detection of clicks showed a consistent pattern of higher levels in late evening and at night compared with the day, which may indicate increased use of echolocation by dolphins during hours of darkness. The PAM results provide evidence that dolphins are using the area around south of Sha Chau throughout the year.

Table 3: Summary of PAM Deployments and Dolphin Detections

Dep #	Data start (dd/mm/yyyy)	Data end (dd/mm/yyyy)	# recording days	# files	Days with dolphins (%)	Files with dolphins (%)
1	16/12/2017	16/01/2018	32	9153	18 (56%)	46 (0.50%)
2	17/01/2018	04/02/2018	19	5427	13 (68%)	34 (0.63%)
3	07/03/2018	02/05/2018	57	16370	27 (47%)	54 (0.33%)
4	08/05/2018	23/06/2018	47	13311	8 (17%)	10 (0.08%)
5	05/09/2018	15/10/2018	41	11808	16 (39%)	29 (0.25%)
6	17/10/2018	28/11/2018	43	12226	17 (40%)	38 (0.31%)
7	29/11/2018	09/01/2019	42	11951	24 (57%)	75 (0.63%)
Total	16/12/2017	09/01/2019	281	80246	123 (44%)	286 (0.36%)

SUMMARY

11. In 2018, CWD use of Hong Kong waters appeared to be relatively stable in WL waters, with an apparent shifting in use from SWL to NL waters. CWD sightings around the Brothers Islands of NEL may be a promising sign of some recovery there. It is estimated that 77 dolphins (on average) were found within Hong Kong waters in 2018, which is up slightly from last year. It is important to note that dolphins shift around within their habitat from year to year, due to both natural and anthropogenic factors. Thus, an apparent increase in numbers from one year to the next should not necessarily be taken as evidence of an overall recovery. Long-term monitoring using consistent methods is needed over an extended period of time in order to evaluate the conservation status of the CWD population and how its use of Hong Kong waters is being affected.

12. From land-based theodolite tracking surveys in 2018, the sightings per survey hour metric was higher than 2016 but lower than 2017. Group sizes of CWDs were generally smaller closer to shore, with larger groups outside the marine park boundary. The behavioural states of foraging and travelling were by far the most frequent off LKC, as in previous years. In 2018, there were no significant indications of reorientation or linearity changing by the parameters of association with different vessel types or travelling at different speeds. Overall, there continues to be no evidence that the ongoing implementation of the SkyPier High Speed Ferry route diversion and speed control zone is having any negative

impacts on dolphin use of the NWL area. Diverted HSFs with speed control measures in place appear to be reducing risks to CWDs using the narrowing waters between south of SCLKCMP and the airport north and do not appear to be resulting in apparent negative impacts on CWDs along the diverted route.

13. The CWD construction phase monitoring data so far appear to be consistent with findings of the ecological assessments completed during the EIA. No unexpected ecological impacts on CWDs have been identified. Construction practices have been modified to avoid negative impacts on dolphins, as much as is feasible. The collective scale of the construction work site and anthropogenic disturbance during 3RS construction was anticipated to lead to temporary displacement of CWDs, and some shifting away from North Lantau waters can be expected during reclamation work for the 3RS construction, as predicted in the EIA. Nevertheless, these impacts are not likely to be permanent, and dolphin numbers in NL waters will probably recover to some extent once the construction work is completed (assuming that the habitat is still of adequate quality). Monitoring for the 3RS continues in line with EM&A requirements and with an eye on evaluating the anticipated 3RS Project impacts as well as any 'recovery' in CWD use of North Lantau waters in the future. Adaptive management measures may be considered, as appropriate, should there be any deviation from anticipated impact. At this stage of 3RS construction, the recommended mitigation and enhancement measures have been implemented in accordance with all requirements and appear to have been effective in managing impacts.

-End-