CONTRACT NO. HY/2013/01
Hong Kong-Zhuhai-Macao Bridge Hong Kong Boundary Crossing Facilities – Passenger Clearance Building
Dolphin Monthly Monitoring

6th Monthly Progress Report (January 2018)
submitted to Leighton – Chun Wo Joint Venture

Submitted by
Samuel K.Y. Hung, Ph.D., Hong Kong Cetacean Research Project

1 February 2018

1. Introduction

1.1. For the Hong Kong-Zhuhai-Macao Bridge (HZMB) Hong Kong Boundary Crossing Facilities (HKBCF), the construction of the Passenger Clearance Building (PCB) requires the contractor (i.e. Leighton – Chun Wo Joint Venture) and the associated environmental team to conduct monthly line-transect vessel surveys for the Chinese White Dolphin to cover the Northwest (NWL) and Northeast Lantau (NEL) survey areas under the Environmental Monitoring and Audit (EM&A) programme.

1.2. In August 2017, Hong Kong Cetacean Research Project (HKCRP) has been commissioned by the contractor to conduct regular dolphin monitoring study in order to collect data on Chinese White Dolphins during the construction phase (i.e. impact period) of the HKBCF-PCB project, and to analyze the collected survey data to monitor distribution, encounter rate, activities and occurrence of dolphin calves. Photo-identification will also be collected from individual Chinese White Dolphins to examine their individual ranging patterns.

1.3. From the monitoring results, any changes in dolphin occurrence within the study area will be examined for possible causes, and appropriate actions and additional mitigation measures will be recommended as necessary.

1.4. This report is the sixth monthly progress report under the HKBCF construction phase dolphin monitoring programme submitted to the HKBCF-PCB contractor, summarizing

the results of the survey findings during the month of January 2018.

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 period. The co-ordinates of all transect lines are shown in Table 1.

Table 1 Co-ordinates of transect lines

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	820827		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 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 20 years of marine mammal monitoring surveys in Hong Kong developed by HKCRP (see Hung 2017). 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 *Fuinon* marine binoculars.

2.1.4. 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.

2.1.5. During on-effort survey periods, the survey team recorded effort data including time, position (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*).

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

2.1.7. 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.

2.1.8. 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.

2.1.9. Encounter rates of Chinese white dolphins (number of on-effort sightings per 100 km of survey effort and number of dolphins from all on-effort sightings 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 collected under Beaufort 3 or below condition would be used for encounter rate analysis. Dolphin encounter rates were calculated using primary survey effort alone, as well as the combined survey effort from both primary and secondary lines.

2.2. Photo-identification Work

2.2.1. When a group of Chinese White Dolphins were sighted during the line-transect survey, the 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.

3. Monitoring Results

3.1. Vessel-based Line-transect Survey

3.1.1. Two sets of systematic line-transect vessel surveys were conducted under the HKBCF dolphin monitoring programme on the 9th, 11th, 19th and 26th of January 2018, to cover all transect lines in NWL and NEL survey areas twice. The survey routes of each survey day are presented in Figures 2-5.

3.1.2. A total of 257.62 km of survey effort was collected, with 94.6% of the total survey effort being conducted under favourable weather conditions (i.e. Beaufort Sea State 3 or below with good visibility) during the January's surveys (Appendix I).

3.1.3. Among the two areas, 98.20 km and 159.42 km of survey effort were collected from NEL and NWL survey areas respectively. The total survey effort conducted on primary and secondary lines were 194.93 km and 62.69 km respectively (Appendix I).

3.1.4. During the two sets of monitoring surveys in January 2018, five groups of 19 Chinese White Dolphins were sighted (Appendix II). All dolphin sightings were made in NWL, while none was made at all in NEL.

3.1.5. From the January's surveys, four of the five dolphin groups were sighted during on-effort search, and all four on-effort sightings were made on primary lines (Appendix II). Notably, none of the sightings was associated with any operating fishing vessel.

3.1.6. Distribution of the dolphin sightings made in January 2018 is shown in Figure 6. The five dolphin groups were scattered to the north of Lung Kwu Chau, east of Sha Chau,

west of the airport, and adjacent to the HKLR09 alignment near Shum Wat (Figure 6). Notably, all dolphin groups were sighted far away from the HKBCF reclamation site (Figure 6).

3.1.7. During the January's surveys, encounter rates of Chinese White Dolphins deduced from the survey effort and on-effort sighting data made under favourable conditions (Beaufort 3 or below) are shown in Tables 2 & 3.

Table 2. Dolphin encounter rates deduced from the two sets of HKBCF surveys (two surveys in each set) in January 2018 in Northeast (NEL) and Northwest Lantau (NWL)

		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**
NEL	Set 1: January 9th / 11th	0.0	0.0
	Set 2: January 19th / 26th	0.0	0.0
NWL	Set 1: January 9th / 11th	2.0	9.8
	Set 2: January 19th / 26th	5.1	20.3

Table 3. Overall dolphin encounter rates (sightings per 100 km of survey effort) from all four HKBCF surveys conducted in January 2018 on primary lines only as well as both primary lines and secondary lines in Northeast and Northwest Lantau

	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	**Both Primary and Secondary Lines**	**Primary Lines Only**	**Both Primary and Secondary Lines**
Northeast Lantau	0.0	0.0	0.0	0.0
Northwest Lantau	3.6	2.7	15.4	11.7

3.1.8. The average dolphin group size in January 2018 was 3.8 individual per group. Three of the five dolphin groups were small in size with 2-3 animals per group, while the other two groups were medium in size with five and seven animals respectively (Appendix II).

3.2. Photo-identification Work

3.2.1. Fifteen known individual dolphins were re-sighted 17 times during the January's surveys

(Appendices III and IV). Almost all individuals were re-sighted only once during the monitoring month, with the exception of two individuals (i.e. CH34 and NL120) being re-sighted twice.

3.2.2. Notably, one of the identified individuals (WL145) was sighted with her young calf during their re-sightings in January 2018.

4. Conclusion

4.1. During this month of dolphin monitoring, no adverse impact from the construction activities of the HKBCF on Chinese White Dolphins was noticeable from general observations.

4.2. Due to monthly variation in dolphin occurrence within the study area, it would be more appropriate to draw conclusion on whether any impacts on dolphins have been detected related to the construction activities of the HKBCF in the quarterly EM&A reports, where comparison on distribution, group size and encounter rates of dolphins between the quarterly impact monitoring period and baseline monitoring period will be made.

5. References

- Buckland, S. T., Anderson, D. R., Burnham, K. P., Laake, J. L., Borchers, D. L., and Thomas, L. 2001. Introduction to distance sampling: estimating abundance of biological populations. Oxford University Press, London.

- Hung, S. K. 2017. Monitoring of Marine Mammals in Hong Kong waters: final report (2016-17). An unpublished report submitted to the Agriculture, Fisheries and Conservation Department, 162 pp.

- Jefferson, T. A. 2000. Population biology of the Indo-Pacific hump-backed dolphin in Hong Kong waters. Wildlife Monographs 144:1-65.

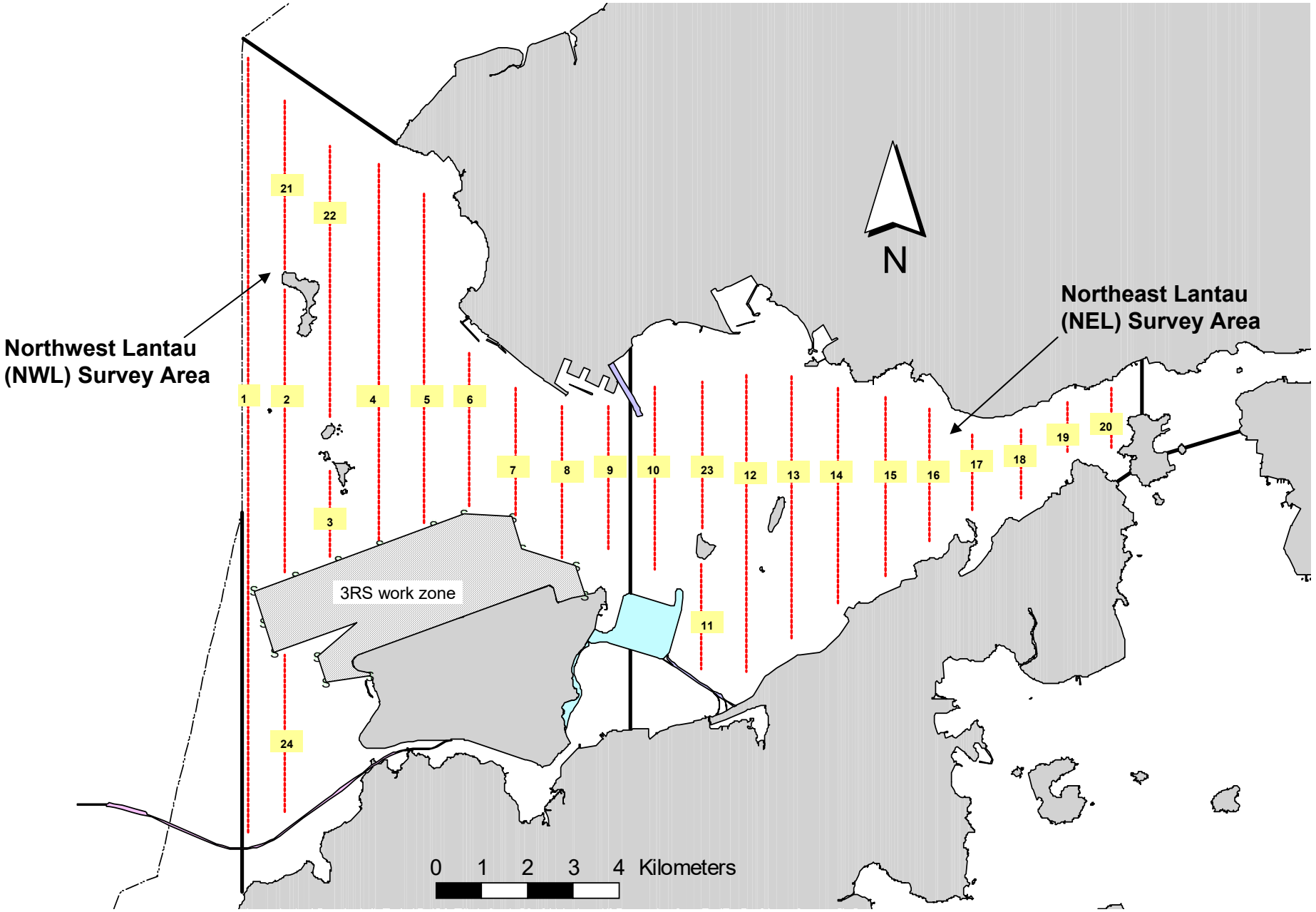

Figure 1. Transect Line Layout in Northwest and Northeast Lantau Survey Areas

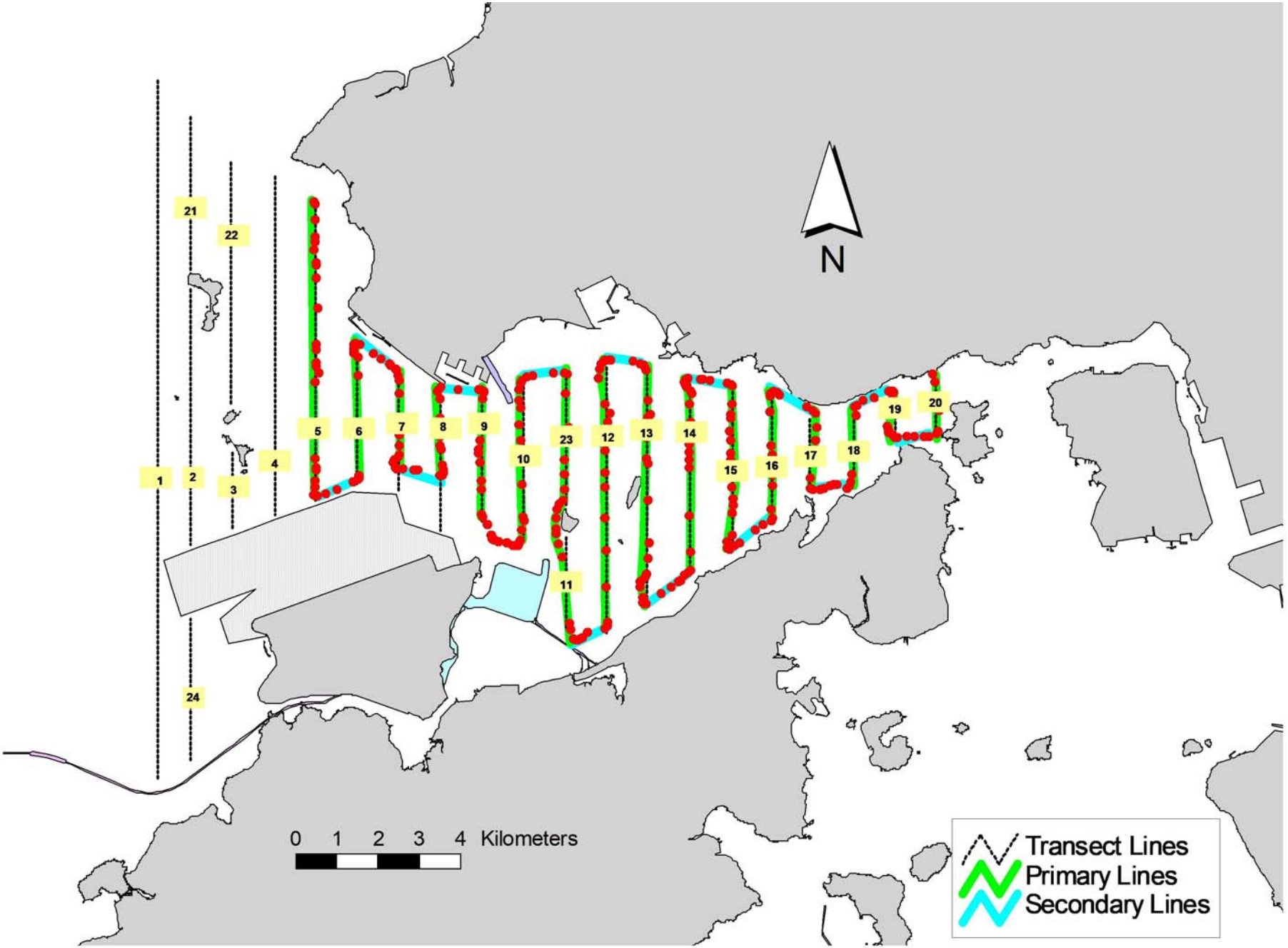

Figure 2. Survey Route on January 9th, 2018

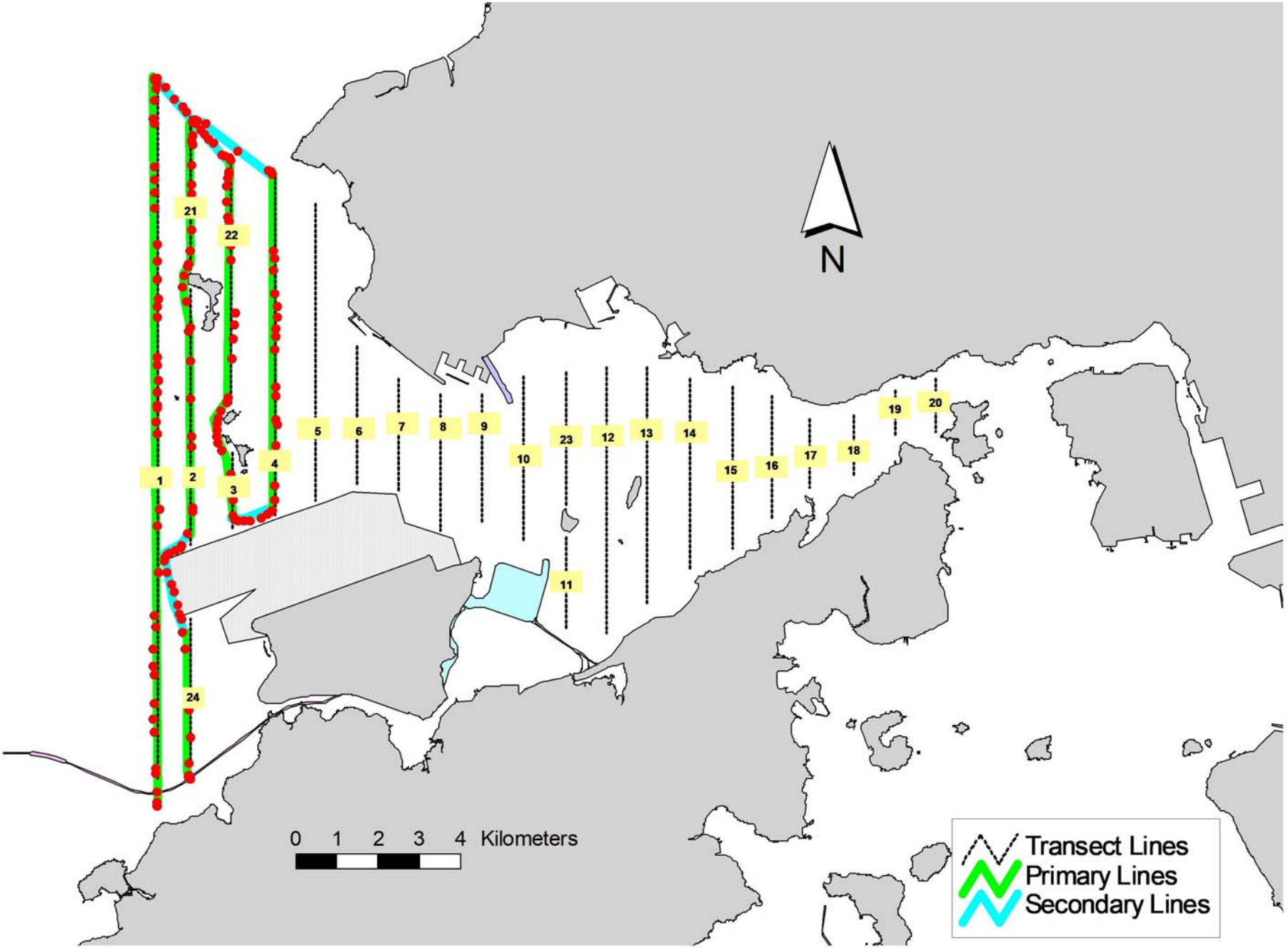

Figure 3. Survey Route on January 11th, 2018

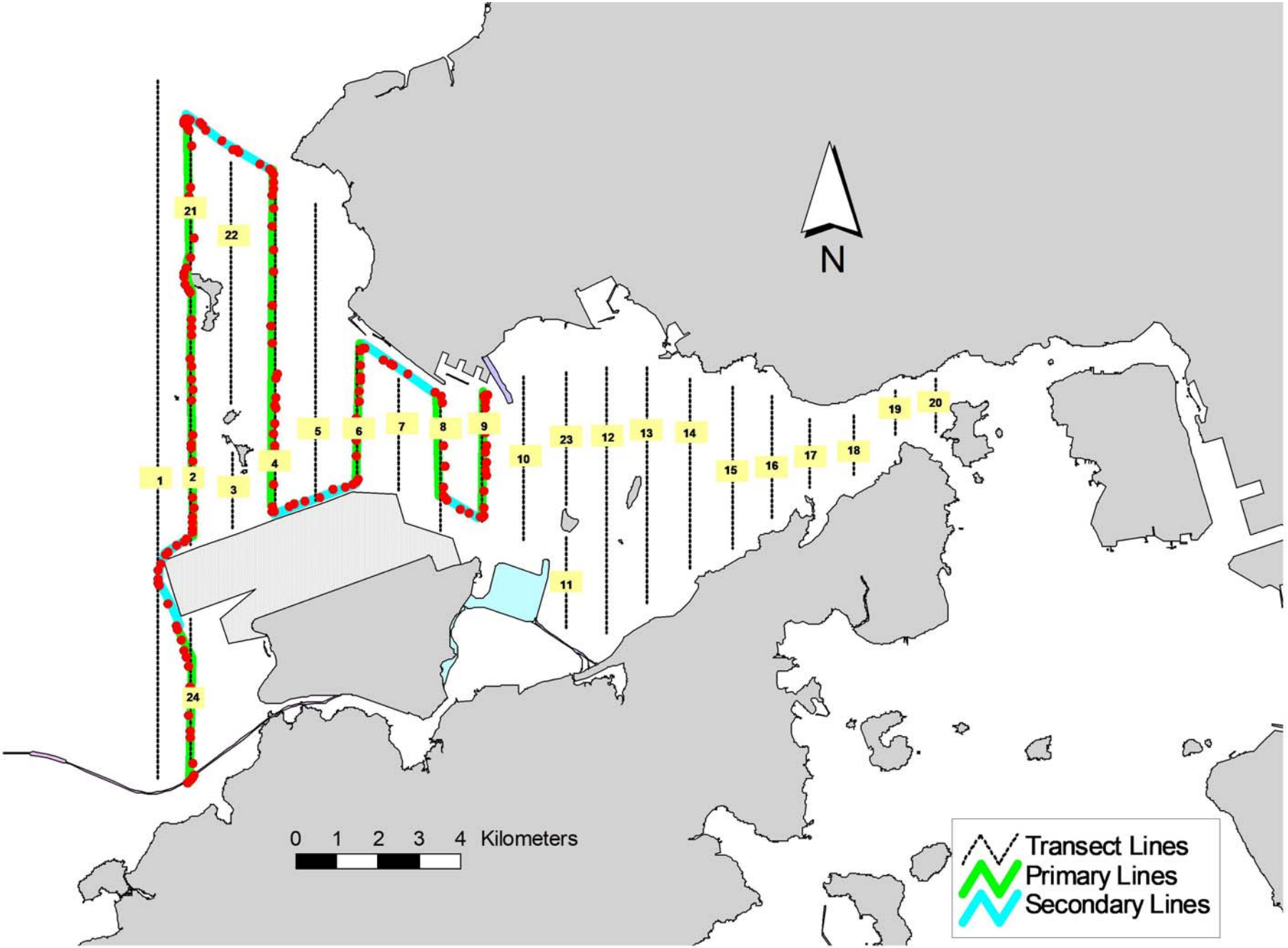

Figure 4. Survey Route on January 19th, 2018

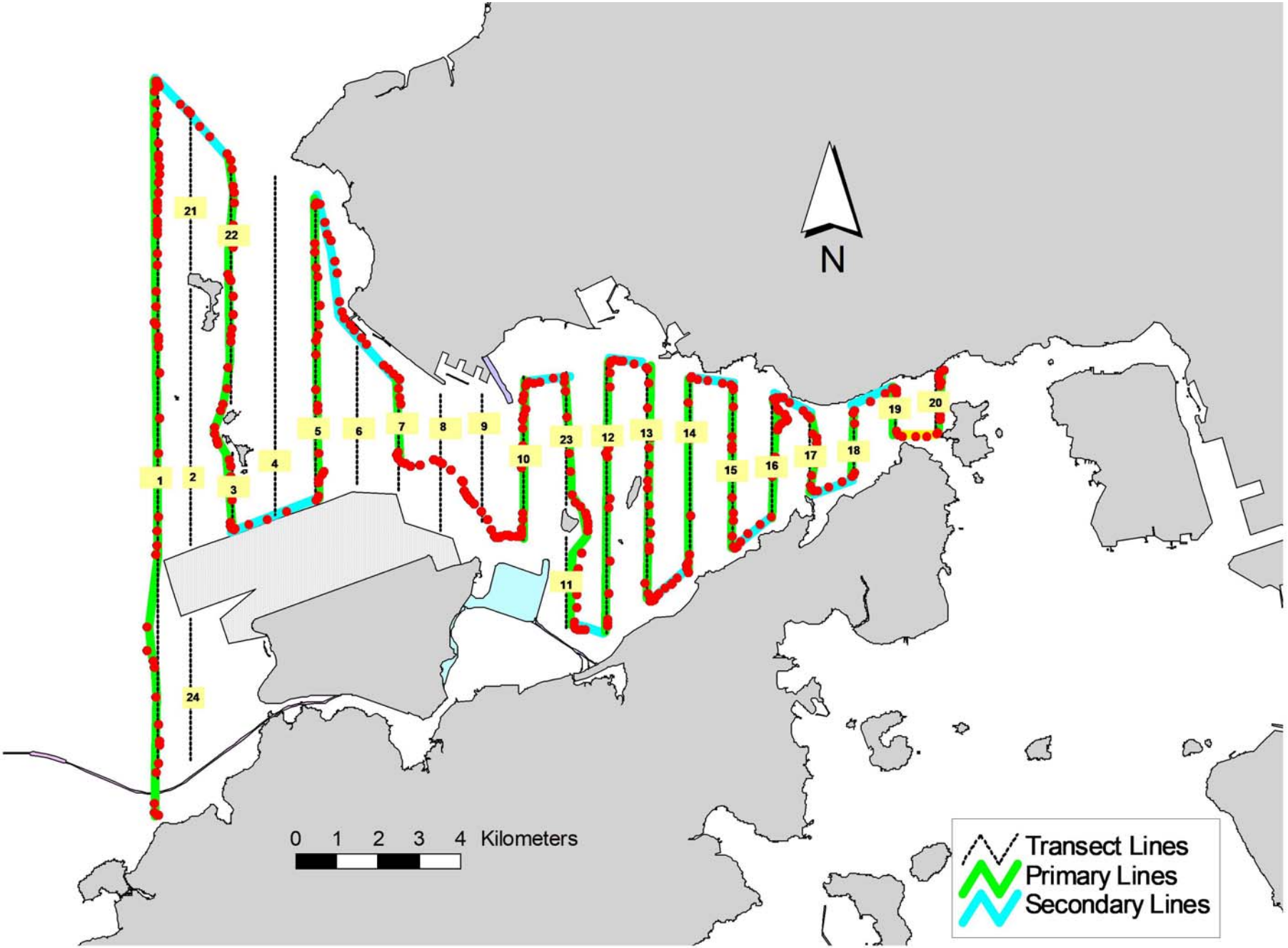

Figure 5. Survey Route on January 26th, 2018

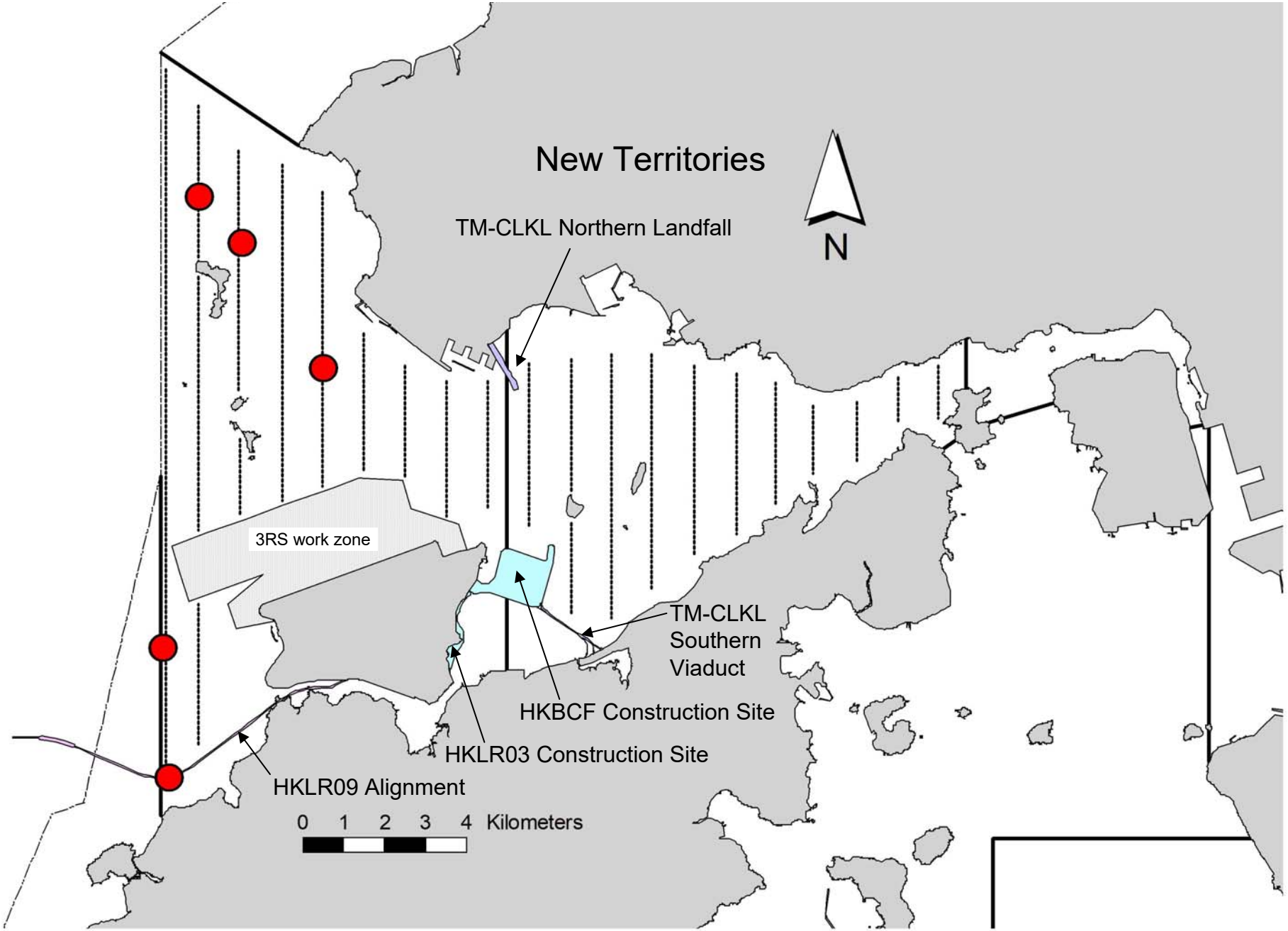

Figure 6. Distribution of Chinese White Dolphin Sightings during January 2018 HKBCF Monitoring Surveys

Appendix I. HKBCF Survey Effort Database (January 2018)

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

DATE	AREA	BEAU	EFFORT	SEASON	VESSEL	TYPE	P/S
9-Jan-18	NE LANTAU	1	1.42	WINTER	STANDARD36826	HKBCF	P
9-Jan-18	NE LANTAU	2	20.01	WINTER	STANDARD36826	HKBCF	P
9-Jan-18	NE LANTAU	3	16.10	WINTER	STANDARD36826	HKBCF	P
9-Jan-18	NE LANTAU	1	1.19	WINTER	STANDARD36826	HKBCF	S
9-Jan-18	NE LANTAU	2	8.28	WINTER	STANDARD36826	HKBCF	S
9-Jan-18	NE LANTAU	3	3.20	WINTER	STANDARD36826	HKBCF	S
9-Jan-18	NW LANTAU	2	11.32	WINTER	STANDARD36826	HKBCF	P
9-Jan-18	NW LANTAU	3	5.86	WINTER	STANDARD36826	HKBCF	P
9-Jan-18	NW LANTAU	2	4.51	WINTER	STANDARD36826	HKBCF	S
11-Jan-18	NW LANTAU	3	34.08	WINTER	STANDARD36826	HKBCF	P
11-Jan-18	NW LANTAU	4	9.19	WINTER	STANDARD36826	HKBCF	P
11-Jan-18	NW LANTAU	5	1.50	WINTER	STANDARD36826	HKBCF	P
11-Jan-18	NW LANTAU	2	1.30	WINTER	STANDARD36826	HKBCF	S
11-Jan-18	NW LANTAU	3	5.33	WINTER	STANDARD36826	HKBCF	S
11-Jan-18	NW LANTAU	4	0.80	WINTER	STANDARD36826	HKBCF	S
11-Jan-18	NW LANTAU	5	2.30	WINTER	STANDARD36826	HKBCF	S
19-Jan-18	NW LANTAU	1	1.40	WINTER	STANDARD36826	HKBCF	P
19-Jan-18	NW LANTAU	2	25.40	WINTER	STANDARD36826	HKBCF	P
19-Jan-18	NW LANTAU	1	4.29	WINTER	STANDARD36826	HKBCF	S
19-Jan-18	NW LANTAU	2	8.61	WINTER	STANDARD36826	HKBCF	S
26-Jan-18	NW LANTAU	1	8.06	WINTER	STANDARD36826	HKBCF	P
26-Jan-18	NW LANTAU	2	24.23	WINTER	STANDARD36826	HKBCF	P
26-Jan-18	NW LANTAU	2	11.24	WINTER	STANDARD36826	HKBCF	S
26-Jan-18	NE LANTAU	1	1.10	WINTER	STANDARD36826	HKBCF	P
26-Jan-18	NE LANTAU	2	35.26	WINTER	STANDARD36826	HKBCF	P
26-Jan-18	NE LANTAU	2	11.64	WINTER	STANDARD36826	HKBCF	S

Appendix II. HKBCF Chinese White Dolphin Sighting Database (January 2018)

(Abberviations: STG# = Sighting Number; HRD SZ = Dolphin Herd Size; BEAU = Beaufort Sea State; PSD = Perpendicular Distance; BOAT ASSOC. = Fishing Boat Association; P/S: Sighting Made on Primary/Secondary Lines)

DATE	STG #	TIME	HRD SZ	AREA	BEAU	PSD	EFFORT	TYPE	NORTHING	EASTING	SEASON	BOAT ASSOC.	P/S
9-Jan-18	1	1401	5	NW LANTAU	3	169	ON	HKBCF	824554	808491	WINTER	NONE	P
19-Jan-18	1	1153	7	NW LANTAU	2	13	ON	HKBCF	828468	805481	WINTER	NONE	P
19-Jan-18	2	1316	2	NW LANTAU	2	ND	OFF	HKBCF	815126	804723	WINTER	NONE	
26-Jan-18	1	1023	2	NW LANTAU	2	664	ON	HKBCF	818138	804585	WINTER	NONE	P
26-Jan-18	2	1152	3	NW LANTAU	2	293	ON	HKBCF	827414	806509	WINTER	NONE	P

Appendix III. Individual dolphins identified during HKBCF monitoring surveys in January 2018

ID#	DATE	STG#	AREA
CH34	19/01/18	1	NW LANTAU
	26/01/18	2	NW LANTAU
NL120	09/01/18	1	NW LANTAU
	19/01/18	1	NW LANTAU
NL136	19/01/18	1	NW LANTAU
NL182	19/01/18	1	NW LANTAU
NL210	26/01/18	2	NW LANTAU
NL226	09/01/18	1	NW LANTAU
NL261	19/01/18	1	NW LANTAU
NL272	19/01/18	1	NW LANTAU
NL295	09/01/18	1	NW LANTAU
NL296	09/01/18	1	NW LANTAU
NL320	19/01/18	1	NW LANTAU
NL328	26/01/18	2	NW LANTAU
WL145	26/01/18	1	NW LANTAU
WL241	19/01/18	2	NW LANTAU
WL243	19/01/18	2	NW LANTAU

Appendix IV. Photographs of Identified Individual Dolphins in January 2018 (HKBCF surveys)

Appendix IV (cont'd).