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

7th Monthly Progress Report (February 2018)
submitted to Leighton – Chun Wo Joint Venture

Submitted by
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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 seventh 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 February 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 1st, 6th, 13th and 26th of February 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 269.42 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 February's surveys (Appendix I).

3.1.3. Among the two areas, 102.80 km and 166.62 km of survey effort were collected from NEL and NWL survey areas respectively. The total survey effort conducted on primary and secondary lines were 189.25 km and 80.17 km respectively (Appendix I).

3.1.4. During the two sets of monitoring surveys in February 2018, a total of 14 groups of 45 Chinese White Dolphins were sighted (Appendix II). Almost all dolphin sightings were made in NWL, while an exceptionally rare sighting was also made in NEL (note: the last dolphin sighting made in NEL during HZMB-related surveys can be dated back to June 2016).

3.1.5. From the February's surveys, all 14 dolphin groups were sighted during on-effort search, and all except three of them 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 February 2018 is shown in Figure 6. The majority of dolphin groups were sighted toward the western end of the North Lantau region, mainly to the west of the airport platform, as well as near Lung Kwu Chau and Sha Chau (Figure 6). The other sightings were scattered near Black Point, Pillar Point and the northeast corner of the airport.

3.1.7. The lone sighting of five dolphins in NEL occurred near Siu Ho Wan (Figure 6). In fact, this dolphin group was first sighted at the northeast corner of airport in NWL, and the research team decided to conduct focal-follow on them as they were moving in eastward direction. The focal-follow session ended two hours later, with the final location of the dolphin group sighted near the Brothers Islands. Then the same dolphin group was sighted again near Siu Ho Wan during on-effort search in NEL.

3.1.8. Notably, all dolphin groups were sighted far away from the HKBCF reclamation site, as well as the HKLR03 reclamation site and TMCLKL alignment (Figure 6). However, two dolphin groups were sighted adjacent to the HKLR09 alignment.

3.1.9. During the February'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 February 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: February 1st / 6th	3.1	15.7
	Set 2: February 13th / 26th	0.0	0.0
NWL	Set 1: February 1st / 6th	4.3	6.5
	Set 2: February 13th / 26th	9.8	34.3

Table 3. Overall dolphin encounter rates (sightings per 100 km of survey effort) from all four HKBCF surveys conducted in February 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	1.5	1.0	7.4	4.9
Northwest Lantau	7.5	7.2	22.4	23.0

3.1.10. The average dolphin group size in February 2018 was 3.2 individual per group. Nine of the 14 dolphin groups were small in size with 1-3 animals per group, while the other five groups were medium in size with 5-7 animals per group (Appendix II).

3.2. Photo-identification Work

3.2.1. Fifteen known individual dolphins were re-sighted 29 times during the February's surveys (Appendices III and IV). Six of them were re-sighted only once during the monitoring month, while the eight individuals were re-sighted twice or thrice. One individual (NL136) was repeatedly re-sighted for six times in total on three survey days.

3.2.2. Notably, one of the identified individuals (WL179) was sighted with her young calf during their re-sightings in February 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.

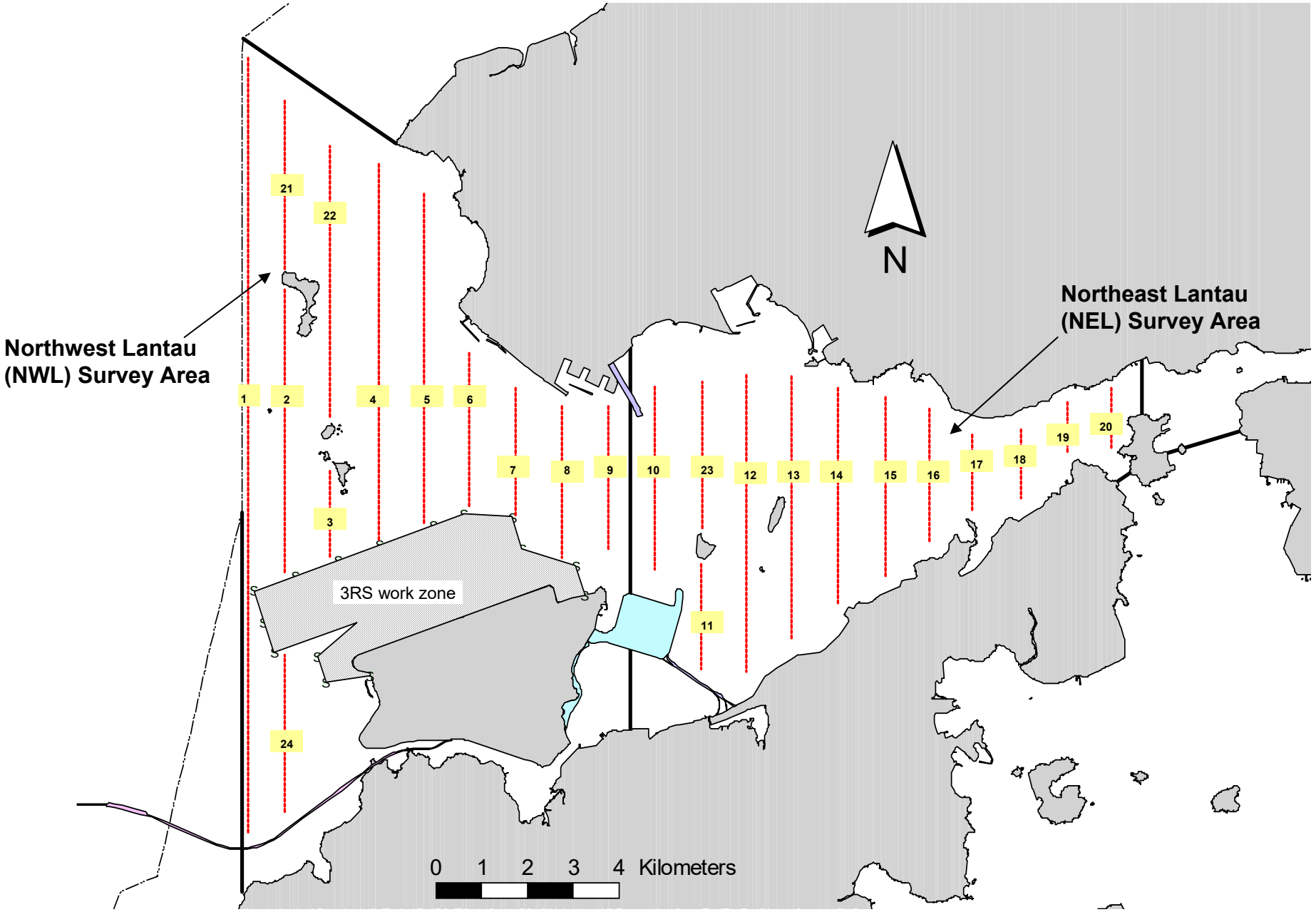


Figure 1. Transect Line Layout in Northwest and Northeast Lantau Survey Areas

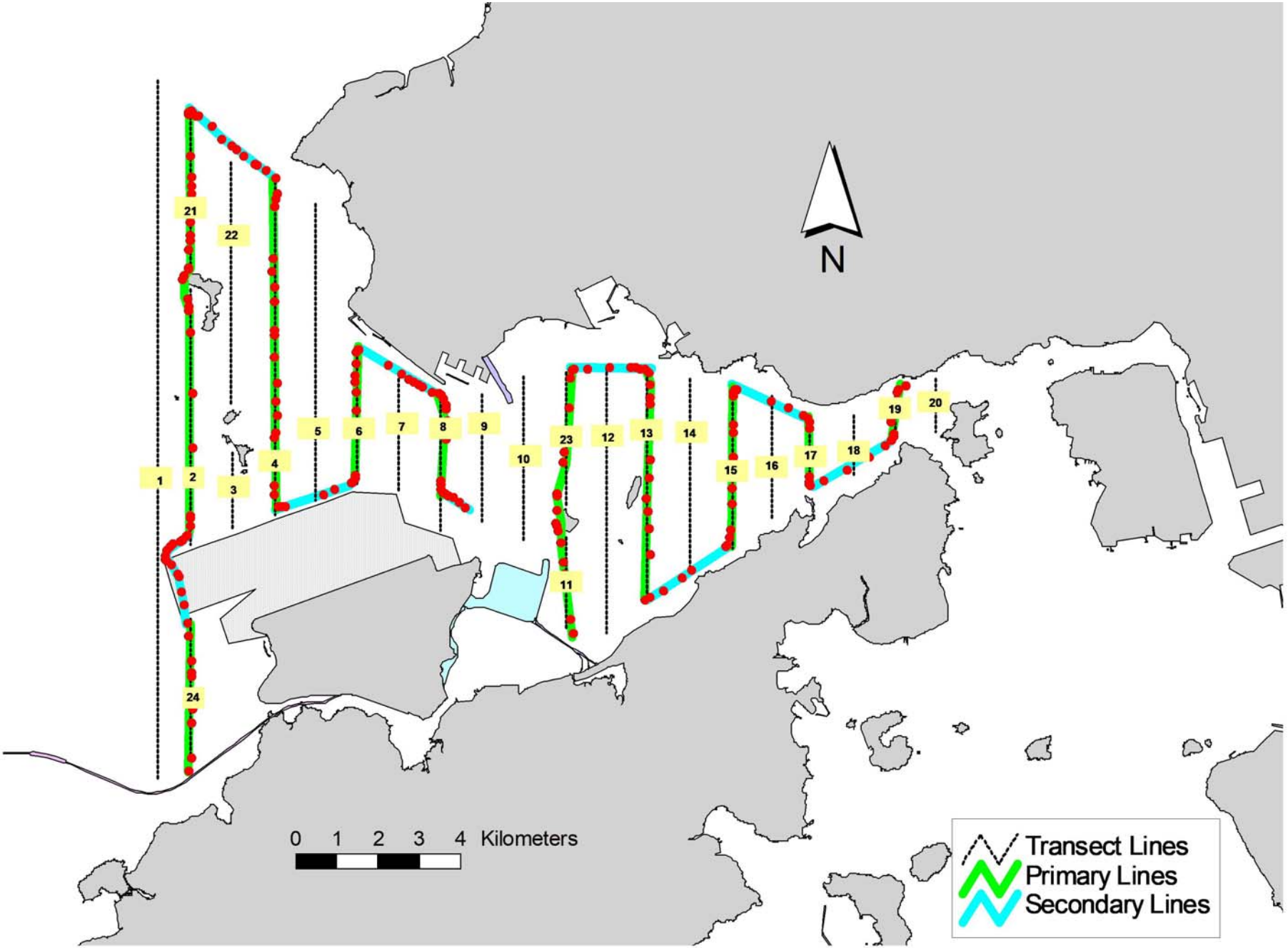


Figure 2. Survey Route on February 1st, 2018

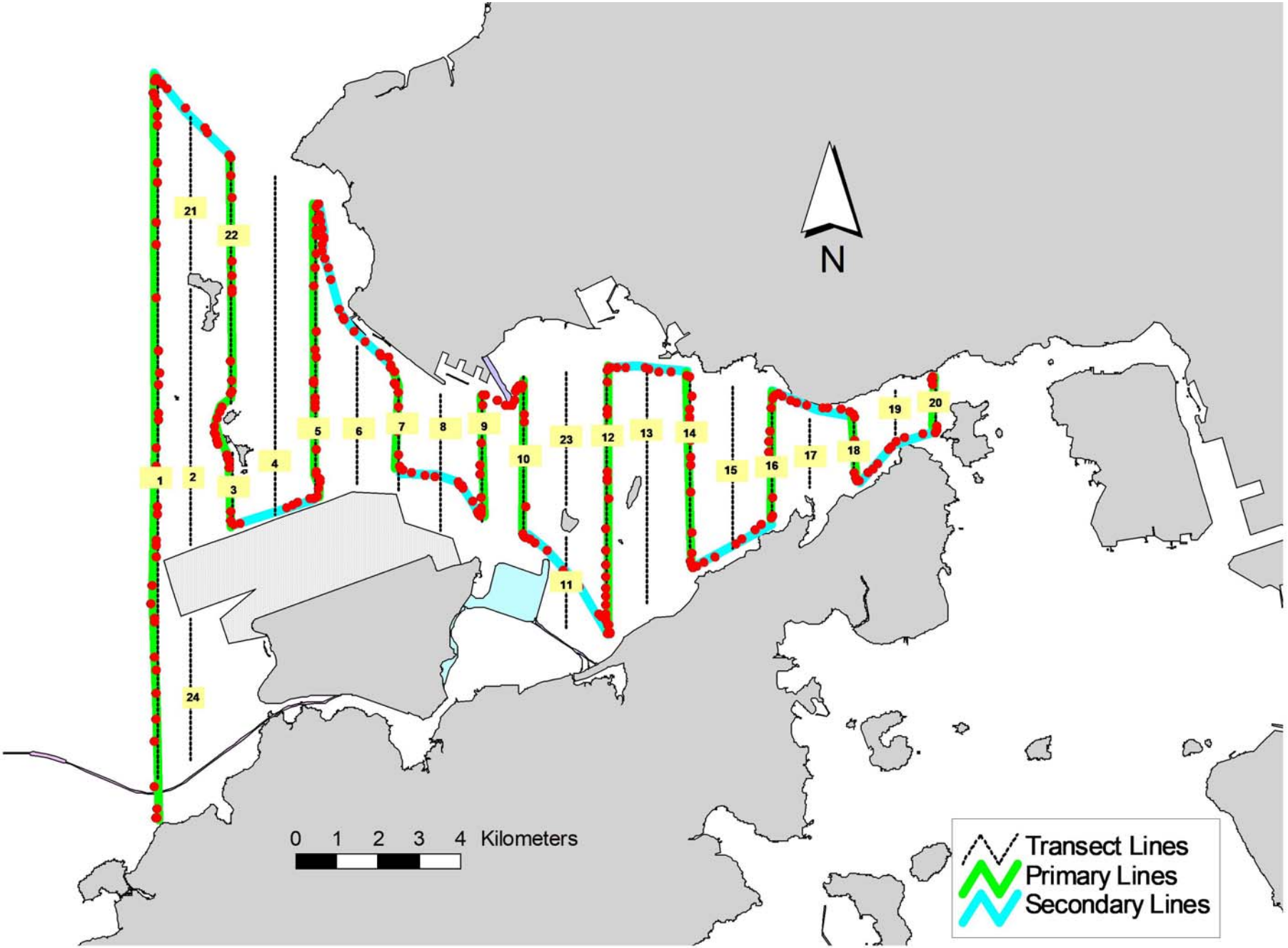


Figure 3. Survey Route on February 6th, 2018

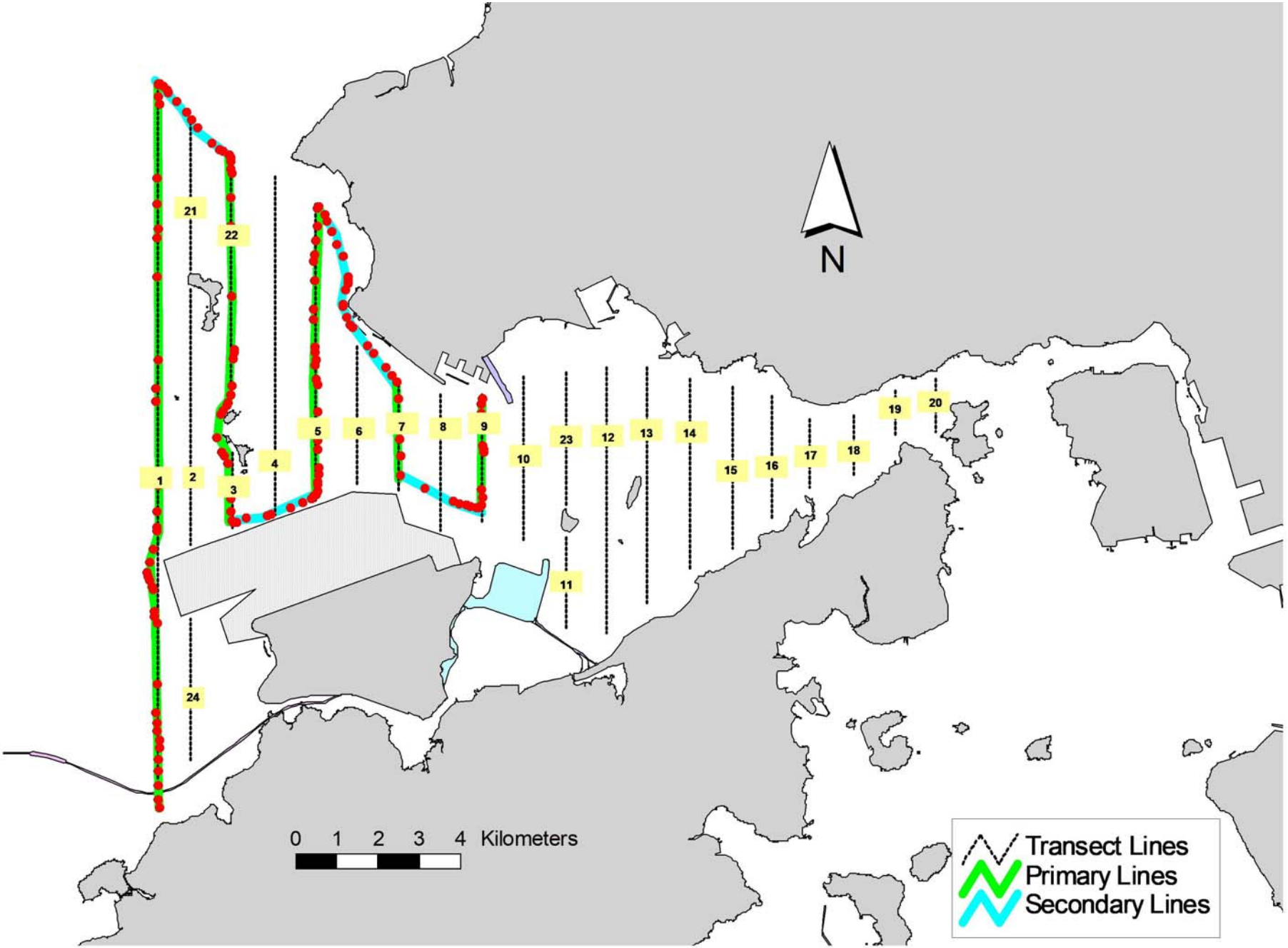


Figure 4. Survey Route on February 13th, 2018

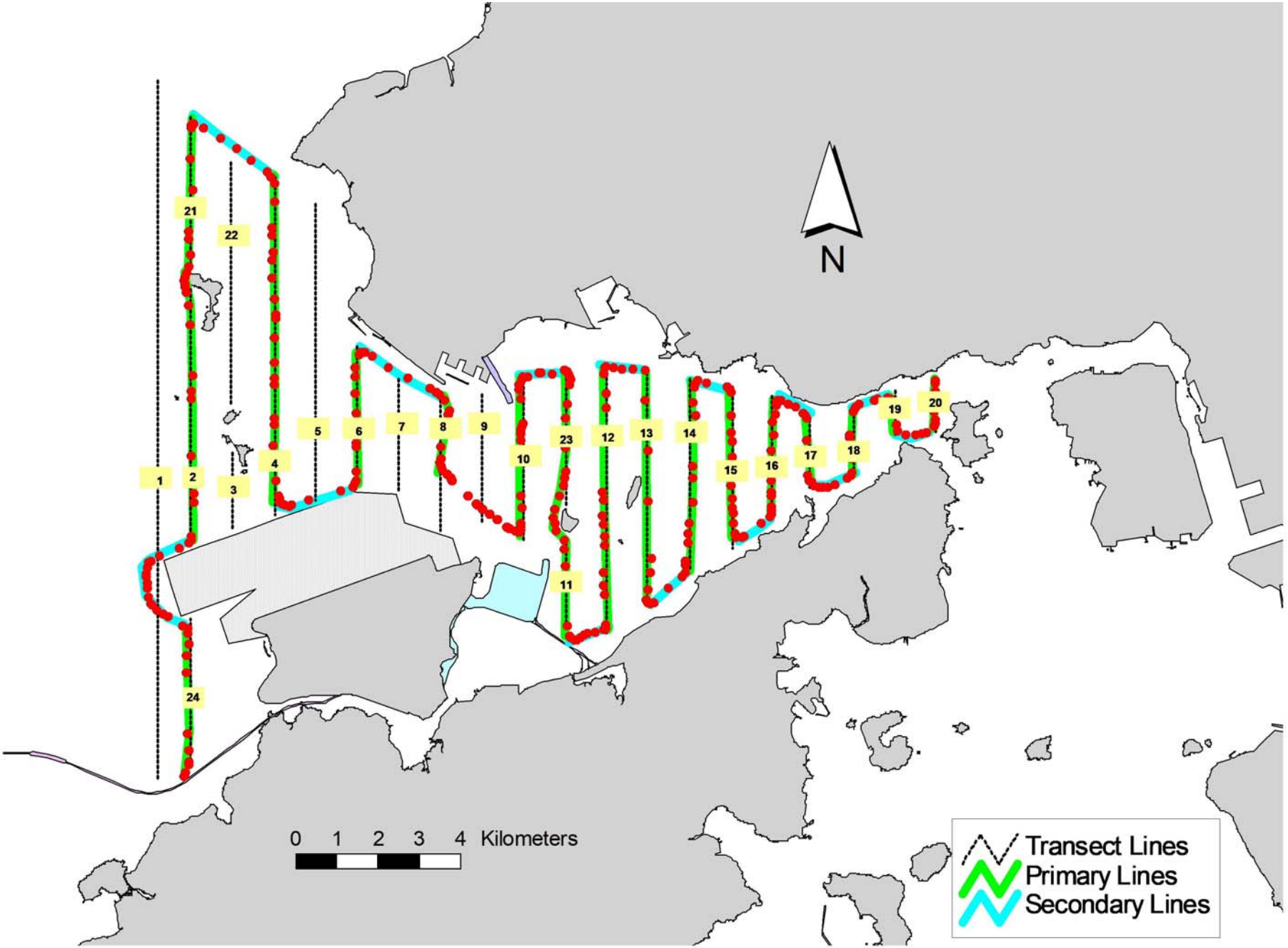


Figure 5. Survey Route on February 26th, 2018

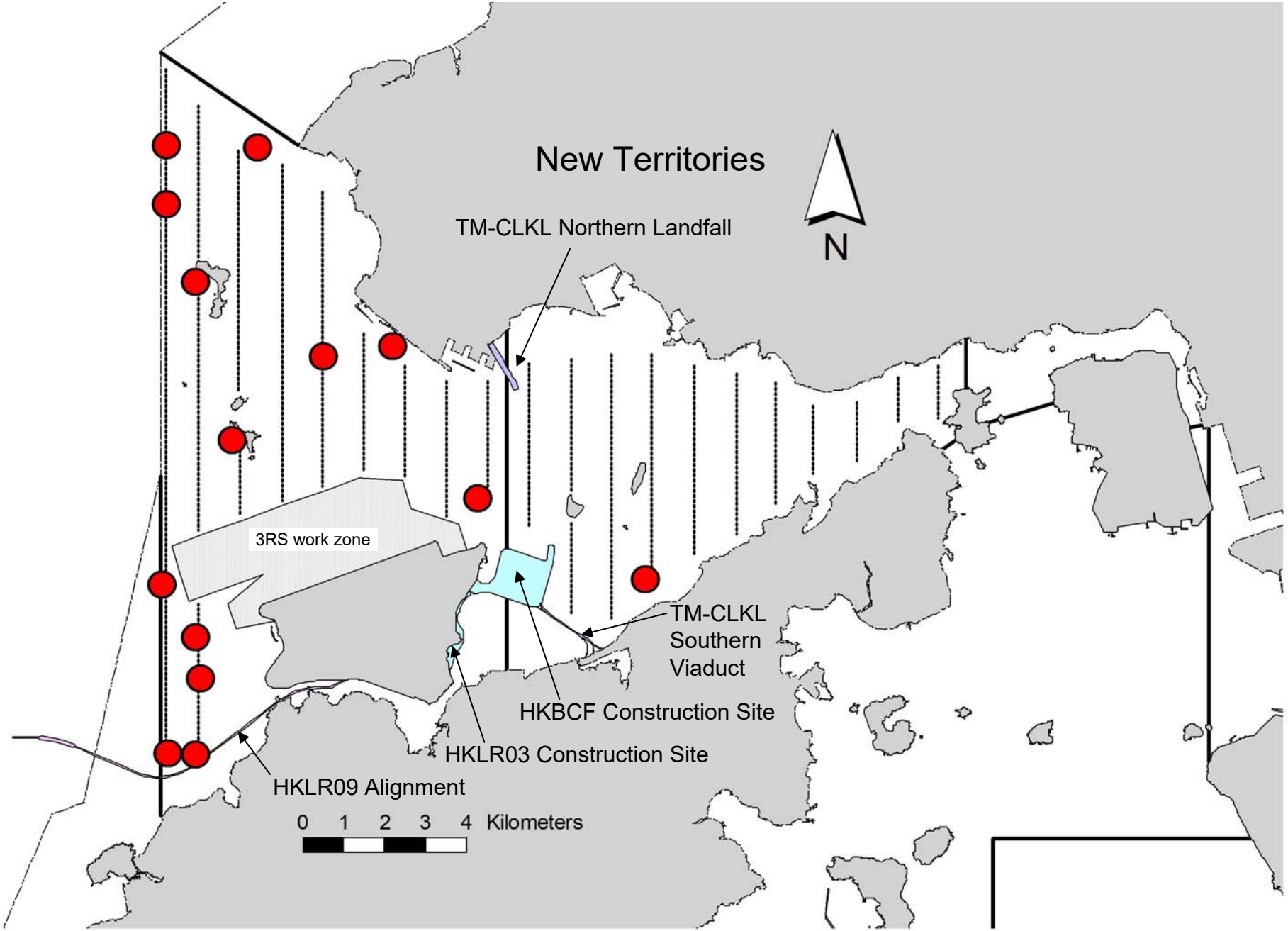


Figure 6. Distribution of Chinese White Dolphin Sightings during February 2018 HKBCF Monitoring Surveys

Annex I. HKBCF Survey Effort Database (February 2018)

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

DATE	AREA	BEAU	EFFORT	SEASON	VESSEL	TYPE	P/S
1-Feb-18	NW LANTAU	2	11.07	WINTER	STANDARD36826	HKBCF	P
1-Feb-18	NW LANTAU	3	13.79	WINTER	STANDARD36826	HKBCF	P
1-Feb-18	NW LANTAU	2	5.23	WINTER	STANDARD36826	HKBCF	S
1-Feb-18	NW LANTAU	3	5.31	WINTER	STANDARD36826	HKBCF	S
1-Feb-18	NE LANTAU	2	15.10	WINTER	STANDARD36826	HKBCF	P
1-Feb-18	NE LANTAU	2	9.70	WINTER	STANDARD36826	HKBCF	S
6-Feb-18	NW LANTAU	2	6.26	WINTER	STANDARD36826	HKBCF	P
6-Feb-18	NW LANTAU	3	14.95	WINTER	STANDARD36826	HKBCF	P
6-Feb-18	NW LANTAU	4	14.58	WINTER	STANDARD36826	HKBCF	P
6-Feb-18	NW LANTAU	2	3.61	WINTER	STANDARD36826	HKBCF	S
6-Feb-18	NW LANTAU	3	9.69	WINTER	STANDARD36826	HKBCF	S
6-Feb-18	NE LANTAU	1	0.70	WINTER	STANDARD36826	HKBCF	P
6-Feb-18	NE LANTAU	2	16.08	WINTER	STANDARD36826	HKBCF	P
6-Feb-18	NE LANTAU	1	2.00	WINTER	STANDARD36826	HKBCF	S
6-Feb-18	NE LANTAU	2	12.62	WINTER	STANDARD36826	HKBCF	S
13-Feb-18	NW LANTAU	1	0.41	WINTER	STANDARD36826	HKBCF	P
13-Feb-18	NW LANTAU	2	35.45	WINTER	STANDARD36826	HKBCF	P
13-Feb-18	NW LANTAU	2	10.87	WINTER	STANDARD36826	HKBCF	S
26-Feb-18	NW LANTAU	2	23.18	WINTER	STANDARD36826	HKBCF	P
26-Feb-18	NW LANTAU	3	2.20	WINTER	STANDARD36826	HKBCF	P
26-Feb-18	NW LANTAU	2	10.02	WINTER	STANDARD36826	HKBCF	S
26-Feb-18	NE LANTAU	2	27.58	WINTER	STANDARD36826	HKBCF	P
26-Feb-18	NE LANTAU	3	7.90	WINTER	STANDARD36826	HKBCF	P
26-Feb-18	NE LANTAU	2	9.42	WINTER	STANDARD36826	HKBCF	S
26-Feb-18	NE LANTAU	3	1.70	WINTER	STANDARD36826	HKBCF	S

Annex II. HKBCF Chinese White Dolphin Sighting Database (February 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
1-Feb-18	1	1014	1	NW LANTAU	3	48	ON	HKBCF	817428	805490	WINTER	NONE	P
1-Feb-18	2	1055	2	NW LANTAU	3	198	ON	HKBCF	826509	805385	WINTER	NONE	P
1-Feb-18	3	1244	7	NW LANTAU	2	285	ON	HKBCF	821568	812236	WINTER	NONE	S
1-Feb-18	4	1546	5	NE LANTAU	2	474	ON	HKBCF	819680	816324	WINTER	NONE	P
6-Feb-18	1	1113	3	NW LANTAU	4	785	ON	HKBCF	829655	804660	WINTER	NONE	P
6-Feb-18	2	1230	2	NW LANTAU	4	24	ON	HKBCF	824797	808482	WINTER	NONE	P
6-Feb-18	3	1310	3	NW LANTAU	2	36	ON	HKBCF	825038	810171	WINTER	NONE	S
13-Feb-18	1	1138	5	NW LANTAU	2	385	ON	HKBCF	822886	806284	WINTER	NONE	P
13-Feb-18	2	1220	7	NW LANTAU	2	467	ON	HKBCF	829595	806884	WINTER	NONE	P
13-Feb-18	3	1302	5	NW LANTAU	2	209	ON	HKBCF	828282	804688	WINTER	NONE	P
13-Feb-18	4	1342	2	NW LANTAU	2	398	ON	HKBCF	819567	804567	WINTER	NONE	P
13-Feb-18	5	1404	1	NW LANTAU	2	799	ON	HKBCF	815702	804693	WINTER	NONE	S
26-Feb-18	1	1015	1	NW LANTAU	2	92	ON	HKBCF	815667	805394	WINTER	NONE	P
26-Feb-18	2	1030	1	NW LANTAU	2	15	ON	HKBCF	818369	805378	WINTER	NONE	P

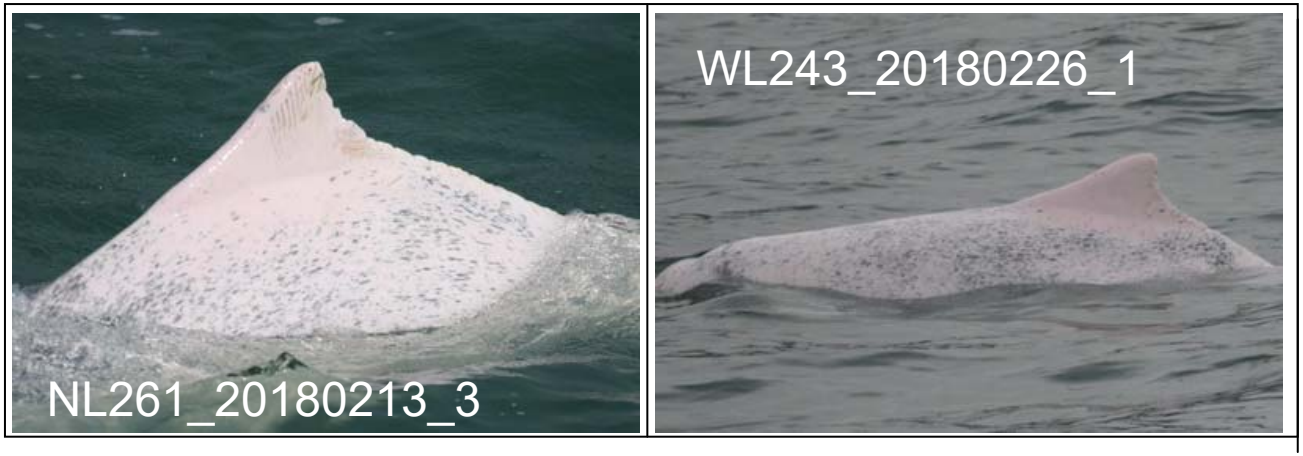
Annex III. Individual dolphins identified during HKBCF monitoring surveys in February 2018

ID#	DATE	STG#	AREA
CH34	13/02/18	2	NW LANTAU
	13/02/18	3	NW LANTAU
NL120	01/02/18	3	NW LANTAU
	01/02/18	4	NE LANTAU
NL123	01/02/18	3	NW LANTAU
	01/02/18	4	NE LANTAU
NL136	01/02/18	3	NW LANTAU
	01/02/18	4	NE LANTAU
	06/02/18	2	NW LANTAU
	06/02/18	3	NW LANTAU
	13/02/18	2	NW LANTAU
	13/02/18	3	NW LANTAU
NL182	06/02/18	2	NW LANTAU
	13/02/18	2	NW LANTAU
	13/02/18	3	NW LANTAU
NL226	01/02/18	3	NW LANTAU
	01/02/18	4	NE LANTAU
NL261	13/02/18	2	NW LANTAU
	13/02/18	3	NW LANTAU
NL272	13/02/18	2	NW LANTAU
NL37	01/02/18	3	NW LANTAU
	01/02/18	4	NE LANTAU
WL167	13/02/18	1	NW LANTAU
WL179	13/02/18	1	NW LANTAU
WL243	13/02/18	1	NW LANTAU
	26/02/18	1	NW LANTAU
WL281	01/02/18	2	NW LANTAU
WL283	01/02/18	2	NW LANTAU
WL291	13/02/18	1	NW LANTAU

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

Appendix IV (cont'd).

Appendix IV (cont'd).



Appendix IV (cont'd).