Appendix 31-1:
Offshore Bat Survey Technical Report

ORIEL WINDFARM
OFFSHORE RENEWABLE ENERGY

A TETRA TECH COMPANY

PARK WIND
JERA GROUP

Energy for generations

ORIEL WIND FARM PROJECT

Environmental Impact Assessment Report
Appendix 31-1: Offshore Bat Survey Technical Report

MDR1520B
EIAR – Appendix 31-1
A1 C01
March 2024

Contents

Figures

Tables

1 INTRODUCTION

The purpose of this report is to provide detail on the methodology used to collect offshore bat activity data (section 2); and presents the Clogherhead offshore wind farm survey results collected through the field surveys undertaken (section 3). The information contained within this report has been used to inform the assessment in chapter 31: Bats in the Marine Environment, of the EIAR.

The Applicant has obtained the survey data presented in this report from the ESB who is proposing to develop the Clogherhead offshore wind farm directly adjacent to the Oriel Wind Farm Project (hereafter referred to as 'the Project'). This data has been used to characterise the baseline for bats in the marine environment. This report sets out the methodology and findings of the survey completed during Summer 2022 in an area directly adjacent to the Project.

There are a total of nine bat species in two families confirmed as resident in Ireland with two vagrant/migratory species. Several of these species such as the common and soprano pipistrelles are widespread and common in Ireland; while others such as the lesser horseshoe bat are rare and restricted in distribution (Pickett *et al*., 2019). Many of these species are known to be migratory outside of Ireland particularly in continental Europe where more northerly breeding species migrate southwards during the autumn and return north in the spring (Bat Conservation Ireland (BCI), 2022).

While it is understood that some bat species undertake seasonal migrations within Ireland, due to a lack of scientific studies, the bat migration patterns within and to/from Ireland are not understood or significantly researched. BCI have records of Brandt's bat (*Myotis brandti*) and the greater horseshoe bat (*Rhinolophus ferrumequinum*) in Ireland, and neither are considered resident species. The Brandt's bat was recorded in Co. Wicklow in 2003 and the greater horseshoe bat in Co. Wexford in 2013. Both species are likely to be vagrants since there is no evidence of additional specimens or resident populations of either species in Ireland, and no evidence of regular migrations to Ireland by these species (BCI, 2022).

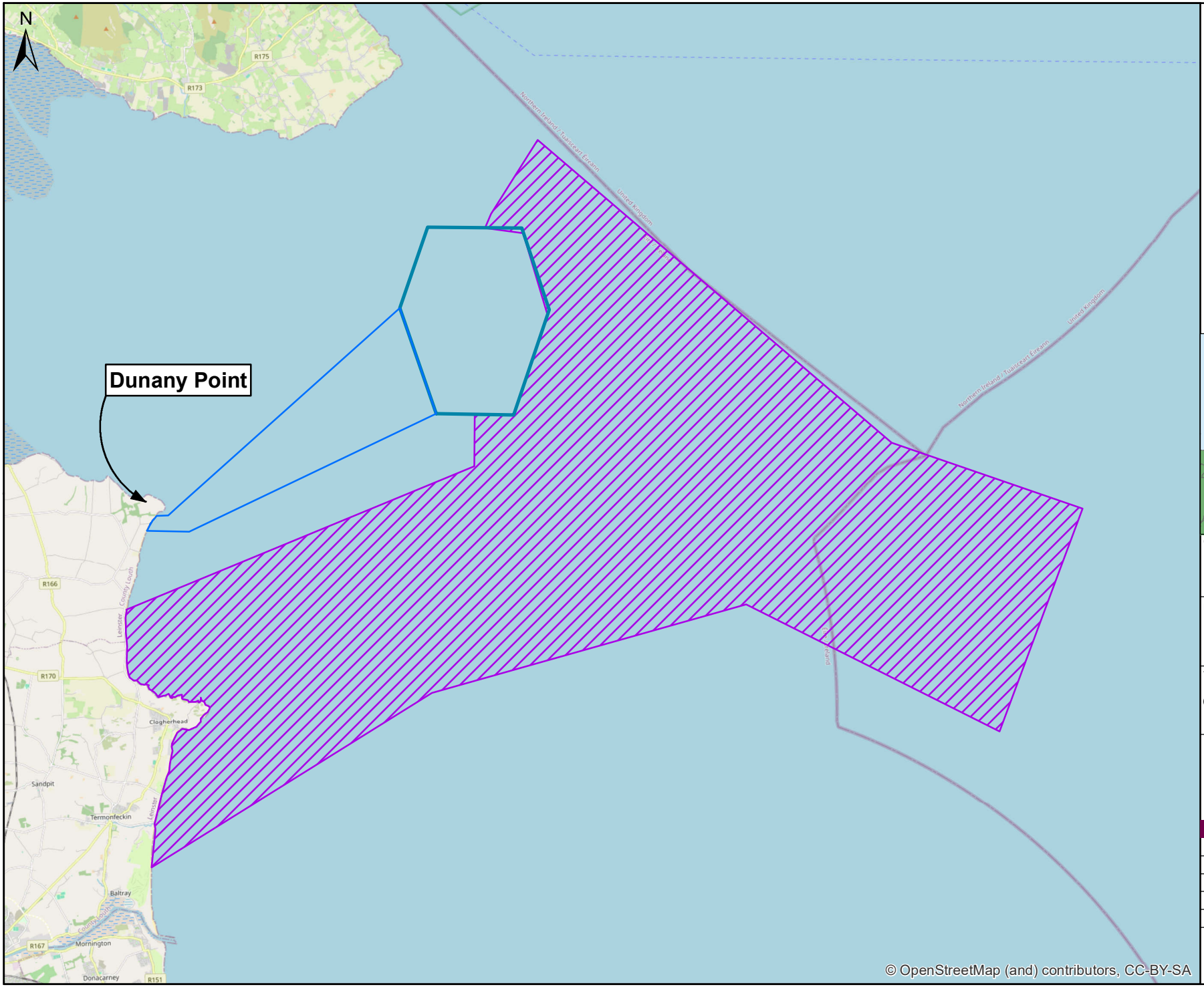
There is currently no published empirical evidence of offshore bat activity (e.g. migration, commuting, foraging) within Irish marine waters. This is solely due to an absence of survey data being gathered rather than empirical evidence that such activity does not occur. Within the wider European context, there is increasing evidence of offshore bat activity (Lagerveld *et al*., 2014, 2021). Certain species, such as Nathusius' pipistrelle (*Pipistrellus nathusii*) (NPWS, 2016) and Leisler's bat (*Nyctalus leisleri*) (McAney, 2006) are known to be migratory outside of Ireland; with migrations of 800 to 1,950 km between summer and hibernation sites being recorded, including long-distance migration by certain species (e.g. between continental Europe and the UK) (Russ *et al*., 2001, Russ, 2014, Ahlén *et al.*, 2007). Given increasing evidence elsewhere, there is a need for empirical evidence within the Irish context to inform impact assessments and, if necessary, mitigation with respect to projects.

1.1 Scope

There are no standard survey methods in Ireland or internationally for characterising offshore bat activity which can be implemented; however, existing United Nations Environment Programme (UNEP) guidelines recommend surveying offshore wind turbines in the same manner as land-based turbines (Rodrigues *et al*., 2015). With respect to the options for offshore survey, there is little published guidance in relation to survey methodologies or best practice guidance. Eurobats (Rodrigues *et al.,* 2014) provides some high-level guidance (section 3.2.4.2)[1]. Currently there are no formal guidelines or industry best practice standards for monitoring or collating baseline information regarding bat activity in the marine environment. The guidance does provide some useful information on timing of surveys for the terrestrial environment. In addition to this, we can also draw from the various North Sea and Scandinavian studies which have been completed (Lagerveld *et al*., 2014, 2021).

[1] Rodrigues, L., Bach, M.J., Dubourg-Savage, B., Karapandza, D., Kovac, T., Kervyn, J., Dekker, A., Kepal, P., Bach, J., Collins, C., Harbusch, K., Park, B., Micevski, J., Minderman (2015) Guidelines for consideration of bats in wind farm projects, UNEP-Eurobats, publication No 6. Revision 2014. UNEP/EUROBATS Secretariat: Bonn, Germany.

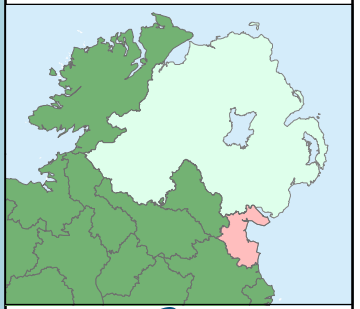
In light of the above, a bespoke survey methodology was developed for the Clogherhead project (located adjacent to the Oriel Wind Farm Project); capitalising on the availability of a marine vessel (RV Baltic Explorer) completing the geophysical surveys within the 12 nm limit. The aim of the survey was to identify any offshore bat activity in the project area (Figure 1-1), which is located up to 30 km offshore within the Irish Sea. Given the timing and duration of the geophysical survey, it was not the aim of the bat survey to try to capture data which would indicate seasonal bat migration. Rather the main aim of the bat survey was to collect opportunistic data on bat activity in the offshore environment in the vicinity of the Clogherhead project area, in order to help build up the evidence base of bat activity in offshore waters on the east coast of Ireland.



Legend

- Offshore Wind Farm Area
- Offshore Cable Corridor
- Clogherhead Survey Area

Data Sources: OWL, OSi



Client

ORIEL WINDFARM
OFFSHORE RENEWABLE ENERGY

Project

Oriel Wind Farm Project

Title

Figure 1-1:
Oriel Wind Farm Project in relation to the Clogherhead survey area

RPS
A TETRA TECH COMPANY

West Pier Business Campus,
Dun Laoghaire,
Co Dublin,
Ireland.

Tel: +353 (0) 1 4882900
Email: ireland@rpsgroup.com
Web Page: rpsgroup.com/ireland

Issue Details

Drawn By: NR	**Project No.** MDR1520b
Checked By: HF	**File Ref:** MDR1520bArc3099F02
Approved By: CC	
Scale: 1:180,000 @ A4	**Projection:** ITM (IRENET95) Geographic Co-ordinates: ETRS89
Date: 14/03/2024	

2 METHODOLOGY

2.1 Deployment method

The equipment was prepared, checked, and deployed aboard the RV Baltic Explorer (IMO: 8917663, MMSI 277199040) which was conducting geophysical surveys for the project, on 25 May 2022 to monitor for the bat activity within the project area. ESB supplied four bat detectors which were subject to appropriate servicing and calibration prior to deployment, as well as being subject to further checks from an experienced RPS ecologist. The bat detectors were Song Meter SM4BAT FS Bat Detectors; each held within an IP67 armoured case with an SMM-U2 Ultrasonic Microphone exiting the armoured case through a sealed aperture. Two of the detectors were also fitted with a GPS receiver/antenna for SM4 Bat Detectors. Given that all detectors were to be deployed on a single vessel, two GPS receiver/antenna were considered sufficient and allowed for some redundancy in the event of one failing during the survey campaign. The setup before deployment can be seen in Figure 2-1. The equipment was prepared by an experienced ecologist, with all detectors set to record 30 minutes pre-sunset until 30 minutes post-sunrise each day, to capture the periods in which bats are known to be most active (McAney, 2006).

The onboard Client Representative/Marine Mammal Observer (MMO) teams were briefed on the following for the maintenance and data collection for the bat detectors:

- The equipment placement, its operation, and the maintenance requirements (including sensitivities relating to batteries and memory checks);
- Back-up of data and logging requirements;
- Basic troubleshooting;
- Points of contact within the RPS team in the event of any issues being identified; and
- The deployment of the equipment.

Figure 2-1: Equipment as deployed: Song Meter SM4BAT FS Bat Detector, held within an IP67 armoured case and an SMM-U2 Ultrasonic Microphone.

The installation of the four detectors was completed by an RPS ecologist during daylight hours, while the vessel was in port prior to the mobilisation to the survey area. Two of the detectors with the GPS attached and their associated armoured cases were secured on the observer level of the survey vessel Baltic Explorer (Figure 2-2) using ratchet straps and cable ties. The remaining two were secured on the aft section of the deck in a built-in storage compartment for the duration of the survey with easy access. The four microphones were secured on the railings on the observer deck of the vessel (approximately 10 m above sea level), pointing out forward (towards the bow) and aft (toward the stern) of the vessel on both the starboard (right) and port (left) sides. The cable lead of the microphone was cable-tied to secure it (Figure 2-3 to Figure 2-7). The placement of the bat detector boxes is detailed in Table 2-1, with the final placement shown in Figure 2-8.

Post the initial deployment, MIC-BT02 was moved from its original placement on the forward port side, due to vibration interference being recorded by the microphone. Following consultation with the RPS remote support team, final placement for this was decided onboard.

Figure 2-2: Baltic Explorer vessel and schematic of the observation deck.

Figure 2-3: Photograph illustrating the placement of the bat detectors and microphones on the vessel ***See Table 2-1 for the placement of detectors BT08 and BT02.***

Figure 2-4: MIC: BT02 initial placement port side forward.

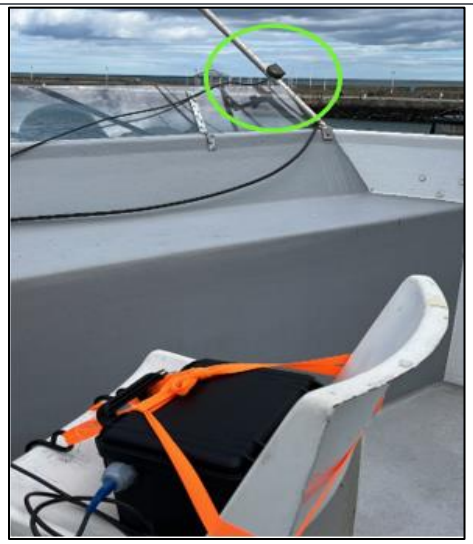


Figure 2-5: MIC: BT05 GPS starboard forward.

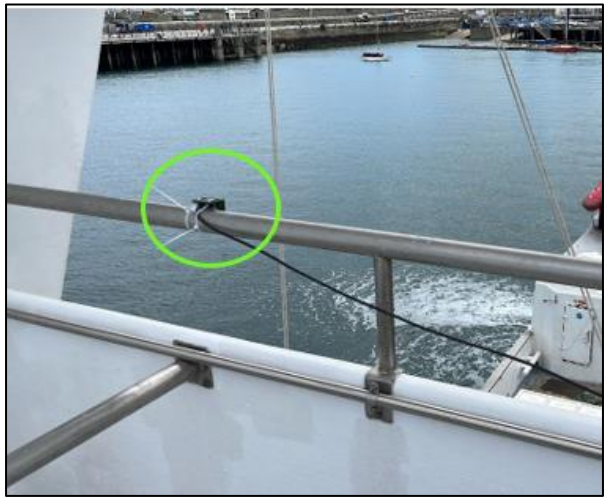


Figure 2-6: MIC: BT08 starboard aft.

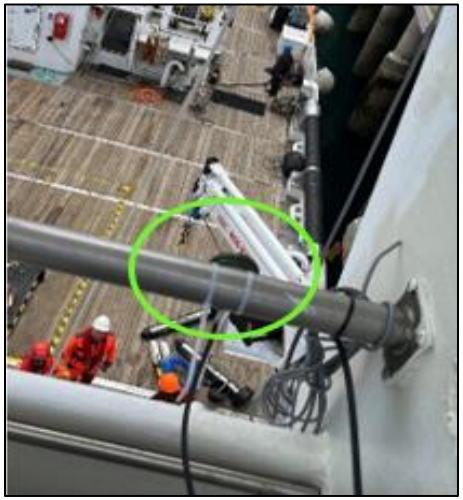


Figure 2-7: MIC: BT05 GPS port side aft.

Figure 2-8: MIC: BT02 port side final placement- attached to unit BT07_GPS.

Table 2-1: Placement of the bat detectors for the duration of the monitoring period (May to August 2022).

Prefix of the recorded sound files	Has GPS attached	Serial number	Location on vessel	Location Image
BT8	NO	S4U08411	Detector secured within smaller box, within deck box. Microphone facing: Aft (toward stern of vessel) on starboard side	 
BT2	NO	S4U08469	Detector secured within smaller box, within deck box. Microphone positioned facing forward (toward bow of vessel) on port side- later moved from its position at the request of RPS. Final position attached to the observer chair	
BT7GPS	YES	S4U08264	In larger box, strapped to deck chair with ratchet straps. Microphone facing: Aft (toward stern of vessel) on port side	

Prefix of the recorded sound files	Has GPS attached	Serial number	Location on vessel	Location Image
BT5GPS	YES	S4U08737	In larger box, strapped to deck chair with ratchet straps. Microphone facing forward (toward bow of vessel) on starboard side	

2.2 Data analysis

After each daily check, where internet connection permitted, the data from the SD cards were transferred from the vessel to RPS via email, where it was downloaded and manually checked for quality and consistency. The data was also backed up daily to an external hard drive onboard the vessel. At the end of the survey, the full recorded data package (which was saved to the external hard drive) was collected by an RPS ecologist and the data was processed for analysis while the vessel was onsite. This was then analysed using Kaleidoscope (Wildlife Acoustics, Inc.) sound analysis software in smaller batches. Following the batch analysis of all audio recordings, 10% of all noise files were manually checked for bat activity. All bat calls, calls with no auto-identification or with multiple bats within the same call, were checked manually to confirm identification. During manual analysis, calls were assigned to species according to their key parameters. Determinations of species identification and activity were made by suitably qualified and experienced RPS ecologists.

2.3 Limitations

2.3.1 Survey timing

The survey was completed opportunistically between 26 May 2022 and 10 August 2022. In the event that seasonal migration does occur between Ireland and UK/Europe, the survey was completed outside of the typical window (Spring or Autumn) where such migration may be evident. It should be noted, however, that bats are generally active in Ireland between April to October (Marnell *et al*., 2022) and therefore the survey was undertaken during the season when bats are most active.

2.3.2 Survey methods

In relation to survey methods, there were a small number of limitations or considerations in relation to the interpretation of the data:

- The absence of any existing offshore structures (fixed or floating) to which functional bat detectors could be fixed, the use of vessels was the alternative approach for deployment available to the project.
- There are no standard survey methods or guidelines in Ireland or internationally for characterising offshore bat activity which can be implemented; however, existing UNEP guidelines recommend surveying offshore wind farm areas in the same manner as land-based turbines[2]. Alongside the limited published guidelines, surveying for bats offshore can be challenging due to the potentially harsh environment and the impact this potentially has on the equipment. It can be expected that there is likely to be some level of equipment failure which can, in part, be mitigated through building in some level of equipment contingency into the survey design and/or regular maintenance/data collection visits to ensure that the equipment is working effectively. Measures such as: multiple detectors, equipment back-ups, and a protocol for daily maintenance checks have been “built in” to the current survey methodology as far as possible to limit these risks.
- The microphones used have a typical detection range of between 15 m to 30 m. This could be a limitation if some species fly higher than can be detected by the microphones as positioned.
- The survey was passive in relation to the routing of the vessel and, therefore, only areas traversed by the vessel were surveyed. The survey covered a significant area of the project area, however there were sections of the project area not traversed by the vessel during the survey.
- Due to the lack of available studies and data sets of a similar nature to this survey type, it is currently unknown if the presence of the vessel (increased light and noise) itself causes avoidance behaviour in bats. This has the potential to be a limiting factor if bats avoid the monitoring area, resulting in their

[2] Rodrigues, L., Bach, M.J., Dubourg-Savage, B., Karapandza, D., Kovac, T., Kervyn, J., Dekker, A., Kepal, P., Bach, J., Collins, C., Harbusch, K., Park, B., Micevski, J., Minderman (2015) Guidelines for consideration of bats in wind farm projects, UNEP-Eurobats, publication No 6. Revision 2014. UNEP/EUROBATS Secretariat: Bonn, Germany.

presence not being detected by the equipment (anecdotal observations from other offshore bat activity surveys, using similar survey equipment on similar survey vessels, have suggested that vessels do not prevent recording of bat registrations).

3 RESULTS

3.1 Data capture

The dates of operation for all four of the detectors was from 26 May 2022 to 10 August 2022 covering the project area (see Figure 3-1 to Figure 3-4). Where it was safe for the onboard Client Representative/MMO teams to do so, there were daily checks of the equipment and download of the previous night's recordings. The onboard Client Representative /MMOs followed the guidelines and protocols prepared by RPS for maintaining and deploying the equipment, with remote assistance provided by RPS for troubleshooting as required. Due to the file sizes, it was not possible to transfer the full datasets via the vessel internet. Where data transfers via internet were possible, intermittent spot checks for quality control on the audio files was carried out on a subset of the files. A physical hard-drive data transfer of the full data set was completed at the end of the survey.

There are challenges associated with the use of survey equipment in the marine environment and the frequency of change-over of operational staff (Client Representative and MMO teams). The rapid changes in weather or harsh conditions which occur offshore led to certain days where it was not safe to access the observation deck. There was loss of data from all the detectors due to periodic equipment malfunction, although detector activity was generally high (Table 3-1). During the survey period the vessel was within the project area for a total of 53 nights. During this timeframe, there was intermittent equipment malfunction for the various detectors at different phases, although this was primarily due to battery depletion, or the detectors being inadvertently turned off. It can also be noted that with the exception of four nights (28 May and 30 May to 2 June) there was always a minimum of two working detectors on the various nights. No water egress into the waterproof boxes was noted during the survey period.

Table 3-1: Nights the detectors were recording for and within the project area.

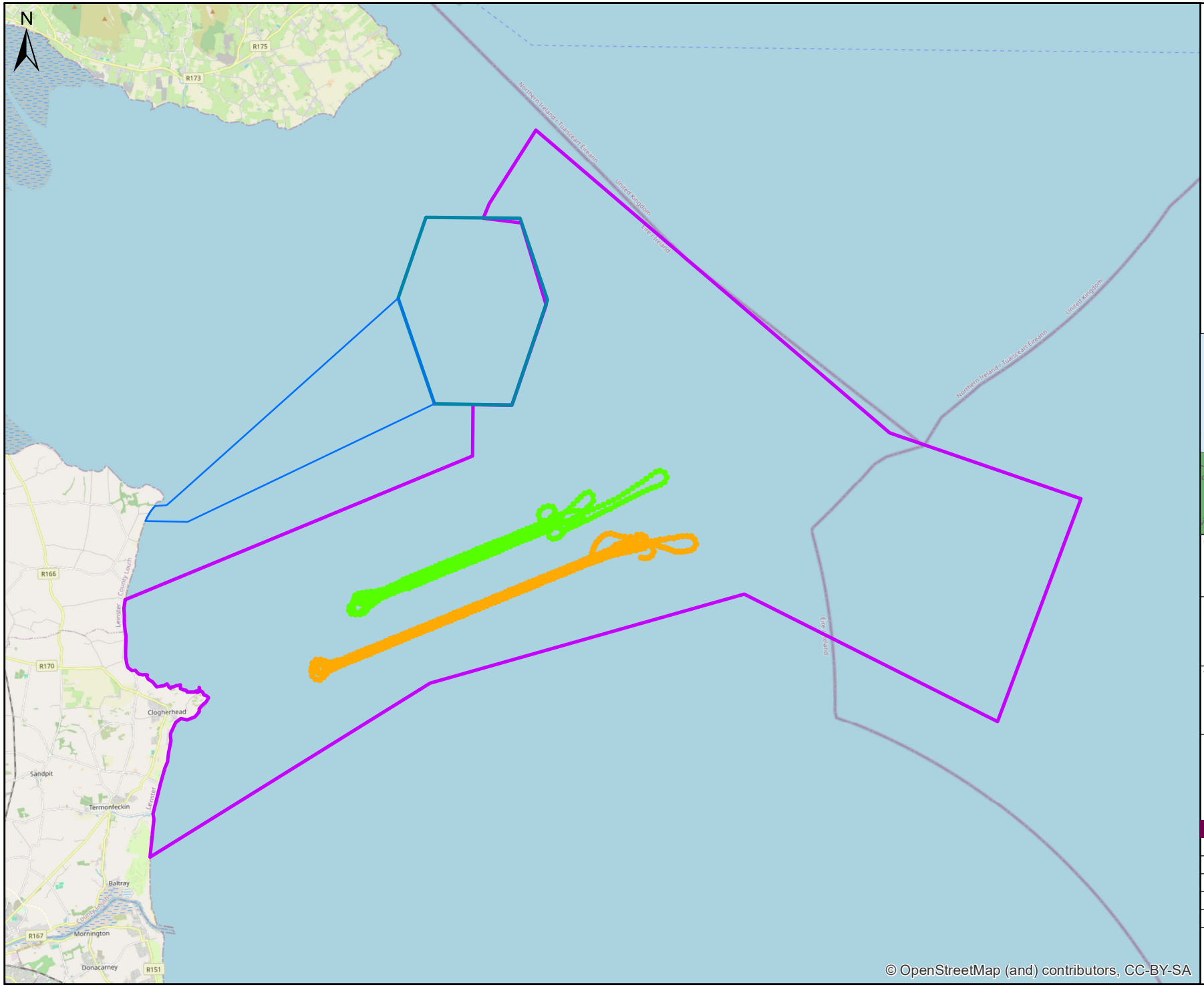
Detector	Month	Total Survey Nights for Deployment of Detectors	No. Nights in project area and Detector Functioning	No. Nights not in project area and Detector Functioning (at port)	% Nights Detector Functioning for Total Deployment	% Nights Detector Functioning and in project area
BT02	*May*	6	1	3	67%	16.67%
	June	30	18	10	93%	60.00%
	July	31	24	6	97%	77.42%
	August	7	5	2	100%	71.43%
	Total	**74**	**48**	**21**	**93%**	**64.86%**
BT05_GPS	*May*	6	1	1	33%	16.67%
	June	30	16	10	87%	53.33%
	July	31	11	6	55%	35.48%
	August	7	5	2	100%	71.43%
	Total	**74**	**33**	**19**	**70%**	**44.59%**
BT07_GPS	*May*	6	1	1	33%	16.67%
	June	30	14	10	80%	46.67%
	July	31	22	6	90%	70.97%
	August	7	5	2	100%	71.43%
	Total	**74**	**42**	**19**	**82%**	**56.76%**
BT08	May	6	2	3	83%	33.33%
	June	30	16	10	87%	53.33%
	July	31	20	6	84%	64.52%
	August	7	5	2	100%	71.43%
	Total	**74**	**43**	**21**	**86%**	**58.11%**

While the Client Representative was originally designated as the person of contact on the vessel for the survey, a combination of factors meant that the responsibility for the detectors' maintenance was delegated to the onboard MMO team. Due to days where it was not safe to go to the observation deck due to the vessel's movement in rough weather, maintenance checks could not be carried out (e.g. battery checks or troubleshooting exercises). The frequent change of the MMO teams also meant that there were multiple training sessions/meetings required during the deployment of the detectors on the following dates: 16/06/2022, 17/06/2022, 27/06/2022, 03/07/2022, 15/07/2022, 24/07/2022, and 08/08/2022.

The changeover of crew during the survey (for both Client Representative and MMO teams) meant that for one of the five changeovers, in person training could not feasibly be completed (due to short window of opportunity). In this incidence, training was given remotely via video call. As planned for, support for the entirety of the survey was given remotely.

It was required that sample files be sent through to RPS ecologists for periodic review both for data quality checks and to ensure that the detectors were working as was expected. Once the survey was safely underway it became apparent that the vessel bandwidth was not sufficient to send the full set of audio files for each detector per day as initially planned. To ensure that the detectors were correctly working a subset of small files for each were sent called "Dump Files". What these files allowed RPS ecologists to do was to check: battery levels, the number of audio files recorded and the recording parameters and to undertake troubleshooting as the initial survey stages progressed. During port calls and for smaller data days where the vessel was close to shore (mobile data could be utilised) small subsets of files were sent for intermittent Quality Control checks.

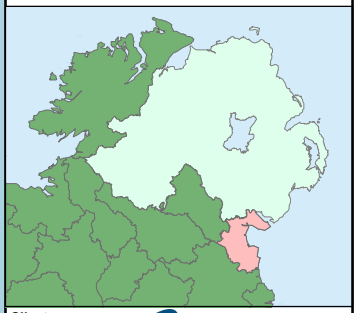
The busy nature of the survey and reliance on third party contractors (for which there were a number of turnovers) for the maintenance and checks of the detectors meant that these issues took time to be noticed and then rectified through remote support. The dates (28 May 2022 and 02 June 2022) where none of the detectors were working, was a date when the decision was taken onboard the vessel to turn the detectors off whilst in port, with the view to save battery power. This issue was picked up on during the check-in process. the correct procedure was highlighted (detectors to remain on for the duration of the survey period, with batteries to be changed, when necessary, as sufficient backups had been provided) for the remainder of the survey period.



Legend

- Offshore Wind Farm Area
- Offshore Cable Corridor
- Clogherhead Survey Area
- 28_05_2022
- 30_05_2022

Data Sources: OWL, Bat Detector GPS tracks



Client

ORIEL WINDFARM
OFFSHORE RENEWABLE ENERGY

Project

Oriel Wind Farm Project

Title

Figure 3-1:
Bat Detector Tracks for May

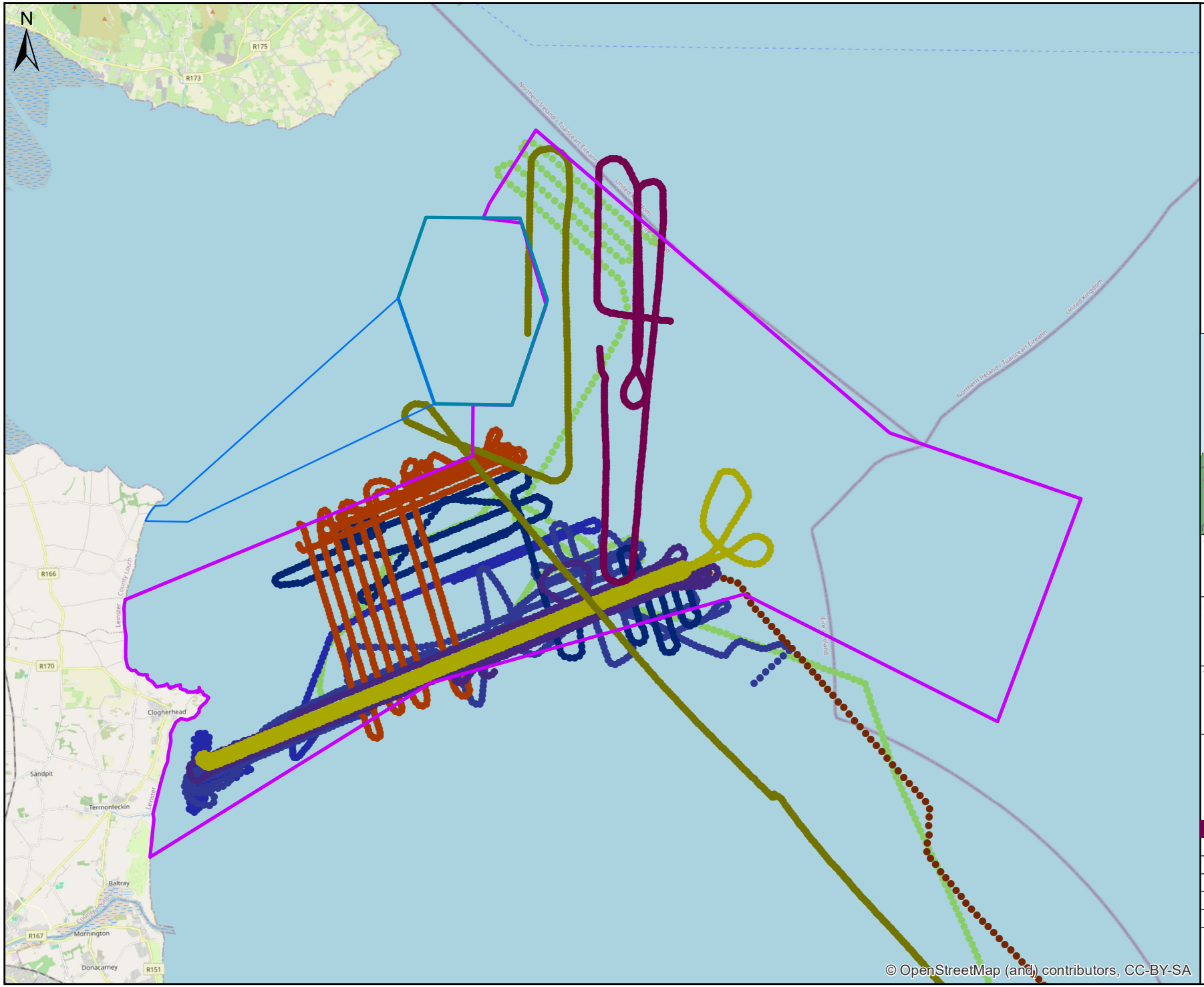
RPS
A TETRA TECH COMPANY

West Pier Business Campus,
Dun Laoghaire,
Co Dublin,
Ireland.

Tel: +353 (0) 1 4882900
Email: ireland@rpsgroup.com
Web Page: rpsgroup.com/ireland

Issue Details

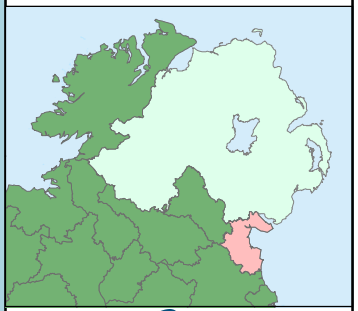
Drawn By: NR	**Project No.** MDR1520b
Checked By: HF	**File Ref:** MDR1520bArc3122F02
Approved By: CC	
Scale: 1:180,000 @ A4	**Projection:** ITM (IRENET95) Geographic Co-ordinates: ETRS89
Date: 14/03/2024	



Legend

- Offshore Wind Farm Area
- Offshore Cable Corridor
- Clogherhead Survey Area
- 22_06_2022
- 25_06_2022
- 01_02_06_2022
- 02_03_06_2022
- 04_06_2022
- 07_08_09_06_2022
- 10_06_2022
- 11_12_13_06_2022
- 14_06_2022
- 15_06_2022

Data Sources: OWL, Bat Detector GPS tracks



Client

ORIEL WINDFARM
OFFSHORE RENEWABLE ENERGY

Project

Oriel Wind Farm Project

Title

Figure 3-2:
Bat Detector Tracks for June

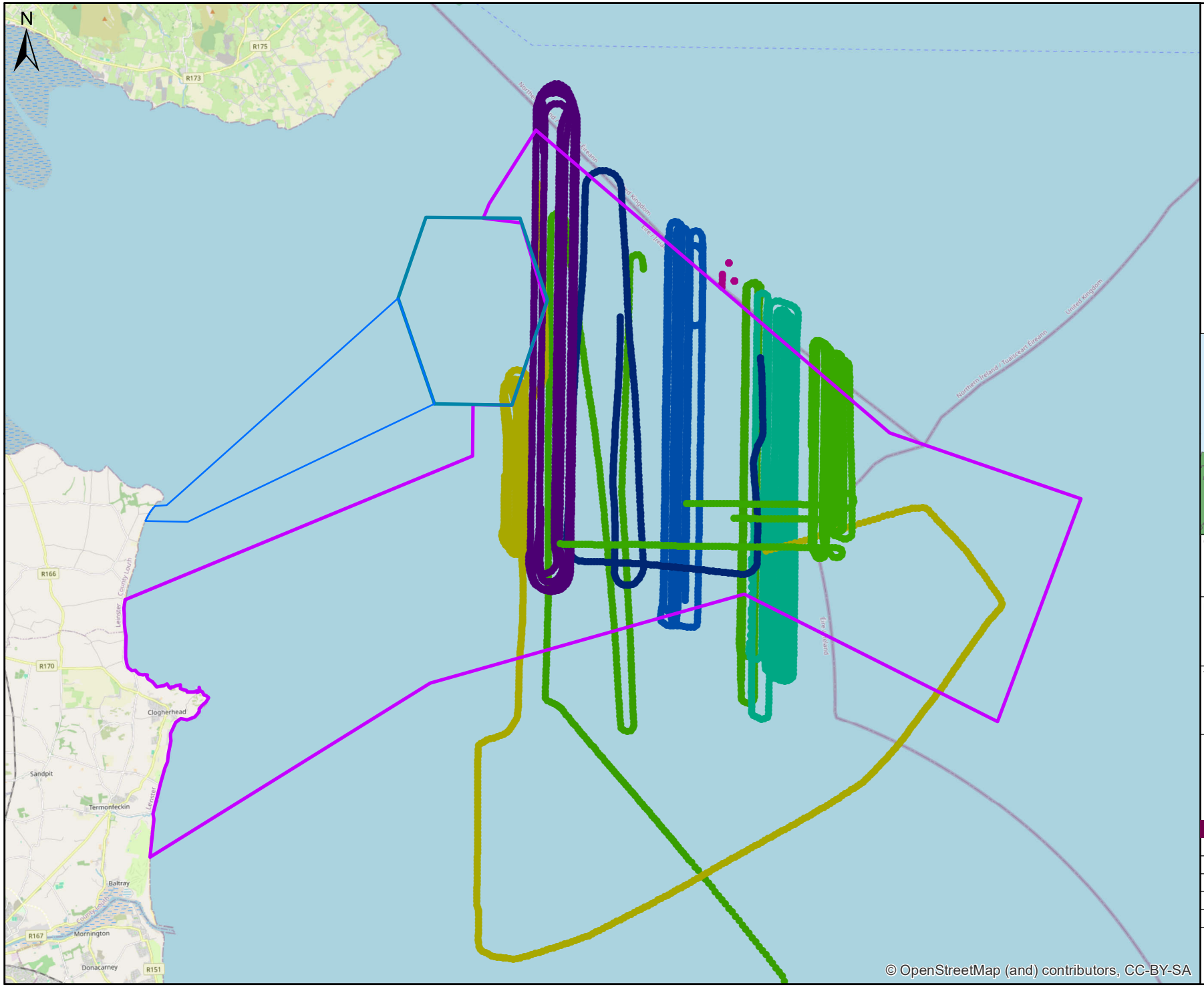
RPS
A TETRA TECH COMPANY

West Pier Business Campus,
Dun Laoghaire,
Co Dublin,
Ireland.

Tel: +353 (0) 1 4882900
Email: ireland@rpsgroup.com
Web Page: rpsgroup.com/ireland

Issue Details

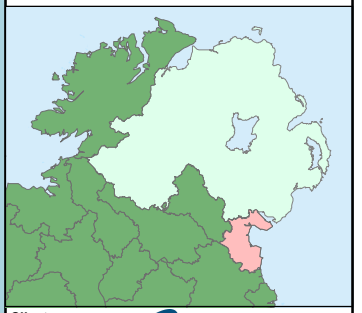
Drawn By: NR	**Project No.** MDR1520b
Checked By: HF	**File Ref:** MDR1520bArc3123F02
Approved By: CC	
Scale: 1:180,000 @ A4	**Projection:** ITM (IRENET95) Geographic Co-ordinates: ETRS89
Date: 14/03/2024	



Legend

- Offshore Wind Farm Area
- Offshore Cable Corridor
- Clogherhead Survey Area
- 27_29_07_22
- 01_07_2022
- 04_07_2022
- 05_07_07_2022
- 08_10_07_2022
- 11_12_07_2022
- 12_16_07_2022
- 16_19_07_2022

Data Sources: OWL, Bat Detector GPS tracks



Client

ORIEL WINDFARM
OFFSHORE RENEWABLE ENERGY

Project

Oriel Wind Farm Project

Title

Figure 3-3:
Bat Detector Tracks for July

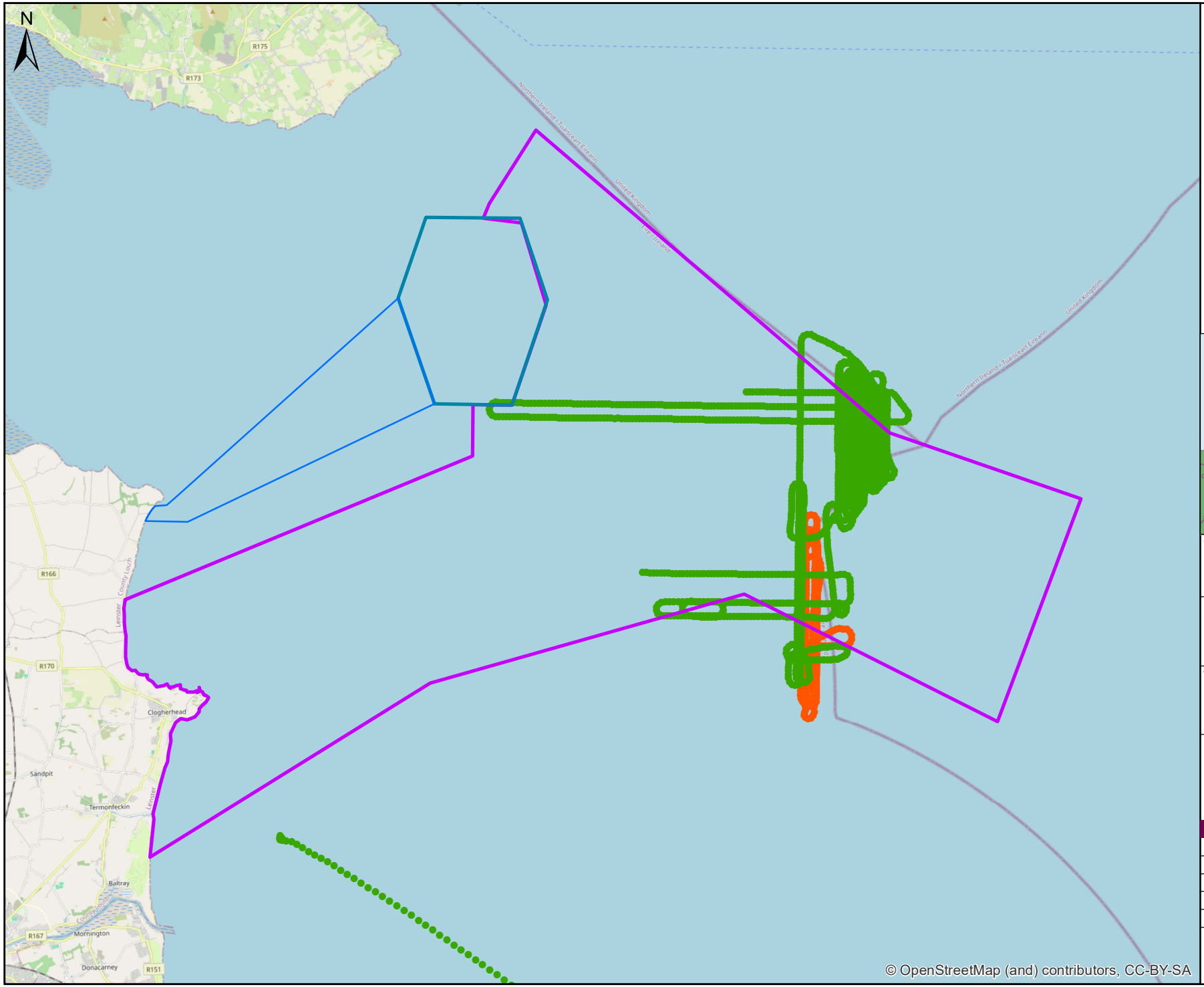
RPS
A TETRA TECH COMPANY

West Pier Business Campus,
Dun Laoghaire,
Co Dublin,
Ireland.

Tel: +353 (0) 1 4882900
Email: ireland@rpsgroup.com
Web Page: rpsgroup.com/ireland

Issue Details

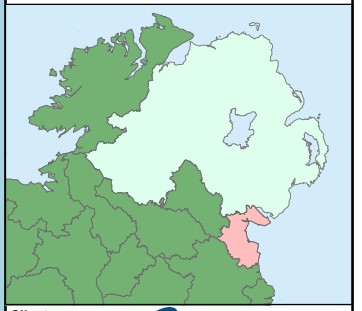
Drawn By: NR	**Project No.** MDR1520b
Checked By: HF	**File Ref:** MDR1520bArc3124F02
Approved By: CC	
Scale: 1:180,000 @ A4	**Projection:** ITM (IRENET95) Geographic Co-ordinates: ETRS89
Date: 14/03/2024	



Legend

- Offshore Wind Farm Area
- Offshore Cable Corridor
- Clogherhead Survey Area
- 02_07_08_2022
- 01_08_2022

Data Sources: OWL, Bat Detector GPS tracks



Client

ORIEL WINDFARM
OFFSHORE RENEWABLE ENERGY

Project

Oriel Wind Farm Project

Title

Figure 3-4:
Bat Detector Tracks for August

RPS
A TETRA TECH COMPANY

West Pier Business Campus,
Dun Laoghaire,
Co Dublin,
Ireland.

Tel: +353 (0) 1 4882900
Email: ireland@rpsgroup.com
Web Page: rpsgroup.com/ireland

Issue Details

Drawn By: NR	**Project No.** MDR1520b
Checked By: HF	**File Ref:** MDR1520bArc3125F02
Approved By: CC	
Scale: 1:180,000 @ A4	**Projection:** ITM (IRENET95) Geographic Co-ordinates: ETRS89
Date: 14/03/2024	

3.2 Bat recordings

No bats were recorded in the offshore survey area (Figure 1-1) for the duration of the detectors' deployment.

Bat activity was recorded only when the vessel was alongside or anchored outside Dun Laoghaire harbour during the survey period, namely Leisler's bats (*Nyctalus leisleri)* which were recorded on all four detectors over the following dates:

- June: 10th and 28th;
- July: 1st, 15th, 23rd, 24th, 29th and 30th; and
- August: 1st, 2nd and 3rd.

The majority of calls noted general echolocation and commuting with foraging and social calls more infrequent. There were no foraging buzzes of note during the survey period. This indicates that the detectors were capable of recording bats in the positions in which they were mounted.

4 CONCLUSION

No evidence of offshore bats was recorded during the survey. Currently there is no publicly available data for the presence of bats offshore in Ireland, however, migratory species have been recorded in Ireland (McAney, 2016). For the activity that was recorded, it was 100% within the vicinity of the port of Dun Laoghaire, Co. Dublin. Being mindful of the limitations of the survey (summer period only- which is outside the migratory period (April and September to October) for bats), this does not indicate that there is no such bat activity offshore, but rather that such activity in the vicinity of the vessel at the time of survey, which coincides with the period when bats are most active (breeding season- late May to early August – Marnell *et al*., 2022), bat activity appears to be low.

It is proposed that if further surveys are carried out that they should ideally encompass the normal migratory seasons in Spring and Autumn. Comparable methodology could be utilised (deployment on a vessel) for dedicated transect surveys, or an alternative would be for the temporary installation of static platforms for the deployment of detectors within the project area, where feasible.

References

Ahlén, I., Bach, L. Baagøe, H.J., and Pettersson, J. (2007) Bats and offshore wind turbines studies in southern Scandinavia – Report 5571. Swedish Environmental Protection Agency.

BCI (2022). [online] Available at: https://www.batconservationireland.org/.

Lagerveld, Sander & Poerink, Bob & Haselager, Raymond & Verdaat, Hans. (2014). Bats in Dutch offshore wind farms in autumn 2012. Lutra. 57. 61-69.

Lagerveld, Sander, Bob Jonge Poerink, and Steve C. V. Geelhoed. (2021). "Offshore Occurrence of a Migratory Bat, *Pipistrellus nathusii*, Depends on Seasonality and Weather Conditions" *Animals* 11, no. 12: 3442. https://doi.org/10.3390/ani11123442

Marnell, F., Kelleher, C. & Mullen, E. (2022) Bat mitigation guidelines for Ireland v2. Irish Wildlife Manuals, No. 134. National Parks and Wildlife Service, Department of Housing, Local Government and Heritage, Ireland

McAney, K. (2006) A conservation plan for Irish vesper bats. Irish Wildlife Manuals, No. 20. National Parks and Wildlife Service, Department of Environment, Heritage and Local Government, Dublin, Ireland

NPWS,, Boston E., Jones J., Whelan C., Montgomery I., Teeling E. (2016), Updating the distribution and status of the Nathusius pipistrelle (Pipistrellus nathusii) in Ireland: Final Report 2016

Pickett, S., Aughney, T., Roche, N., & Langton, S. (2019) BATLAS 2020 – A Bat Distribution Survey: Final Report 2016-2018. www.batconservationireland.org.

Rodrigues, L., Bach, M.J., Dubourg-Savage, B., Karapandza, D., Kovac, T., Kervyn, J., Dekker, A., Kepal, P., Bach, J., Collins, C., Harbusch, K., Park, B., Micevski, J., Minderman (2015) Guidelines for consideration of bats in wind farm projects, UNEP-Eurobats, publication No 6. Revision 2014. UNEP/EUROBATS Secretariat: Bonn, Germany.

Russ, J.M, A.m Hutson, W.i. Montgomery, P.A. Racey and J.R. Speakman (2001) The status of Nathusius' pipistrelle (*Pipistrellus nathusii* Keyserling & Blasius, 1839) in the British Isles, J. Zool., Lond. 254, 91-100.

Russ, J.M. (2014) Nathusius' pipistrelle in Great Britain and Ireland. Available at: http://www.nathusius.org.uk. Accessed September 2023.