NORTH FALLS

Offshore Wind Farm

ENVIRONMENTAL STATEMENT

Appendix 15.1 Navigational Risk Assessment (Part 2 of 3)

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Offshore Wind Farm

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10.2 Offshore Cable Corridor

287. This section provides an overview of vessel traffic movements within the cable corridor study area, as defined in section 3.4. It is noted that the data periods covered in this section are the same as in section 10.1, however this section provides analysis of AIS data only. The survey AIS data assessed in this section has been augmented by data recorded by coastal receivers.

288. A plot of the vessel tracks recorded during the 28-day winter survey period within the study area, colour-coded by vessel type and excluding temporary traffic, is presented in Figure 10-26. Following this, Figure 10-27 presents the same data converted to a density heat map within a 0.25nm x 0.25nm grid.

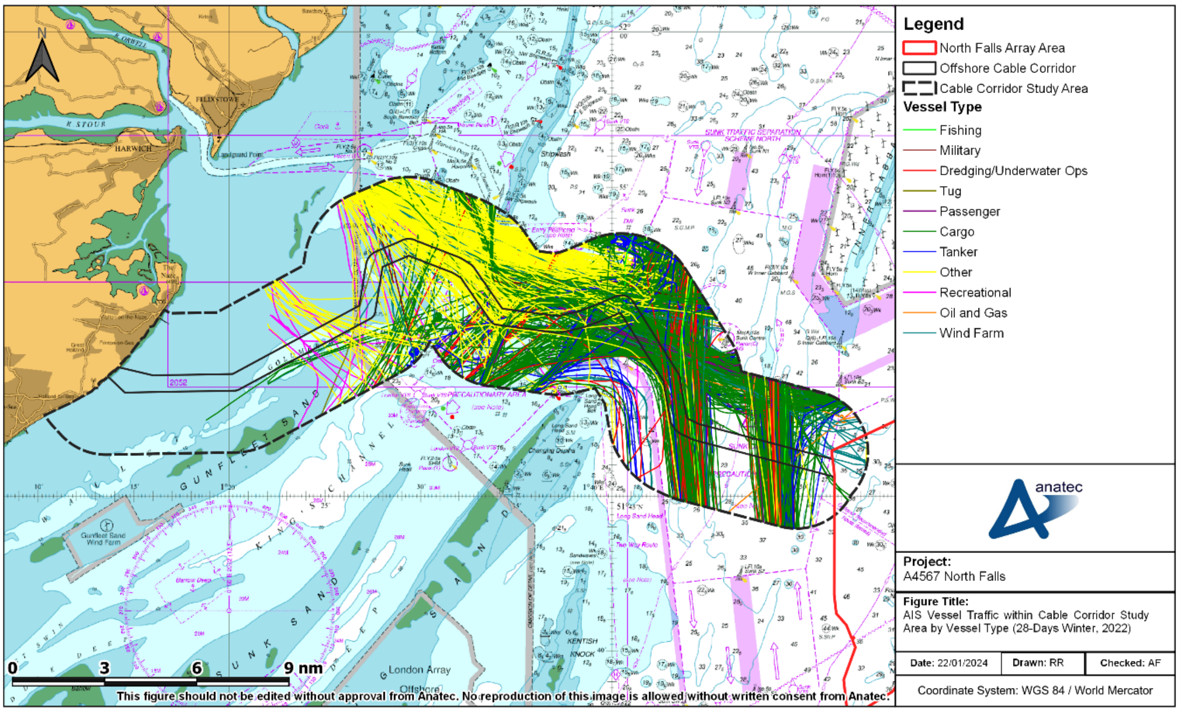

Figure 10-26 AIS Vessel Traffic within the Cable Corridor Study Area by Vessel Type (28-Days Winter, 2022)

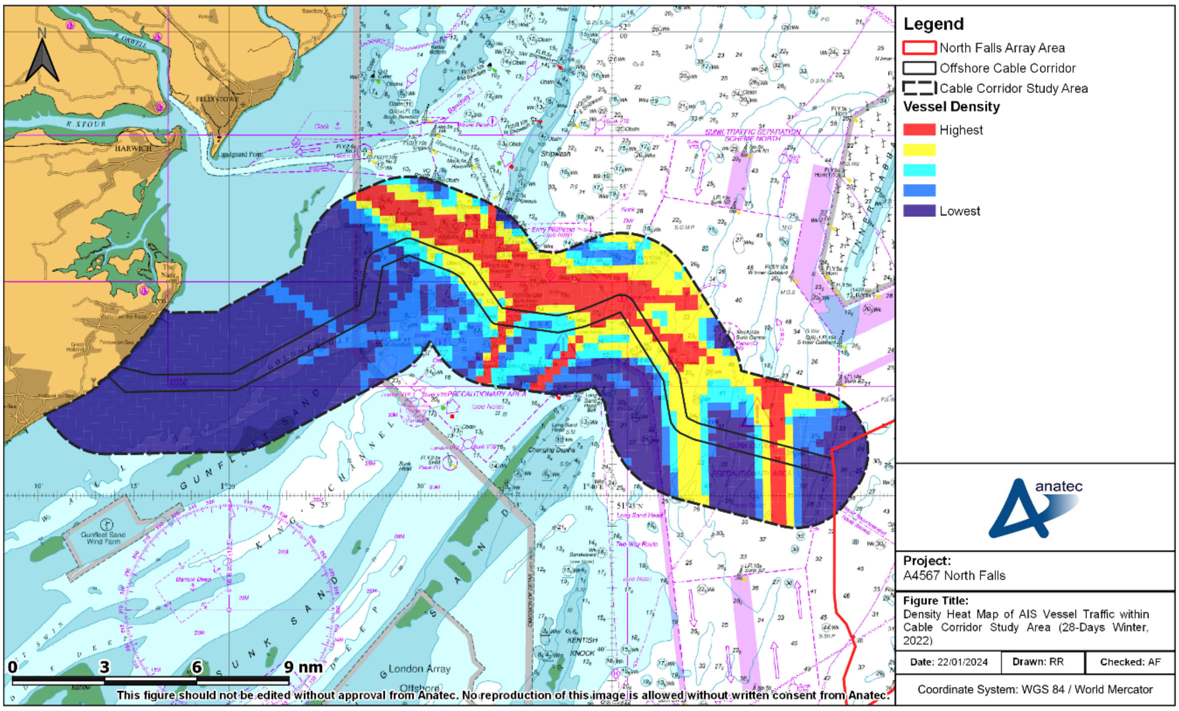

Figure 10-27 Density Heat Map of AIS Vessel Traffic within the Cable Corridor Study Area (28-Days Winter, 2022)

289. A plot of the vessel tracks recorded during the 14-day summer survey period within the cable corridor study area, colour-coded by vessel type and excluding temporary traffic, is presented in Figure 10-28. Following this, Figure 10-29 presents the same data converted to a density heat map within a 0.25nm x 0.25nm grid. It is noted that the same density bins were used as per the winter survey period to allow for direct comparison, and these differ from density figures illustrated for the array area in Section 10.1.

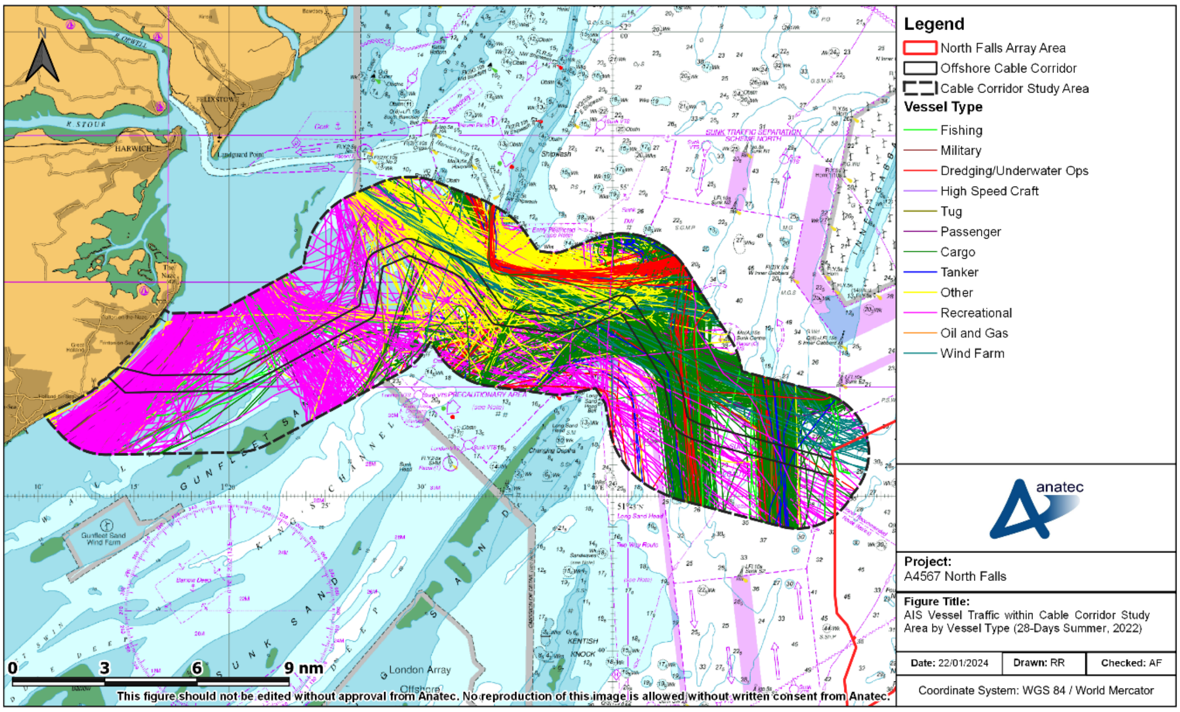

Figure 10-28 AIS Vessel Traffic within the Cable Corridor Study Area by Vessel Type (28-Days Summer, 2022)

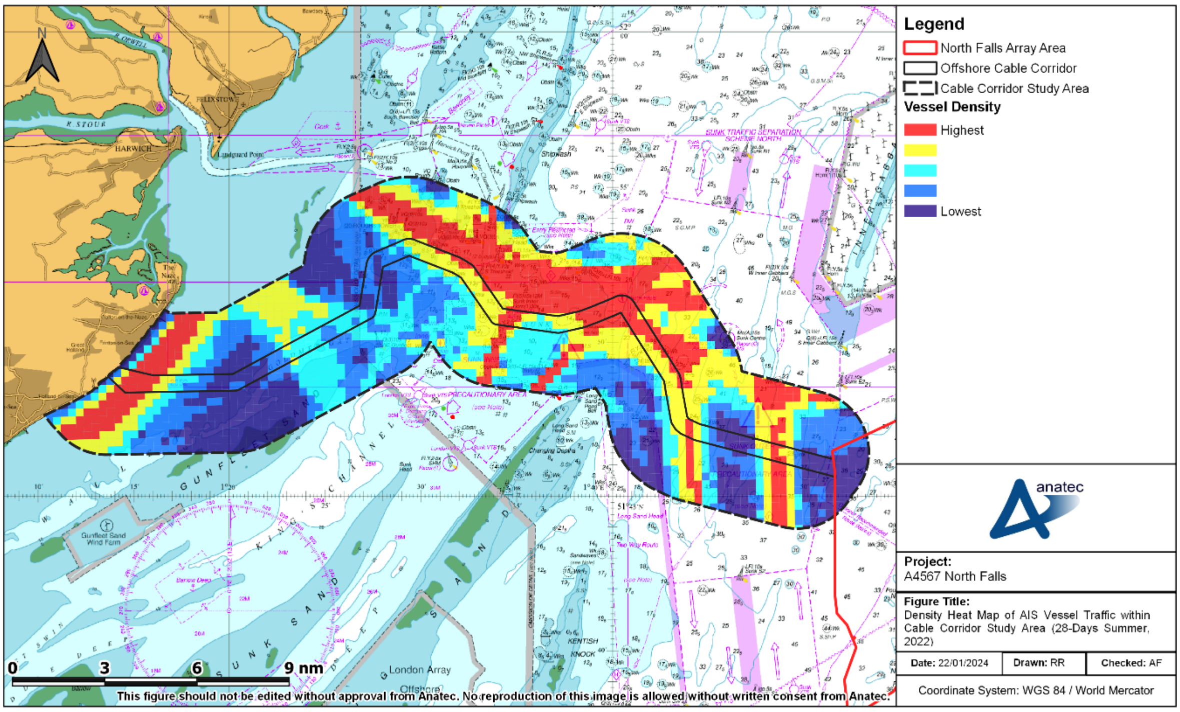

Figure 10-29 Density Heat Map of AIS Vessel Traffic within the Cable Corridor Study Area (28-Days Summer, 2022)

290. Comparing both survey periods, there is an area of high density to the immediate north of the offshore cable corridor. This area is associated with defined commercial routeing due to the presence of routeing measures in the area, including the Sunk TSSs, DW routes and restricted entry areas (detailed in Section 7.2). The Sunk Deep Water Anchorage (detailed in Section 7.5) is also located to the north of the offshore cable corridor which routeing vessels would avoid, resulting in a more concentrated vessel density within the area. The Sunk Pilot station is also located within this area of high density (Section 7.3) of which the presence of pilot vessels and the commercial vessels attending the area will be a key factor.

291. Areas of high density were also noted within the Sunk TSS South lanes during both survey periods with an area of high density parallel to the coast also noted during the summer period, resulting from increased recreational vessel traffic.

10.2.1 Vessel Counts

292. Figure 10-30 illustrates the daily number of unique vessels recorded within the cable corridor study area during the winter survey period. It should be noted that partial survey days, as detailed in Section 5.2, have been represented by a shaded count, similar to those in Section 10.1.1 for the array area.

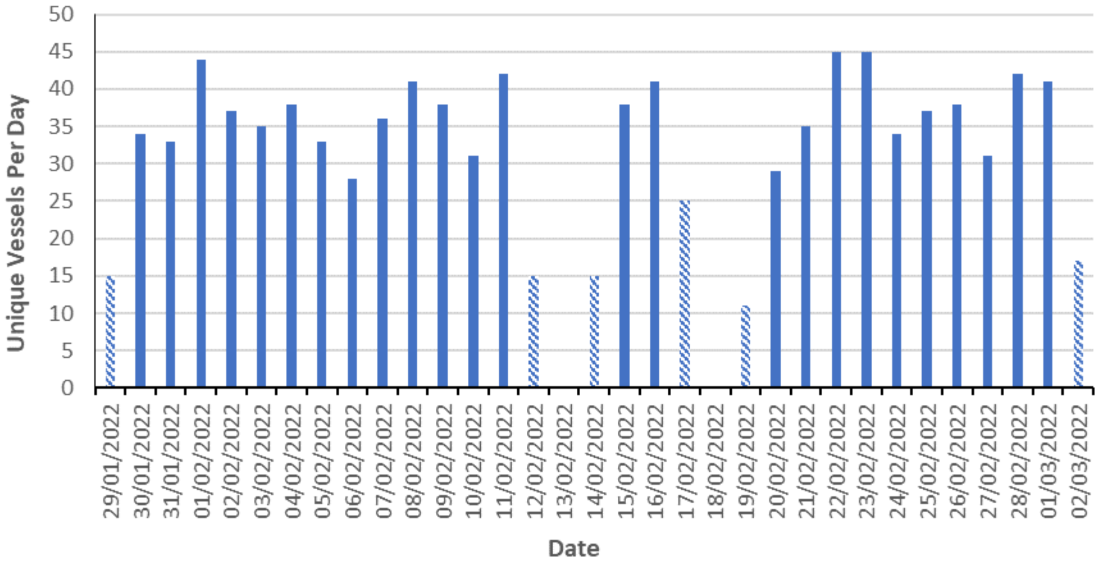

Figure 10-30 Unique Vessels Counts per Day within the Cable Corridor Study Area (28-Days Winter, 2022)

293. An average of 37 unique vessels per day were recorded within the cable corridor study area during the winter survey period. Approximately 87% of all vessels recorded during the winter survey period within the cable corridor study area intersected the offshore cable corridor, or an average of 32 vessels per day.

294. The busiest full days[7] recorded within the cable corridor study area during the winter survey period were the 22nd and 23rd February 2022, during which 45 unique vessels were recorded each day.

295. The quietest full day recorded within the cable corridor study area during the winter survey period was the 6th February 2022, during which 28 unique vessels were recorded.

296. Figure 10-31 illustrates the daily number of unique vessels recorded within the cable corridor study area during the summer survey period. It should be noted that partial survey days, as detailed in Section 5.2, have been represented by a shaded count.

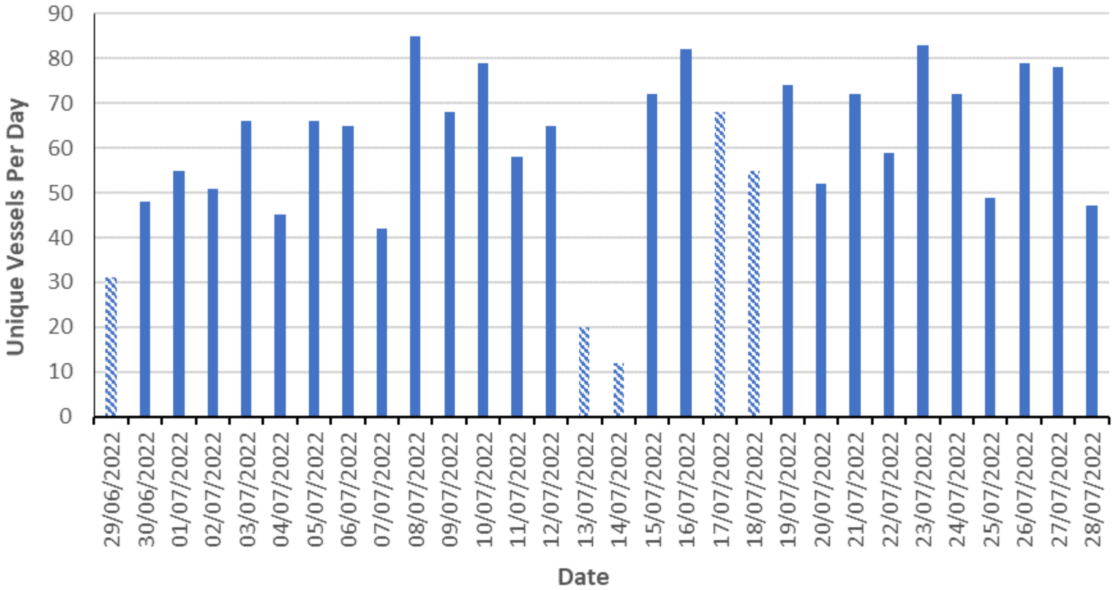

Figure 10-31 Unique Vessels Counts per Day within the Cable Corridor Study Area (28-Days Summer, 2022)

297. An average of 64 unique vessels per day were recorded within the cable corridor study area during the summer survey period. Approximately 85% of all vessels recorded during the summer survey period within the study area intersected the array area, or an average of 55 vessels per day. When compared to the winter survey period, summer recorded a greater average which is likely due to the increased volume of recreational traffic, especially closer to shore.

298. The busiest full day[8] recorded within the cable corridor study area during the summer survey period was the 8th July 2022, during which 85 unique vessels were recorded.

[7] Noting the first and last days were partial days, as were the 12th, 14th, 17th, and 19th February. The survey vessel was off site during the 13th and 18th February.
[8] Noting the first and last days were partial days, as were the 13th and 14th of July.

299. The quietest full day recorded within the cable corridor study area during the summer survey period was the 7th July 2022, during which 42 unique vessels were recorded.

10.2.2 Vessel Type

300. The percentage distribution of the main vessel types recorded within the cable corridor study area during the winter survey period is presented in Figure 10-32. The same distribution for vessel recorded during the summer survey period is presented in Figure 10-33.

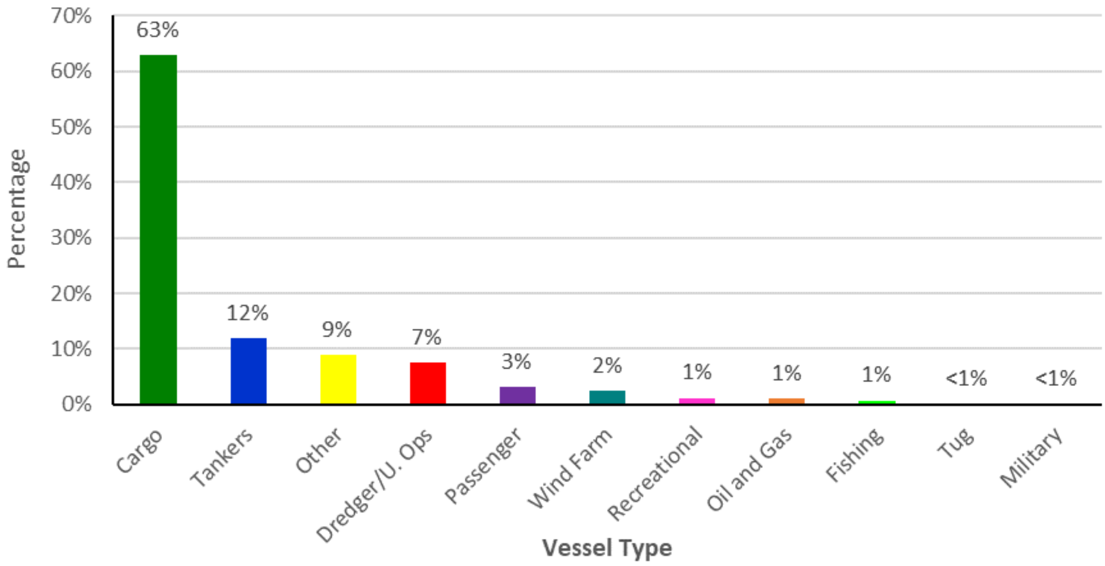

Figure 10-32 Vessel Type Distribution within the Cable Corridor Study Area (28-Days, Winter 2022)

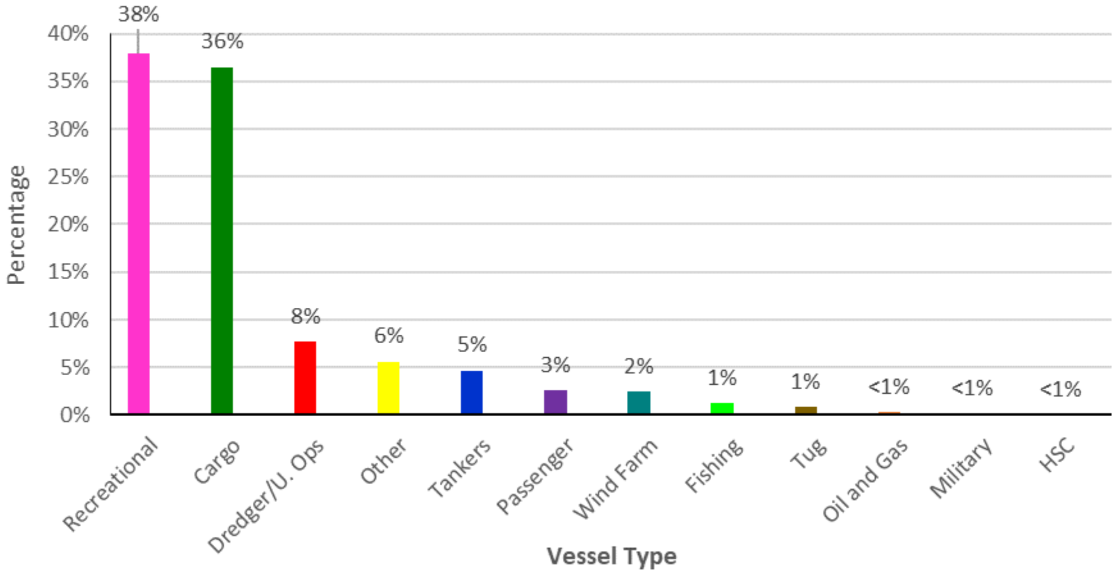

Figure 10-33 Vessel Type Distribution within the Cable Corridor Study Area (28-Days, Summer 2022)

301. Throughout the winter survey period, the main vessel types within the cable corridor study area were cargo vessels (63%) and tankers (12%).

302. Throughout the summer survey period, the main vessel types were recreational vessels (38%) and cargo vessels (36%).

303. The following subsections consider each of the main vessel types individually.

10.2.2.1 Cargo Vessels

304. Figure 10-34 presents the cargo vessels recorded within the cable corridor study area during the combined winter and summer survey periods, colour coded by cargo sub type.

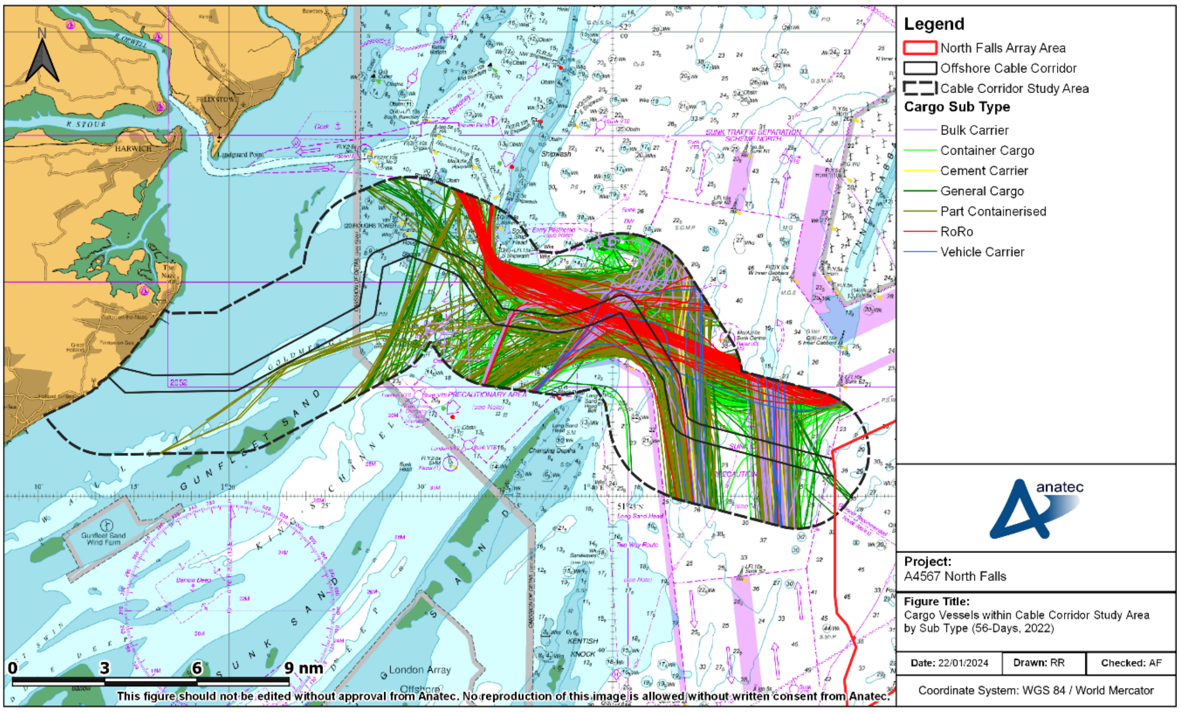

Figure 10-34 Cargo Vessels within the Cable Corridor Study Area by Sub Type (56-Days Winter, 2022)

305. An average of 23 unique cargo vessels per day were recorded within the cable corridor study area during the 56-day period, with the same distribution across both survey periods.

306. Container cargos were the most common sub type of cargo vessel recorded within the cable corridor study area during the 56-day period, accounting for 46% of all cargo vessels recorded. This was followed by general cargo (24%) and part containerised vessels (18%).

307. Cargo vessels were mainly routeing through the lanes of the Sunk TSS South, with vessels also routeing around the north of the Long Sands shallows before entering the Sunk TSS South from the west. The only cargo vessels routeing further inshore than 7nm, were part containerised vessels routeing to Brightlingsea, UK, to the west of the Gunfleet Sands shallows.

308. RoRo vessels accounted for 5% of all cargo vessels recorded within the cable corridor study area across the 56-day survey period. Of these vessels, 97% were operated by three top operators (identified in Section 10.1.2.1.1), with the remaining operators not accounting for more than 3% of all RoRo recorded. The main RoRo operators include DFDS which operated 60% of all RoRo recorded within the cable corridor study area. Stena Line accounted for 18% and Grimaldi Lines were 9%.

309. All RoRo vessels recorded were a continuation of the RoRo recorded in Section 10.1.2.1.1 for the array area. No new RoRo routes or vessels were recorded. This

main route for RoRo vessels intersected the offshore cable corridor south of the Sunk Pilot Boarding Station, with only vessels operated by Grimaldi Lines routeing south of the offshore cable corridor.

10.2.2.2 Recreational Vessels

310. Figure 10-35 presents the recreational vessels recorded within the cable corridor study area during the combined winter and summer survey periods.

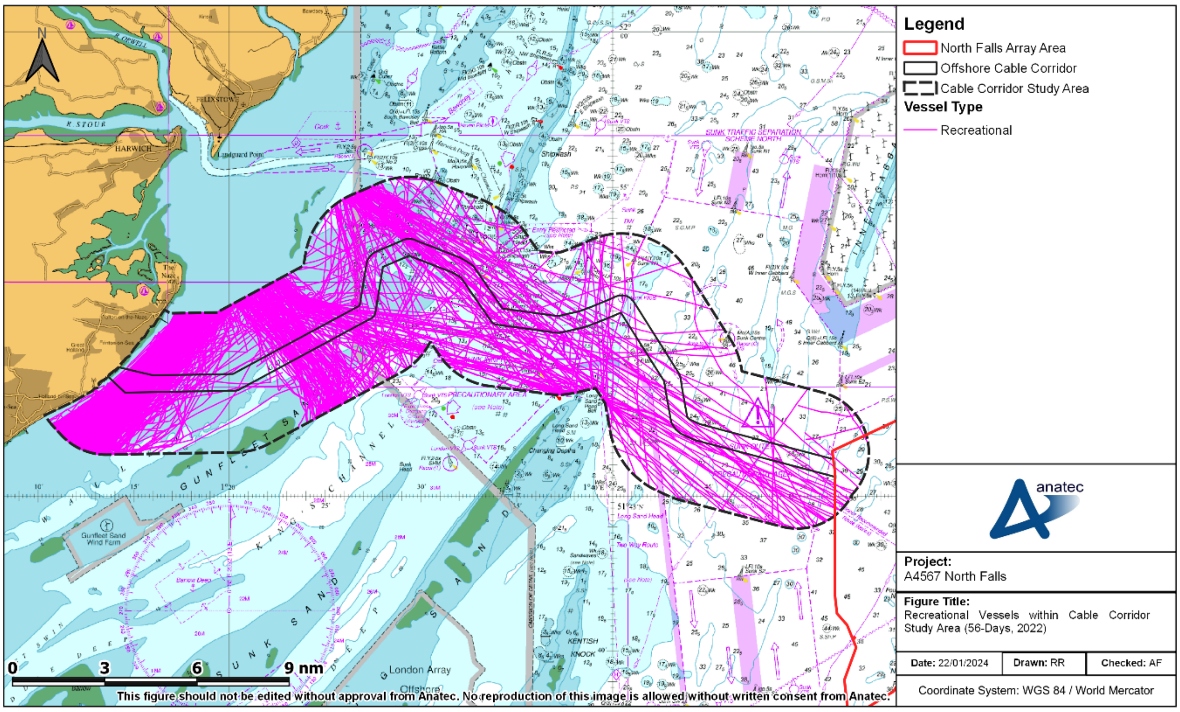

Figure 10-35 Recreational Vessels within the Cable Corridor Study Area (56-Days, 2022)

311. An average of 12 unique recreational vessels per day were recorded within the cable corridor study area during the 56-day period. Overall, approximately 98% of recreational vessels were recorded during the summer survey period, equating to an average of 24 unique recreational vessels per day during the summer survey period and one unique recreational vessel every four days during the winter survey period.

312. Recreational traffic is therefore deemed to be seasonal within the cable corridor study area.

313. Over half (53%) of all recreational vessels recorded within the cable corridor study area were on transit within 3nm of the coastline, transiting parallel to the shore. These vessels tracks are presented in Figure 10-36. Recreational vessels were also noted transiting north-west to south-east slightly further offshore and were likely heading to/from harbours and marinas located further north via the mouth of the Stour and Orwell Estuaries. Any recreational vessels noted further offshore were likely to be intercontinental between the UK and mainland Europe.

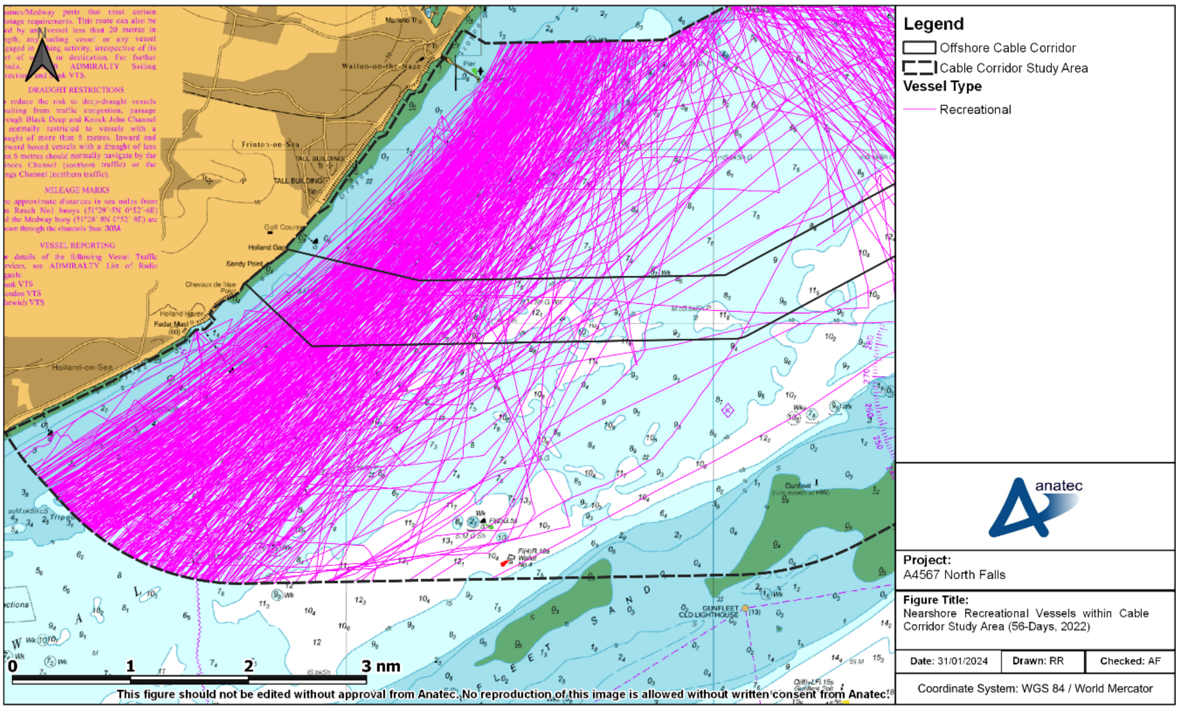

Figure 10-36 Nearshore Recreational Vessels within Cable Corridor Study Area (56-Days, 2022)

10.2.2.3 Tankers

314. Figure 10-37 presents the tankers recorded within the cable corridor study area during the combined winter and summer survey periods.

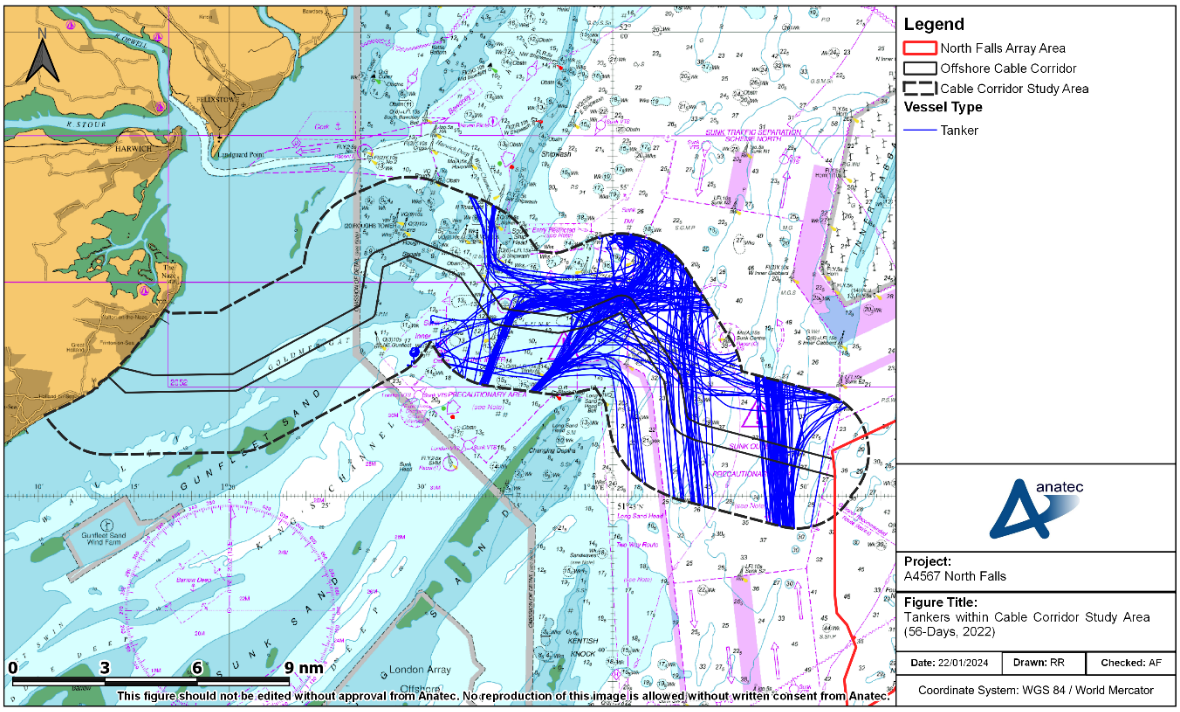

Figure 10-37 Tankers within the Cable Corridor Study Area (56-Days Winter, 2022)

315. An average of four unique tankers per day were recorded within the cable corridor study area during the 56-day period. Slightly greater numbers were recorded during the winter survey period when compared with the summer.

316. All tankers remained in water depths greater than 10m below CD and so no tanker was recorded inshore of 8nm. Just like cargo vessels, tankers were mainly noted utilising the Sunk TSSs lanes as well as the defined DW routes.

317. As for tanker sub type, the main sub types recorded were combined oil/chemical tankers (33%) and product tankers (31%).

10.2.2.4 Marine Aggregate Dredgers

318. As identified in Section 10.2.2, dredgers/underwater operation vessels equated to 8% of all vessel traffic recorded within the cable corridor study area. Of these vessels, all were marine aggregate dredgers.

319. Figure 10-38 presents the marine aggregate dredgers recorded within the cable corridor study area during the combined winter and summer survey periods along with the licensed marine aggregate dredging areas identified in Section 7.4.

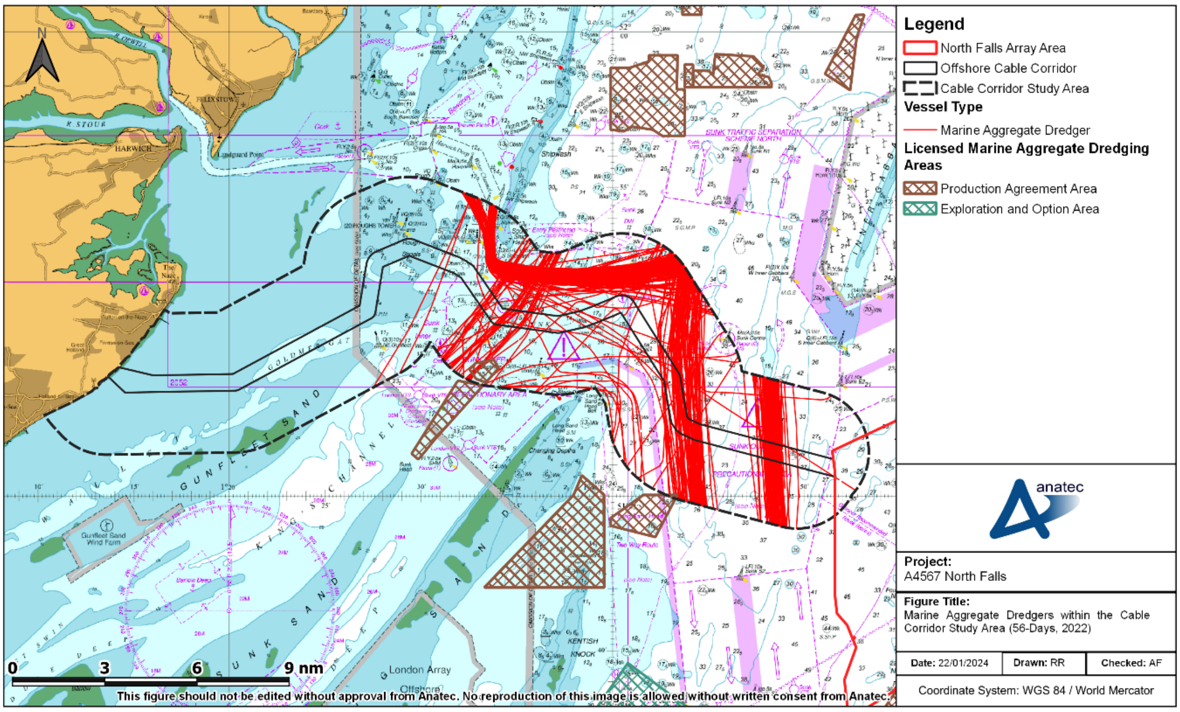

Figure 10-38 Marine Aggregate Dredgers within the Cable Corridor Study Area (56-Days, 2022)

320. An average of four unique marine aggregate dredgers per day were recorded within the cable corridor study area during the 56-day period. Approximately 65% of these vessels were recorded during the summer survey period.

321. Marine aggregate dredgers were again concentrated to the east in deeper waters avoiding the shallow banks. Although licensed areas 509/1 and 510/2 intersect the cable corridor study area, no active dredging was recorded, and all vessels were on transit. Transiting vessels mainly used the Sunk TSSs lanes and DW routes.

10.2.2.5 Pilot Vessels

322. Figure 10-39 presents the pilot vessels recorded within the cable corridor study area during the two combined winter and summer survey periods.

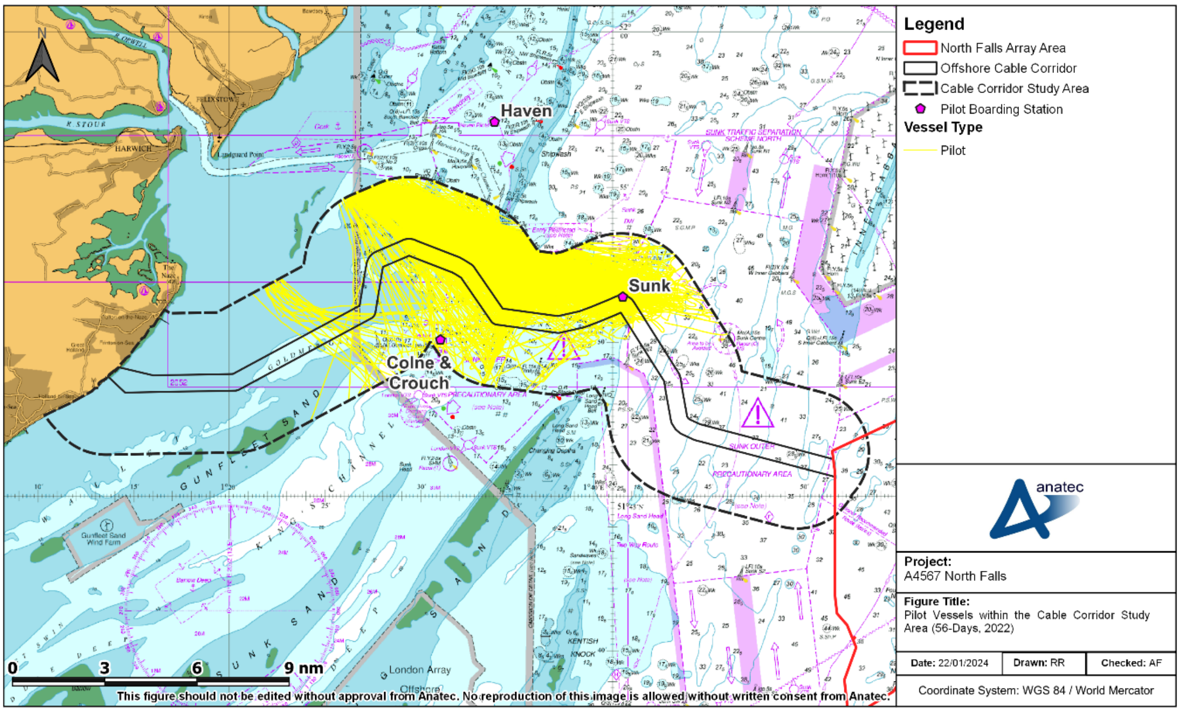

Figure 10-39 Pilot Vessels within the Cable Corridor Study Area (56-Days, 2022)

323. Pilot vessels were heavily concentrated in the vicinity of the Sunk Pilot Boarding Station (which is introduced in Section 7.3). Six pilot vessels were recorded during the survey period. Four vessels, those identified in Section 10.1.2.8, equated to over 99% of pilot vessels recorded. An average of two to three unique pilot vessels were recorded per day within the cable corridor study area.

324. Based on the data, it was estimated that an average of 15 transits, either to or from the Sunk Pilot Boarding Station occurred per day across the 56-day period. Vessels in proximity to the Sunk Pilot Boarding Station are presented in Figure 10-40.

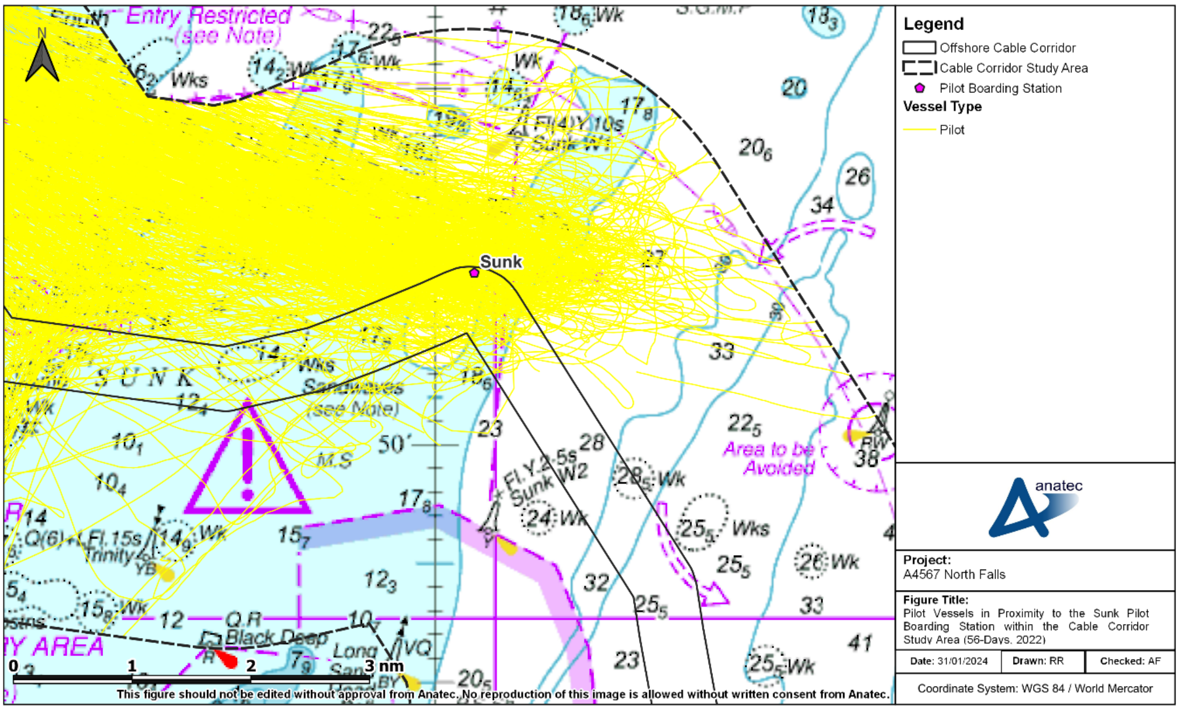

Figure 10-40 Pilot Vessels in Proximity to the Sunk Pilot Boarding Station within the Cable Corridor Study Area (56-Days, 2022)

10.2.2.6 Passenger Vessels

325. Figure 10-41 presents the passenger vessels recorded within the cable corridor study area during the combined winter and summer survey periods, colour-coded by sub type.

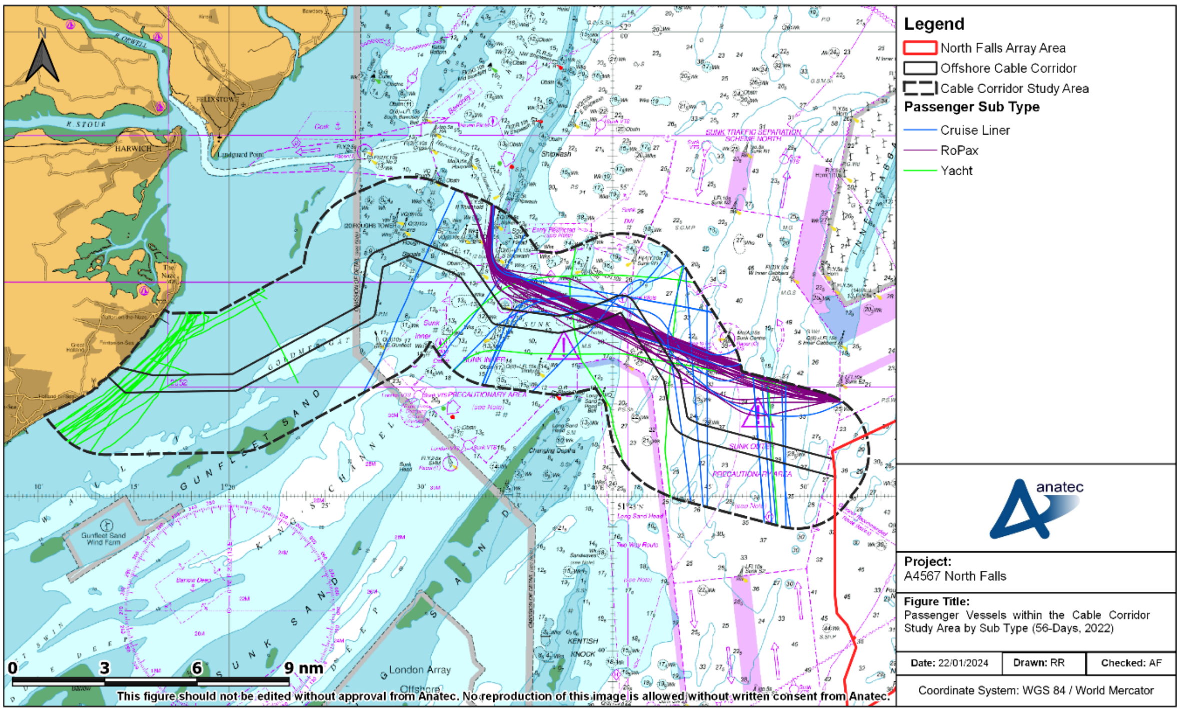

Figure 10-41 Passenger Vessels within the Cable Corridor Study Area by Sub Type (56-Days, 2022)

326. An average of one unique passenger vessel per day was recorded within the cable corridor study area during the 56-day period, with slightly higher numbers recorded during the summer survey period compared to the winter.

327. RoPax vessels accounted for 52% of all cargo vessels recorded within the cable corridor study area across the 56-day survey period.), All RoPax vessels recorded were operated by Stena Line and were a continuation of the RoPax routes recorded in Section 10.1.2.3.1 for the array area. No new RoPax routes or vessels were recorded. This main route for RoPax vessels intersected the offshore cable corridor south of the Sunk Pilot Boarding Station heading to/from the Harwich Deep Channel Route.

328. Larger yachts were also recorded and accounted for 26% of all passenger vessels recorded and were mainly noted inshore transiting parallel to the coast. Cruise liners accounted for 22% of all passenger vessels recorded and were mainly noted utilising the Sunk TSSs.

10.2.2.7 Wind Farm Vessels

329. Figure 10-42 presents the wind farm vessels recorded within the cable corridor study area during the combined winter and summer survey periods.

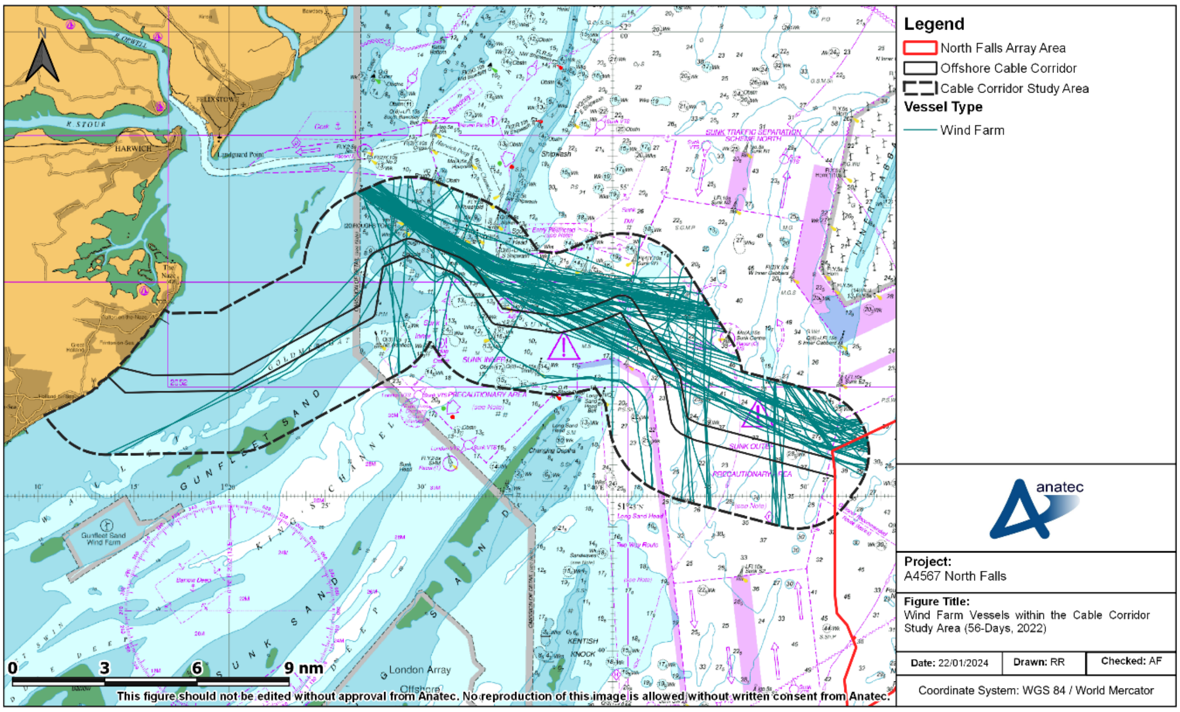

Figure 10-42 Wind Farm Vessels within the Cable Corridor Study Area (56-Days, 2022)

330. An average of one unique wind farm vessel per day was recorded within the cable corridor study area during the 56-day period. Approximately 65% of these vessels were recorded during the summer survey period.

331. Wind farm vessels were primarily attending the Greater Galloper and Gabbard sites to the north and north-east of the array area. These vessels were mainly coming from Lowestoft and Harwich with this route intersecting the offshore cable corridor. Several vessels were also utilising the Sunk TSSs.

10.2.2.8 Fishing Vessels

332. Figure 10-43 presents the fishing vessels recorded within the cable corridor study area during the combined winter and summer survey periods.

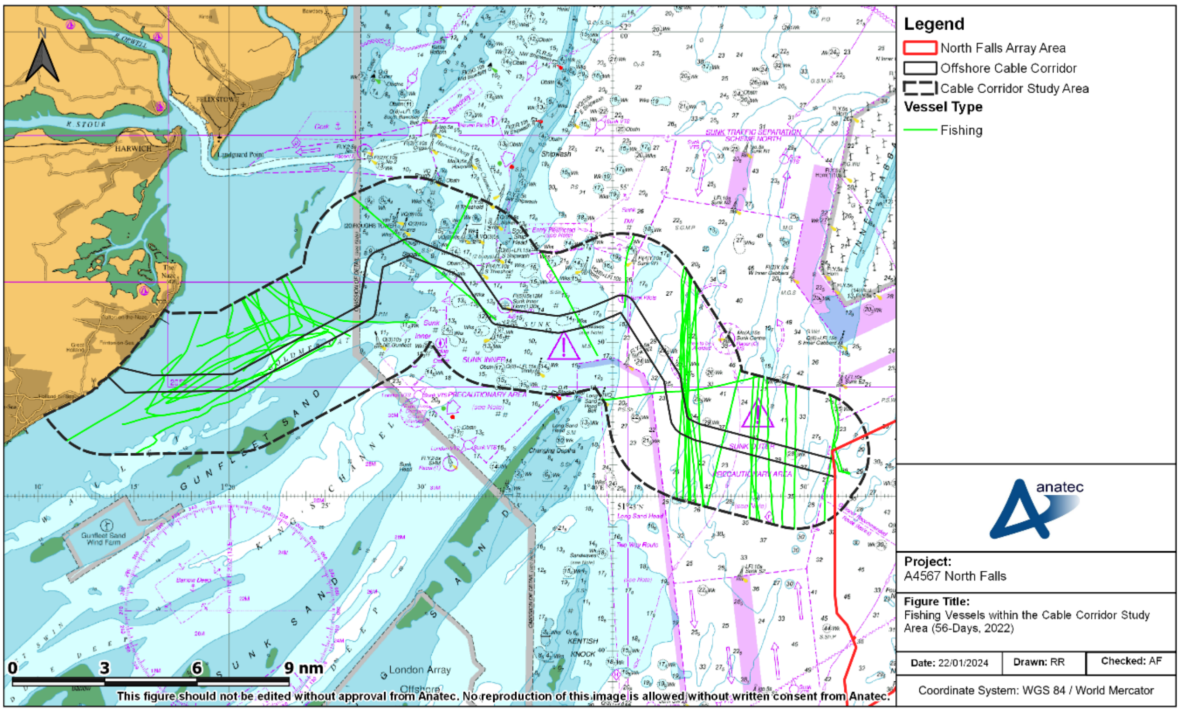

Figure 10-43 Fishing Vessels within the Cable Corridor Study Area (56-Days, 2022)

333. An average of one unique fishing vessel was recorded every two days within the cable corridor study area during the 56-day period. Approximately 76% of these vessels were recorded during the summer survey period.

334. Fishing vessels were recorded both inshore and within the Sunk TSSs. Based on behaviours identified by vessel speed, track behaviour, and by information broadcast via AIS, it is likely that no vessels were deemed to be engaged in fishing activities and were likely on transit to/from fishing grounds. However, an inshore fishing vessel of 10m LOA was noted engaged in repeat transits over three separate days close to the coast and could be a potential occurrence of potting behaviour.

10.2.3 Vessel Size

335. This section provides analysis of the sizes of vessels recorded within the cable corridor study area during the two 28-day periods, in terms of vessel length and draught.

10.2.3.1 Vessel Length

336. Vessel LOA was available for 99% of vessels recorded during the combined winter and summer survey periods. Those vessels of unspecified LOA recorded via AIS were all recreational vessels broadcasting on Class B AIS (see Section 5.4.1). Figure 10-44 presents a plot of the vessel tracks recorded during the combined survey periods, colour-coded by vessel LOA. Following this, Figure 10-45 illustrates the same data by distribution of vessel LOA.

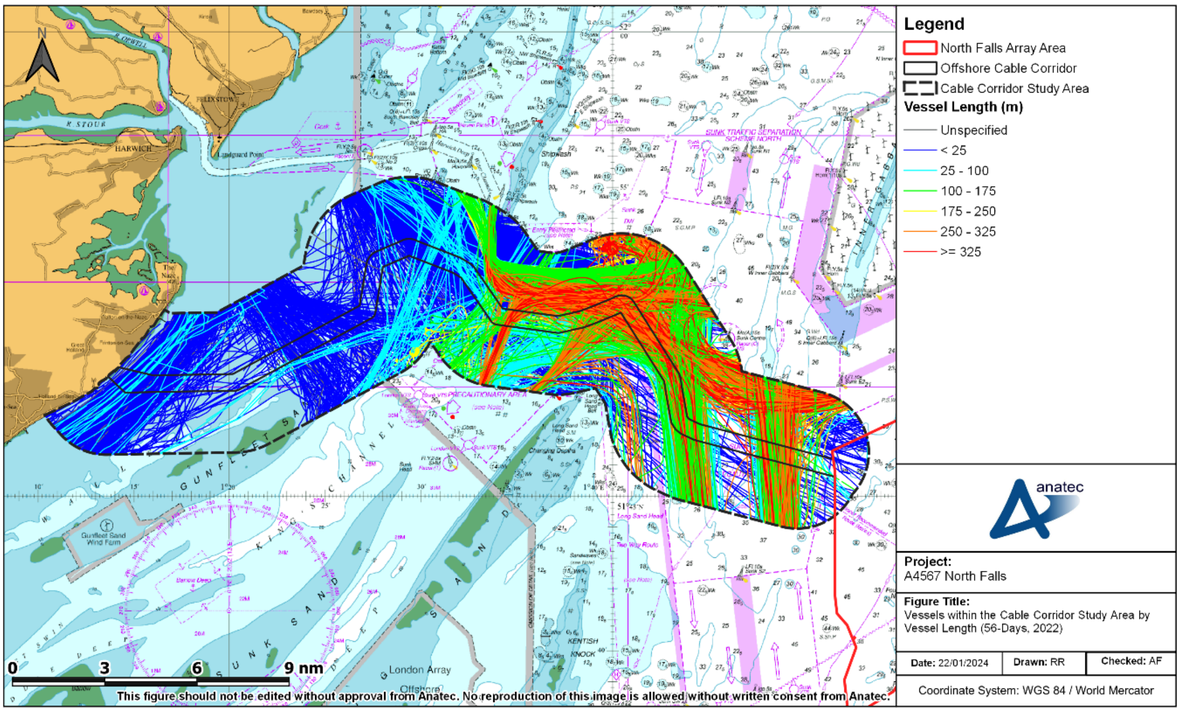

Figure 10-44 Vessels within the Cable Corridor Study Area by Vessel Length (56-Days, 2022)

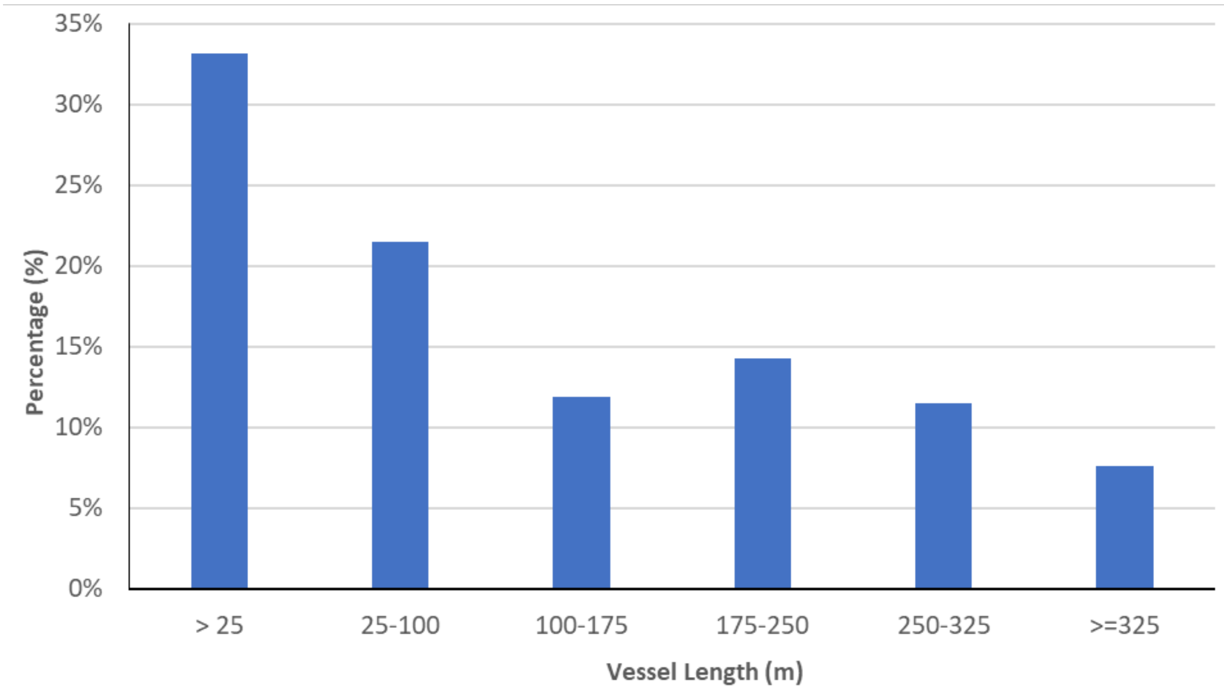

Figure 10-45 Vessel Length Distribution within the Cable Corridor Study (56-Days, 2022)

337. Excluding the proportion of vessels for which LOA was not available, the average LOA of vessels within the cable corridor study area during the combined winter and

summer survey periods was 128m. There was variation in average LOA between both survey periods with the average vessel LOA smaller in the summer survey period at 104m when compared to the average of 165m in the winter. This could be attributed to the greater number of recreational vessels and wind farm vessels present during more favourable sailing conditions during summer months when compared to the winter survey period.

338. Larger vessels were commercial vessels typically recorded routeing to/from the Sunk TSSs as well as using the DW routes. Some of these vessels were also recorded anchored within the Sunk Deep Water Anchorage (as seen in section 7.5) at the northern extent of the cable corridor study area. The largest vessels were 400m in length and were all container cargo vessels (17 unique vessels). A detailed overview of vessels with lengths of at least 300m are shown in Figure 10-46.

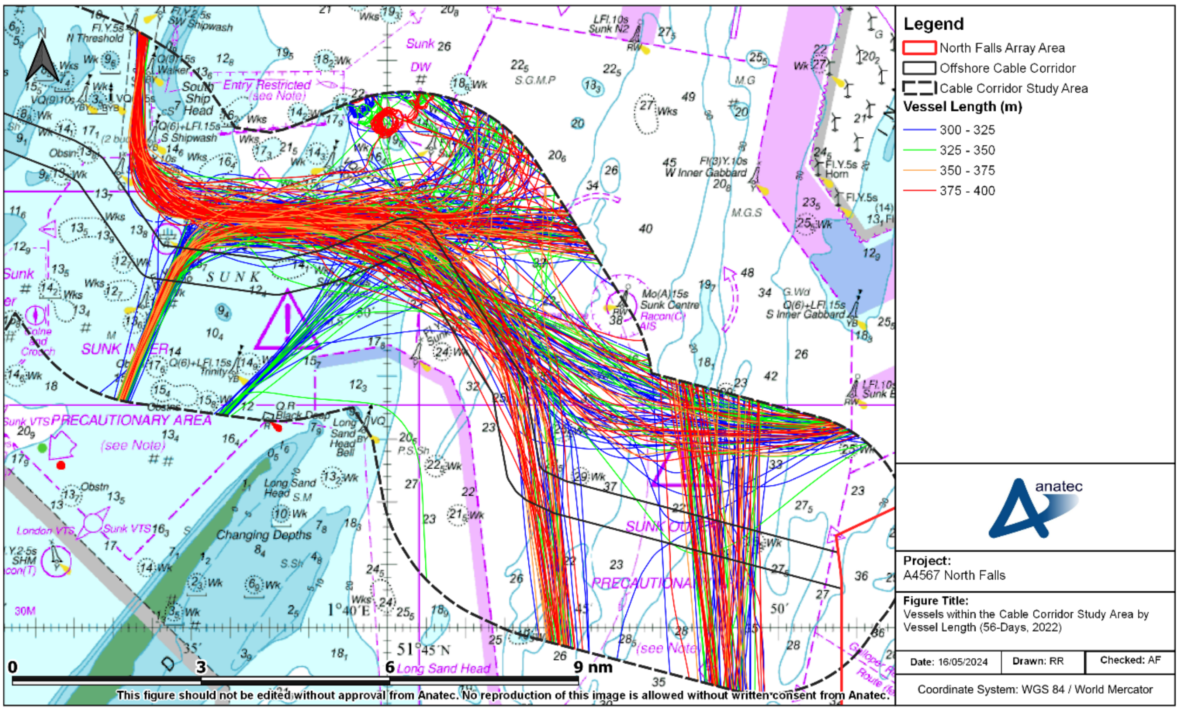

Figure 10-46 Longest Vessels by Vessel Length (56 Days, 2022)

339. Smaller vessels were mainly recorded inshore and were primarily recreational vessels recorded during the summer survey period. Knowing that recreational vessels equated to a large percentage of the vessel type (see Section 10.2.2) this correlates with Figure 10-45, with vessels of a length less than 25m displayed the highest distribution.

10.2.3.2 Vessel Draught

340. Vessel draught was available for approximately 80% of vessels recorded during the combined winter and summer survey periods. Those unspecified vessels recorded via AIS were primarily recreational vessels broadcasting on Class B AIS (see Section

5.4.1). Figure 10-47 presents a plot of the vessel tracks recorded during the combined survey periods, colour-coded by vessel draught. Following this, Figure 10-48 illustrates the same data by distribution of vessel draughts.

341. It is noted that this analysis represents an overarching overview assessment of the cable corridor study area only. Detailed analysis of the DW routes including in terms of vessel draught is provided in Section 10.2.3.2.

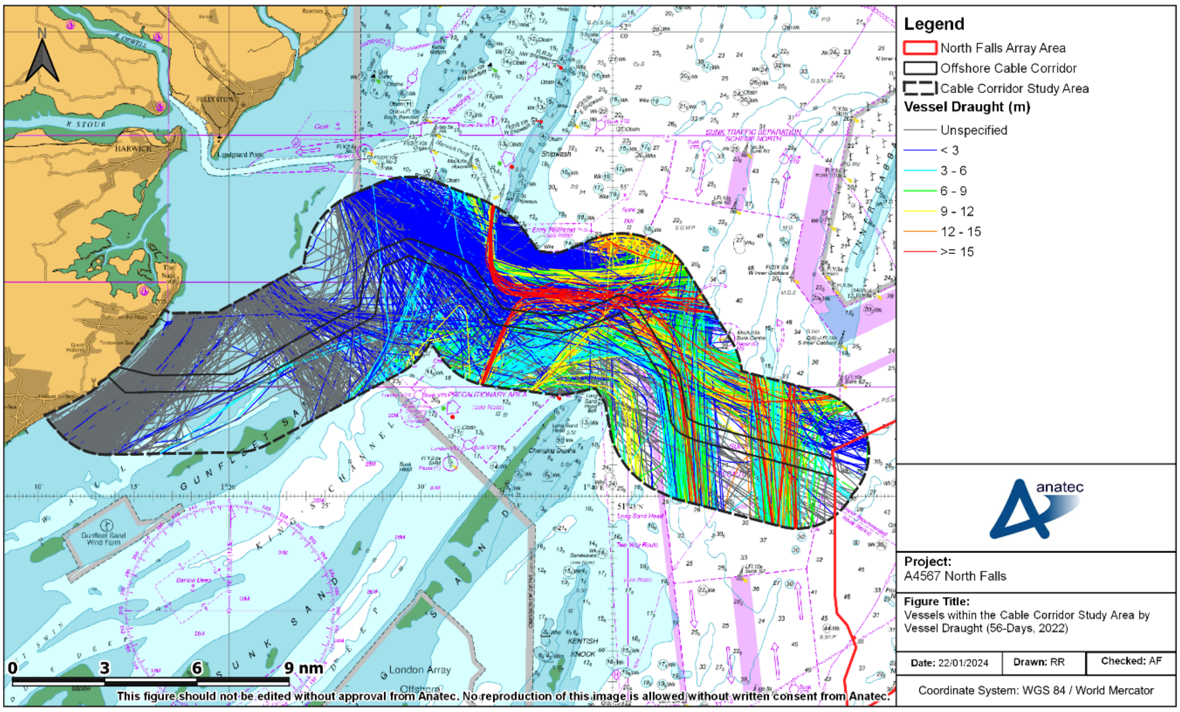

Figure 10-47 Vessels within the Cable Corridor Study Area by Vessel Draught (56-Days, 2022)

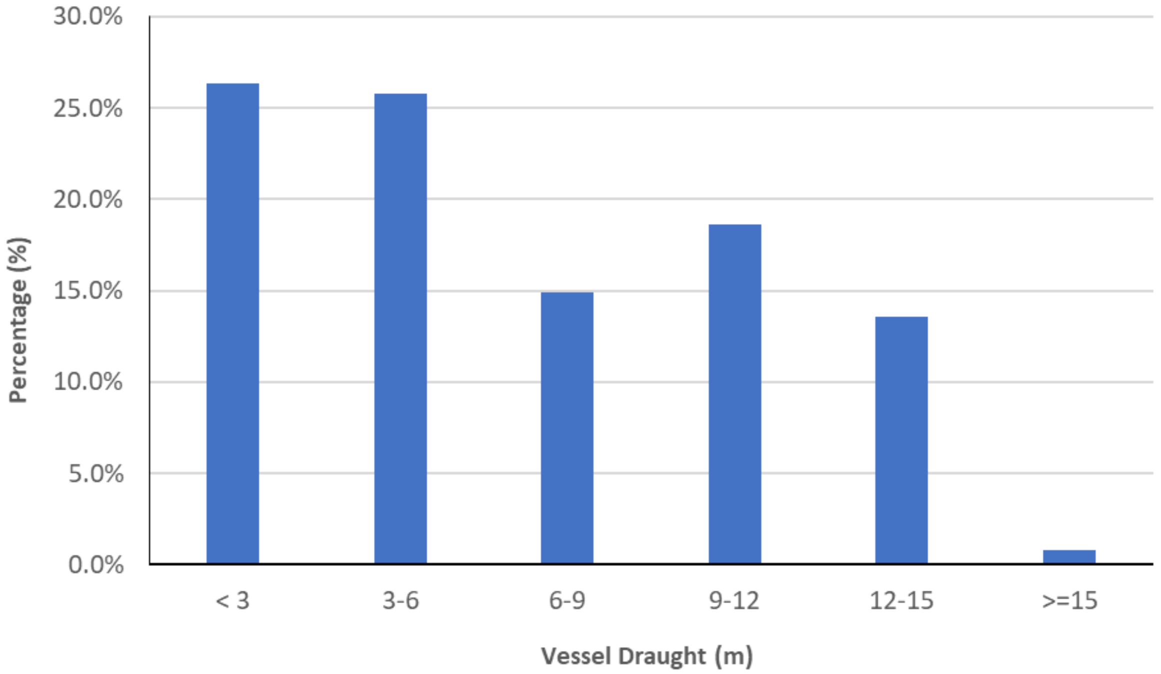

Figure 10-48 Vessel Draught Distribution within the Cable Corridor Study (56-Days, 2022)

342. Excluding the proportion of vessels for which a draught was not available, the average draught of vessels within the study area during the combined winter and summer survey periods was 6.5m. The largest vessel draught recorded was 15.7 from two unique container cargo vessels. Over half (52%) of vessels had a recorded draught under 6m.

343. Similar to the vessel LOA distribution, the largest vessels by draught were typically commercial vessels within the DW routes. These vessels are highlighted more in Section 10.2.3.2.1 below. The vessels with smaller draughts were typically pilot vessels, wind farm vessels, or recreational vessels seen transiting to/from the north of the cable corridor study area.

10.2.3.2.1 *DW Routes*

344. The same data presented above in Figure 10-47 is illustrated again in Figure 10-49 with a focus on vessels utilising the DW routes within the offshore cable corridor which were introduced in Section 7.2.2. Vessels are colour-coded by vessel draught with a focus on those with a draught equal to or greater than 12m.

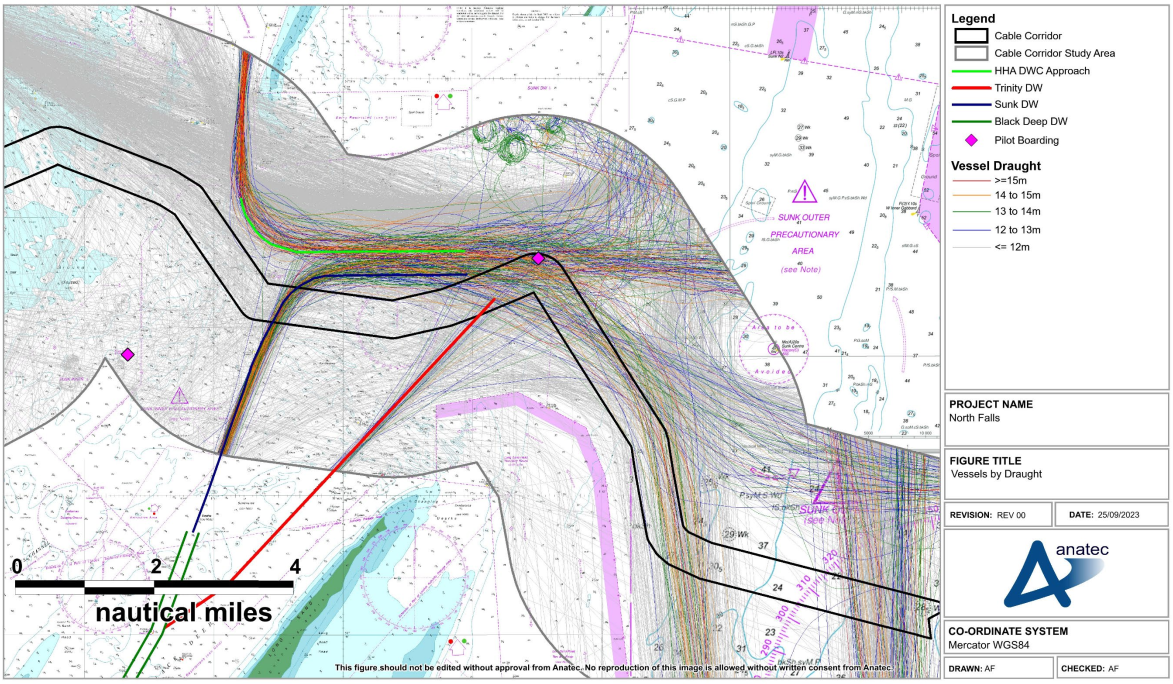

Figure 10-49 Vessels within the DW Routes by Vessel Draught (56-Days, 2022)

345. Vessels with draughts equal to or greater than 12m were rarely noted outside of the three DW routes within the cable corridor study area. Over the 56-day period, an average of two to three unique vessels per day, with a vessel draught equal to or greater than 12m, were recorded using the Sunk DW Route which intersects the offshore cable corridor. An average of one to two unique vessels per day were recorded using the Harwich DW Route to the north of the offshore cable corridor, again with a vessel draught equal to or greater than 12m. An average of one unique vessel with a vessel draught of greater than 12m was recorded using the Trinity DW Route every three days.

346. Vessels with a draught of greater than or equal to 15m recorded across the cable corridor study area are presented in Figure 10-50, noting the majority of vessels in this draught category are utilising the Sunk and Harwich DW routes or within the cable corridor study area, it is noted that vessel draught was recorded at a maximum of 15.7m.

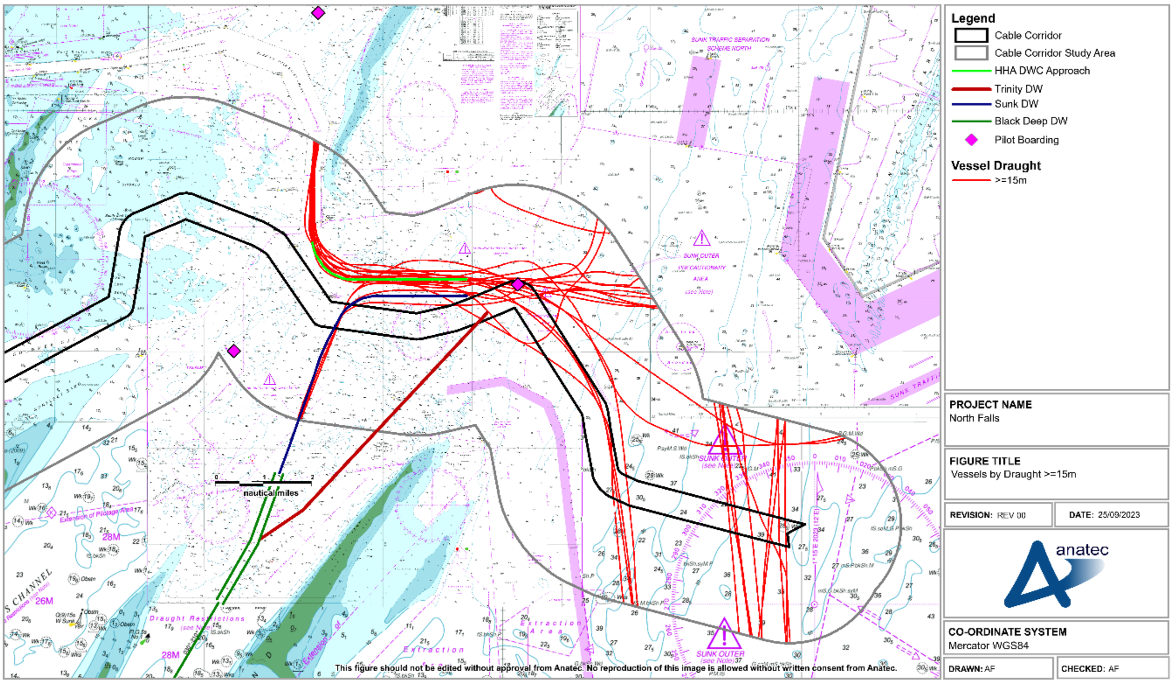

Figure 10-50 Vessels by Vessel Draught >=15m within Cable Corridor Study Area (56-Days, 2022)

347. Over the 56-day period, a vessel with a draught equal to or greater than 15m was recorded on average every four to five days using the Harwich DW Route. An average of one vessel with a draught equal to or greater then 15m was recorded every two weeks using the Sunk DW route. No vessels within this draught category were recorded across the 56-days using the Trinity DW route.

10.2.4 Anchored Vessels

348. Anchored vessels within the cable corridor study area were identified using the same criteria as set out in Section 10.1.4.

349. After applying these criteria, 64 unique instances of a vessel anchoring were identified within the cable corridor study area, corresponding to an average of one to two vessels anchoring each day. Many vessels were at anchor for more than one day at a time, and so at any given time during the 56-day period, there was an average of three unique vessels at anchor within the cable corridor study area. Of the anchored vessels identified, all bar one vessel broadcast an AIS navigational status of “at anchor”.

350. All anchored vessels were at anchor either within the Sunk Deep Water anchorage which intersects the north of the cable corridor study area, or within the Sunk Inner anchorage which intersects the south of the cable corridor study area. No vessels were at anchor within the offshore cable corridor itself.

351. Figure 10-51 presents an overview of vessels deemed to be at anchor within the study area during the 56-day period.

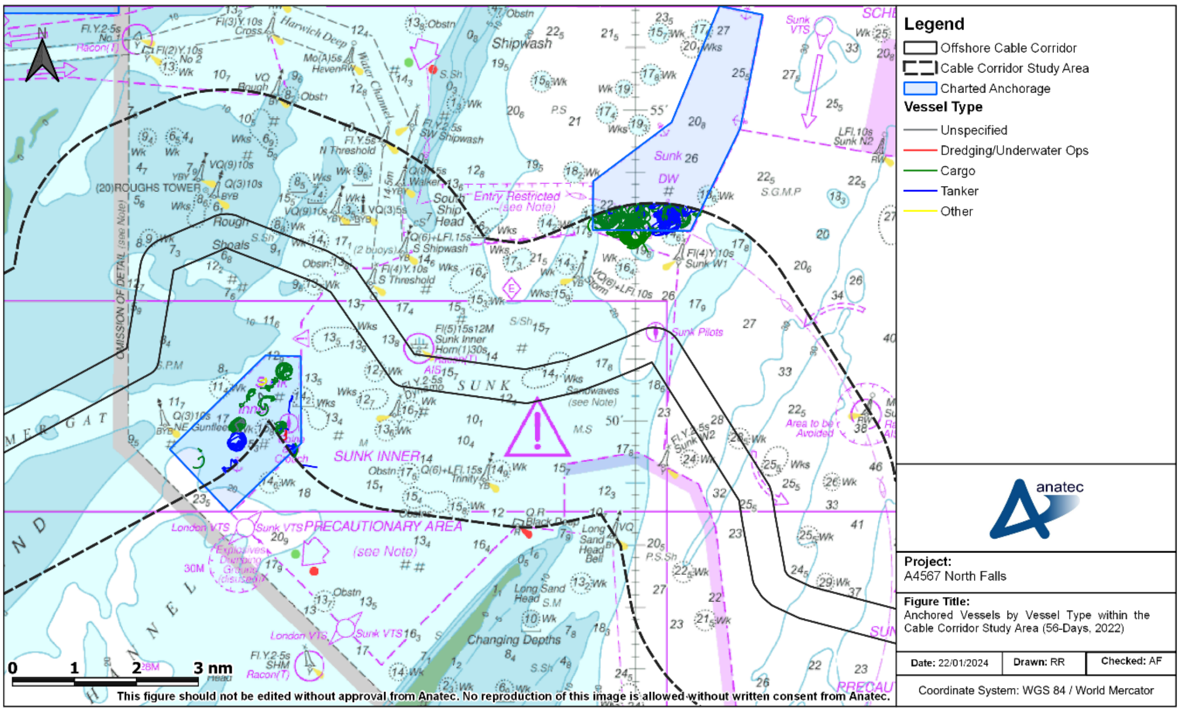

Figure 10-51 Anchored Vessels by Vessel Type within the Cable Corridor Study Area (56-Days, 2022)

10.3 Assessment of the Original Galloper Recommended Route

352. This section provides additional and specific vessel traffic assessment of the Original Galloper Recommended Route (see Section 7.2).

10.3.1 Background

353. On the 1st of July 2007, the modification and extension of the existing Sunk Precautionary Area and the establishment of three TSSs, a two-way traffic route at Long Sand Head, an area to be avoided and a recommended route at the Galloper was implemented in the northern approaches to the Thames Estuary (IMO, 2006). These changes were approved prior by the IMO (IMO, 2006) to improve the safety of navigation in the area and were implemented with consideration to the future presence of the Greater Gabbard Offshore Wind Farm.

354. The recommended route was designed in the south-east of the area to enable regular ferry traffic routeing to and from the Port of Ostend in Belgium to both enter and leave the Sunk Outer Precautionary Area without having to utilise the Sunk TSS South or Sunk TSS East. This route was charted on all relevant nautical charts and was known as the “Galloper Recommended Route”, as illustrated in Figure 10-52. As shown, the array area intersects the Galloper Recommended Route.

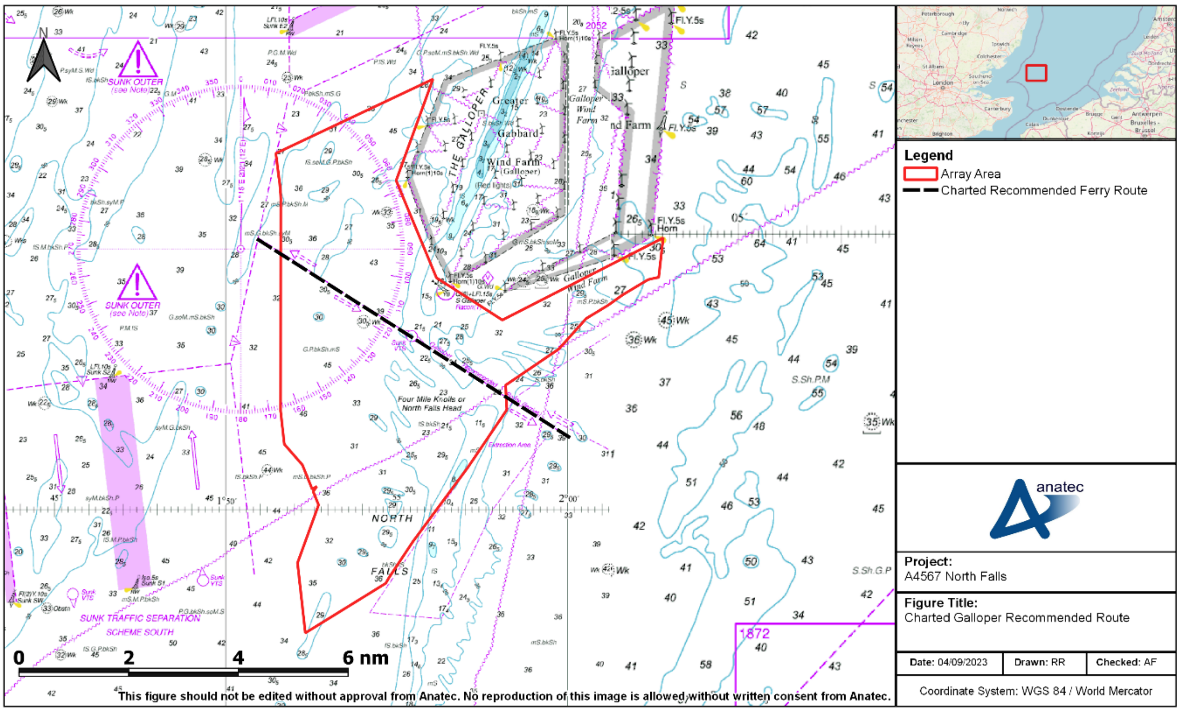

Figure 10-52 Charted Galloper Recommended Route for Ferries

10.3.2 Historical Use of Route by Commercial Ferries

355. The use of the Galloper Recommended Route was initially intended for use by commercial ferries routeing between Ostend (Belgium) and Harwich Haven ports on the east coast of England, primarily Ipswich and Harwich.

356. Between 2000 and 2007, Ferryways, a Belgian RoRo vessel operator, operated a commercial ferry route between Ostend (Belgium) and Ipswich (UK) on a three-sailings-a-day schedule. Vessels on this route, at the time named *Sapphire/Ostend Way, Flanders Way, Ipswich Way* and *Anglian Way,* were sold to Cobelfret (now CLdN) in 2007 when Ferryways ceased commercial operations. Scheduled routeing between Ostend and Ipswich officially ceased for these vessels in June 2007, but limited irregular transits still occurred until 2009 under operation by Cobelfret, which also included several transits to Harwich by these vessels. While on these routes, the vessels will likely have utilised the Galloper recommended route.

357. In February 2009, the route was re-opened by Associated British Ports (ABP) (owner of Ipswich Port) in a joint venture with Belgian firm Dart Line NV (which was owned by Cobelfret since 2006) (Ipswich Star, 2008). This route was then utilised twice daily by the chartered *Anglian Way* RoRo before ceasing and changing name in April 2009 to *Taurine*. Based on available published information at the time of research, there has been no record of any usage of this route to/from Ostend since 2009. However, it is noted that between April 2009 and April 2010 the RoRo *Taurine* utilised the

recommended route while routeing between Ipswich (UK) and Zeebrugge (Belgium)[9].

10.3.3 Green Shipping Corridor

358. As per the Clydebank Declaration established at the COP26 climate summit, which Belgium and the UK among many other countries have signed, a green corridor is a shipping route between two or more ports which is served by green marine transport operations (DfT, 2022). This includes zero-carbon emissions vessels and other emissions reduction programmes to be deployed, and emission reductions are measured and enabled through public and private actions and policies.

359. A green corridor has already been agreed between North Sea Port (Ghent) (Belgium) and Gothenburg (Sweden) and is aiming to use alternative fuels for vessels on this route by 2025 (North Sea Port, 2022). The Belgium Government have also submitted a tender to introduce the development of hydrogen import infrastructure with the Port of Antwerp already being a “major green energy hub” taking up a leading position as a European import hub for green hydrogen (Port of Antwerp, 2023).

360. As for the Port of Ostend, the development of a hydrogen bunker station at the port could be operational by 2025 (Port Oostende, 2023). This will allow vessels to take on fuel and could see the port also taking up a role in green corridor shipping for the country.

361. The Port of Dover became the UK’s first high-volume green shipping corridor in September 2022 in partnership with two ports in France; Calais and Dunkirk. The Port of Tyne is also being backed by the DfT to develop The Clean Tyne Shipping Corridor (Global Maritime Forum, 2022). These are the only two operational green shipping corridors in the UK, with several ports on the west UK coast being considered for future green routes.

362. However, no agreement for any such routes has been agreed for the Port of Ostend and if these routes were to be established in the future between the two UK ports agreed for green corridor shipping (Dover and Tyne) these routes would not be affected by North Falls. If a green corridor shipping route was to be established for any of the Haven ports and Belgium, they would likely seek to utilise the Galloper recommended route. However, in May 2022, a statement released from Hutchison Ports (UK) Limited, who owns and operates the Port of Felixstowe and Harwich International Port, stated that *“To date we are not aware of any progress towards the Clydebank declaration to establish zero-emission green shipping corridors”* (Hutchison Ports, 2022).

[9] Based on review of Anatecs in house AIS data.

10.3.4 Assessment of Long-Term Data

10.3.4.1 Overview

363. Three years AIS vessel traffic data was analysed within a 3nm study area of the Galloper recommended route from July 2020 to June 2023 (hereafter the 'data period').

364. Data was reviewed to identify those vessel tracks that were on north-west/south-east transits through the North Falls array area and could have potentially been utilising the Galloper recommended route. Vessel tracks were recorded at some instances up to 6nm south of the Galloper recommended route and so it is assumed that a large proportion of the vessel tracks included were not intentionally using the route. This also included vessels transiting around the Galloper wind farm and due to the need to deviate are on the same route for a proportion of their route.

365. All tracks were initially analysed and only those vessel types deemed to be routeing on the Galloper recommended route are included in the sections below. The key vessel types were observed to include cargo vessels and dredger/subsea operation vessels. It is noted that recreational vessels were also recorded, however have not been considered in detail given they will likely still be able to transit through the operational array.

10.3.4.2 Detailed Vessel Type

10.3.4.2.1 *Commercial Vessels*

366. Commercial vessels recorded across the data period within the North Falls array area are presented in Figure 10-53. These vessels include cargo vessels (95%), passenger vessels (4%) and tankers (1%).

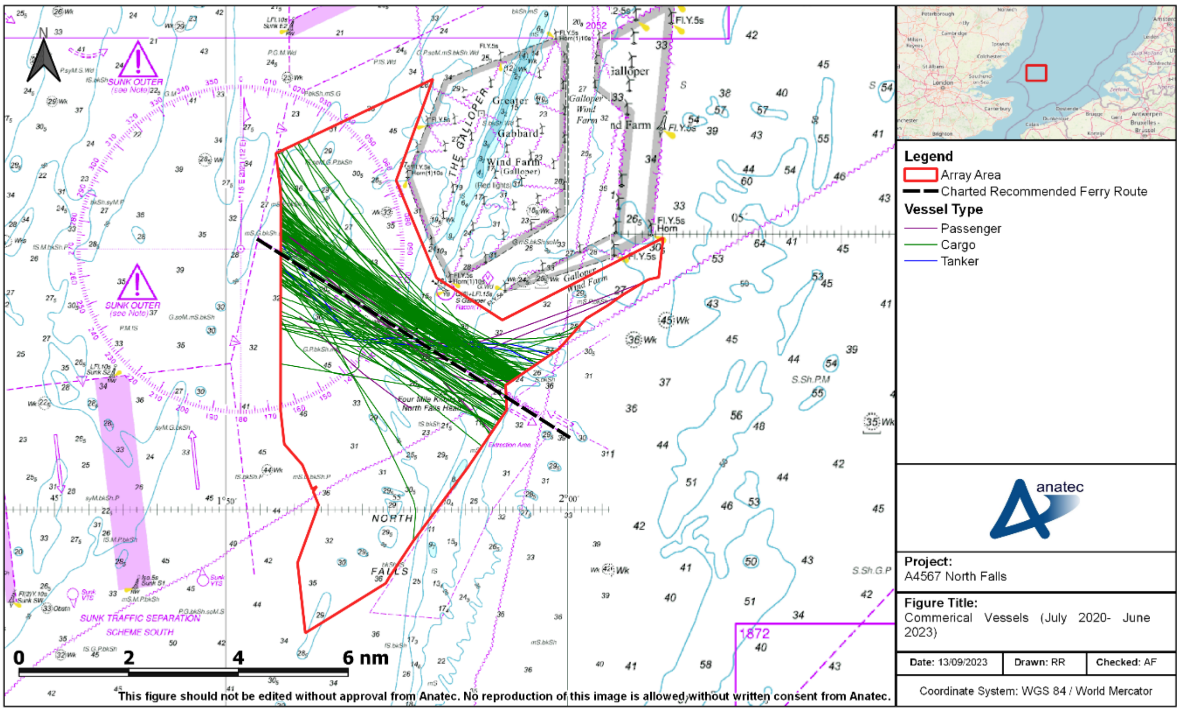

Figure 10-53 Commercial Vessels (July 2020 - June 2023)

367. An average of one unique cargo vessel was recorded every eight days across the data period. This varied across the years with 2020/2021 recording one vessel every nine days, 2021/2022 recording one vessel every six days, and 2022/2023 recording one vessel every 14 days.

368. Cargo vessels were primarily following the charted Galloper recommended route. Of the cargo vessels recorded, subtypes included: general cargo (80%), container cargo (13%), RoRo (5%), bulk carriers (2%) and one unique vehicle carrier.

369. As for passenger vessels, only five unique instances of a passenger vessel were recorded across the data period. Each of these transits were routeing south-east with three heading north-east around the Galloper wind farm. These three unique tracks were from one RoPax vessel (detailed further in Section 10.3.4.2.2) while the other two tracks were large sailing vessels.

370. Only one tanker was recorded within the data period on two unique transits both to and from the Isle of Grain (UK) on the same day in August 2020.

10.3.4.2.2 *Commercial Ferries*

371. Two unique RoRo vessels were recorded and illustrated in Figure 10-54. One RoRo was operated by StenaLine and was utilizing this route heading south-east on its Rotterdam (The Netherlands) —Harwich (UK) route. This was recorded on five unique instances across the data period. The second vessel, operated by DFDS Seaways was also routeing south-east on its Vlaardingen (The Netherlands) –

Felixstowe (UK) route. The majority of these transits correlate to periods of bad weather, particularly high winds, recorded by the Met Office (2023) and so could be a route used in adverse weather conditions. If so, the usage as an adverse weather route is considered extremely low with one commercial ferry on this route twice per year.

372. Seasonality is considered with peaks of higher counts recorded in the summer and early autumn months when compared to those winter months across the data period.

373. Noting commercial ferries, one RoPax vessel operated by StenaLine was also recorded routeing south-east on its route between Harwich (UK) – Hook of Holland (The Netherlands). The vessel was recorded on three occasions in early 2021 and again could be associated with adverse weather routeing. However, this vessel on each transit routes to the east and does not utilise the Galloper recommended route.

374. The overall findings align with consultation undertaken with Stena in December 2021 (see Section 4.3), where Stena representatives indicated that the Recommended Route is sometimes used during periods of heavy weather.

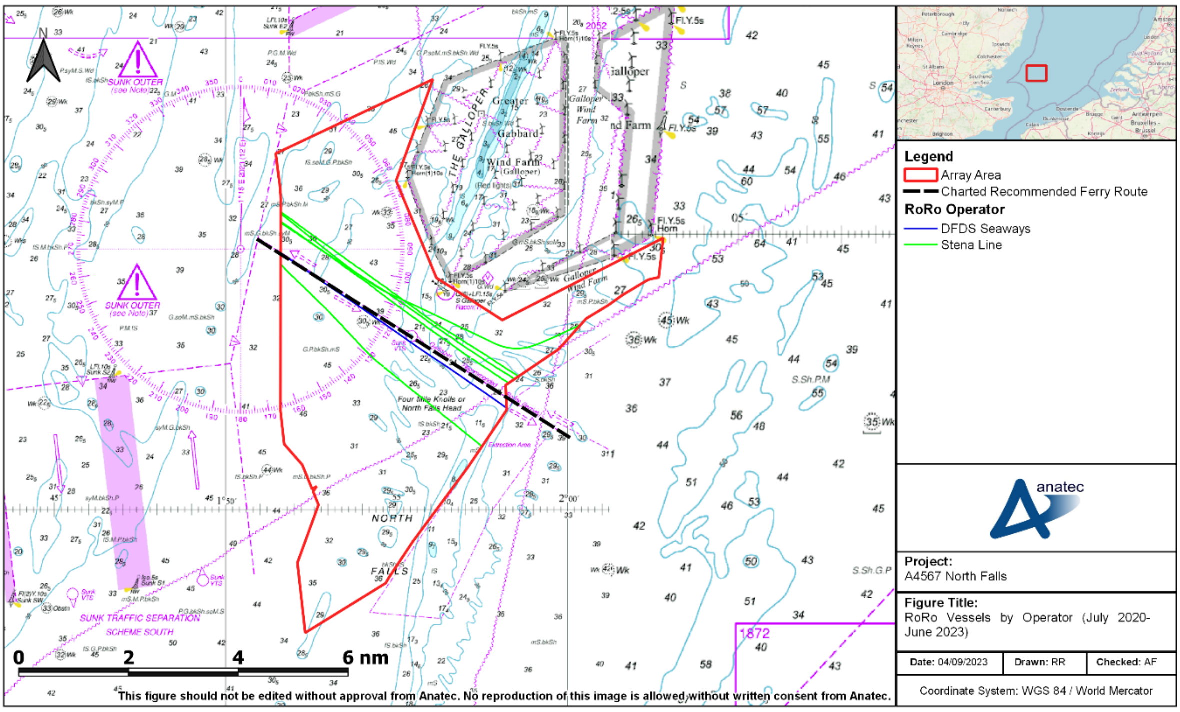

Figure 10-54 RoRo Vessels by Operator (July 2020 - June 2023)

10.3.4.2.3 *Dredger/Subsea Operations*

375. Dredger/subsea operation vessels recorded across the data period within the North Falls array area are presented in Figure 10-55.

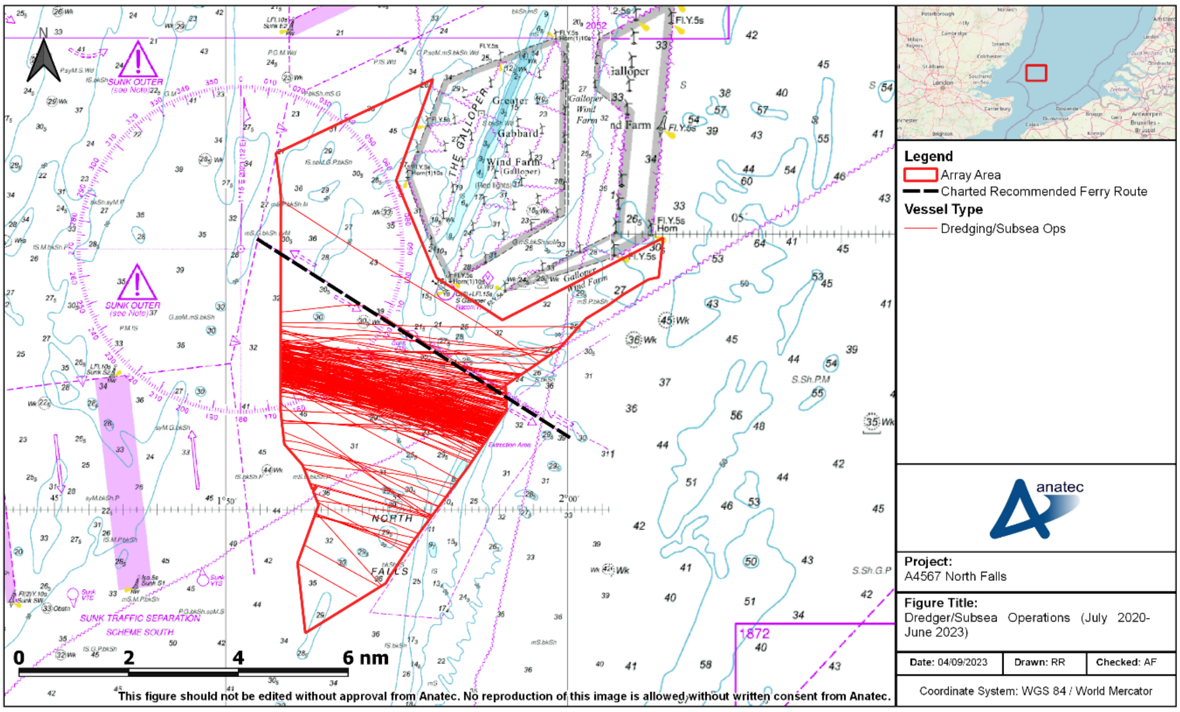

Figure 10-55 Dredger/Subsea Operations (July 2020 – June 2023)

376. An average of one unique dredger/subsea operations vessel was recorded every seven days (one per week) across the data period. This was consistent across the data period with only the first data year (2020/2021) recording slightly higher numbers at one unique vessel every five to six days.

377. Across the data period only six unique vessels were recorded with three vessels being hopper dredgers and the other three trailing suction hopper dredgers. Of these vessels one vessel accounted for over 56% of all tracks recorded.

378. As can be seen from Figure 10-55, based on bearing, vessels were not necessarily deliberately using the Galloper recommended route and were primarily on routes south of the Galloper recommended route. The routeing tended to be generally east/west north of the Sunk TSS South as opposed to transiting north-west south-east along the charted recommended ferry route.

379. There was no great seasonality in the presence of marine aggregate dredgers with greater average numbers recorded between June and December months with a peak also in the March months across the data period.

380. There would be no restriction on marine aggregate dredgers passing through the array (other than through active safety zones), however they may choose not to do so depending on the final layout of structures.

10.3.4.2.4 *Recreational Vessels*

381. An average of one unique recreational vessel was recorded every three days across the data period and so although recreational vessels were the most common vessel type, overall numbers are still considered to be relatively low. The 2022/2023 period was observed to be the busiest year for recreational vessels with one unique vessel being recorded every one to two days across the year. However, these values are due to recreational vessels being highly seasonal with vessels primarily being recorded in the summer months from May to August. Of all reactional vessels, 92% were recorded within these months across the data period.

382. Recreational vessels were recorded across the width of the array area with a particular dense route to the north of the Galloper recommended route where vessels are routeing to/from the north-east and keeping tight to the perimeter of the neighbouring Greater Gabbard. As for vessels on transit directly north-west south-east across the Galloper recommended route, 44% of all recreational vessels recorded were on transit within 1nm of the charted route. Of these vessels within 1nm, 32% were recorded transiting around the Galloper wind farm and only following the north-west south-east route while navigating the perimeter of the wind farm.

10.3.5 Pre-COVID Vessel Traffic Assessment

383. A year of vessel traffic data from March 2019 to March 2020 (introduced in Section 5.1 and presented in Section Annex B) has been analysed as supplementary information to the vessel traffic data outlined previously in Section 10.3.4.1. This period was carefully selected for NRA purposes to avoid COVID and to identify more typically representative vessel traffic activity.

384. Similar to the data period, dredgers/subsea operation vessels were observed to bypass the recommended route and transit west over the neighbouring TSS. Fishing vessels, recreational vessels, and several commercial vessels were noted transiting close to or on the Galloper recommended route. Given the transiting nature of fishing vessels and recreational vessels it is likely they are simply on transit in the area and avoiding the busy commercial traffic of the TSSs and not intentionally using the recommended ferry route.

385. As for the commercial vessels, one unique tanker and several cargo vessels were recorded in proximity to the Galloper recommended route, however, no RoRo vessels were recorded. There was one RoPax vessel operated by Stena Line recorded passing over the route on four unique occasions during the month of February 2022. This vessel was routeing south-east to Hook of Holland (the Netherlands) from Harwich (UK) on each occasion. Each of these instances align with periods of extreme weather and Met Office recorded storms (Met Office, 2023) and so could be utilising the route as an adverse weather deviation. No record of this vessel on this route was recorded again throughout the data period.

11 Base Case Vessel Routeing

11.1 Definition of a Main Commercial Route

386. Main commercial routes have been identified using the principles set out in MGN 654 (MCA, 2021). Vessel traffic data are assessed and vessels transiting at similar headings and locations are identified as a main route. To help identify main routes, vessel traffic data can also be interrogated to show vessels (by name and/or operator) that frequently transit those routes. The route width is then calculated using the 90th percentile rule from the mean line of the potential shipping route as shown in Figure 11-1.

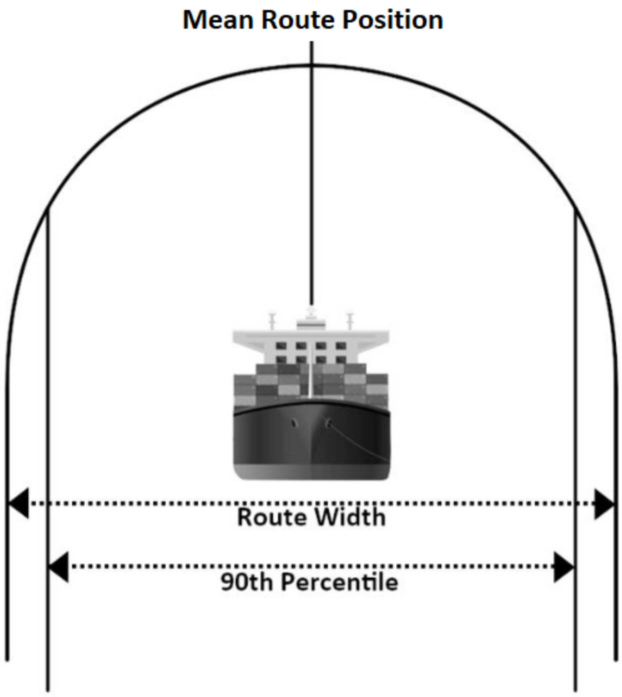

Figure 11-1 Illustration of Main Route Calculation

11.2 Pre Wind Farm Main Commercial Routes

387. A total of 43 main commercial routes were identified within the study area from the long-term vessel traffic dataset. This section details the 16 highest use main commercial routes with additional “medium use” and “low use” main commercial routes detailed further in Annex E.

388. For clarity, these routes have been grouped based on traffic volumes, but with the vessel traffic density associated with all routeing included in each case. The main commercial routes have been split into high use, medium use, and low use again based on traffic volumes. The 16 high use main commercial vessel routes (more than 2 transits per day) are presented in Figure 11-2 relative to the study area and described in Table 11.1.

389. Routes identified with less than one transit every two days (less than four per week) have not been shown. However, they are accounted for in the collision and allision risk modelling (see Section 15).

390. It is noted that further consideration of the Sunk DW route, Trinity DW route, and Harwich approach are provided in Section 10.2.3.2.1.

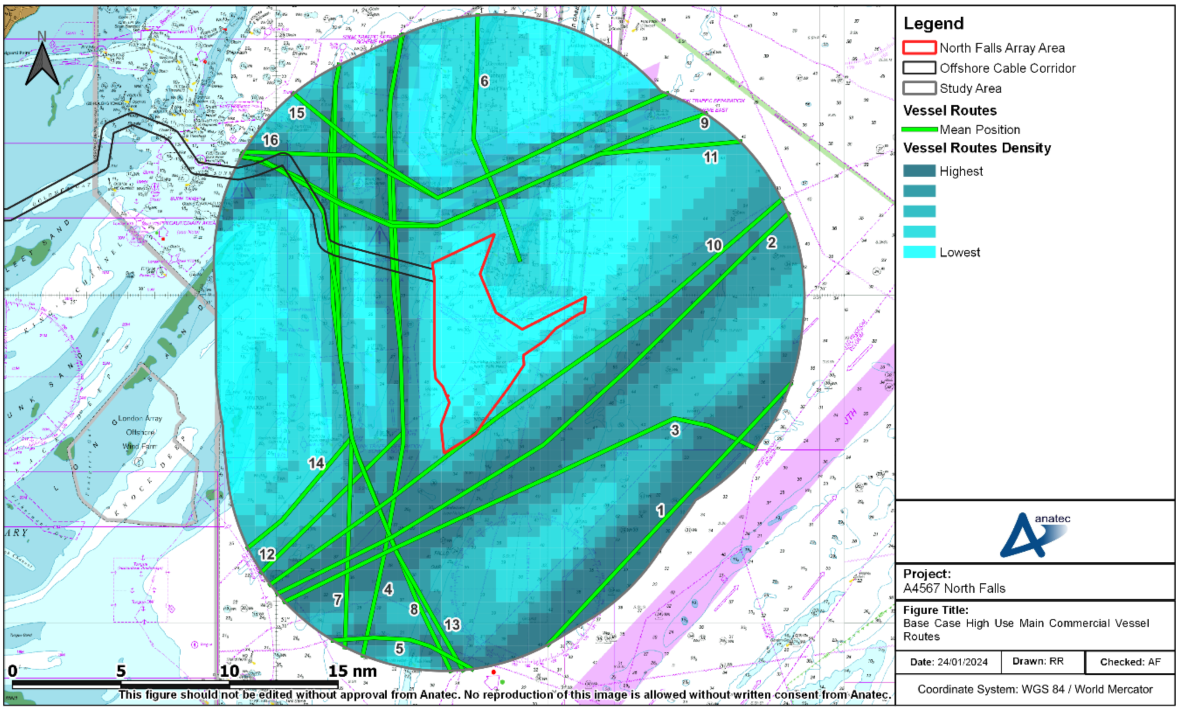

Figure 11-2 Base Case High Use Main Commercial Vessel Routes

Table 11.1 Description of High Use Main Commercial Routes

Route Number	Average Vessels per Day	Average Vessels per Week	Description
1	73[10]	513	**Eastern Europe Ports – Dover Strait via the North Hinder TSS Southbound Lane**. Generally used by cargo vessels (61%) and tankers (34%).
2	26	181	**Zeebrugge (Belgium) – River Thames Ports (UK).** Generally used by cargo vessels (80%).
3	13	90	**Zeebrugge (Belgium) – Tilbury/Purfleet (UK).** Generally used by cargo vessels (94%).

[10] It is noted that the traffic data studied does not cover the entirety of the North Hinder TSS. Consideration has therefore been given to other datasets referenced in Section 5 and conservative assumptions have been made. It is noted that the estimated traffic volumes also broadly align with those estimated in the Shipping Analysis of the North Sea undertaken by AqualisBraemar (2021).

Route Number	Average Vessels per Day	Average Vessels per Week	Description
4	9	64	**Dover Strait – Felixstowe (UK) via Sunk TSS South Northbound Lane.** Generally used by cargo vessels (59%) and tankers (20%).
5	9	62	**Belgium/The Netherlands Ports – River Thames Ports (UK)** Generally used by cargo vessels (65%) and tankers (28%).
6	9	61	**Greater Gabbard Offshore Wind Farm (UK) - Lowestoft (UK).** Only used by wind farm vessels (100%).
7	5	34	**Sunk TSS North – Dover Strait via Sunk TSS South Southbound Lane.** Generally used by cargo vessels (60%) tankers (16%) and marine aggregate dredgers (15%).
8	5	32	**Sunk TSS North – West Hinder TSS via Sunk TSS South Southbound Lane.** Generally used by cargo vessels (61%) and marine aggregate dredgers (22%).
9	5	32	**Felixstowe (UK) – Hamburg (Germany)/Rotterdam (The Netherlands) via Sunk TSS East Eastbound Lane.** Generally used by cargo vessels (74%) and passenger vessels (18%).
10	3	22	**Tilbury/Purfleet (UK) - Rotterdam (The Netherlands).** Generally used by cargo vessels (87%).
11	3	19	**Harwich (UK) - Hook of Holland/Rotterdam (The Netherlands) via Sunk TSS East Eastbound Lane.** Generally used by cargo vessels (50%) and passenger vessels (42%).
12	3	18	**River Thames Ports (UK) – Jelsa (Norway) and North Sea Dredge Areas via Sunk TSS South Northbound Lane.** Generally used by cargo vessels (43%) and marine aggregate dredgers (37%).
13	3	18	**Felixstowe/London Gateway (UK) - Antwerp (Belgium) via Sunk TSS South Southbound Lane.** Generally used by cargo vessels (94%).
14	2-3	17	**North Sea Dredge Areas – Charlton/Dagenham (UK) via Sunk TSS South Southbound Lane.** Generally used by marine aggregate dredgers (62%) and cargo vessels (23%).
15	2-3	16	**German Ports/Rotterdam (The Netherlands) - Felixstowe/London Gateway (UK) via Sunk TSS East Westbound Lane.** Generally used by cargo vessels (72%) tankers (24%).
16	2-3	16	**German Ports/Rotterdam (The Netherlands) - Felixstowe/London Gateway (UK) via Sunk TSS East Westbound Lane.** Generally used by cargo vessels (79%).

11.3 Adverse Weather Routeing

391. Certain vessels and vessel operators currently operate alternative routes during periods of adverse weather after considering weather forecasts, as part of the

passage planning process required by Chapter V of the SOLAS Chapter V (IMO, 1974). Such routeing tends to be infrequent.

392. Adverse weather includes wind, wave, and tidal conditions as well as reduced visibility due to fog that can hinder a vessel's standard route, speed of navigation and/or ability to enter the destination port. Adverse weather routes are assessed to be significant course adjustments to mitigate vessel motion in adverse weather conditions. When transiting in adverse weather conditions, a vessel is likely to encounter various types of weather and tidal phenomena, which may lead to severe roll motions, potentially causing damage to cargo, equipment and/or discomfort and danger to persons on board. The sensitivity of a vessel to these phenomena will depend upon the actual stability parameters, hull geometry, vessel type, vessel size and speed.

11.3.1 Commercial Vessels

393. As per Section 10.3, StenaLine indicated during consultation a preference for use of the Original Galloper Recommended Route during certain periods of adverse weather. However, they also confirmed that use of the Sunk TSS South lanes was a safe alternative, albeit less preferable than the Original Galloper Recommended Route.

11.3.2 Small Craft use of Safe Havens

394. No clear evidence of safe haven use has been observed within the available vessel traffic data, and no concerns have been raised during consultation with the RYA and Cruising Association.

395. As per SOLAS Chapter V (IMO, 1974), all vessels at sea are required to passage plan and part of the passage planning process requires them to consider forecast weather conditions. It is anticipated that vessels would then take account of these forecasts prior to embarking on a passage in proximity to the array area.

12 Navigation, Communication and Position Fixing Equipment

396. This section discusses the potential effects on the use of navigation, communication and position fixing equipment of vessels that may arise due to the infrastructure associated with the Project.

12.1 Very High Frequency Communications (including Digital Selective Calling)

397. In 2004, trials were undertaken at the North Hoyle Offshore Wind Farm, located off the coast of North Wales. As part of these trials, tests were undertaken to evaluate the operational use of typical small vessel VHF transceivers (including Digital Selective Calling (DSC)) when operated close to WTGs.

398. The WTGs had no noticeable effect on voice communications within the array or ashore. It was noted that if small craft vessel to vessel and vessel to shore communications were not affected significantly by the presence of WTGs, then it is reasonable to assume that larger vessels with higher powered and more efficient systems would also be unaffected.

399. During this trial, a number of telephone calls were made from ashore, both within and offshore of the array area. No effects were recorded using any system provider (MCA and QinetiQ, 2004).

400. Furthermore, as part of SAR trials carried out at the North Hoyle Offshore Wind Farm in 2005, radio checks were undertaken between the Sea King helicopter and both Holyhead and Liverpool coastguards. The aircraft was positioned to offshore of the array area and communications were reported as very clear, with no apparent degradation of performance. Communications with the service vessel located within the array were also fully satisfactory throughout the trial (MCA, 2005).

401. In addition to the North Hoyle trials, a desk-based study was undertaken for the Horns Rev 3 Offshore Wind Farm in Denmark in 2014 and it was concluded that there were not expected to be any conflicts between point-to-point radio communications networks and no interference upon VHF communications (Energinet, 2014).

402. Following consideration of these reports and noting that since the trials detailed above there have been no significant issues with regards to VHF observed or reported, the presence of the Project is anticipated to have no significant impact upon VHF communications.

12.2 Very High Frequency Direction Finding

403. During the North Hoyle Offshore Wind Farm trials in 2004, the VHF Direction Finding (DF) equipment carried in the trial boats did not function correctly when very close to WTGs (within approximately 50m). This is deemed to be a relatively small-scale impact due to the limited use of VHF direction finding equipment and will not impact operational or SAR activities (MCA and QinetiQ, 2004).

404. Throughout the 2005 SAR trials carried out at North Hoyle, the Sea King radio homer system was tested. The Sea King radio homer system utilises the lateral displacement of a vertical bar on an instrument to indicate the sense of a target relative to the aircraft heading. With the aircraft and the target vessel within the array, at a range of approximately 1nm, the homer system operated as expected with no apparent degradation.

405. Since the trials detailed above, no significant issues with regards to VHF DF have been observed or reported, and therefore the presence of the Project is anticipated to have no significant impact upon VHF DF equipment.

12.3 Automatic Identification System

406. No significant issues with interference to AIS transmission from operational offshore wind farms have been observed or reported to date. Such interference was also absent in the trials carried out at the North Hoyle Offshore Wind Farm (MCA and QinetiQ, 2004).

407. In theory there could be interference when there is a structure located between the transmitting and receiving antennas (i.e., blocking line of sight) of the AIS. However, given no issues have been reported to date at operational developments or during trials, no significant impact is anticipated due to the presence of the Project.

12.4 Navigational Telex System

408. The Navigational Telex (NAVTEX) system is used for the automatic broadcast of localised Maritime Safety Information (MSI) and either prints it out in hard copy or displays it on a screen, depending upon the model.

409. There are two NAVTEX frequencies. All transmissions on NAVTEX 518 Kilohertz (kHz), the international channel, are in English. NAVTEX 518 kHz provides the mariner (both recreational and commercial) with weather forecasts, severe weather warnings and navigation warnings such as obstructions or buoys off station. Depending on the user's location, other information options may be available such as ice warnings for high latitude sailing.

410. The 490 kHz national NAVTEX service may be transmitted in the local language. In the UK full use is made of this secondary frequency including useful information for smaller craft, such as the inshore waters forecast and actual weather observations from weather stations around the coast.

411. Although no specific trials have been undertaken, no significant effect on NAVTEX has been reported to date at operational developments, and therefore no significant impact is anticipated due to the presence of the Project.

12.5 Global Positioning System

412. Global Positioning System (GPS) is a satellite based navigational system. GPS trials were also undertaken throughout the 2004 trials at North Hoyle Offshore Wind Farm and it was stated that "*no problems with basic GPS reception or positional accuracy were reported during the trials*".

413. The additional tests showed that "even with a very close proximity of a wind turbine to the GPS antenna, there were always enough satellites elsewhere in the sky to cover for any that might be shadowed by the wind turbine tower" (MCA and QinetiQ, 2004).

414. Therefore, there are not expected to be any significant impacts associated with the use of GPS systems within or in proximity to the Project, noting that there have been no reported issues relating to GPS within or in proximity to any operational offshore wind farms to date.

12.6 Electromagnetic Interference

415. A compass, magnetic compass or mariner's compass is a navigational instrument for determining direction relative to the earth's magnetic poles. It consists of a magnetised pointer (usually marked on the north end) free to align itself with the Earth's magnetic field. A compass can be used to calculate heading, used with a sextant to calculate latitude, and with a marine chronometer to calculate longitude.

416. Like any magnetic device, compasses are affected by nearby ferrous materials as well as by strong local electromagnetic forces, such as magnetic fields emitted from power cables. As the compass still serves as an essential means of navigation in the event of power loss or as a secondary source, it is important that potential impacts from Electromagnetic Field (EMF) are minimised to ensure continued safe navigation.

417. The vast majority of commercial traffic uses non-magnetic gyrocompasses as the primary means of navigation, which are unaffected by EMF. Therefore, it is considered highly unlikely that any interference from EMF as a result of the presence the Project will have a significant impact on vessel navigation. However, some smaller craft (fishing or leisure) may rely on it as their sole means of navigation.

12.6.1 Subsea Cables

418. The sub-sea cables (export cables (under options 1 and 2), array cables and platform interconnector cable) for the Project will be Alternating Current (AC), with studies indicating that AC does not emit an EMF significant enough to impact marine magnetic compasses (Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR), 2008). Therefore, electromagnetic interference due to cables associated with the Project are not considered any further.

12.6.2 Wind Turbine Generators

419. MGN 654 (MCA, 2021) notes that small vessels with simple magnetic steering and hand bearing compasses should be wary of using these close to WTGs as with any structure in which there is a large amount of ferrous material (MCA and QinetiQ, 2004). Potential effects are deemed to be within acceptable levels when considered alongside other mitigation such as the mariner being able to make visual observations (not wholly reliant on the magnetic compass), lighting, sound signals and identification marking in line with MGN 654.

12.6.3 Experience at Operational Offshore Wind Farms

420. No issues with respect to magnetic compasses have been reported to date in any of the trials (MCA and QinetiQ, 2004) undertaken (inclusive of SAR helicopters) nor in any published reports from operational offshore wind farms.

12.7 Marine Radar

421. This section summarises the results of trials and studies undertaken in relation to Radar effects from offshore wind farms in the UK. It is important to note that since the time of the trials and studies discussed, WTG technology has advanced significantly, most notably in terms of the size of WTGs available to be installed and utilised. The use of these larger WTGs allows for a greater spacing between WTGs than was achievable at the time of the studies being undertaken, which is beneficial in terms of Radar interference effects (and surface navigation in general) as detailed below.

12.7.1 Trials

422. During the early years of offshore renewables within the UK, maritime regulators undertook a number of trials (both shore-based and vessel-based) into the effects of WTGs on the use and effectiveness of marine Radar.

423. In 2004 trials undertaken at the North Hoyle Offshore Wind Farm (MCA, 2005) identified areas of concern regarding the potential impact on marine- and shore-based Radar systems due to the large vertical extents of the WTGs (based on the technology at that time). This resulted in Radar responses strong enough to produce interfering side lobes and reflected echoes (often referred to as false targets or ghosts).

424. Side lobe patterns are produced by small amounts of energy from the transmitted pulses that are radiated outside of the narrow main beam. The effects of side lobes are most noticeable within targets at short range (below 1.5nm) and with large objects. Side lobe echoes form either an arc on the Radar screen similar to range rings, or a series of echoes forming a broken arc, as illustrated in Figure 12-1.

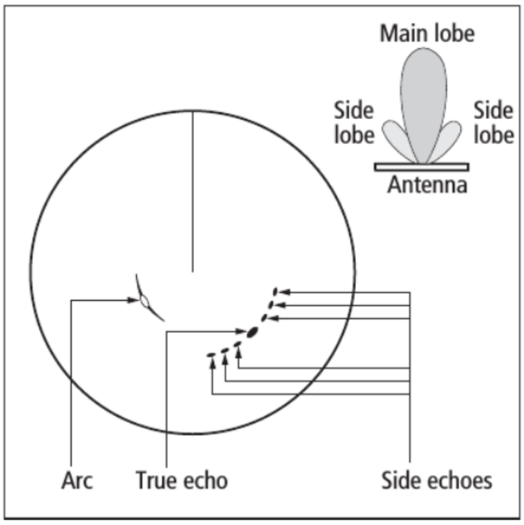

Figure 12-1 Illustration of side lobes on Radar screen

425. Multiple reflected echoes are returned from a real target by reflection from some object in the Radar beam. Indirect echoes or 'ghost' images have the appearance of true echoes but are usually intermittent or poorly defined; such echoes appear at a false bearing and false range, as illustrated in Figure 12-2.

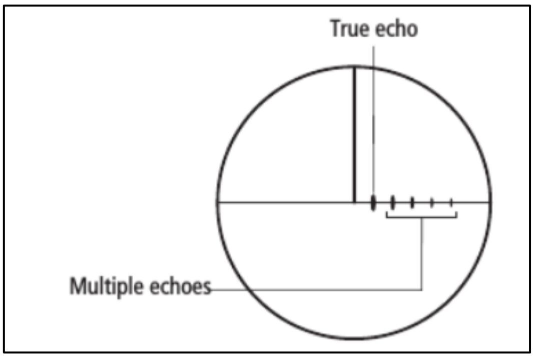

Figure 12-2 Illustration of multiple reflected echoes on Radar screen

426. Based on the results of the North Hoyle trials, the MCA produced a Shipping Route Template designed to give guidance to mariners on the distances which should be established between shipping routes and offshore wind farms. However, as experience of effects associated with use of marine Radar in proximity to offshore wind farms grew, the MCA refined their guidance, offering more flexibility within the most recent Shipping Route Template contained within MGN 654 (MCA, 2021).

427. A second set of trials conducted at Kentish Flats Offshore Wind Farm in 2006 on behalf of the British Wind Energy Association (BWEA) – now called RenewableUK (BWEA, 2007) – also found that Radar antennas which are sited unfavourably with respect to components of the vessel's structure can exacerbate effects such as side lobes and reflected echoes. Careful adjustment of Radar controls suppressed these spurious Radar returns but mariners were warned that there is a consequent risk of

losing targets with a small Radar cross section, which may include buoys or small craft, particularly yachts or Glass Reinforced Plastic (GRP) constructed craft; therefore due care should be taken in making such adjustments.

428. Theoretical modelling of the effects of the development of the proposed Atlantic Array Offshore Wind Farm, which was to be located off the south coast of Wales, on marine Radar systems was undertaken by the Atlantic Array project (Atlantic Array, 2012) and considered a wider spacing of WTGs than that considered within the early trials[11]. The main outcomes of the modelling were the following:

- Multiple and indirect echoes were detected under all modelled parameters;
- The main effects noticed were stretching of targets in azimuth (horizontal) and appearance of ghost targets;
- There was a significant amount of clear space amongst the returns to ensure recognition of vessels moving amongst the WTGs and safe navigation;
- Even in the worst case with Radar operator settings artificially set to be poor, there is significant clear space around each WTG that does not contain any multipath or side lobe ambiguities to ensure safe navigation and allow differentiation between false and real (both static and moving) targets;
- Overall it was concluded that the amount of shadowing observed was very little (noting that the model considered lattice-type foundations which are sufficiently sparse to allow Radar energy to pass through);
- The lower the density of WTGs the easier it is to interpret the Radar returns and fewer multipath ambiguities are present;
- In dense, target rich environments S-Band Radar scanners suffer more severely from multipath effects in comparison to X-Band Radar scanners;
- It is important for passing vessels to keep a reasonable separation distance between the WTGs in order to minimise the effect of multipath and other ambiguities;
- The Atlantic Array study undertaken in 2012 noted that the potential for Radar interference was mainly a problem during periods of reduced visibility when mariners may not be able to visually confirm the presence of other vessels in proximity (those without AIS installed which are usually fishing and recreational craft). It is noted that this situation would arise with or without WTGs in place; and
- There is potential for the performance of a vessel's ARPA to be affected when tracking targets in or near the array. Although greater vigilance is required, during the Kentish Flats trials it was shown that false targets were quickly identified as such by the mariners and then by the equipment itself.

429. In summary, experience in UK waters has shown that mariners have become increasingly aware of any Radar effects as more offshore wind farms become operational. Based on this experience, the mariner can interpret the effects

[11] It is acknowledged that other theoretical analysis has been undertaken.

correctly, noting that effects are the same as those experienced by mariners in other environments such as in close proximity to other vessels or structures. Effects can be effectively mitigated by "*careful adjustment of Radar controls*".

430. The MCA has also produced guidance to mariners operating in proximity to OREIs in the UK which highlights Radar issues amongst others to be taken into account when planning and undertaking voyages in proximity to OREIs (MCA, 2008). The interference buffers presented in Table 12.1 are based on MGN 654 (MCA, 2021), MGN 371 (MCA, 2008), MGN 543 (MCA, 2016) and MGN 372 (MCA, 2008), and MGN 372 Amendment 1 (MCA, 2022).

Table 12.1 Distances at which impacts on marine Radar occur

Distance at Which Effect Occurs (nm)	Identified Effects
0.5	▪ Intolerable impacts can be experienced. ▪ X-Band Radar interference is intolerable under 0.25nm. ▪ Vessels may generate multiple echoes on shore-based Radars under 0.45nm.
1.5	▪ Under MGN 654, impacts on Radar are considered to be tolerable with mitigation between 0.5 and 3.5nm. ▪ S-band Radar interference starts at 1.5nm. ▪ Echoes develop at approximately 1.5nm, with progressive deterioration in the Radar display as the range closes. Where a main vessel route passes within this range considerable interference may be expected along a line of WTGs. ▪ The WTGs produce strong Radar echoes giving early warning of their presence. ▪ Target size of the WTG echo increases close to the WTG with a consequent degradation on both X and S-Band Radars.

431. As noted in Table 12.1, the onset range from the WTGs of false returns is approximately 1.5nm, with progressive deterioration in the Radar display as the range closes. If interfering echoes develop, the requirements of the Convention on International Regulations for Preventing Collisions at Sea (COLREGs) *Rule 6 Safe Speed* are particularly applicable and must be observed with due regard to the prevailing circumstances (IMO, 1972/77). In restricted visibility, *Rule 19 Conduct of Vessels in Restricted Visibility* applies and compliance with *Rule 6* becomes especially relevant. In such conditions mariners are required, under *Rule 5 Look-out* to take into account information from other sources which may include sound signals and VHF information, for example from a VTS or AIS (MCA, 2016).

12.7.2 Experience from Operational Developments

432. The evidence from mariners operating in proximity to existing offshore wind farms is that they quickly learn to adapt to any effects. Figure 12-3 presents the example of the Galloper and Greater Gabbard Offshore Wind Farms, which are located in proximity to the same IMO routeing measures as the array area. Despite this proximity to the TSS lanes, there have been no reported incidents or issues raised by mariners who operate within the vicinity. This aligns with input received by Stena Line (see Section 4), who stated of potential impacts on radar from offshore wind farms that *"they can be dealt with in practice using appropriate radar settings".*

433. The interference buffers presented in Figure 12-3 are as per Table 12.1.

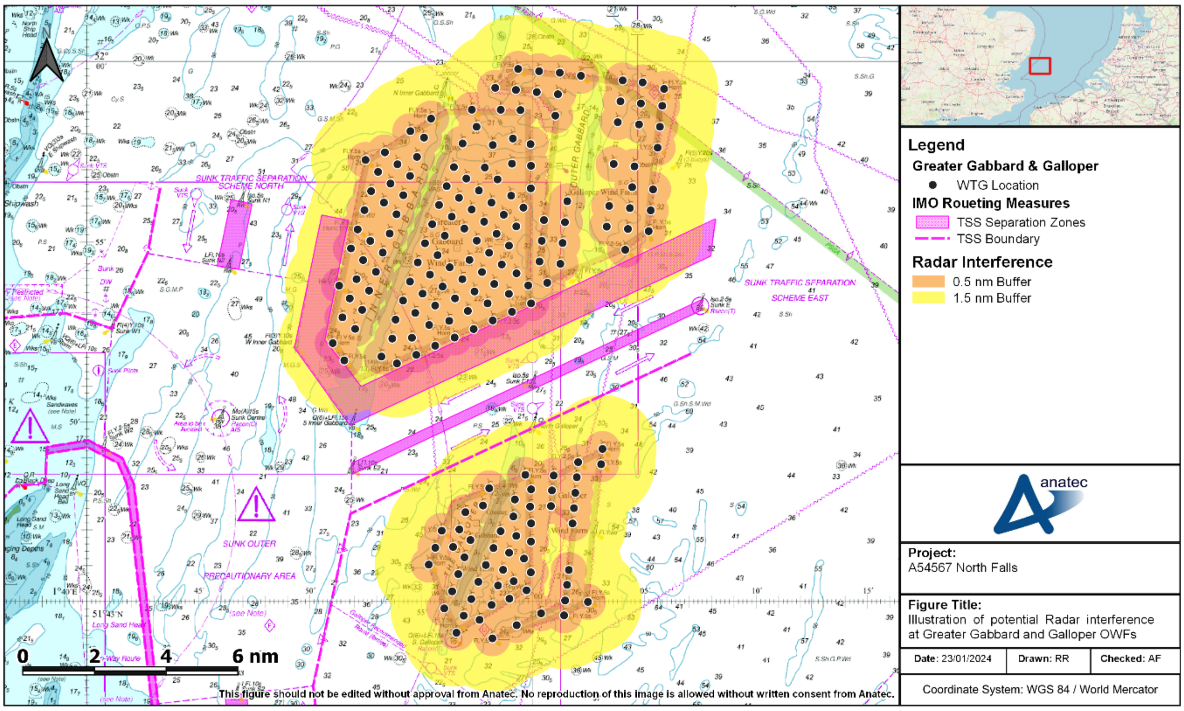

Figure 12-3 Illustration of potential Radar interference at Greater Gabbard and Galloper Offshore Wind Farms

434. As indicated by Figure 12-3, vessels utilising these Sunk TSS East lanes will experience some Radar interference based on the available guidance. Both developments are operational, and each of the lanes is used by an average of up to five vessels per day on average. However, to date, there have been no incidents recorded (including any related to Radar use) or concerns raised by the users.

435. AIS information can also be used to verify the targets of larger vessels (generally vessels over 15m LOA – the minimum threshold for fishing vessel AIS carriage requirements). Approximately 3% of the marine traffic recorded within the study area was under 15m LOA, although throughout the vessel traffic surveys > 99% of vessel tracks were recorded on AIS, indicating a high level of AIS take-up among

vessels for which AIS carriage is not mandatory. It is also noted that all vessels which are currently passing within the TSS lanes in proximity to Greater Gabbard and Galloper will be the exact same vessels passing the Project and so would be at no greater risk of Radar interference.

436. For any smaller vessels, particularly fishing vessels and recreational vessels, AIS Class B devices are becoming increasingly popular and allow the position of these small craft to be verified when in proximity to an offshore wind farm.

12.7.3 Increased Radar Returns

437. Beam width is the angular width, horizontal or vertical, of the path taken by the Radar pulse. Horizontal beam width ranges from 0.75° to 5°, and vertical beam width from 20° to 25°. How well an object reflects energy back towards the Radar depends upon its size, shape and aspect angle.

438. Larger WTGs (either in height or width) will return greater target sizes and/or stronger false targets. However, there is a limit to which the vertical beam width would be affected (20° to 25°) dependent upon the distance from the target. Therefore, increased WTG height in the array will not create any effects in addition to those already identified from existing operational wind farms (interfering side lobes, multiple and reflected echoes).

439. Again, when taking into consideration the potential options available to marine users (such as reducing gain to remove false returns) and feedback from operational experience, this shows that the effects of increased returns can be managed effectively.

12.7.4 Fixed Radar Antenna Use in proximity to an Operational Wind Farm

440. It is noted that there are multiple operational wind farms including the local Galloper project that successfully operate fixed Radar antenna from locations on the periphery of the array. These antennas are able to provide accurate and useful information to onshore coordination centres.

12.7.5 Application to the Project

441. Upon development of the Project, some commercial vessels may pass within 1.5nm of the wind farm structures and therefore may be subject to a minor level of Radar interference. Trials, modelling and experience from existing developments note that any impact can be mitigated by adjustment of Radar controls.

442. Figure 12-4 presents an illustration of potential Radar interference due to the Project. The Radar effects have been applied to the indicative array layout introduced in Section 6.

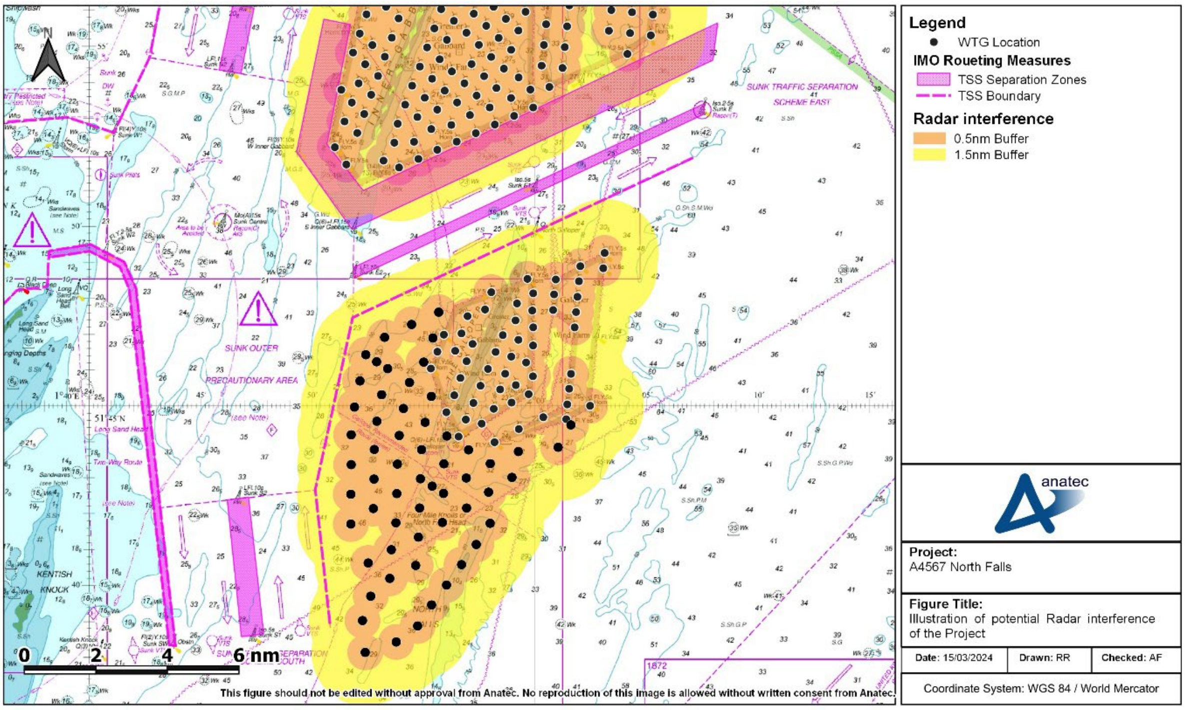

Figure 12-4 Illustration of potential Radar interference at the Project

443. Vessels passing within the array will be subject to a greater level of interference with impacts becoming more substantial in close proximity to WTGs. This will require additional mitigation by any vessels including consideration of the navigational conditions (visibility) when passage planning and compliance with the COLREGs (IMO, 1972/77) will be essential.

444. Overall, the impact on marine Radar due to the Project in isolation (with existing developments) is expected to be low and no further impact upon navigational safety is anticipated outside the parameters which can be mitigated by operational controls. This aligns with input received by Stena Line (see Section 4), who stated of potential impacts on radar from offshore wind farms that "*they can be dealt with in practice using appropriate radar settings*".

12.8 Sound Navigation Ranging Systems

445. No evidence has been found to date with regard to existing offshore wind farms to suggest that Sound Navigation Ranging (SONAR) systems produce any kind of SONAR interference which is detrimental to the fishing industry, or to military systems. No impact is therefore anticipated in relation to the presence of the Project.

12.9 Noise

446. No evidence has been found to date with regard to existing offshore wind farms to suggest that prescribed sound signals are in any way impacted by acoustic noise produced by the wind farm.

12.10 Summary of Potential Effects on Use

447. Based on the detailed technical assessment of the effects due to the presence of the Project on navigation, communication and position fixing equipment in the previous subsections, Figure 12-2 summarises the assessment of frequency and consequence and the resulting risk for each component of this impact.

Table 12.2 Summary of risk to navigation, communication and position fixing equipment

Topic	Frequency	Consequence	Significance of Risk
VHF	Negligible	Minor	Broadly Acceptable
VHF direction finding	Extremely Unlikely	Minor	Broadly Acceptable
AIS	Negligible	Minor	Broadly Acceptable
NAVTEX	Negligible	Minor	Broadly Acceptable
GPS	Negligible	Minor	Broadly Acceptable
EMF	Extremely Unlikely	Negligible	Broadly Acceptable
Marine Radar	Remote	Minor	Broadly Acceptable
SONAR	Negligible	Minor	Broadly Acceptable
Noise	Negligible	Minor	Broadly Acceptable

13 Cumulative and Transboundary Overview

448. Potential cumulative effects have been considered for activities in combination and cumulatively with the Project. This section provides an overview of the developments and projects that have been screened into the cumulative impact assessment based on the criteria provided in Section 3.3.

449. Following this, the developments are shown in Table 13.1, colour coded by cumulative tier.

Table 13.1 Cumulative Screening Summary

Project	Type	Status	Distance from Array Area (nm)	Distance from Cable Corridor (nm)	Data Confidence	Screening	Rationale	Tier
Five Estuaries	Offshore Wind Farm	Pre Planning	0	0.7	Medium	Screened in	Offshore wind farm within 10nm, interaction with main routes	1
Dunkerque	Offshore Wind Farm	In Planning	31.8	39	Medium	Screened In	Offshore wind farm within 50nm, no interaction with main routes	3
East Anglia TWO	Offshore Wind Farm	Consented	16.9	20.3	High	Screened in	Offshore wind farm within 50nm, no interaction with main routes	3
East Anglia ONE NORTH	Offshore Wind Farm	Consented	34	36	High	Screened in	Offshore wind farm within 50nm, no interaction with main routes	3
NeuConnect Interconnector	Subsea Cable	Pre Construction	1.3	0	High	Screened in	Interconnector between UK and Germany in proximity to the Project.	1
Nautilus Interconnector	Subsea Cable	Pre Application	Cable route unknown	Cable route unknown	Low	Screened in	The offshore study area for Nautilus intersects with the Project. Therefore, there is potential for cumulative effects, subject to the final location and programme for the interconnector.	3
Sea Link	Subsea Cable	Pre Application	2.9	0	Medium	Screened in	The emerging preferred and alternative routes for Sea Link intersect with the offshore cable corridor.	1

Project	Type	Status	Distance from Array Area (nm)	Distance from Cable Corridor (nm)	Data Confidence	Screening	Rationale	Tier
Tarchon Energy Interconnector	Subsea Cable	Pre Planning	Cable route unknown	Cable route unknown	Low	Screened in	Interconnector between UK and Germany with potential to be in proximity to the Project.	3
BritNed Interconnector	Subsea Cable	Operational	0	5	High	Screened out	Baseline	n/a
Offshore Wind Farm Borssele I	Offshore Wind Farm	Operational	34.5	41.5	High	Screened out	Baseline	n/a
Offshore Wind Farm Borssele II	Offshore Wind Farm	Operational	37.3	44.3	High	Screened out	Baseline	n/a
Offshore Wind Farm Borssele III	Offshore Wind Farm	Operational	31.7	38.7	High	Screened out	Baseline	n/a
Offshore Wind Farm Borssele IV	Offshore Wind Farm	Operational	27.0	34.0	High	Screened out	Baseline	n/a
Borssele Kavel V	Offshore Wind Farm	Operational	35.4	42.3	High	Screened out	Baseline	n/a
Borssele	Offshore Wind Farm	In Planning	27.0	33.9	Low	Screened out	Low data confidence, no interaction with main routes	n/a
Hollandse Kust F	Offshore Wind Farm	In Planning	47.7	53.5	Low	Screened out	Low data confidence, no interaction with main routes	n/a
Northwind	Offshore Wind Farm	Operational	31.5	38.5	High	Screened out	Baseline	n/a

Project	Type	Status	Distance from Array Area (nm)	Distance from Cable Corridor (nm)	Data Confidence	Screening	Rationale	Tier
Belwind phase 1	Offshore Wind Farm	Operational	27.8	34.8	High	Screened out	Baseline	n/a
Rentel	Offshore Wind Farm	Operational	32.7	39.7	High	Screened out	Baseline	n/a
Norther	Offshore Wind Farm	Operational	36.0	42.9	High	Screened out	Baseline	n/a
Seastar	Offshore Wind Farm	Operational	29.7	36.7	High	Screened out	Baseline	n/a
Mermaid	Offshore Wind Farm	Operational	24.7	31.7	High	Screened out	Baseline	n/a
Northwester 2	Offshore Wind Farm	Operational	25.4	32.4	High	Screened out	Baseline	n/a
C-Power (Zone A)	Offshore Wind Farm	Operational	33.4	40.3	High	Screened out	Baseline	n/a
C-Power (Zone B)	Offshore Wind Farm	Operational	35.6	42.5	High	Screened out	Baseline	n/a
Belwind phase 2 (Nobelwind) (Zone 2)	Offshore Wind Farm	Operational	28.7	35.7	High	Screened out	Baseline	n/a
Belwind phase 2 (Nobelwind) (Zone 1)	Offshore Wind Farm	Operational	27.1	34.4	High	Screened out	Baseline	n/a
Borssele Kavel II	Offshore Wind Farm	Operational	37.3	44.3	High	Screened out	Baseline	n/a

Project	Type	Status	Distance from Array Area (nm)	Distance from Cable Corridor (nm)	Data Confidence	Screening	Rationale	Tier
Borssele Kavel III	Offshore Wind Farm	Operational	31.7	38.7	High	Screened out	Baseline	n/a
Borssele Kavel IV	Offshore Wind Farm	Operational	27.0	34.0	High	Screened out	Baseline	n/a
Borssele Kavel I	Offshore Wind Farm	Operational	34.5	41.5	High	Screened out	Baseline	n/a
Gunfleet Sands I	Offshore Wind Farm	Operational	22.4	3.2	High	Screened out	Baseline	n/a
Gunfleet Sands II	Offshore Wind Farm	Operational	21.0	3.5	High	Screened out	Baseline	n/a
Gunfleet Sands Demo	Offshore Wind Farm	Operational	24.3	5.7	High	Screened out	Baseline	n/a
Kentish Flats	Offshore Wind Farm	Operational	29.7	20.5	High	Screened out	Baseline	n/a
Kentish Flats Extension	Offshore Wind Farm	Operational	29.7	21.4	High	Screened out	Baseline	n/a
London Array	Offshore Wind Farm	Operational	11.1	8.8	High	Screened out	Baseline	n/a
Thanet	Offshore Wind Farm	Operational	13.4	19.4	High	Screened out	Baseline	n/a
Greater Gabbard	Offshore Wind Farm	Operational	0	2.1	High	Screened out	Baseline	n/a

Project	Type	Status	Distance from Array Area (nm)	Distance from Cable Corridor (nm)	Data Confidence	Screening	Rationale	Tier
Galloper	Offshore Wind Farm	Operational	0	3.4	High	Screened out	Baseline	n/a
East Anglia ONE	Offshore Wind Farm	Operational	28.7	32.0	High	Screened out	Baseline	n/a

14 Future Case Vessel Traffic

450. The characterisation of vessel traffic established in the baseline (see Section 10) is used as input to the risk assessment (see Section 16). However, it is also necessary to consider potential future case vessel traffic, in terms of general volume and size changes, port developments which may influence movements, and changes to movements associated with the presence of the Project (the post wind farm scenario).

14.1 Consultation Feedback

451. Stakeholder feedback to date as part of the NRA process has included input into potential future case scenarios, and highlighted the importance of ensuring the NRA considers potential increases in both vessel volumes and vessel sizes. A summary of the relevant consultation input is provided below:

- Traffic volume:
- CoS suggested a future case traffic scenario of 30% was included, in addition to 10% and 20% future cases (PEIR response and meeting on the 27th October 2023).
- London Gateway indicated that vessel numbers into their port were expected to double by the time of operation (meeting on the 4th October 2023).
- The application of a 30% future case scenario was presented at the hazard workshop and no concerns were raised (12th October 2023).
- Vessel size:
- HHA indicated a future case vessel draught of 20m should be assumed (PEIR response).
- PLA indicated a need for “20m of water plus any burial depth required for cable protection” (PEIR response).
- The CoS stated that “Over the last 20 years, vessel draught has increased considerably and further if more limited increases are expected” (PEIR response).
- General consensus at the hazard workshop (12th October 2023) was that a conservative future case draught assessment of 20m should be assumed in the NRA. London Gateway indicated an upper range of 23m as a worst case.

14.2 NRA Assumptions - Vessel Size

452. This section sets out process by which the future case assumptions have been made within the NRA in terms of vessel size.

14.2.1 Draught against Vessel Capacity - Study by PierNext

453. Based on the Lloyds Database, PierNext has analysed data for container vessels since 1964 to gain insight into trends for vessel draught relative to capacity (PierNext, 2019). Figure 14-1 indicates there is an approximate ceiling for draughts, with very few container vessels exceeding 16 m draught, irrespective of the capacity. Draught is relatively stable for capacities over 12,000 twenty-foot equivalent unit (TEU).

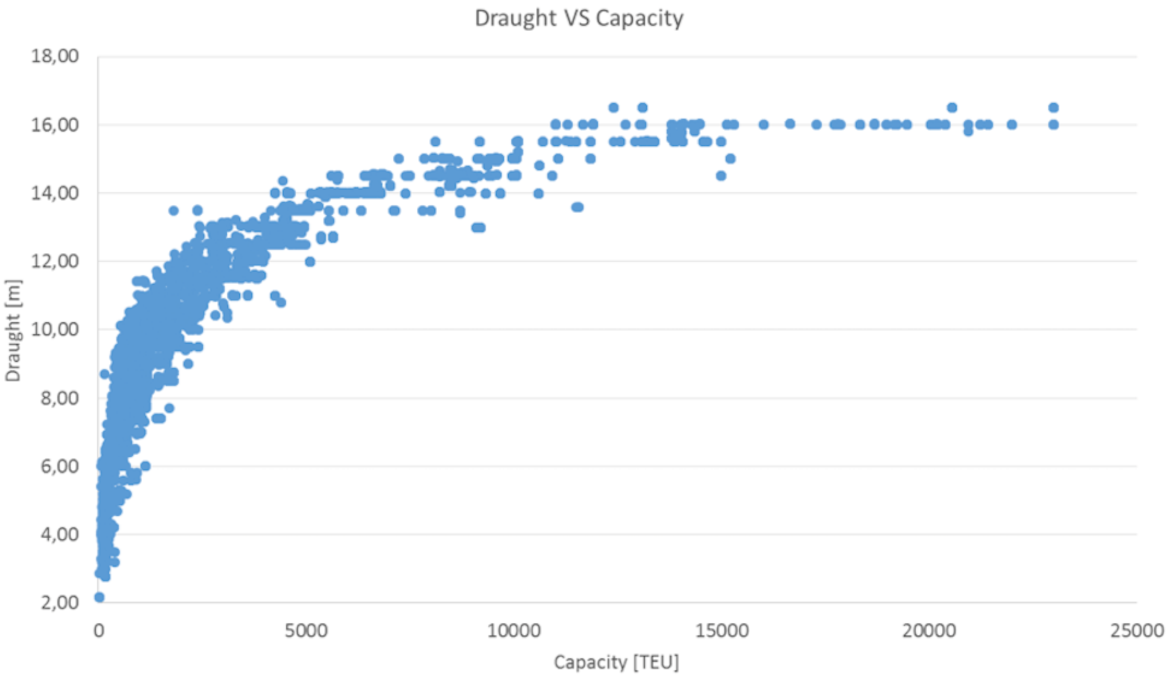

Figure 14-1 Relationship Between Vessel Draught and Capacity (1964 to 2019) (PierNext, 2019)

14.2.2 Suez Canal

454. A number of stakeholders referenced the Suez Canal during consultation as an important consideration for future case traffic sizes. The Suez Canal provides a navigable route between the Mediterranean (which connects to the waters within which North Falls is located) and Red Seas. The Suez Canal drastically reduces transit times and fuel consumption for vessels since the alternative option is to make passage around the Cape of Good Hope and north-south through the Atlantic Ocean. Therefore, vessel draught on an international level is highly reliant upon the Suez Canal since alternative routeing options are generally not economical. This is demonstrated by the effects of the Suez Canal's blockage due to the grounding of the Ever Given in March 2021, with "some estimates that it cost the global economy around $10 billion per day" (SAFETY4SEA, 2023).

455. Moreover, the economic importance of the Suez Canal was emphasised by vessel movements during the COVID-19 pandemic; although internationally vessel movements declined markedly during 2020, the Suez Canal Authority reported a decline of just 0.27% in transits for the full year of 2020 (Maritime Executive, 2021).

456. The Rules of Navigation for the Suez Canal (Suez Canal Authority, 2020) gives maximum authorised draught values for various values of beam for a loaded vessel, with an overall maximum of allowable draught of 66 feet (ft) (22.1 m). However, there is also potential for the Suez Canal to be dredged in the future to increase depths and subsequently allow larger draught vessels. Figure 14-2 presents the

maximum vessel draught permitted within the Suez Canal historically since it was nationalised in 1956.

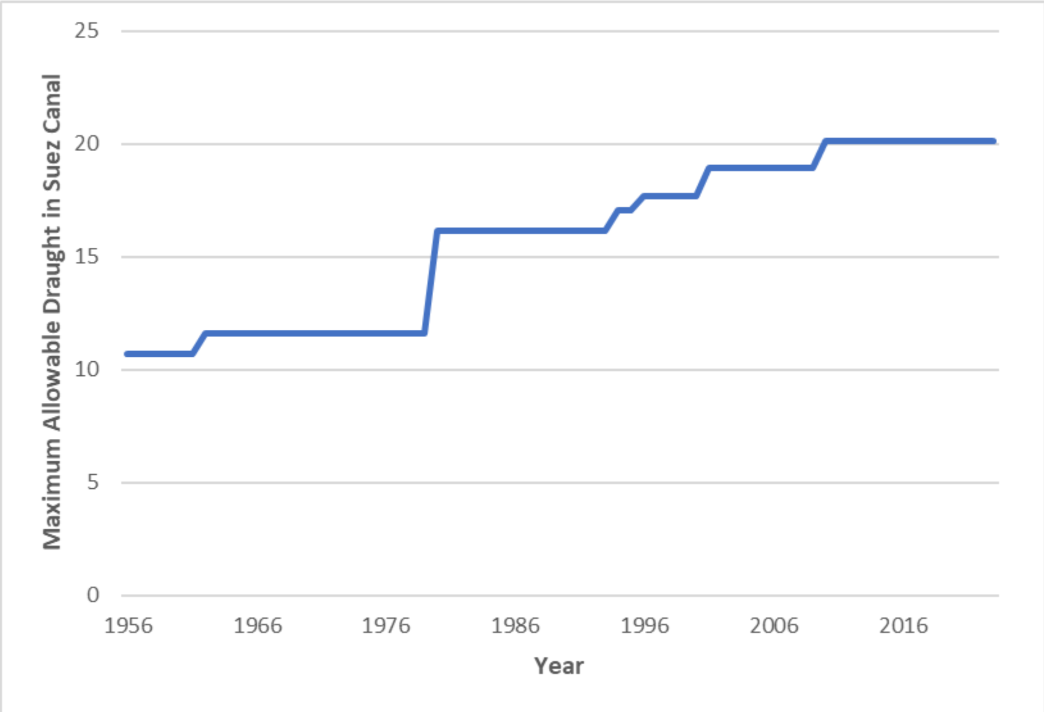

Figure 14-2 Maximum Vessel Draught by Year for the Suez Canal (1956 to 2023) (Suez Canal Authority, 2023)

457. The maximum vessel draught permitted within the Suez Canal has increased substantially through the decades at various stages of development. However, only once (in 1980) has the maximum permitted draught increased substantially and there has been only one increase since 2001 (in 2010). Therefore, further monumental increases in the maximum vessel draught permitted are considered unlikely and from research there are no current plans for increases in the future.

458. There are vessels which would benefit from a further deepening of the Suez Canal, namely Chinamax vessels. With a maximum draught of 24 m, these are not currently able to navigate the Suez Canal. Subsequently, noting the economic implications of alternative routeing options and based on Anatec's experience of vessel traffic analysis in the region, Chinamax vessels do not currently navigate regularly within the North Sea.

14.2.3 Consideration of Under Keel Clearance

459. Vessel draught relative to the available navigable depth is a crucial factor in ensuring safe manoeuvrability. This section considers the water depths necessary to accommodate potential increases in vessel draught. Key draughts values considered are as follows:

- **Base case:** the maximum vessel draught recorded within the inner precautionary area in the vessel traffic datasets considered in the NRA is **16.9m**. It is noted that this draught was for a vessel using the Harwich deep water channel. The maximum vessel draughts recorded using the Sunk and Trinity DW routes were 15.7m and 14.1m respectively.
- **Future case (realistic worst case):** general consensus at the hazard workshop was that a value of **20m** was a conservative realistic assumption.
- **Future case (maximum worst case):** the largest potential draught referenced by stakeholders during consultation was **23m**, and this is therefore considered a worst case value.

460. For the purposes of this subsection, the follow definitions are used:

- **Static draught** – the draught when a vessel is not making way or subject to sea and swell influences, i.e., the maximum draught the vessel is loaded to.
- **Dynamic draught** – the draught when a vessel is making way and subject to squat, swell, and heel when turning.
- **Percentage under keel clearance** – percentage of a vessel's draught required as under keel clearance.
- **Published minimum under keel clearance** – the minimum clearance required by a port or berth operator irrespective of static or dynamic draught.

461. Table 14.1 provides the percentage and published minimum under keel clearance values associated with relevant port and berth operators (where available).

Table 14.1 Percentage and Published Minimum Under Keel Clearance Associated with Local Ports, Berths, and Terminals

Port/Berth/Terminal	Source	Percentage Under Keel Clearance (%)	Published Minimum Under Keel Clearance
PLA	Navigational Assessment Working Group (PLA, 2013)	-	0.9m on flood tide and 1.4m on ebb tide
HHA	Percentage under keel clearance provided during consultation (PEIR response)	10	-
London Gateway	London Gateway Information Guide for Shipmasters (DP World, 2023)	10	1.4m

462. The calculation of dynamic draught is vessel specific; therefore this assessment considers a general rule of thumb for calculating the percentage under keel

clearance. For the restricted waters and port approaches considered in this NRA, the percentage under keel clearance is calculated as 10% of the static draught. Given this is in excess of the published minimum under keel clearance, this is considered a conservative value which accounts for both static and dynamic draughts.

463. Table 14.2 shows the water depth required for the base case, realistic future case and worst case future case draughts used in this assessment. The base case values have been split by vessels using the three DW routes in the area (Harwich, Sunk, and Trinity).

Table 14.2 Water Depth Required per Vessel Draught

Vessel Draught	Published Minimum Under Keel Clearance	Water Depth Required Based on Published Minimum Under Keel Clearance	Percentage Under Keel Clearance Required	Water Depth Required Based on Percentage Under Keel Clearance
16.9m (maximum base case) – Harwich Deep Water Channel	n/a	n/a	1.7m	18.6m
15.7m (maximum base case) – Sunk DW Route	1.4m	17.1m	1.6m	17.3m
14.1m (maximum base case) – Trinity DW Route	1.4m	15.5m	1.4m	15.5m
20 m (realistic future worst case)	1.4 m	21.4m	2.0m	22m
23 m (maximum future worst case)	1.4 m	24.4m	2.3m	25.3m

14.2.3.1 Inner Precautionary Area

464. Within the inner precautionary area, the key areas in terms of underkeel clearance are the Sunk and Trinity DW routes, and the area around the charted Sunk pilot boarding area (noting this includes vessels associated with transits to / from the Harwich deep water channel). The vessels with draughts of 15m and above (maximum recorded draught was 16.9m) recorded within the six months of AIS data (see Annex F) are presented against the Sunk DW route in Figure 14-3, and the Trinity DW route and Sunk pilot boarding area in Figure 14-4. Both plots are shown at zoom levels where the charted water depths are visible.

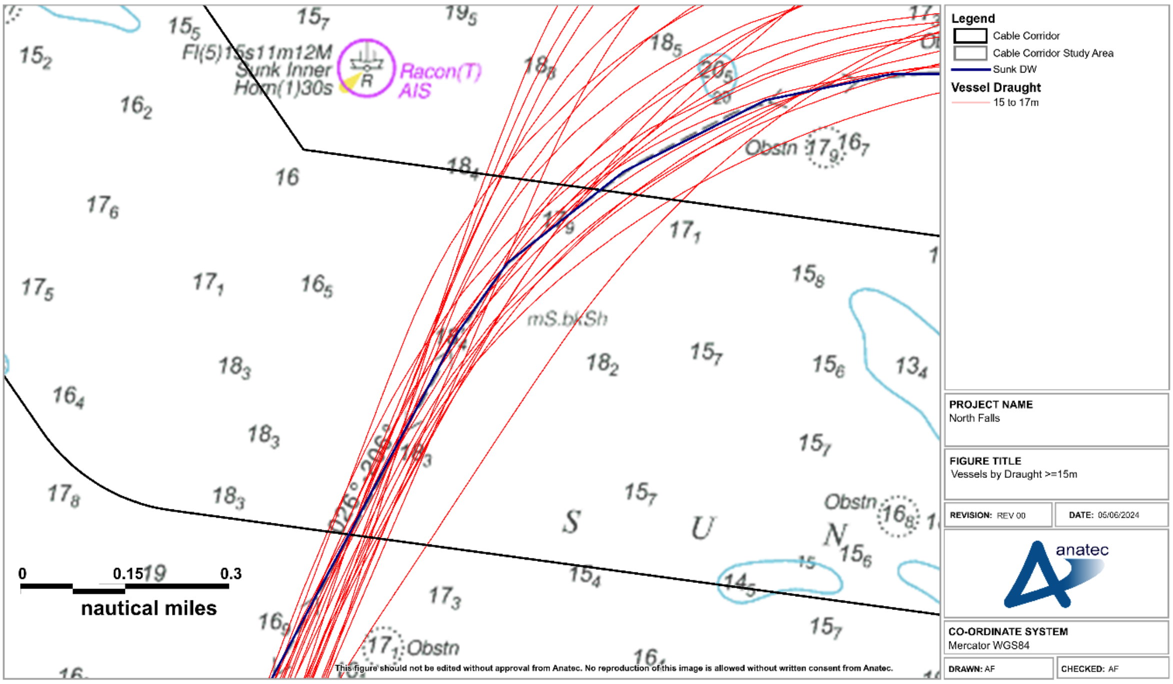

Figure 14-3 Vessels with Draughts >=15m using Sunk DW Route – Six Months AIS 2023

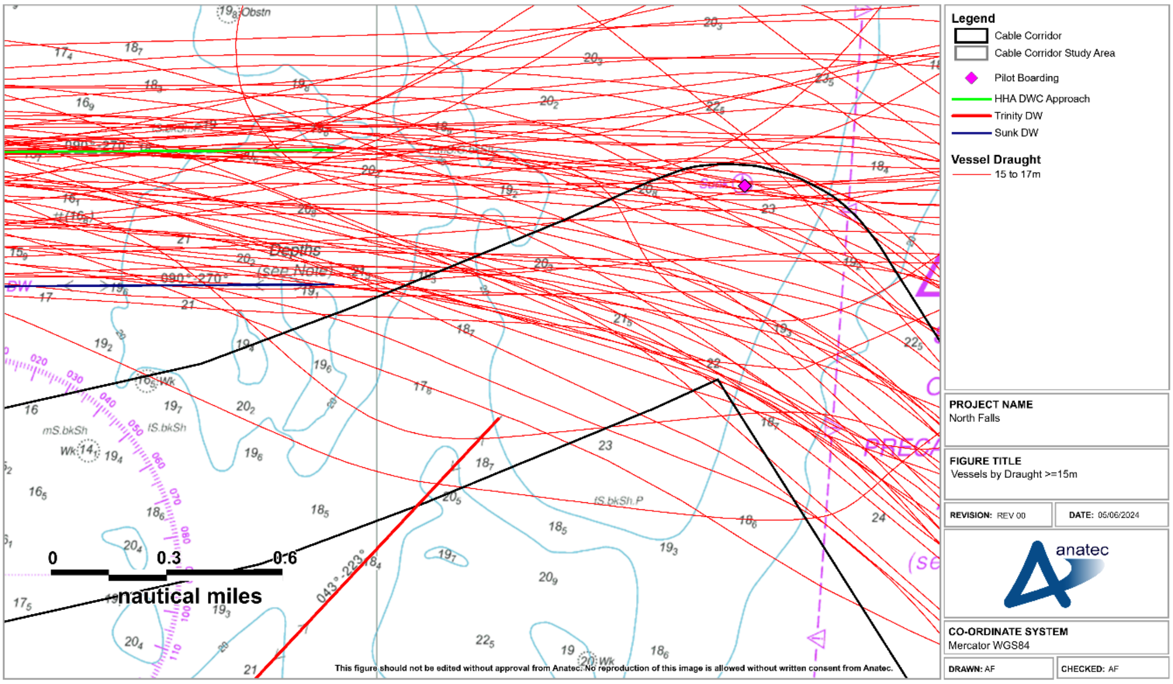

Figure 14-4 Vessels with Draughts >=15m near Sunk Pilotage – Six Months AIS 2023

465. A summary of the key areas in terms of charted water depths is provided as follows, noting that bathymetry data collected by North Falls indicates depths over the DW routes are deeper than charted depths:

- Charted water depths in the area used by the vessels of draught greater than 15m using the Sunk DW route within the offshore cable corridor ranged from 17.1 to 18.4m.
- No vessels of draught greater than 15m used the Trinity DW, noting that local charted water depths ranged from 18.7m to 20.5m.
- Vessels greater than 15m in draught associated with transits to or from the Harwich Deep Water Channel used the full width of the offshore cable corridor in the area around the Sunk pilotage. Charted water depths ranged from 17.8m to 23m in this area.

466. It is assumed that suitable base case depths are achievable given vessels are already using the available depths, however this assumes depths are not reduced further via cable protection / crossings.

467. For the realistic future worst case (20m draught), there are areas where required depths (22m) are not currently available. Should vessels achieve a draught of 20 m within the lifetime of North Falls additional dredging over the installed cables would be required (assuming the areas are not pre-dredged) and therefore consideration of this and agreement on values would be required as part of the cable burial risk assessment. It is noted that these depths would require dredging along the existing deep-water routes, within turning areas and berths at the relevant ports. Additionally, burial depths should account for tidal constraints associated with larger vessel movements within the areas of concern including at flood tides.

468. For the maximum future worst case, the required depths are not currently available. However, unlike the realistic future worst case scenario, the likelihood of these values being required is considered extremely unlikely. The following list details the reasoning behind this assertion and why its consideration is not necessary in the lifetime of North Falls:

- Historical vessel trends suggests that there is limited appetite for container vessels with draughts exceeding 16 m.
- The Suez Canal allows for a maximum draught of 22.1 m and thus would require material dredging works to facilitate use by a vessel with 23 m draught.
- The maximum vessel draught permitted in the Suez Canal has increased only once since 2001 indicating that there is limited international appetite for deeper draught vessels.
- To allow vessel access to local ports would require extensive dredging works within the region and at the time of writing there were no such plans in place for any of the local ports.
- Extensive dredging works would also be required beyond the jurisdiction of the local ports, noting that charted water depths within the Sunk TSS as a whole are under 24 m in some locations, and such dredged depths would have to be maintained on an ongoing basis.

- Notable berth modifications would also be required including dredging, turning circles, and crane size and capacity.

14.2.3.2 Outer Precautionary Area

469. Charted water depths within the offshore cable corridor overlap with the outer precautionary area are in excess of 22m. Therefore, required water depths for the maximum base case and realistic future worst case are considered achievable within the outer precautionary area based on Table 14.2. The maximum future worst case considerations made for the inner precautionary area are considered as remaining applicable for the outer precautionary area.

14.3 NRA Future Case Assumptions – Traffic Volumes

470. This section sets out process by which the future case assumptions have been made within the NRA in terms of traffic volumes.

14.3.1 Clarksons Research Service - Global Fleet from 2005 to 2023

471. As part of the consultation process, the CoS provided information from the Clarksons Research Service which included details of changes in global vessel numbers between 2005 and 2023. The change is shown in Figure 14-5. Overall, there has been a 56% increase in vessel numbers globally over the 2005 to 2023 period, however as shown in Figure 14-6 the rate of increase is declining.

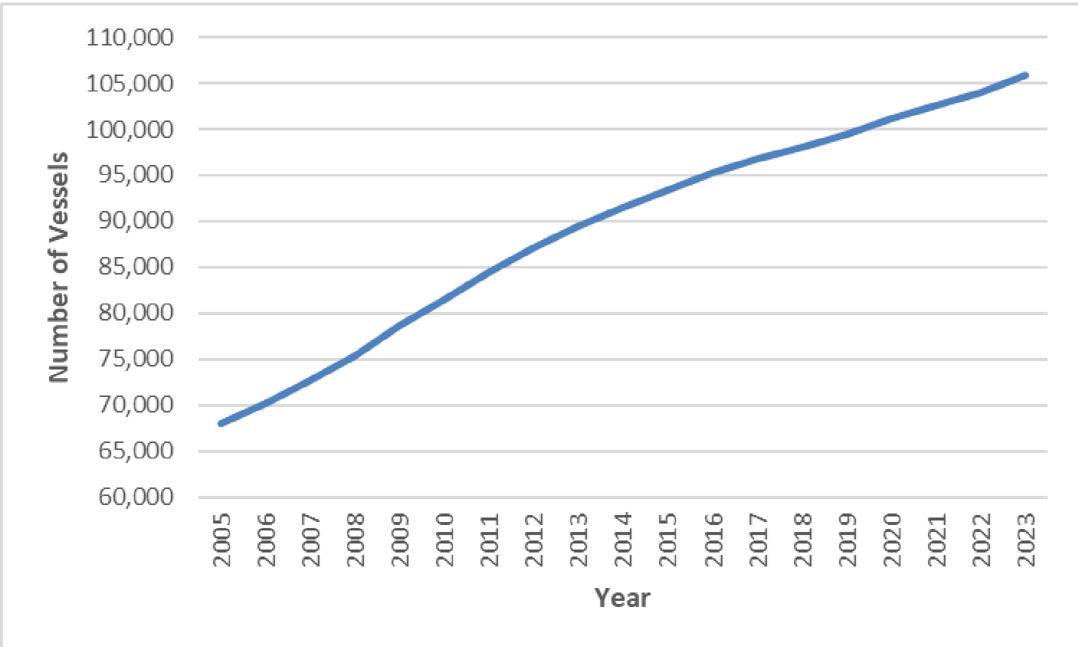

Figure 14-5 Number of Vessels in Global Fleet by Year (2005 to 2023) - Clarksons Research Service

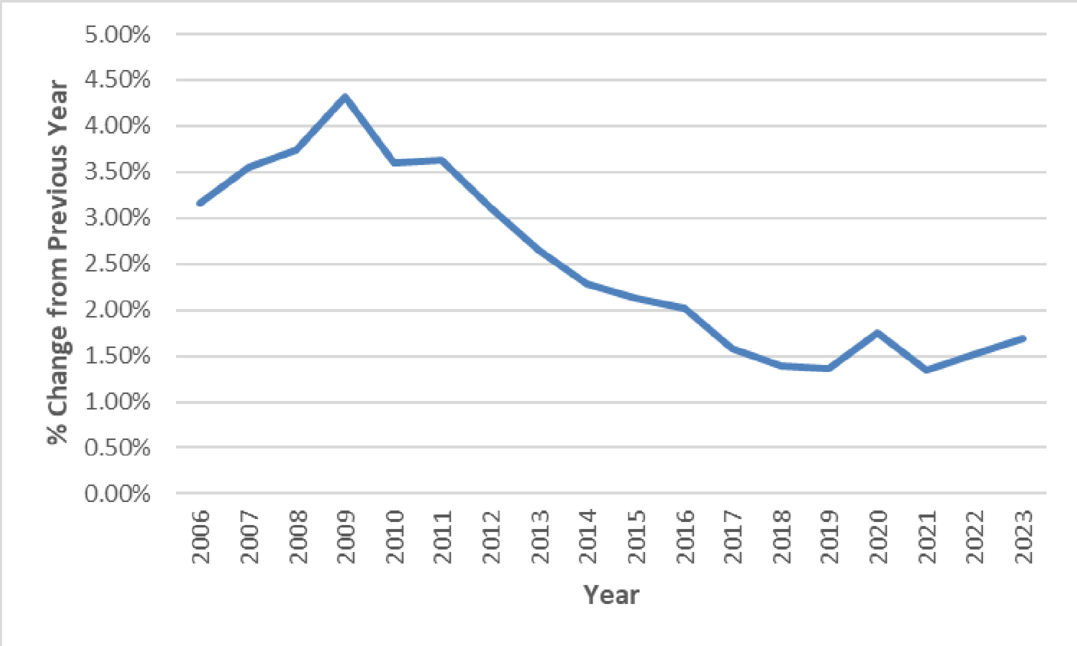

Figure 14-6 % Change in Vessel Numbers from Previous Year (2006 to 2023) - Clarksons Research Service

14.3.2 Increases in Commercial Vessel Activity

472. There is uncertainty associated with long-term predictions of vessel traffic growth including the potential for any other new developments in UK or transboundary ports and the long-term effects of Brexit on vessel access.

473. Therefore, to account for variation three independent scenarios of potential growth in commercial vessel movements of 10%, 20% and 30% have been estimated throughout the lifetime of the Project. These values align with input from the CoS and were also presented to stakeholders at the hazard workshop.

14.3.3 Increases in Commercial Fishing Vessel and Recreational Vessel Activity

474. There is similar uncertainty associated with long-term predictions for commercial fishing vessel and recreational vessel transits given the limited reliable information on future trends upon which any firm assumption could be made.

475. Therefore, the same three independent scenarios of potential growth in commercial fishing vessel and recreational vessel movements of 10%, 20% and 30% has been estimated throughout the lifetime of the Project.

14.3.4 Increases in Traffic associated with the Project Operations

476. During the construction phase up to 2,532 annual return trips to port will be made by vessels involved in the installation of the Project (see Section 6.4). During the O&M phase, up to 1,222 annual return trips to port will be made by vessels involved in the O&M of the Project (see Section 6.5).

477. It is noted that the CoS raised within their PEIR response that other proposed wind farm developments in the area (e.g., Five Estuaries and East Anglia Two) may also increase traffic locally, which informed their recommendation that a 30% traffic scenario was included. As per Section 14.3.2 this 30% scenario has been applied.

14.4 Commercial Traffic Routeing (the Project in Isolation)

14.4.1 Methodology for Deviations

478. It is not possible to consider all potential alternative routeing options for commercial traffic and therefore worst-case alternatives have been considered. Assumptions for re-routeing include:

- All alternative routes maintain a minimum mean distance of 1nm from offshore installations and existing offshore wind farm boundaries in line with industry experience. This distance is considered for shipping and navigation from a safety perspective as explained below; and
- All mean routes take into account sandbanks, AtoNs and known routeing preferences.

479. Annex 2 of MGN 654 defines a methodology for assessing passing distance from offshore wind farm boundaries (the Shipping Route Template) but states that it is "*not a prescriptive tool but needs intelligent application*".

480. To date, internal and external studies undertaken by Anatec on behalf of the UK Government and individual clients show that vessels do pass consistently and safely within 1nm of established offshore wind farms (including between distinct developments) and these distances vary depending upon the sea room available as well as the prevailing conditions. This evidence also demonstrates that the Mariner defines their own safe passing distance based upon the conditions and nature of the traffic at the time, but they are shown to frequently pass 1nm off established developments. Evidence also demonstrates that commercial vessels do not transit through arrays.

481. The NRA also aims to establish the MDS based on navigational safety parameters, and when considering this the most conservative realistic scenario for vessel routeing is considered to be when main commercial routes pass 1nm off developments. Evidence collected during numerous assessments at an industry level confirms that it is a safe and reasonable distance for vessels to pass; however, it is likely that a large number of vessels would instead choose to pass at a greater distance depending upon their own passage plan and the current conditions.

482. The MCA noted during consultation the intention that an application will be made to the IMO to amend the Long Sand Head Two Way route. This will lead to future changes in vessel behaviours. However, routes utilising the Long and Head Two Way route do not interact with the array area, and therefore any future change does not impact the deviation and modelling assessments undertaken in the NRA.

14.4.2 Deviations

14.4.2.1 Commercially Routed Vessels

483. The methodology detailed in Section 14.4.1 has been applied to potential deviations that may arise to the base case routes identified and discussed in Section 11 to cargo vessels, tankers, and passenger vessels on regular routes. Wind farm vessels and marine aggregate dredgers have been considered separately in Sections 14.4.2.2 and 14.4.2.3 respectively.

484. Vessels using the Sunk TSS South and East and the Outer Precautionary Area are unlikely to experience any notable deviations based on the position of the array area, however it is still important to consider other impacts in a future case environment. The Galloper Recommended Ferry Route is observed to be low use based on the data studied (see Section 10.3) and therefore no associated main routes were identified, however considerations of deviations has still been undertaken in Section 14.4.3.1. Further discussion of the Sunk Routeing Measures on a future case basis is provided in Section 14.4.3.

485. On the basis of the above, the only regular cargo vessel, tanker, and passenger vessel routeing likely to experience deviation are those using the broadly east/west routeing passing south of the array area or intersecting the southern extent of the array area, namely the two routes listed below (see Section 11 for further details):

- **Route 10**: Mainly cargo vessels routeing between Tilbury/Purfleet (UK) and Rotterdam (The Netherlands); and
- **Route 42**: Mainly cargo vessels routeing between Norwegian Ports and Sheerness (UK).

486. The identified mean route positions of these routes are shown relative to the worst case deviations as per the Section 14.4.1 methodology in Figure 14-7. Following this, Table 14.3 provides the changes in distance associated with the worst case deviations.

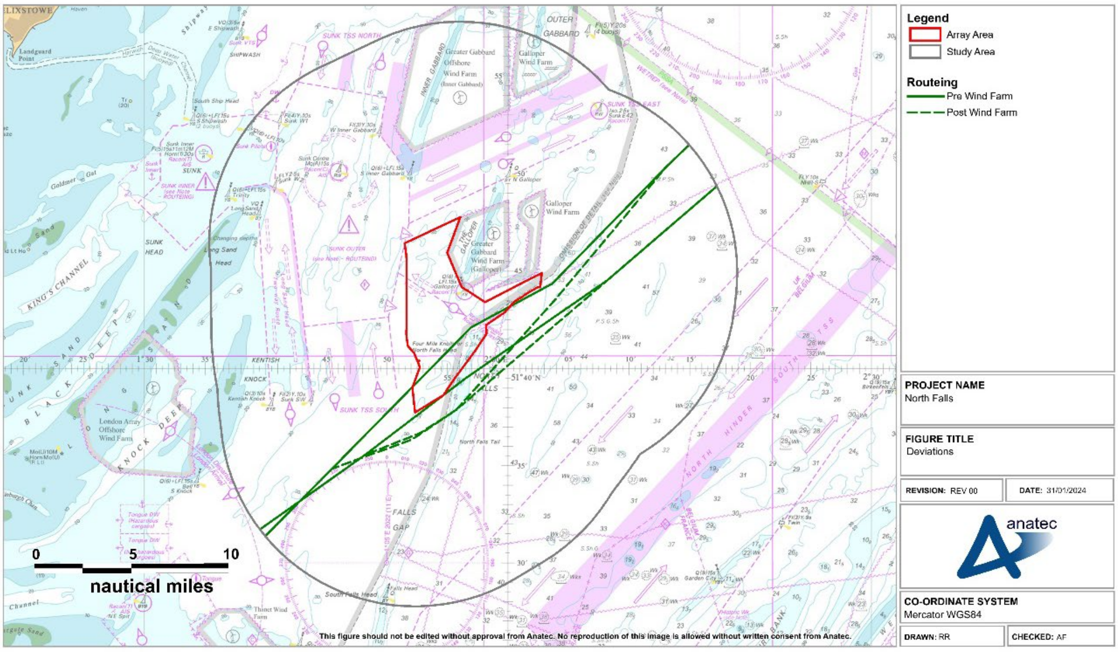

Figure 14-7 Deviations

Table 14.3 Deviation Summary within Study Area

Route	Type	Vessels per Day	Distance within Study Area (nm)	
			Pre Wind Farm	Post Wind Farm
10	High Use	3	29.4	29.5 (< 1% increase)
42	Low Use	0-1	29.8	30.1 (1% increase)

487. As shown, the worst case deviations are low, with changes within the study area estimated at 1%. These findings align with consultation input (see Section 4), in that CLdN (who operate vessels passing south of the array area as per Section 10.1.2.1.1) indicated that “slight rerouteing” would be required, but that this did “not seem to be significant issue”.

14.4.2.2 Wind Farm Vessels

488. As per Section 10.1.2.5, wind farm vessels associated with the existing Galloper and Greater Gabbard offshore wind farms were recorded within the array area, the majority of which were accessing the area south of the Sunk TSS East from the Outer Precautionary area or vice versa. Given these vessels will be used to operating within wind farms, it is considered that they are more likely to be comfortable transiting through the array area than certain other vessel types. It is also noted that the spacing at the existing Galloper and Greater Gabbard offshore wind farms is lower than what will be case within the array area.

14.4.2.3 Marine Aggregate Dredgers

489. As per Section 10.2.2.4, marine aggregate dredging activity was recorded in the study area. The majority of this activity was observed to pass inshore of the array area including within the Sunk TSS South, however east/west transits through the array area were recorded. There would be no restriction on marine aggregate dredgers transiting through the array area (other than through any active safety zones). Any marine aggregate dredgers that chose not to transit through would likely deviate either south of the array area, or utilise the Sunk TSS East to pass north.

14.4.2.4 Cumulative

490. The methodology detailed in Section 14.4.1 has been applied to potential deviations on a cumulative basis, considering the screened in cumulative offshore wind farm developments as detailed in Section 13. Following this, Table 14.4 provides a summary of the associated changes in distance within the study area.

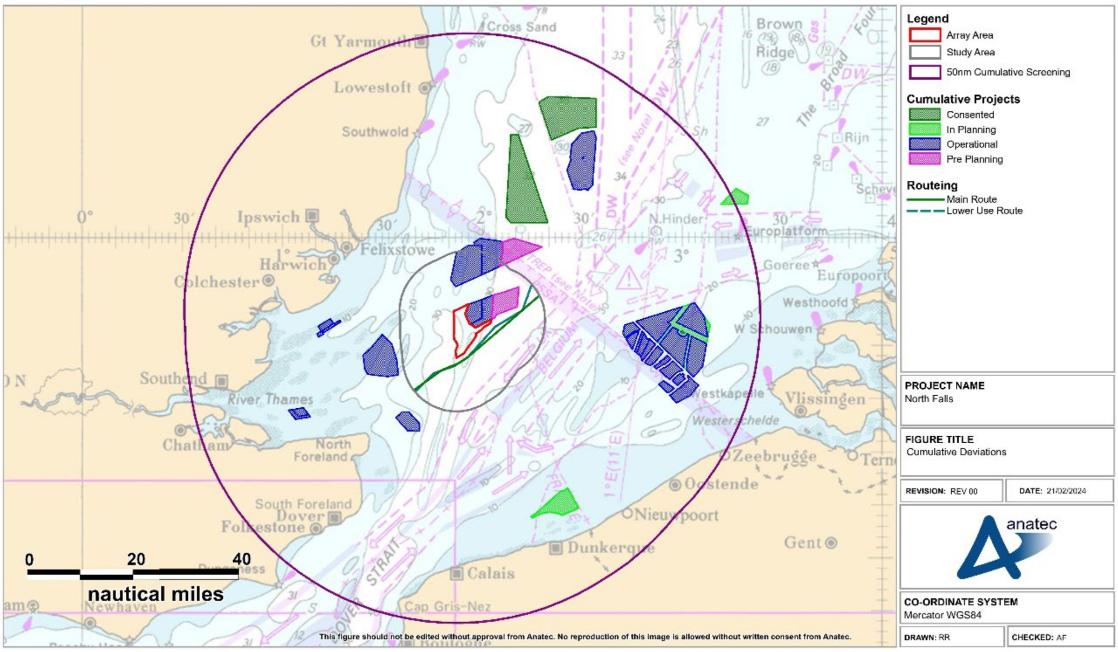

Figure 14-8 Cumulative Routeing

Table 14.4 Cumulative Routeing Summary

Route	Type	Distance within Study Area (nm)		
		Pre Wind Farm	Post Wind Farm	Cumulative
10	High Use	29.4	29.5 (< 1% increase)	29.5 (< 1% increase)
42	Low Use	29.8	30.1 (1% increase)	30.8 (3% increase)

491. As shown, there are no notable cumulative changes in deviation distance when compared against the pre wind farm and in isolation post wind farm cases (see Section 14.4.2.1). The values shown are for the study area, however as shown in Figure 14-8, there are no cumulatively screened in developments inshore of the study area, and open sea room including the relevant IMO Routeing Measures to the east. As such further large changes in the wider cumulative area are unlikely. This aligns with discussion at the hazard workshop (see Section 4), with the agreed minutes stating that "*Cumulative issues were reviewed for the array but general consensus was that the removal of the northern array had dealt with the key navigational concerns*".

14.4.3 Consideration of Sunk Routeing Measures

14.4.3.1 Recommended Ferry Route

492. Although highlighted in Section 10.3 that the Galloper Recommended Ferry Route is no longer deemed to be utilised for its original intended purpose, and is now suggested as an adverse weather route for commercial ferries, potential deviation options have been identified for the historical ferry route between Ostend and the Sunk routeing measures for any vessel which may intend on using the route (noting that as per Section 10.3 current use is very low). The routeing is indicative only and designed to provide preliminary details around potential routeing options.

493. Routeing has been identified based on study of historic AIS data, Anatec's ShipRoutes database, and a review of Admiralty Charts.

494. The potential deviations identified are shown in Figure 14-9. The change in journey distance associated with each deviation is shown in Table 14.5, including the percentage change it represents over the historic route.

Table 14.5 Potential Indicative Deviation Summary

Option	Direction	Distance (nm)	Change (nm)	Change (%)	Notes
Historic Route	Northbound	86.2	n/a	0%	Original Ostend route through the Galloper Recommended Route based on historic AIS data.
	Southbound	83.7	n/a	0%	
1	Northbound	94.4	8.2	10%	AIS data indicates this a potential alternate crossing point over the TSS already used by vessels.
	Southbound	93.4	9.7	12%	
2	Northbound	94.3	8.1	9%	Similar to historic route but with a deviation south of North Falls through the Sunk TSS South.
	Southbound	93.4	9.7	11%	
3	Northbound	90.6	4.5	5%	

Option	Direction	Distance (nm)	Change (nm)	Change (%)	Notes
	Southbound	87.7	4.0	5%	Uses West Hinder TSS to access Sunk TSS South.
4	Northbound	92.2	6.0	7%	Uses TSS Off North Hinder to access Sunk TSS East.
	Southbound	90.9	7.2	9%	

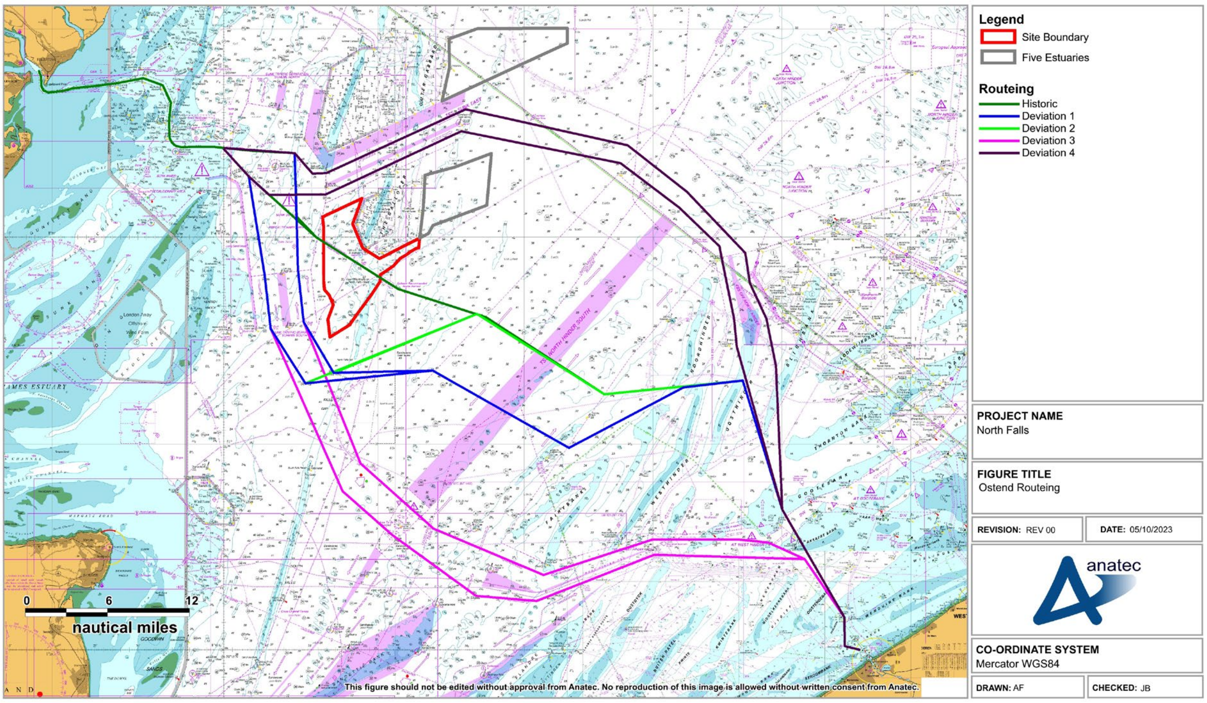

Figure 14-9 Potential Indicative Deviations

14.4.3.2 TSS and Outer Precautionary Area

495. As discussed in Section 1.3, the array area has been refined to remove overlap with the Outer Precautionary Area and increase the distance to the Sunk TSS lanes.

496. MCA feedback on the array area during consultation was that a minimum of 1nm is required from the Sunk Routeing Measures to any surface piercing infrastructure (this aligns with the MGN 654 shipping route template which states that 1nm is the "minimum distance to parallel an IMO routeing measure", albeit this guidance is "not a prescriptive tool but needs intelligent application"). On this basis, an SEZ has been defined within the array area as shown in Figure 14-10. No surface piercing infrastructure will be installed within the SEZ (including blades) unless otherwise agreed with the MCA. Subsea cables can still be installed within the SEZ.

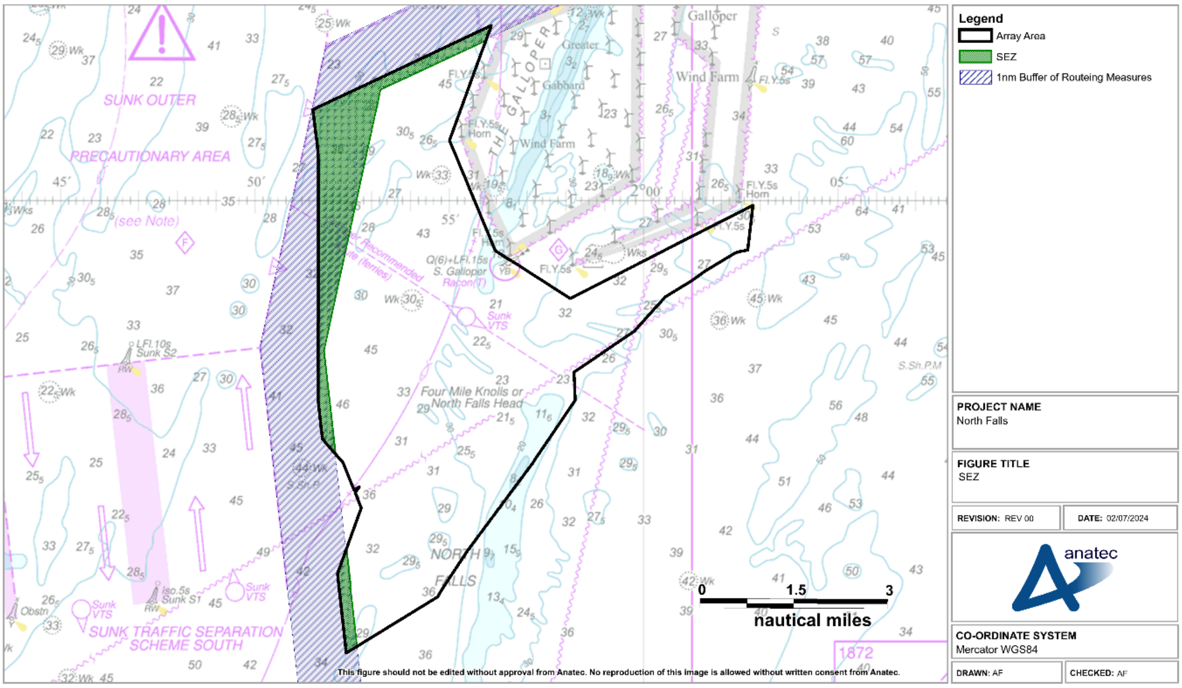

Figure 14-10 SEZ

497. For comparison, the distances of the existing WTGs on the periphery of the Greater Gabbard Offshore Wind Farm to the Sunk Routeing measures are shown in Figure 14-11, with the distances shown accounting for blade length. As shown, distances of the existing periphery WTGs range from 0.82nm to 1.03nm to the routeing measures. The implementation of the SEZ therefore means the structure within North Falls will be further from the Sunk routeing measures than the majority of the existing Greater Gabbard WTGs, noting there have been no reported allision or collision incidents associated with the existing WTGs (see Section 9.6).

498. For the purposes of Figure 14-11 a periphery WTG has been defined as any structure with a marine light, or in line with a structure with marine light. Galloper WTGs have not been included, noting all are further than 1nm from the Sunk TSS East lanes.

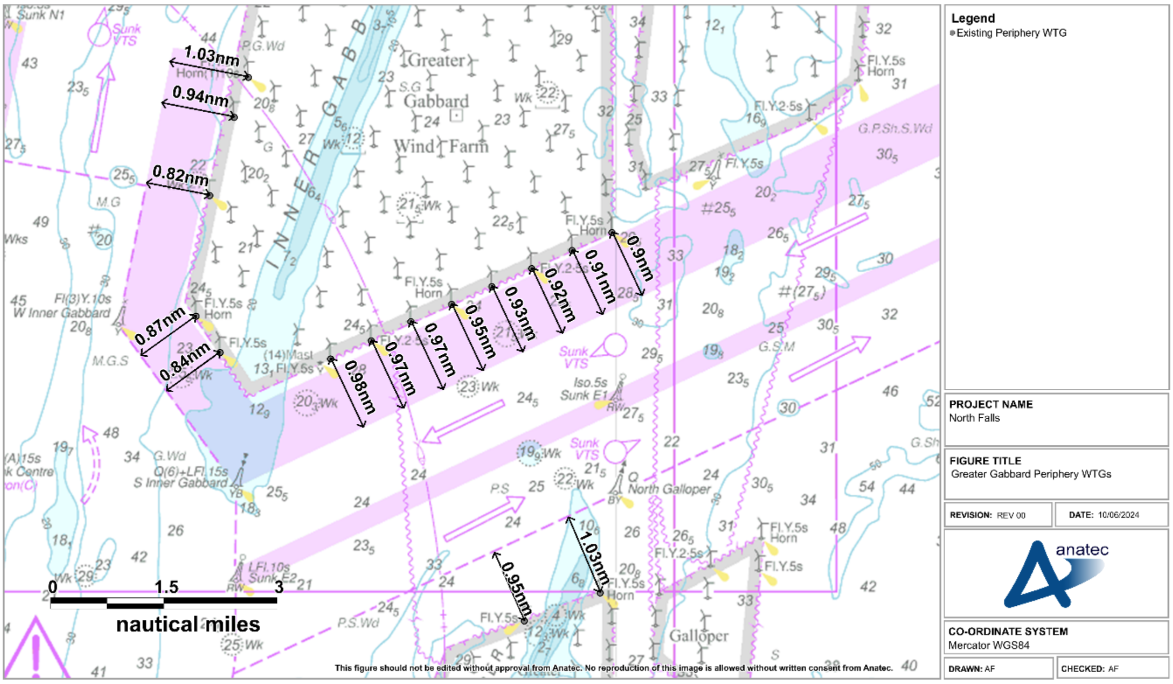

Figure 14-11 Greater Gabbard Periphery WTGs

15 Collision and Allision Risk Modelling

499. To inform the risk assessment, a quantitative assessment of some of the major hazards associated with the Project has been undertaken. The following subsections outline the inputs and methodology used for the collision and allision risk modelling.

15.1 Hazards Under Consideration

500. Hazards considered in the quantitative assessment are as follows:

- increased vessel to vessel collision risk;
- increased powered vessel to structure allision risk;
- increased drifting vessel to structure allision risk; and
- increased fishing vessel to structure allision risk.

501. The pre wind farm assessment has been informed by the vessel traffic survey data (see Section 10) in combination with the outputs of consultation (see Section 4) and other baseline data sources (see Section 5). Conservative assumptions have been made with regard to route deviations and future shipping growth over the lifetime of the Project.

15.2 Scenarios Under Consideration

502. For each element of the quantitative assessment both a pre and post wind farm scenario with base and future case vessel traffic levels (as per Section 14) have been considered. As a result, eight distinct scenarios have been modelled:

- Pre wind farm with the base case vessel traffic level;
- Pre wind farm with a future case vessel traffic level defined by a:
- 10% increase in traffic;
- 20% increase in traffic;
- 30% increase in traffic.
- Post wind farm with the base case traffic level; and
- Post wind farm with a future case vessel traffic level defined by a:
- 10% increase in traffic; and
- 20% increase in traffic;
- 30% increase in traffic.

503. The results of the base case scenarios are detailed in full in the following subsections with the equivalent results for the future case scenarios provided in Section 15.6.

15.3 Post Wind Farm Routeing

504. The methodology for determining the post wind farm routeing is outlined in Section 14.

15.4 Pre Wind Farm Routeing

15.4.1 Vessel to Vessel Encounters

505. An assessment of current vessel to vessel encounters has been undertaken by replaying at high speed the vessel traffic data collected as part of the vessel traffic surveys (see Section 5.2). The model defines an encounter as two vessels passing within 1nm of each other within the same minute. This helps to illustrate where existing shipping congestion is highest and therefore where offshore developments, such as an offshore wind farm, could potentially increase congestion and therefore also increase the risk of encounters and collisions. No account of whether encounters are head on or stern to head are given; only close proximity is accounted for.

506. The identified encounters were manually checked to determine whether there were any clear cases of non-genuine encounters (e.g., towing operations). Any such instances have been removed.

507. Figure 15-1 presents a heat map based upon the geographical distribution of vessel encounter tracks within a density grid.

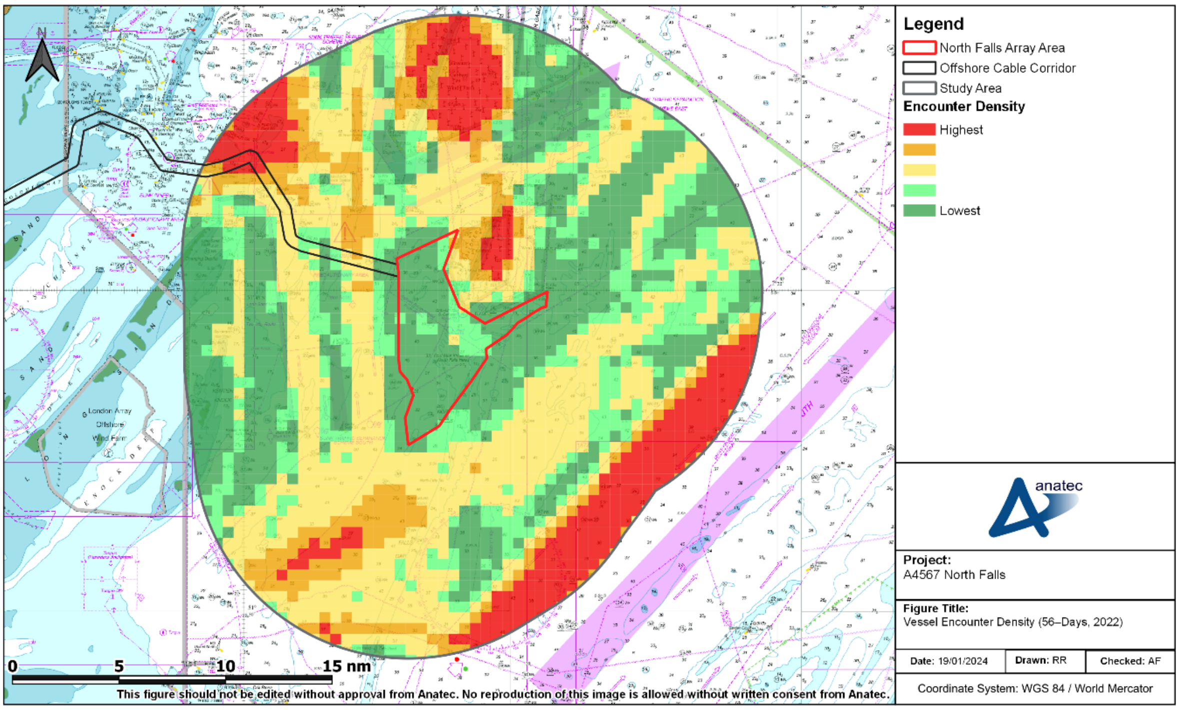

Figure 15-1 Vessel Encounter Density (56–Days, 2022)

508. There was an average of 102 encounters per day within the study area throughout the survey periods. The greatest number of encounters recorded on one day was 197, on 15 July 2022, mainly consisting of wind farm vessels involved in routeing and activities at Greater Gabbard and Galloper. Encounter density was greatest within the north-west of the study, within the Sunk Outer Precautionary Area, where

approximately 27% of all encounters were recorded, noting this is also where the Sunk Pilot Boarding Station is located which can result in periods of prolonged encounters. Approximately 25% of all encounters were recorded from wind farm vessels within Greater Gabbard and Galloper, and approximately 24% were recorded from vessels utilising the North Hinder TSS southbound lane,

509. The most frequent vessel types involved in the encounters during the survey period were cargo vessels (42%), wind farm vessels (26%) and tankers (14%).

15.4.2 Vessel to Vessel Collisions

510. Using the pre wind farm vessel routeing as input, Anatec's COLLRISK model has been run to estimate the existing vessel to vessel collision risk in proximity to the Project.

511. A heat map based upon the geographical distribution of collision risk within a 0.5×0.5nm grid for the base case is presented in Figure 15-2.

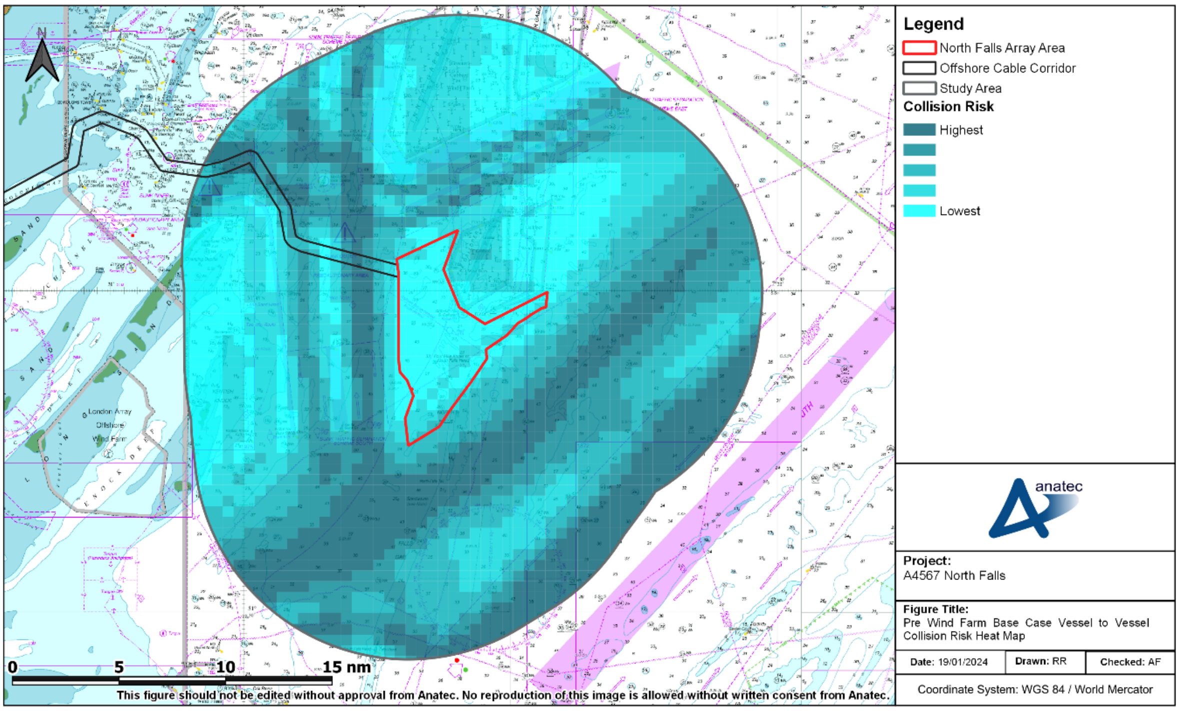

Figure 15-2 Pre Wind Farm Base Case Vessel to Vessel Collision Risk Heat Map

512. Assuming base case vessel traffic levels, the annual collision frequency pre wind farm was estimated to be 3.48×10^{-1}, corresponding to a return period of approximately one in 2.87 years. This is a high return period compared to that estimated in the pre wind farm scenario for certain other UK offshore wind farm developments and is reflective of the high volume of vessel traffic in the area, in particular the Sunk and North Hinder TSS. As per Section 11, conservative assumptions have been made on vessel numbers through the North Hinder TSS.

513. It is noted that the model is calibrated based upon major incident data at sea which allows for benchmarking but does not cover all incidents, such as minor impacts. Other incident data, which includes minor incidents, is presented in Section 9.

15.5 Post Wind Farm

15.5.1 Vessel to Vessel Collisions

514. Using the post wind farm routeing as input, Anatec's COLLRISK model has been run to estimate the anticipated vessel to vessel collision risk in proximity to the Project.

515. A heat map based upon the geographical distribution of collision risk within a 0.5×0.5nm grid for the base case is presented in Figure 15-3.

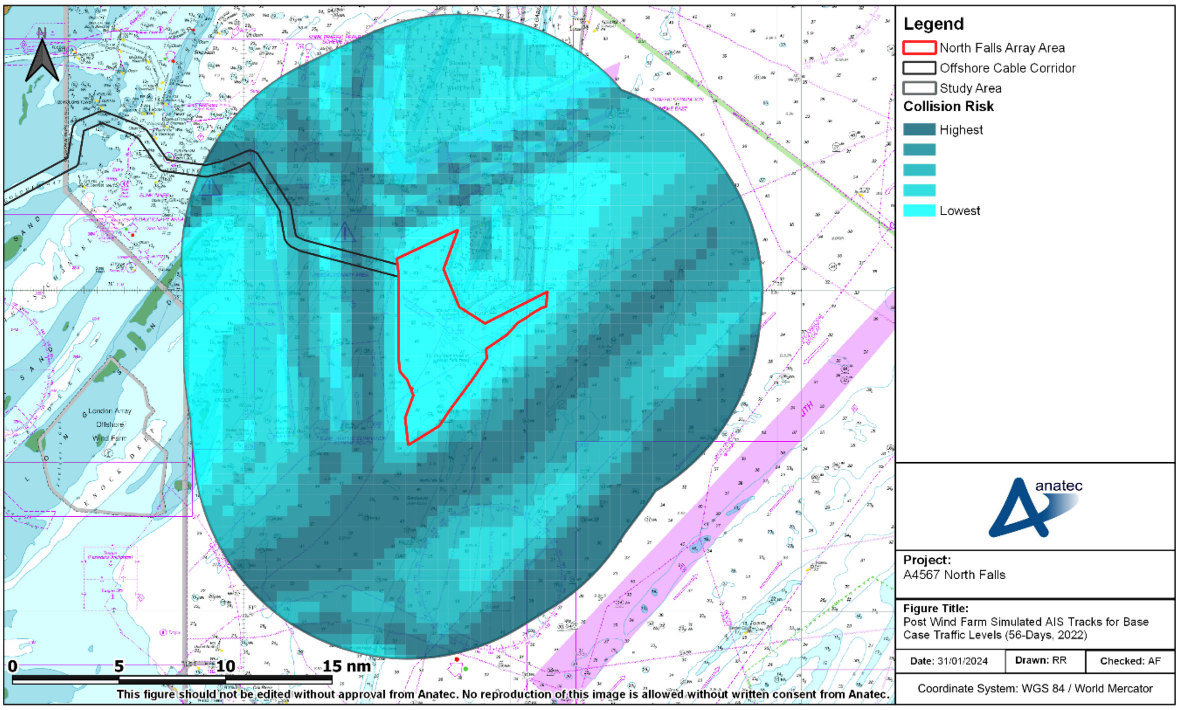

Figure 15-3 Post Wind Farm Base Case Vessel to Vessel Collision Risk Heat Map

516. Assuming base case vessel traffic levels, the annual collision frequency post wind farm was estimated to be 3.49×10^{-1}, corresponding to a return period of approximately one in 2.87 years. This represents a 0.37% increase in collision frequency compared to the pre wind farm base case result.

517. The low percentage change is reflective of the collision risk already being high within the area due to traffic volumes, and the anticipated limited deviations required. As per Section 14.4.2, deviations are anticipated to be limited and impact a very low number of vessels.

518. It is noted that a large proportion of baseline collision risk was observed to be associated with the North Hinder TSS. If the spatial area covered by the North Hinder TSS is removed from the study area, then the collision risk post wind farm increase rises to 0.84% which is still very low i.e., it is not considered that the inclusion of the North Hinder TSS is diluting the finding that the array area has limited impact on collision risk in modelling terms. As per Section 11, conservative assumptions have been made on vessel numbers through the North Hinder TSS.

15.5.2 Powered Vessel to Structure Allision

519. Based upon the vessel routeing identified in the study area, the anticipated re-routeing as a result of the presence of the Project, and assumptions that relevant embedded mitigation measures are in place (see Section 19), the frequency of an errant vessel under power deviating from its route to the extent that it came into proximity with a wind farm structure associated with the Project is considered to be low.

520. From consultation with the shipping industry, it is also assumed that commercial vessels would be highly unlikely to navigate between wind farm structures due to the restricted sea room and will instead be directed by the AtoNs located in the region and those present at the Project. During the construction and decommissioning phases this will primarily consist of the buoyed construction area whilst during the O&M phase this will primarily consist of the lighting and marking of the wind farm structures themselves.

521. Using the post wind farm routeing as input, together with the worst-case indicative layout and local meteorological ocean data, Anatec's COLLRISK model was run to estimate the likelihood of a commercial vessel alliding with one of the wind farm structures within the infrastructure boundary whilst under power. In order to maintain an MDS, the model did not consider one structure shielding another.

522. A plot of the annual powered allision frequency per structure for the base case is presented in Figure 15-4, with the chart background removed to increase the visibility of those structures with lower allision frequencies.

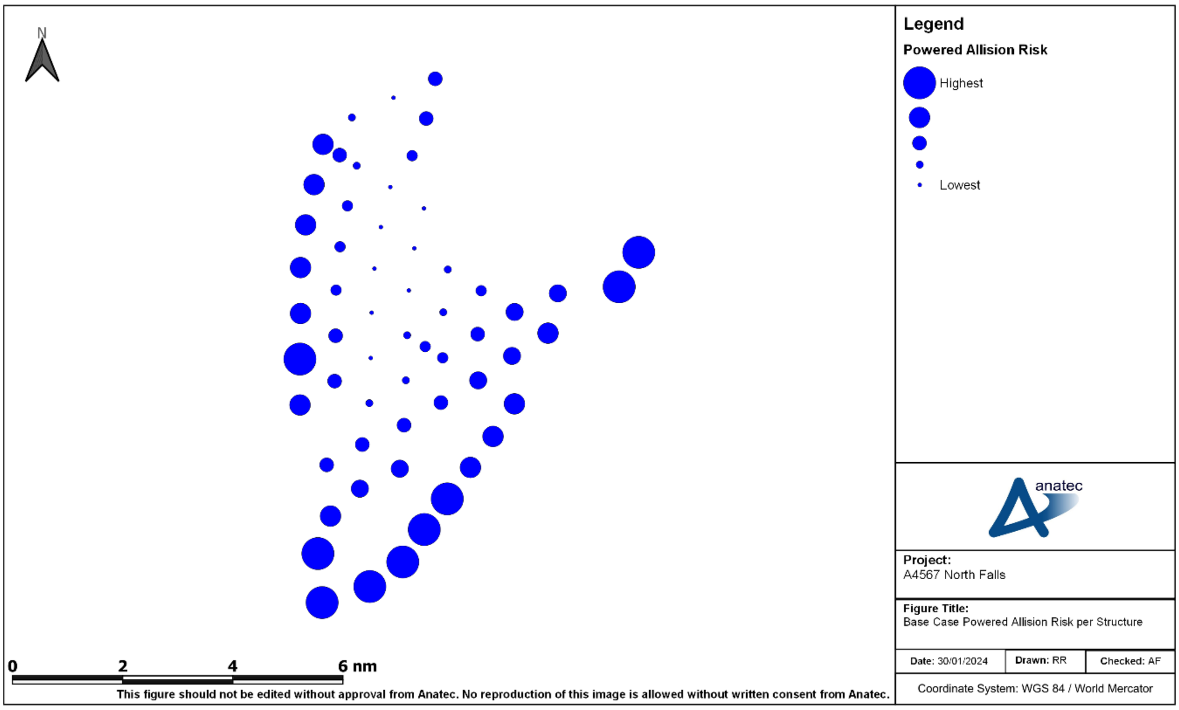

Figure 15-4 Base Case Powered Allision Risk per Structure

523. Assuming base case vessel traffic levels, the annual powered allision frequency was estimated to be 6.84×10^{-3}, corresponding to a return period of approximately one in 146 years.

524. The greatest powered vessel to structure allision risk was associated with structures at the southern corner of layout, where a high volume of traffic from multiple main commercial routes all pass within close proximity (1nm). Overall, the greatest area of risk is on the southern periphery of the array area with the greatest individual allision risk was associated with a WTG on the southern point (approximately 2.34×10^{-3} or one in 427 years). Although this area has the greatest risk, there is ample sea room available to the south of the array area for vessels to pass further south if required or preferred as illustrated in Figure 15-7, along with the pre wind farm route that currently pass within the area between the array area and the North Hinder TSS.

525. If only the routeing using the Sunk TSS lanes adjacent to the array area are considered, the allision risk reduces to $3.39x10^{-4}$, or one allision in 2,900 years. This equates to the vessels using the TSS lanes accounting for approximately 5% of the total risk, reflective of separation introduced by the TSS lanes to the array area.

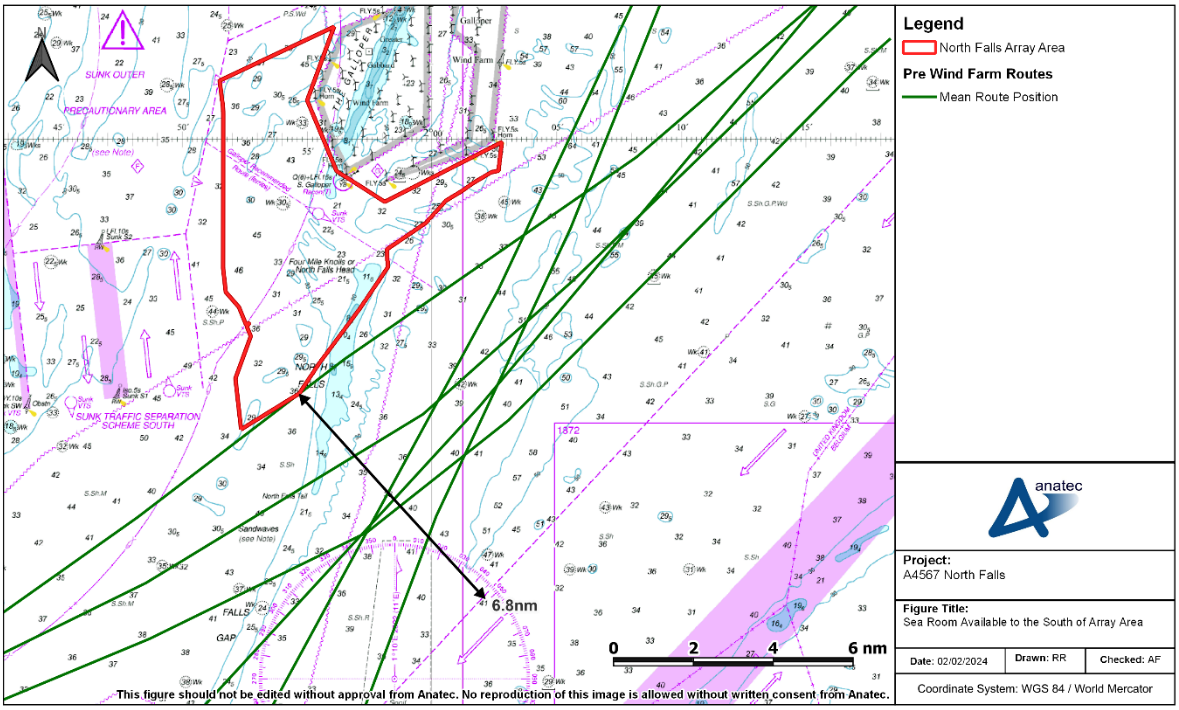

Figure 15-5 Sea Room Available to the South of the Array Area

15.5.3 Drifting Vessel to Structure Allision

526. Using the post wind farm routeing as input, together with the worst-case indicative layout and local meteorological ocean data, Anatec's COLLRISK model was run to estimate the likelihood of a commercial vessel alliding with one of the wind farm structures within the infrastructure boundary. The model is based on the premise that propulsion on a vessel must fail before drifting will occur. The model takes account of the type and size of the vessel, the number of engines and the average time required to repair but does not consider navigational errors caused by human actions.

527. The exposure times for a drifting scenario are based upon the vessel hours spent in proximity to the infrastructure boundary (up to 10nm from the infrastructure boundary). These have been estimated based on the vessel traffic levels, speeds, and revised routeing patterns. The exposure is divided by vessel type and size to ensure that these specific factors, which are based upon analysis of historical incident data have been shown to influence incident rates, are taken into account for the modelling.

528. Using this information, the overall rate of mechanical failure in proximity to the infrastructure boundary was estimated. The probability of a vessel drifting towards a wind farm structure and the drift speed are dependent on the prevailing wind, wave, and tidal conditions at the time of the incident. Therefore, three drift scenarios were modelled, each using the meteorological ocean data provided in Section 8:

- Wind;
- Peak spring flood tide; and
- Peak spring ebb tide.

529. The probability of vessel recovery from drift is estimated based upon the speed of the drift and hence the time available before arriving at a wind farm structure. Vessels which do not recover within this time are assumed to allide. Conservatively, no account is made for another vessel (including a project vessel) rendering assistance.

530. After modelling the three drifting scenarios, it was established that the peak spring ebb tide dominated scenario produced the worst-case results. A plot of the annual powered allision frequency per structure for the base case is presented in Figure 15-6, with the chart background removed to increase the visibility of those structures with a low allision frequency.

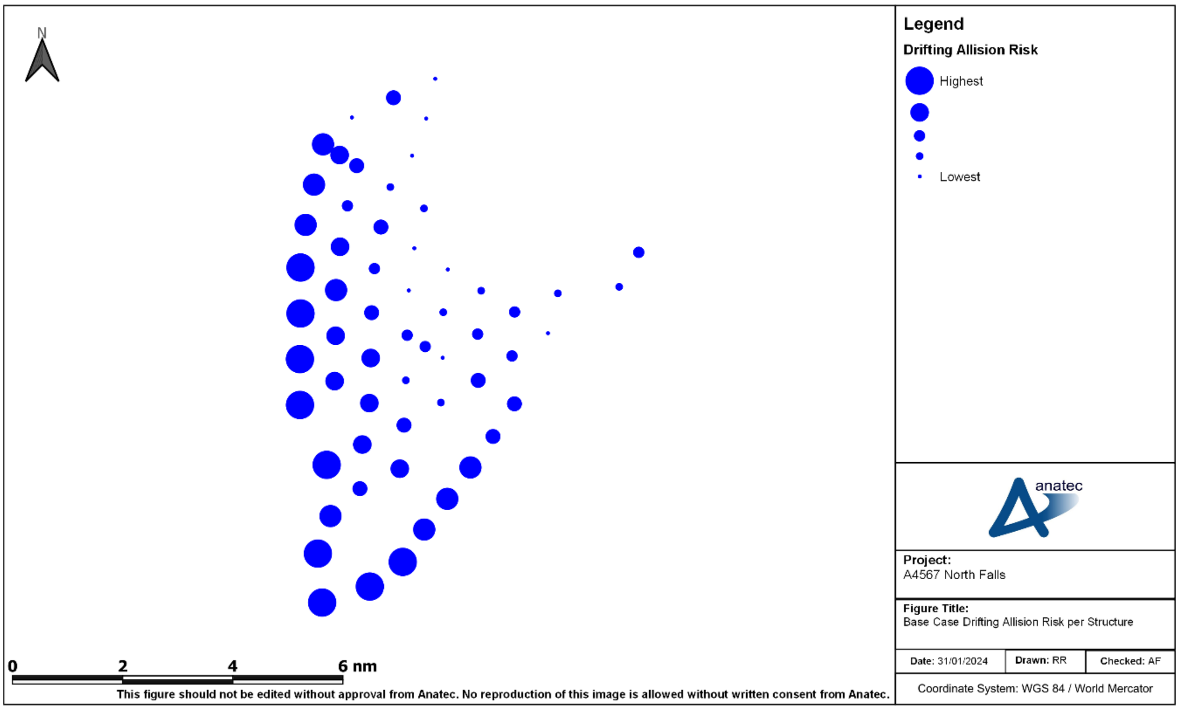

Figure 15-6 Base Case Drifting Allision Risk per Structure

531. Assuming base case vessel traffic levels, the annual drifting allision frequency was estimated to be 1.30×10^{-3}, corresponding to a return period of approximately one in 772 years.

532. The greatest drifting vessel to structure allision risk was again associated with structures at the southern point where multiple main commercial routes pass at the closest distance from the layout. The greatest individual allision risk was associated with a WTG on the southern point of the layout (approximately 2.47×10^{-4} or one in 4,046 years).

533. It is noted that historically there have been no reported drifting allision incidents with wind farm structures in the UK. Whilst drifting vessels do occur every year in UK waters, in most cases the vessel has been recovered prior to any allision incident occurring (such as by anchoring, restarting engines, or being taken in tow).

15.5.4 Fishing Vessel to Structure Allision

534. Using the vessel traffic survey data as input, Anatec's COLLRISK model was run to estimate the likelihood of a fishing vessel alliding with one of the wind farm structures within the infrastructure boundary.

535. A fishing vessel allision is classified separately from other allisions since, unlike in the case of the commercial traffic characterised using the main commercial routes, fishing vessels may be either in transit or actively fishing within the study area. Moreover, fishing vessels could be observed internally within the infrastructure boundary in addition to externally. Anatec's COLLRISK model uses vessel numbers, sizes (length and beam), infrastructure boundary layout and structure dimensions. The likelihood of a major allision incident has been calibrated against historical maritime incident data and historical AIS vessel traffic data within operational offshore wind farm arrays.

536. The model conservatively assumes no change in baseline fishing activity i.e., no account is made of vessels passing over or in close proximity to structure locations choosing to increase passing distance post wind farm. This is considered an extremely conservative assumption.

537. A plot of the annual fishing vessel allision frequency per structure for the base case is presented in Figure 15-7.

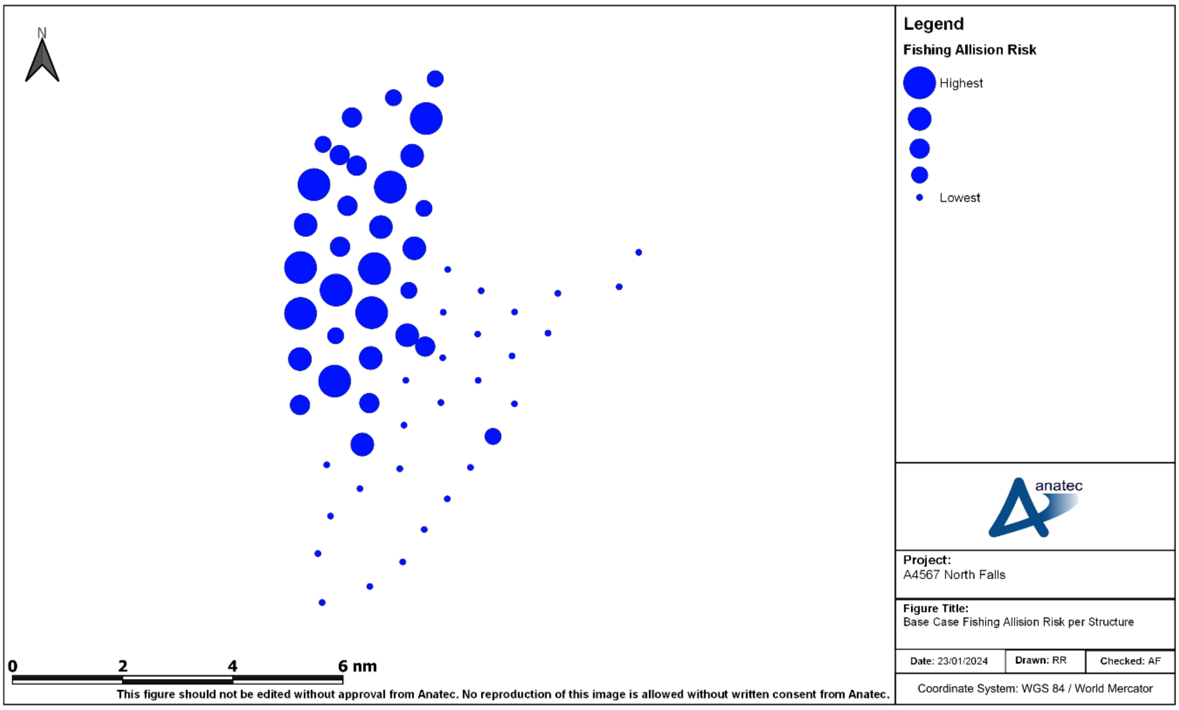

Figure 15-7 Base Case Fishing Vessel Allision Risk per Structure

538. Assuming base case vessel traffic levels, the annual fishing vessel to structure allision frequency was estimated to be 7.44×10^{-2}, corresponding to a return period of approximately one in 13 years.

539. The greatest fishing vessel to structure allision risk was associated with structures at the north and western extent of the array area where active fishing activity was observed. The greatest individual allision risk was associated with a WTG in the north west of the array area (approximately 5.58×10^{-3} or one in 179 years).

15.6 Risk Results Summary

540. The previous sections modelled two scenarios, namely the pre and post wind farm scenarios with base case traffic levels. In order to incorporate the potential for future traffic growth, pre and post wind farm scenarios have also been modelled for future case traffic levels (10%, 20% and 30% increases).

541. Table 15.1 summarises the results of all six scenarios modelled.

Table 15.1 Summary of Annual Collision and Allision Risk Results

Risk	Scenario	Annual Frequency (Return Period)		
		Pre Wind Farm	Post Wind Farm	Change
Vessel to vessel collision	Base case	3.48×10^{-1} (1 in 2.87 years)	3.50×10^{-1} (1 in 2.86 years)	1.29×10^{-3} (1 in 777 years)
	Future case (10%)	4.22×10^{-1} (1 in 2.37 years)	4.23×10^{-1} (1 in 2.36 years)	1.56×10^{-3} (1 in 640 years)
	Future case (20%)	5.02×10^{-1} (1 in 1.99 years)	5.04×10^{-1} (1 in 1.99 years)	1.96×10^{-3} (1 in 511 years)
	Future case (30%)	5.89×10^{-1} (1 in 1.70 years	5.91×10^{-1} (1 in 1.69 years	2.18×10^{-3} (1 in 458 years)
Powered vessel to structure allision	Base case	N/A	6.84×10^{-3} (1 in 146 years)	6.84×10^{-3} (1 in 146 years)
	Future case (10%)	N/A	7.52×10^{-3} (1 in 133 years)	7.52×10^{-3} (1 in 133 years)
	Future case (20%)	N/A	8.21×10^{-3} (1 in 122 years)	8.21×10^{-3} (1 in 122 years)
	Future case (30%)	N/A	8.90×10^{-3} (1 in 112 years)	8.90×10^{-3} (1 in 112 years)
Drifting vessel to structure allision	Base case	N/A	1.30×10^{-3} (1 in 772 years)	1.30×10^{-3} (1 in 772 years)
	Future case (10%)	N/A	1.43×10^{-3} (1 in 702 years)	1.43×10^{-3} (1 in 702 years)
	Future case (20%)	N/A	1.55×10^{-3} (1 in 643 years)	1.55×10^{-3} (1 in 643 years)
	Future case (30%)	N/A	1.68×10^{-3} (1 in 594 years)	1.68×10^{-3} (1 in 594 years)

Risk	Scenario	Annual Frequency (Return Period)		
		Pre Wind Farm	Post Wind Farm	Change
Fishing vessel to structure allision	Base case	N/A	7.44×10^{-2} (1 in 13.4 years)	7.44×10^{-2} (1 in 13.4 years)
	Future case (10%)	N/A	8.18×10^{-2} (1 in 12.2 years)	8.18×10^{-2} (1 in 12.2 years)
	Future case (20%)	N/A	8.92×10^{-2} (1 in 11.2 years)	8.92×10^{-2} (1 in 11.2 years)
	Future case (30%)	N/A	$9.67x10^{-2}$ (1 in 10.3 years)	$9.67x10^{-2}$ (1 in 10.3 years)
Total	**Base case**	3.48×10^{-1} (1 in 2.87 years)	4.32×10^{-1} (1 in 2.31 years)	8.38×10^{-2} (1 in 11.9 years)
	Future case (10%)	4.22×10^{-1} (1 in 2.37 years)	5.14×10^{-1} (1 in 1.95 years)	9.23×10^{-2} (1 in 10.83 years)
	Future case (20%)	5.02×10^{-1} (1 in 1.99 years)	6.03×10^{-1} (1 in 1.66 years)	1.01×10^{-1} (1 in 9.90 years)
	Future case (30%)	5.89×10^{-1} (1 in 1.70 years	6.99×10^{-1} (1 in 1.43 years)	1.09×10^{-1} (1 in 9.13 years)

16 Risk Assessment

542. This section provides a qualitative and quantitative risk assessment (using FSA) for the hazards identified due to the Project, based on baseline data, expert opinion, outputs of the Hazard Workshop, stakeholder concerns and lessons learnt from existing offshore developments.

543. The risk control log (see Section 18) summarises the risk assessment and a concluding risk statement is provided (see Section 21.7).

16.1 Potential Hazards During Construction

16.1.1 Hazard 1: Vessel to Structure Allision Risk

544. The structures within the buoyed construction area will increase allision risk to passing vessels or vessels navigating internally.

545. In terms of passing vessels, there is a large volume of commercial traffic passing in proximity to the array area which could be at risk of a powered or drifting allision with structures in the buoyed construction area. The MCA and Trinity House raised during consultation that certain sections of the array area would be of concern given that build out into those sections would either overlap the routeing measures or fail to provide a sufficient buffer based on existing precedents and guidance in MGN 654.

546. On this basis, a refinement of the array areas at PEIR stage has been made, with the following being removed:

- The entirety of the northern array area;
- All overlap with the precautionary area; and
- Site area within 0.8nm of the Sunk TSS South and Sunk TSS East.

547. As per the consultation section (Section 4), the MCA have indicated that within the refined array area, there should be a minimum distance of 1nm from all surface piercing infrastructure including blades to the Outer Precautionary Area, Sunk TSS South and Sunk TSS East. The Applicant has considered this and included a Development Consent Order (DCO) requirement (draft DCO, Document Reference: 6.1) which provides that, unless otherwise agreed with the MCA, the Applicant will implement an SEZ, whereby all surface piercing infrastructure including blades will be located at least 1nm from the local routeing measures unless otherwise agreed with the MCA. Further details are provided in Section 14.4.3.2.

548. Commercial vessels are expected to comply with international and flag state regulations (including the COLREGs and SOLAS) and will be able to passage plan in advance given the promulgation of information relating to the Project including display of the structure locations on nautical charts to ensure powered and drifting allision risk is minimised. Further, during the construction phase the structures will also be lit and marked as directed by Trinity House to ensure passing mariner

awareness including in poor visibility (this includes deployment of the buoyed construction area and temporary lighting of the structures).

549. Vessels transiting in the region will already be familiar with navigating in proximity to offshore wind farms while using the neighbouring routing measures, including Greater Gabbard and Galloper, noting no allisions have occurred at either of these developments to date. The presence of construction operations and partial structures, however, does introduce new allision risk which is localised in nature given that a vessel must be in close proximity to a structure for an allision incident to occur.

550. Based on experience of other UK wind farms under construction, it is likely that all commercial vessels and the majority of smaller vessels (e.g., fishing and recreational vessels) will avoid the buoyed construction area and hence the structures therein. However, in terms of internal navigation, the final layout will be agreed with the MCA and Trinity House to ensure the structures are spaced and located to safely facilitate internal transits and minimise internal allision risk. Minimum cross wind direction spacing of 944m and minimum downwind spacing of 1,180m is considered sufficient to accommodate internal navigation noting it exceeds that of other operational wind farms. Further, pre-commissioning safety zones of 50m in radius will be applied for around structures up until the point of final commissioning of the Project.

551. It is noted that modelling has been undertaken (see Section 15.5) to quantify the risks based on the worst case parameters under consideration, including the future case considerations described for the vessel displacement impact, noting that a full build out of the array area is assumed. This includes modelling of powered, drifting, and internal navigation scenarios. These are detailed below.

16.1.1.1 Powered Allision Risk

552. From historical incident data, there have been two reported instances of a third-party vessel alliding with an operational wind farm structure in the UK. These incidents both involved a fishing vessel, with a RNLI lifeboat attending on each occasion and a helicopter deployed in one case. Given the already embedded and firm routeing measures present in the region (i.e., the Sunk TSSs and precautionary areas) and subsequent heightened mariner alertness, it is unlikely that such an incident will occur at North Falls. In this regard it is noted that there have been no reported allision incidents associated with the existing WTGs of the Greater Gabbard and Galloper developments, likely reflective of the extensive existing mitigation including the routeing measures and the Sunk VTS. The presence of these existing developments also means that passing vessels will be used to safely navigating in proximity to wind farm infrastructure.

553. Post wind farm modelling undertaken (see Section 15.5.2) using the main commercial route deviations as input gives an estimated powered allision return period of one in 146 years for base case traffic levels. The significant majority of this

risk was observed to be associated with the WTGs on the southern periphery, resulting from the traffic predicted to pass to the south. There is notable searoom to the south, and it is likely that vessels will utilise a larger passing distance than that assumed within the modelling.

554. Approximately 5% of the total modelled powered allision risk was associated with traffic using the TSS lanes, equating to a return period of one per 2,900 years. However, as discussed above based on consultation input from the MCA, to further reduce the risk the Applicant has included a DCO requirement (draft DCO, Document Reference: 6.1) which provides that, unless otherwise agreed with the MCA, the Applicant will implement a SEZ whereby all surface piercing infrastructure will be located at least 1nm from the local routeing measures.

555. During construction, the array area will be marked as a buoyed construction area, with temporary lighting used to mark individual structures to ensure the presence of structures is clear to passing traffic.

556. Should a powered allision incident occur, the consequences will depend on multiple factors including the energy of the contact, structural integrity of the vessel involved, type of structure contacted, and the sea state at the time of the contact. Small craft including commercial fishing vessels and recreational vessels are considered most vulnerable to the hazard given the potential for a non-steel construction.

557. With consideration of lessons learned the most likely consequences are minor damage with the vessel involved able to resume passage and undertake a full inspection at the next port of call. As a worst case foundering resulting in Potential Loss of Life (PLL) and pollution may occur.

16.1.1.2 Drifting Allision Risk

558. A vessel adrift may only develop into an allision situation where the vessel is in proximity to a structure and the direction of the wind and/ or tide is such as to direct the vessel towards the structure. In a circumstance where a vessel drifts towards a structure, there are actions that may be taken to prevent the incident developing into an allision situation.

559. For a powered vessel, the ideal and most likely solution would be restoring power prior to reaching the array (by rectifying any fault). If not possible, the vessel will follow the emergency response procedures that are implemented which may include emergency anchoring following a check of the relevant nautical charts to ensure the deployment of the anchor will not lead to other effects (such as anchor snagging on a subsea cable), or use of thrusters (dependent on the vessel and power status).

560. Where anchor deployment is not possible then project vessels on-site may be able to render assistance including under SOLAS obligations (IMO, 1974) and this response will be managed via marine coordination (in liaison with HMCG) and depends on the type and capability of vessels on site, and the drifting vessel itself.

This would be particularly relevant for sailing vessels whose propulsion is dictated solely by the metocean conditions, although if the vessel becomes adrift in proximity to a structure there may be limited time to render assistance. However, if a drifting allision was to occur, the speed at which the contact occurs will likely be lower than that of a powered vessel, resulting in the contact energy to be lower.

561. Post wind farm modelling (see Section 15.5.3) using the main commercial route deviations as input gives an estimated drifting allision return period of one in 772 years for base case traffic levels. As discussed above, based on consultation input from the MCA, to further reduce the risk the Applicant has included a DCO requirement (draft DCO, Document Reference: 6.1) which provides that, unless otherwise agreed with the MCA, the Applicant will implement a SEZ whereby all surface piercing infrastructure will be located at least 1nm from the local routeing measures.

562. There is some potential for a vessel to run adrift in this region; this is reflected in the number of machinery failure incidents reported locally to the MAIB (33% of all reported incidents within the study area across a recent 10-year period). From historical incident data, there have been no instances of a third-party vessel alliding with an operational wind farm structure in the UK whilst Not Under Command (NUC). This includes no drifting allisions with the existing Greater Gabbard and Galloper developments.

16.1.1.3 Internal Allision Risk

563. Post wind farm modelling undertaken using the vessel traffic survey data as an input gives an estimated commercial fishing allision return period of one in 13.4 years for base case traffic levels. This return period is largely characteristic of fishing vessels engaged in fishing rather than in transit, and it is noted that the model assumes extremely conservative assumptions around fishing vessel behaviour. Full details are provided in Section 15.5.4.

564. The minimum spacing (cross wind direction spacing of 944m and minimum downwind spacing of 1,180m) is sufficient for safe internal navigation and is greater than that associated with many other UK offshore wind farms, some of which are navigated by commercial fishing vessels transiting in favourable conditions. The minimum spacing between structures is also greater than that at the neighbouring Greater Gabbard and Galloper developments (approximately 800m).

565. As aforementioned, the final array layout will be agreed with the MCA and Trinity House post consent but will be compliant with the requirements of MGN 654 (MCA, 2021), including the completion of a safety justification for a single line of orientation layout should this be taken forward. As with any passage, a vessel navigating internally within the array is expected to passage plan in accordance with SOLAS Chapter V (IMO, 1974). The construction phase lighting and marking of the array area, as required by Trinity House will assist with minimising the likelihood of a

mariner becoming disoriented whilst navigating internally within the buoyed construction area.

566. For recreational vessels under sail navigating internally within the array area, there is also potential for effects such as wind shear, masking, and turbulence to occur. From previous studies of offshore wind developments, it has been concluded that WTGs do reduce wind velocity downwind of a WTG (MCA, 2022) but that no negative effects on recreational craft have been reported on the basis of the limited spatial extent of the effect and its similarity to that experienced when passing a large vessel or close to other large structures (such as bridges) or the coastline. In addition, no practical issues have been raised by recreational users to date when operating in proximity to existing offshore wind developments.

567. An additional allision risk associated with the WTG blades applies for recreational vessels with a mast when navigating internally within the array. However, the minimum air gap will be 27m above MHWS which is greater than the minimum clearance the RYA recommend for localised allision risk (RYA, 2019) and which is also noted in MGN 654.

568. Should an internal allision incident occur, the consequences will be similar to those outlined for a powered allision incident, including the determining factors. However, as with a drifting allision incident, the speed at which the contact occurs will likely be lower than for an external allision, resulting in the contact energy being lower.

16.1.1.4 Frequency of Occurrence

569. Frequency of occurrence is considered to be remote noting the embedded mitigations including layout approval and lighting and marking.

16.1.1.5 Severity of Consequence

570. Severity of consequence is considered to be serious given the potential for a notable incident including fatalities.

16.1.1.6 Hazard Significance

571. Noting that the final layout will be agreed with the MCA and Trinity House and the additional mitigation of the SEZ to maintain a distance of at least 1nm from all surface piercing infrastructure to the local IMO routeing measures unless otherwise agreed with the MCA, the hazard is assessed as being tolerable and ALARP.

16.1.2 Hazard 2: Vessel Displacement Due to Activities Associated with the Project

572. Based on operational experience, it is likely that commercial vessels will deviate to avoid the buoyed construction area established around the array area (as directed by Trinity House) during the construction phase. Smaller vessels (e.g., fishing and recreation), may still choose to transit through at the discretion of individual vessel masters.

573. As detailed in Section 10.1, the majority of vessel routeing in the vicinity of the array area is defined by the TSS lanes and precautionary areas, and as such the majority of commercial traffic already avoids the array area. However, certain vessels are associated with routes outside of the TSS lanes and precautionary areas that may alter passage as a result of the Project depending on the final build out scenario.

574. Commercial vessels using the Galloper Recommended Ferry Route are also likely to require to deviate to avoid the array area, noting this includes adverse weather routeing (see Section 11.3). Consultation input from Stena (see Section 4) indicates such use is infrequent, and that safe alternate passage would be available around the array area via the Sunk TSS South or Sunk TSS East, albeit requiring a longer transit time.

575. It should also be considered that vessels on routes associated with the routeing measures may still utilise very minor deviations, for example to increase passing distance from the buoyed construction area when accessing or departing a TSS lane.

576. The Galloper Recommended Ferry Route was observed to be used on a very infrequent basis by commercial vessels, with an average of one unique cargo vessel every eight days estimated based on study of three years of AIS data between July 2020 and June 2023. Within this period, only five transits from passenger vessels and two transits from one tanker were recorded. It is considered likely that following deployment of the buoyed construction area, these vessels would use either the Sunk TSS East or Sunk TSS South noting this aligns with input from Stena Line who use the Galloper Recommended Ferry Route on an infrequent basis as outlined above. Similarly, deviations exist for any future ferry routes from Ostend or other Belgian ports that would have previously used the Galloper Recommended Ferry route (noting the route was originally defined for routeing into the Sunk from Ostend). Study of six months of AIS data from 2023 shows that vessels transiting to Belgium ports from the Sunk area do not typically use the Galloper Recommended Ferry route and instead most commonly use the Sunk TSS South, with certain transits also recorded using the Sunk TSS East. It is noted that there are no known plans to reopen the Ostend ferry route for which the original Galloper Recommended Ferry Route was defined.

577. In Section 11, main commercial routes have been identified in line with the principles set out in MGN 654 (MCA, 2021) based primarily on vessel traffic data collected during dedicated surveys (56 days in winter and summer 2022) and from coastal receivers (12 months in 2019/20) as well as using Anatec's ShipRoutes database.

578. Quantitative assessment of vessel deviations arising from the array area along with the full methodology used to assume each deviation can be found in Section 14.4. Deviations due to the presence of the Project could be required for two out of the 43 main commercial routes identified (one a high use route and the other a low use route), with the level of deviation no greater than 1%. Both routes are expected to pass south of the array area, where there is sea room to accommodate such

deviations (in excess of 6nm of sea room is available between the array area and the North Hinder TSS).

579. Smaller vessels may still utilise the buoyed construction area for transit noting entry would not be prohibited other than through any active safety zones. The minimum spacing (cross wind direction spacing of 944m and minimum downwind spacing of 1,180m) is sufficient for safe internal navigation and is greater than that associated with many other UK offshore wind farms, some of which are navigated by commercial fishing vessels in favourable conditions. The minimum spacing between structures is also greater than that at the neighbouring Greater Gabbard and Galloper developments. The final layout will be agreed with the MCA and Trinity House and these discussions will include consideration of facilitation of internal navigation.

580. The most likely consequences of vessel displacement will be increased journey times and distances for affected third-party vessels. Vessels are expected to comply with international and flag state regulations (including the COLREGs and SOLAS) and will be able to passage plan in advance given the promulgation of information relating to the Project and relevant nautical charts. This high level of awareness will assist with ensuring that vessels make safe and effective deviations which minimise journey increases.

581. As a worst case, there could be disruption to schedules, particularly for commercial ferry operators in the region but given the anticipated size of the deviations outlined above and the international nature of routeing in the region alongside the ability to passage plan, disruptions to schedule are expected to be minimal.

582. There will also be some displacement associated with the installation of the offshore export cables within the offshore cable corridor. Any such displacement would be temporary and spatially limited, however does have the potential to impact routeing and pilotage within the precautionary areas. On this basis liaison procedures should be in place with PLA and HHA to determine appropriate arrangements for instances of cable installation. This is assessed in more detail in Section 16.1.6.

16.1.2.1 Frequency of Occurrence

583. Frequency of occurrence is considered to be reasonably probable noting limited deviations are anticipated to occur.

16.1.2.2 Severity of Consequence

584. Severity of consequence is considered to be minor given the layout will require MCA and Trinity House approval.

16.1.2.3 Hazard Significance

585. Minor deviations will occur albeit with sufficient searoom for safe navigation and alternate routeing options, the hazard is therefore assessed as being tolerable and ALARP.

16.1.3 Hazard 3: Increased Vessel to Vessel Collision Risk Between Third Party Vessels Due to Vessel Displacement

586. As discussed in Section 16.1.2, it is likely that commercial vessels will deviate to avoid the buoyed construction area established around the array area (as directed by Trinity House) during the construction phase. Such vessels displaced from the array area may increase encounter rates with other third party vessels which may lead to an increase in collision risk.

587. Local traffic patterns inshore of the array area are currently managed by the existing Sunk routeing measures. These routeing measures are used by a relatively large number of vessels per day, however there was only one collision incident recorded within the study area over the most recent 10 years of incident data studied (2012 to 2021). This incident involved two cargo vessels manoeuvring within the Sunk Deepwater Anchorage but was a near miss and the vessels did not make contact. This incident was also not a case of routeing vessels or any vessels in proximity to the array area. One collision incident was also reported in the preceding ten year period (2002-2011), which again occurred within the northwest of the study area involving a fishing vessel and a tug and was the result of a fishing gear snag. The limited number of collisions is likely reflective of the risk being managed by the significant traffic management mitigations already in place including the routeing measures and the Sunk VTS.

588. In poor visibility, third-party vessels may experience limitations regarding visual identification of other third-party vessels when passing on another side of the buoyed construction areas. These limitations may increase the potential for an encounter. However, this will be mitigated by the application of the COLREGs (reduced speeds) in adverse weather conditions. Moreover, the minimum spacing between WTGs (cross wind direction spacing of 944m and minimum downwind spacing of 1,180m) will be sufficient to ensure any visual restriction is very short-term in nature. Given the presence of the array area between routeing measures and noting the presence of the precautionary area, it is also likely that vessels will be very aware of the potential for other vessels navigating locally.

589. Post wind farm modelling undertaken in Section 15.5.1 using all main commercial routes identified as input gives an estimated collision return period of one in 2.87 years for base case traffic levels. The high level of collision risk is due to the significant volumes of vessels already within the surrounding area of the Project. The base case collision result represents a 0.32% increase compared to the pre wind farm base case result, indicating that the influence of the array area on the overall collision risk for

commercial traffic is very low. This is reflective of the open searoom available to the south of the array area where vessels would be expected to deviate as per Section 16.1.2. However, as discussed in the allision risk hazard (Section 16.1.1), based on consultation input from the MCA, to further reduce the risk the Applicant has included a DCO requirement (draft DCO, Document Reference: 6.1) which provides that, unless otherwise agreed with the MCA, the Applicant will implement a SEZ whereby all surface piercing infrastructure will be located at least 1nm from the local routeing measures. This will increase searoom for vessels within the TSS lanes in the event that collision avoidance is necessary.

590. During the Hazard Workshop, it was raised that recreational vessels that would normally transit through the array area to avoid the TSS lanes may be displaced by the buoyed construction area into the TSS lanes. However, minimum spacing (cross wind direction spacing of 944m and minimum downwind spacing of 1,180m) is sufficient for safe internal navigation and is greater than that associated with many other UK offshore wind farms, some of which are navigated by commercial fishing vessels in favourable conditions. The minimum spacing between structures is also greater than that at the neighbouring Greater Gabbard and Galloper developments. While 500m safety zones will be present, these would only be active where construction was ongoing at any given structure (i.e., only a limited number of 500m safety zones will be active at any given time), and therefore access through the array area would not be prevented. The final layout will be agreed with the MCA and Trinity House and these discussions will include consideration of facilitation of internal navigation for smaller vessels including recreational vessels.

591. In the event that an encounter does occur, it is likely to be very localised and occur for only a short duration, with collision avoidance action implemented by the vessels involved, in line with the COLREGs, thus minimising the risk that the situation will develop into a collision incident.

592. Historical collision incident data (as per Section 9.6.1) also indicates that no collision incidents between third-party vessels have occurred directly as a result of a UK offshore wind farm and that the most likely consequences will be low should a collision occur, with minor contact between the vessels resulting in minor damage and no injuries to persons, with both vessels able to resume their respective passages and undertake a full inspection at the next port. As an unlikely worst case, one of the vessels could be foundered resulting in a PLL and / or pollution.

16.1.3.1 Frequency of Occurrence

593. Frequency of occurrence of a collision is considered to be remote.

16.1.3.2 Severity of Consequence

594. Severity of consequence is considered to be moderate based on consideration of historical incident data.

16.1.3.3 Hazard Significance

595. Noting the embedded mitigation in place, the existing traffic management measures, and assuming the implementation of the additional mitigation of the SEZ to maintain a distance of at least 1nm from all surface piercing infrastructure and the local IMO routeing measures unless otherwise agreed with the MCA, the hazard is assessed as being tolerable and ALARP.

16.1.4 Hazard 4: Vessel to Vessel Collision Risk (Third Party to Project Vessel)

596. Increases in wind farm vessel activity associated with the construction of North Falls could lead to increased collision rates in the area.

597. All Project vessel movements will be managed via marine coordination for the purposes of ensuring any potential increase in encounter rates with third party vessels is minimised. The Applicant will also ensure effective promulgation including in relation to construction activities which will highlight to marine users when and where there may be increased activity.

598. It is also noted that there is already wind farm vessel activity present within the area associated with the operation and maintenance of the existing Galloper and Gabbard projects. On this basis, local users and regular operators are likely to already be familiar with similar works and transits that will occur in relation to North Falls. In this regard it is noted that there have been no reported collision incidents between vessels associated with Greater Gabbard and Galloper and third party vessels to date. Further, as detailed in Section 9.6.1, there has only been one reported collision incident between a third party vessel and a wind farm vessel in the UK, noting this incident occurred within a harbour.

599. The CoS recommended during consultation (see Section 4) that entry / exit points for project vessels accessing or leaving the array area were defined to maximise mariner awareness of where project vessel encounters may occur. As per Section 19, these have been assumed as embedded mitigation as part of marine coordination procedures.

600. The Applicant will apply for safety zones of 500m around any structure where construction is ongoing (i.e., where there may be sensitive vessel operations underway). Advisory safe passing distances may also be promulgated around any sensitive operations where a safety zone does not apply (e.g., cable installation). These measures will ensure third party vessels are aware of the areas that should be avoided to minimise collision risk with project vessels.

601. In terms of cable installation, a key output of consultation was that mitigation was needed to manage hazards associated with the cable installation process, noting the location of the offshore cable corridor intersecting the outer and inner precautionary areas, the Trinity and Sunk DW routes, and the charted Sunk pilotage (see Section 7). The cable installation process will require a vessel(s) that is Restricted in Ability to

Manoeuvre. North Falls has therefore created an Outline Navigation and Installation Plan (NIP) (document reference 7.24) in liaison with the local ports and other key maritime stakeholders which sets out procedures by which associated hazards will be managed.

16.1.4.1 Frequency of Occurrence

602. Frequency of occurrence is considered to be remote.

16.1.4.2 Severity of Consequence

603. Severity of consequence is considered to be moderate based on consideration of historical incident data.

16.1.4.3 Hazard Significance

604. The hazard is therefore determined to be tolerable and ALARP assuming the implementation of the NIP.

16.1.5 Hazard 5: Hazards on Vessels Involved in Marine Aggregate Operations

605. The offshore infrastructure, project vessels and activities may impact marine aggregate dredging operations in the area during construction.

606. In terms of transit to / from marine aggregate dredging areas, there will be no restriction on entry into the buoyed construction area other than through active safety zones. However, marine aggregate dredgers may choose to deviate to avoid the array area. This aligns with consultation input from CEMEX who stated during consultation (September 2021) their vessels would likely deviate to use the Sunk TSS South lanes without difficulty. The vessel traffic data showed the majority of dredger transits already occur in the TSS lanes, and on this basis it is not considered that there will be notable impacts on transits.

607. In terms of active marine aggregate dredging, there is one marine aggregate dredging area located adjacent to the array area; area 524 (“Thames D”) – adjacent to the southeastern boundary of the array area, operated by DEME. Input from DEME noted a minimum of 25 visits per year or 110,000 tonnes. The six months of AIS data collected during 2023 and the winter vessel traffic survey also identified marine aggregate dredging within Area 524. DEME stated during consultation that operational marine aggregate dredging is unlikely to be notably impacted given the extents of Area 524 are not typically dredged to ensure the activity remains within the licensed boundaries. Five yearly surveys do occur in and around Area 524, and it was confirmed during consultation that liaison between North Falls and DEME would be undertaken in advance of and during any works occurring to ensure operations from both parties can be facilitated.

608. It is noted that the northern array area was located adjacent to dredging Area 507/6 operated by CEMEX which during consultation (Section 4) was of concern given use

of the area would be restricted during flood tides given the size of the area and fast tides as vessels need additional space to turn. With the northern array now removed in its entirety, in which shipping and navigation stakeholders were a driving factor, there is now no proximity hazard with Area 507/6.

16.1.5.1 Frequency of Occurrence

609. Frequency of occurrence is considered to be remote.

16.1.5.2 Severity of Consequence

610. Severity of consequence is considered to be minor.

16.1.5.3 Hazard Significance

611. The hazard is therefore determined to be broadly acceptable under the FSA.

16.1.6 Hazard 6: Hazard On Vessels Transiting To/From Local Ports in The Area, Including Use of Approach Channels, Port Operations and Pilotage

612. Vessels or activities associated with the construction of North Falls may restrict or hinder third party traffic access to local ports and facilities, including approach channels and pilotage.

613. The offshore cable corridor intersects or passes in proximity to the following features:

- Sunk Outer Precautionary Area;
- Charted Sunk Pilot Station;
- Sunk Inner Precautionary Area;
- Harwich DW Channel; and
- Sunk, Trinity, and Harwich approach DW routes.

614. As part of Site Selection work (**Chapter 4 Site Selection and Assessment of Alternatives (Document Reference 3.1.6)**), the Applicant has engaged with PLA and HHA with regard to cable routeing and has implemented changes to the offshore cable corridor to minimise impacts on the key areas raised as being of concern. Changes made include:

- Shifting the offshore cable corridor further south from the Sunk Pilot Station;
- Shifting the offshore cable corridor south of the Harwich DW Channel;
- TSS crossing angle moved closer to 90 degrees; and
- Offshore cable corridor moved as far as practicable from the Sunk roundabout feature.

615. The final layout will be agreed with MCA and Trinity House. On this basis, and noting the majority of commercial vessel traffic already utilise the TSS lanes as well as the size of main commercial route deviations due to the presence of the buoyed

construction areas (as outlined for the vessel displacement hazard) are small, it is considered unlikely that the buoyed construction area will notably impact port/pilot access and arrival times and anything that will occur will be minimal and so schedules are not deemed to be impacted.

616. In terms of cable installation, a key output of consultation was that mitigation was needed to manage hazards associated with the cable installation process, noting the location of the offshore cable corridor intersecting the outer and inner precautionary areas, the Trinity and Sunk DW routes, and the charted Sunk pilotage. North Falls has therefore created an Outline NIP (document reference 7.24) in liaison with the local ports and other key maritime stakeholders which sets out procedures by which associated hazards will be managed.

617. As per Section 16.1.4, Project vessel movements will be managed via marine coordination including entry / exit points to the array area. All project vessels will also be compliant with all Flag State regulations including the COLREGs, to ensure any impact on third party vessels accessing local ports is minimised. Given the presence of Greater Gabbard and Galloper, whose O&M vessels are operated out of Harwich Haven and Port of Lowestoft, respectively, mariners will already have experience of increased vessel movements associated with offshore wind farms in the area.

618. The most likely consequences of reduced port access in relation to the array area will be limited effects on port/pilot schedules. As a worst case, there could be disruption to port/pilot schedules, but with no safety issues.

619. Consideration of impacts on water depths in terms of port access have been considered in Section 16.2.7, including consideration of future case increases in vessel size.

16.1.6.1 Frequency of Occurrence

620. Frequency of occurrence is considered to be reasonably probable.

16.1.6.2 Severity of Consequence

621. Severity of consequence is considered to be moderate.

16.1.6.3 Hazard Significance

622. The hazard is assessed as being tolerable and ALARP assuming the implementation of the NIP.

16.1.7 Hazard 7: Reduction Of Emergency Response Capability Due To Increased Incident Rates and/or Reduced Access For SAR Responders

623. The construction of North Falls will lead to an increased level of vessels and personnel in the area over current baseline levels. The increased vessel and

personnel numbers may lead to an increase in the number of incidents requiring an emergency response over baseline rates.

624. It is not anticipated that the construction of North Falls will lead to a notable increase in baseline incident rates, noting that as detailed in Section 9.6.1, there have not been a significant number of reported incidents associated with constructing or operational wind farms in the UK. Further, the on site vessels will form additional resources in the event of an emergency incident, and may be able to assist in liaison with the MCA.

625. As required under MGN 654, the Applicant will produce and submit an Emergency Response Cooperation Plan (ERCoP) to the MCA detailing cooperation and assistance procedures in the event of an emergency incident. This will include the anticipated vessel and equipment resources the Project will have available. A SAR checklist will also be produced and agreed with the MCA setting out what additional SAR mitigations are implemented.

626. The final layout will be agreed with the MCA and Trinity House post-consent, as required under the DCO. These discussions will include how the layout will comply with MGN 654 (MCA, 2021) in terms of maintaining SAR access, and will give due consideration to the existing structures associated with Greater Gabbard.

16.1.7.1 Frequency of Occurrence

627. Frequency of occurrence is considered to be extremely unlikely noting low baseline incident rates and the additional Project resources that may be able to assist in an emergency.

16.1.7.2 Severity of Consequence

628. Severity of consequence is considered to be serious given the potential for a notable incident with potential for fatalities.

16.1.7.3 Hazard Significance

629. Given the additional resources associated with the Project and noting layout agreement to ensure suitable SAR access, the hazard is considered tolerable and ALARP under the FSA.

16.2 Potential Hazards During Operation

16.2.1 Hazard 1: Vessel to Structure Allision Risk

630. The structures within the array area will increase allision risk to passing vessels or vessels navigating internally.

631. As discussed in the equivalent construction phase hazard (Section 16.1.1), the MCA and Trinity House raised during consultation that certain sections of the array area

would be of concern given that build out into those sections would either overlap the routeing measures or fail to provide a sufficient buffer based on existing precedents and guidance in MGN 654.

632. On this basis, a refinement of the array areas at PEIR stage has been made, with the following being removed:

- The entirety of the former northern array area;
- All overlap with the precautionary area; and
- Site area within 0.8nm of the Sunk TSS South and Sunk TSS East.

633. As per the consultation section (Section 4), the MCA have indicated that within the refined array area, there should be a minimum distance of 1nm from all surface piercing infrastructure including blades to the Outer Precautionary Area, Sunk TSS South and Sunk TSS East. Applicant has included a DCO requirement (draft DCO, Document Reference: 6.1) which provides that, unless otherwise agreed with the MCA, the Applicant will implement a SEZ whereby all surface piercing infrastructure will be located at least 1nm from the local routeing measures. Further details are provided in Section 14.4.3.2.

634. Commercial vessels are expected to comply with international and flag state regulations (including the COLREGs and SOLAS) and will be able to passage plan in advance given the promulgation of information relating to the Project including display of the structure locations on nautical charts to ensure powered and drifting allision risk is minimised. Further, the structures will also be lit and marked as directed by Trinity House to ensure passing mariner awareness (e.g., lights, sound signals) including in poor visibility. Vessels transiting in the region will already be familiar with navigating in proximity to offshore wind farms while using the neighbouring routing measures, including Greater Gabbard and Galloper. The presence of new surface structures, however, does introduce new allision risk which is localised in nature given that a vessel must be in close proximity to a structure for an allision incident to occur.

635. Based on experience of other UK wind farms, it is likely that all commercial vessels will avoid the array area and hence the structures therein. However, smaller vessels may choose to transit through. In terms of internal navigation, the final layout will be agreed with the MCA and Trinity House to ensure the structures are spaced and located to safely facilitate internal transits and minimise internal allision risk.

636. It is noted that modelling has been undertaken (see Section 15.5) to quantify the risks based on the worst case parameters under consideration, including the future case considerations described for the vessel displacement hazard, noting that a full build out of the array area is assumed. This includes modelling of powered, drifting, and internal navigation scenarios. These are detailed below.

16.2.1.1 Powered Allision Risk

637. From historical incident data, there have been two instances of a third-party vessel alliding with an operational wind farm structure in the UK. These incidents both involved a fishing vessel, with a RNLI lifeboat attending on each occasion and a helicopter deployed in one case. Given the already embedded and firm routeing measures present in the region (i.e., the Sunk TSSs and precautionary areas) and subsequent heightened mariner alertness, it is unlikely that such an incident will occur at North Falls. In this regard it is noted that there have been no reported allision incidents associated with the existing WTGs of the Greater Gabbard and Galloper developments, likely reflective of the extensive existing mitigation including the routeing measures and the Sunk VTS. The presence of these existing developments also means that passing vessels will be used to safely navigating in proximity to wind farm infrastructure.

638. Post wind farm modelling using the main commercial route deviations as input gives an estimated powered allision return period of one in 146 years for base case traffic levels. The significant majority of this risk was observed to be associated with the WTGs on the southern periphery, resulting from the traffic predicted to pass to the south. There is notable searoom to the south, and it is likely that vessels will utilise a larger passing distance than that assumed within the modelling.

639. Approximately 5% of the total modelled powered allision risk was associated with traffic using the TSS lanes, equating to a return period of one per 2,900 years. However, as discussed above based on consultation input from the MCA, to further reduce the risk Applicant has included a DCO requirement (draft DCO, Document Reference: 6.1) which provides that, unless otherwise agreed with the MCA, the Applicant will implement a SEZ whereby all surface piercing infrastructure will be located at least 1nm from the local routeing measures.

640. During the operational phase, operational lighting and marking will be in place as per IALA G1162 (IALA, 2021a) and as directed by Trinity House. All infrastructure will also be shown on appropriate navigational charts. This will ensure the structure locations are clear to passing traffic.

641. Should a powered allision incident occur, the consequences will depend on multiple factors including the energy of the contact, structural integrity of the vessel involved, type of structure contacted, and the sea state at the time of the contact. Small craft including commercial fishing vessels and recreational vessels are considered most vulnerable to the hazard given the potential for a non-steel construction.

642. With consideration of lessons learned the most likely consequences are minor damage with the vessel involved able to resume passage and undertake a full inspection at the next port of call. As a worst case foundering resulting in PLL and pollution may occur.

16.2.1.2 Drifting Allison Risk

643. A vessel adrift may only develop into an allision situation where the vessel is in proximity to a structure and the direction of the wind and/ or tide is such as to direct the vessel towards the structure. Vessel traffic in this area, although of high volume, is within highly regulated routeing measures and it is assumed that in a circumstance where a vessel drifts towards a structure, there are actions that may be taken to prevent the incident developing into an allision situation.

644. For a powered vessel, the ideal and most likely solution would be restoring power prior to reaching the array (by rectifying any fault). If not possible, the vessel will follow the emergency response procedures that are implemented which may include emergency anchoring following a check of the relevant nautical charts to ensure the deployment of the anchor will not lead to other effects (such as anchor snagging on a subsea cable), or use of thrusters (dependent on the vessel and power status).

645. Where anchor deployment is not possible then project vessels on-site may be able to render assistance including under SOLAS obligations (IMO, 1974) and this response will be managed via marine coordination (in liaison with HMCG) and depends on the type and capability of vessels on site and the drifting vessel itself. This would be particularly relevant for sailing vessels whose propulsion is dictated solely by the metocean conditions, although if the vessel becomes adrift in proximity to a structure there may be limited time to render assistance. If a drifting allision was to occur, the speed at which the contact occurs will likely be lower than that of a powered vessel, resulting in the contact energy to be lower.

646. Post wind farm modelling using the main commercial route deviations as input gives an estimated drifting allision return period of one in 772 years for base case traffic levels. As discussed above, based on consultation input from the MCA, to further reduce the risk Applicant has included a DCO requirement (draft DCO, Document Reference: 6.1) which provides that, unless otherwise agreed with the MCA, the Applicant will implement a SEZ whereby all surface piercing infrastructure will be located at least 1nm from the local routeing measures.

647. There is some potential for a vessel to run adrift in this region; this is reflected in the number of machinery failure incidents reported locally to the MAIB (33% of all reported incidents within the study area across a recent 10-year period). From historical incident data, there have been no instances of a third-party vessel alliding with an operational wind farm structure in the UK whilst NUC. This includes no drifting allisions with the existing Greater Gabbard and Galloper developments.

16.2.1.3 Internal Allision Risk

648. Post wind farm modelling undertaken using the vessel traffic survey data as an input gives an estimated to commercial fishing allision return period of one in 13.4 years for base case traffic levels. This return period is largely characteristic of fishing

vessels engaged in fishing rather than in transit, and it is noted that the model assumes extremely conservative assumptions around fishing vessel behaviour. Full details are provided in Section 15.5.4.

649. The minimum spacing (cross wind direction spacing of 944m and minimum downwind spacing of 1,180m) is sufficient for safe internal navigation and is greater than that associated with many other UK offshore wind farms, some of which are navigated by commercial fishing vessels in favourable conditions. The minimum spacing between structures is also similar to that present at the neighbouring Greater Gabbard and Galloper.

650. As aforementioned, the final array layout will be agreed with the MCA and Trinity House post consent but will be compliant with the requirements of MGN 654 (MCA, 2021), including the completion of a safety justification for a single line of orientation layout should this be taken forward. As with any passage, a vessel navigating internally within the array is expected to passage plan in accordance with SOLAS Chapter V (IMO, 1974). The lighting and marking of the array area as required by Trinity House and the MCA (as per MGN 654) includes compliant unique identification marking of structures in an easily identifiable pattern which will assist with minimising the likelihood of a mariner becoming disoriented whilst navigating internally within the array area.

651. For recreational vessels under sail navigating internally within the array, there is also potential for effects such as wind shear, masking, and turbulence to occur. From previous studies of offshore wind developments, it has been concluded that WTGs do reduce wind velocity downwind of a WTG (MCA, 2022) but that no negative effects on recreational craft have been reported on the basis of the limited spatial extent of the effect and its similarity to that experienced when passing a large vessel or close to other large structures (such as bridges) or the coastline. In addition, no practical issues have been raised by recreational users to date when operating in proximity to existing offshore wind developments.

652. An additional allision risk associated with the WTG blades applies for recreational vessels with a mast when navigating internally within the array. However, the minimum air gap will be 27m above MHWS which is greater than the minimum clearance the RYA recommend for localised allision risk (RYA, 2019) and which is also noted in MGN 654.

653. Should an internal allision incident occur, the consequences will be similar to those outlined for a powered allision incident, including the determining factors. However, as with a drifting allision incident, the speed at which the contact occurs will likely be lower than for an external allision, resulting in the contact energy being lower.

16.2.1.4 Frequency of Occurrence

654. Frequency of occurrence is considered to be remote noting the embedded mitigations including layout approval and lighting and marking.

16.2.1.5 Severity of Consequence

655. Severity of consequence is considered to be serious given the potential for a notable incident including fatalities.

16.2.1.6 Hazard Significance

656. Noting that the final layout will be agreed with the MCA and Trinity House and the additional mitigation of the SEZ to maintain a distance of at least 1nm from all surface piercing infrastructure to the local IMO routeing measures unless otherwise agreed with the MCA, the hazard is assessed as being tolerable and ALARP.

16.2.2 Hazard 2: Vessel Displacement Due to Activities Associated with the Project

657. Based on operational experience, it is likely that commercial vessels will deviate to avoid the array area during the operational phase on similar deviations to those established during construction (see Section 16.1.2). Smaller vessels (e.g., fishing and recreation), may still choose to transit through at the discretion of individual vessel masters.

658. As detailed in 10.1, the majority of vessel routeing in the vicinity of the array area is defined by the TSS lanes and precautionary areas, and as such the majority of commercial traffic already avoids the array area. However, certain vessels are associated with routes outside of the TSS lanes and precautionary areas that may alter passage as a result of the Project depending on the final build out scenario.

659. Commercial vessels using the Galloper Recommended Ferry Route are also likely to require to deviate to avoid the array area, noting this includes adverse weather routeing (see Section 11.3). Consultation input from Stena (see Section 4) indicates such use is infrequent, and that safe alternate passage would be available around the array area via the Sunk TSS South or Sunk TSS East, albeit requiring a longer transit time. Similarly, deviations exist for any future ferry routes from Ostend or other Belgian ports that would have previously used the Galloper Recommended Ferry route (noting the route was originally defined for routeing into the Sunk from Ostend). Study of six months of AIS data from 2023 shows that vessels transiting to Belgium ports from the Sunk area do not typically use the Galloper Recommended Ferry route and instead most commonly use the Sunk TSS South, with certain transits also recorded using the Sunk TSS East. It is noted that there are no known plans to reopen the Ostend ferry route for which the original Galloper Recommended Ferry Route was defined.

660. It should also be considered that vessels on routes associated with the routeing measures may still utilise very minor deviations, for example to increase passing distance from the array area when accessing or departing a TSS lane.

661. As per Section 16.1.2, deviations due to the presence of the Project could be required for two out of the 43 main commercial routes identified (one a high use route and the other a low use route), with the level of deviation no greater than 1%. Both routes are expected to pass south of the array area, where there is sea room to accommodate such deviations (in excess of 6nm of sea room is available between the array area and the North Hinder TSS).

662. The Galloper Recommended Ferry Route was observed to be used on a very infrequent basis by commercial vessels, with an average of one unique cargo vessel per every eight days was estimated based on study of three years of AIS data between July 2020 and June 2023. Within this period, only five transits from passenger vessels (three of which were from one RoPax and the other two large sailing vessels) and two transits from one tanker were recorded. It is considered likely that these vessels would use either the Sunk TSS East or Sunk TSS South noting this aligns with input from Stena Line who use the Galloper Recommended Ferry Route on an infrequent basis as outlined above.

663. Smaller vessels may still utilise the array area for transit noting entry would not be prohibited other than through any active safety zones. The minimum spacing (cross wind direction spacing of 944m and minimum downwind spacing of 1,180m) is sufficient for safe internal navigation and is greater than that associated with many other UK offshore wind farms, some of which are navigated by commercial fishing vessels in favourable conditions. The minimum spacing between structures is also greater than that at the neighbouring Greater Gabbard and Galloper developments. The final layout will be agreed with the MCA and Trinity House and these discussions will include consideration of facilitation of internal navigation.

664. The most likely consequences of vessel displacement will be increased journey times and distances for affected third-party vessels and as a worst case, there could be disruption to schedules, particularly for commercial ferry operators in the region but given the anticipated size of the deviations outlined above and the international nature of routeing in the region alongside the ability to passage plan, disruptions to schedule are expected to be minimal. Vessels are expected to comply with international and flag state regulations (including the COLREGs and SOLAS) and will be able to passage plan in advance given the promulgation of information relating to the Project and relevant nautical charts. This high level of awareness will assist with ensuring that vessels make safe and effective deviations which minimise journey increases.

665. As a worst case, there could be disruption to schedules, particularly for commercial ferry operators in the region but given the anticipated size of the deviations outlined

above and the international nature of routeing in the region alongside the ability to passage plan, disruptions to schedule are expected to be minimal.

666. There will also be some displacement associated with any maintenance of the offshore export cables within the offshore cable corridor. Any such displacement would be temporary and spatially limited and likely to be much less frequent than during the construction phase, however, does have the potential to impact routeing and pilotage within the precautionary areas if it were to occur. On this basis liaison procedures will be in place with PLA and HHA to determine appropriate arrangements for instances of cable maintenance, via the NIP. This is assessed in more detail in Section 16.2.6.

16.2.2.1 Frequency of Occurrence

667. Frequency of occurrence is considered to be reasonably probable noting limited deviations are anticipated to occur.

16.2.2.2 Severity of Consequence

668. Severity of consequence is considered to be minor given the layout will require MCA and Trinity House approval and deviations will already have been established during the construction phase.

16.2.2.3 Hazard Significance

669. Minor deviations will occur albeit with sufficient searoom for safe navigation and alternate routeing options, the hazard is therefore assessed as being tolerable and ALARP.

16.2.3 Hazard 3: Increased Vessel to Vessel Collision Risk Between Third Party Vessels Due to Vessel Displacement

670. As discussed in Section 16.2.2, it is likely that commercial vessels will deviate to avoid the array area during the operational phase. Such vessels displaced from the array area may increase encounter rates with other third party vessels which may lead to an increase in collision risk.

671. Local traffic patterns inshore of the array area are currently managed by the existing Sunk routeing measures. These routeing measures are used by a relatively large number of vessels per day, however as detailed in Section 16.1.3, there was only one collision incidents recorded within the study area over the 10 years of incident data studied. One collision incident was also reported in the preceding ten year period. The limited number of collisions is likely reflective of the risk being managed by the significant traffic management mitigations already in place including the routeing measures and the Sunk VTS.

672. In poor visibility, third-party vessels may experience limitations regarding visual identification of other third-party vessels when passing on another side of the array

area. These limitations may increase the potential for an encounter. However, this will be mitigated by the application of the COLREGs (reduced speeds) in adverse weather conditions. Moreover, the minimum spacing between WTGs (cross wind direction spacing of 944m and minimum downwind spacing of 1,180m) will be sufficient to ensure any visual restriction is very short-term in nature. Given the presence of the array area between routeing measures and noting the presence of the precautionary area, it is also very likely that vessels will be very aware of the potential for other vessels navigating locally.

673. Post wind farm modelling undertaken in Section 15.5.1 using all main commercial routes identified as input gives an estimated collision return period of one in 2.87 years for base case traffic levels. The high level of collision risk is due to the significant volumes of vessels already within the surrounding area of the Project. The base case collision result represents a 0.32% increase compared to the pre wind farm base case result, indicating that the influence of the array area on the overall collision risk for commercial traffic is very low. This is reflective of the open searoom available to the south of the array area where vessels would be expected to deviate as discussed in Section 16.2.2. However, as discussed in the allision risk hazard (Section 16.2.1), based on consultation input from the MCA, to further reduce the risk Applicant has included a DCO requirement (draft DCO, Document Reference: 6.1) which provides that, unless otherwise agreed with the MCA, the Applicant will implement a SEZ whereby all surface piercing infrastructure will be located at least 1nm from the local routeing measures.

674. During the Hazard Workshop, it was raised that recreational vessels that would normally transit through the array area to avoid the TSS lanes may be displaced into the TSS lanes. However, minimums spacing (cross wind direction spacing of 944m and minimum downwind spacing of 1,180m) is sufficient for safe internal navigation and is greater than that associated with many other UK offshore wind farms, some of which are navigated by commercial fishing vessels in favourable conditions. The minimum spacing between structures is also greater than that at the neighbouring Greater Gabbard and Galloper developments. The final layout will be agreed with the MCA and Trinity House and these discussions will include consideration of facilitation of internal navigation for smaller vessels including recreational vessels.

675. In the event that an encounter does occur, it is likely to be very localised and occur for only a short duration, with collision avoidance action implemented by the vessels involved, in line with the COLREGs, thus minimising the risk that the situation will develop into a collision incident.

676. Historical collision incident data (as per Section 9.6.1) also indicates that no collision incidents between third-party vessels have occurred directly as a result of a UK offshore wind farm and that the most likely consequences will be low should a collision occur, with minor contact between the vessels resulting in minor damage and no injuries to persons, with both vessels able to resume their respective

passages and undertake a full inspection at the next port. As an unlikely worst case, one of the vessels could be foundered resulting in a PLL and / or pollution.

16.2.3.1 Frequency of Occurrence

677. Frequency of occurrence of a collision is considered to be remote.

16.2.3.2 Severity of Consequence

678. Severity of consequence is considered to be moderate based on consideration of historical incident data.

16.2.3.3 Hazard Significance

679. Noting that the final layout will be agreed with the MCA and Trinity House and the additional mitigation of the SEZ to maintain a distance of at least 1nm from all surface piercing infrastructure to the local IMO routeing measures unless otherwise agreed with the MCA, the hazard is assessed as being tolerable and ALARP.

16.2.4 Hazard 4: Vessel to Vessel Collision Risk (Third Party to Project Vessel)

680. Increases in wind farm vessel activity associated with the operation of North Falls could lead to increased collision rates in the area.

681. All Project vessel movements will be managed via marine coordination for the purposes of ensuring any potential increase in encounter rates with third party vessels is minimised. The Applicant will also ensure effective promulgation including in relation to maintenance activities which will highlight to marine users when and where there may be increased activity.

682. It is also noted that there is already wind farm vessel activity present within the area associated with the operation and maintenance of the existing Galloper and Gabbard projects. Further, there will likely be lower activity associated with North Falls during the operational phase than was the case during construction. On this basis, local users and regular operators are likely to already be familiar with similar works and transits that will occur in relation to the operation of North Falls. In this regard it is noted that there have been no reported collision incidents between vessels associated with Greater Gabbard and Galloper and third party vessels to date. Further, as per Section 9.6.1, there has only been one reported collision incident between a third party vessel and a wind farm vessel in the UK, noting this incident occurred within a harbour.

683. The CoS recommended during consultation (see Section 4) that entry / exit points for project vessels accessing or leaving the array area were defined to maximise mariner awareness of where project vessel encounters may occur. As per Section 19, these have been assumed as embedded mitigation as part of marine coordination procedures.

684. The Applicant will apply for safety zones of 500m around any structure where major maintenance is ongoing (i.e., where there may be sensitive vessel operations underway). Advisory safe passing distances may also be promulgated around any sensitive operations where a safety zone does not apply (e.g., cable maintenance). These measures will ensure third party vessels are aware of the areas that should be avoided to minimise collision risk with project vessels.

685. In terms of the export cables, a key output of consultation was that mitigation was needed to manage hazards associated with any cable maintenance, noting the location of the offshore cable corridor intersecting the outer and inner precautionary areas, the Trinity and Sunk DW routes, and the charted Sunk pilotage.

686. North Falls has therefore created an Outline NIP (document reference 7.24) in liaison with the local ports and other key maritime stakeholders which sets out procedures by which associated hazards will be managed. This includes consideration of the need for any cable maintenance, noting any such need is likely to be a very infrequent event.

16.2.4.1 Frequency of Occurrence

687. Frequency of occurrence is considered to be extremely unlikely.

16.2.4.2 Severity of Consequence

688. Severity of consequence is considered to be moderate based on consideration of historical incident data.

16.2.4.3 Hazard Significance

689. The hazard is therefore determined to be Broadly Acceptable.

16.2.5 Hazard 5: Hazards on Vessels Involved in Marine Aggregate Operations

690. The offshore infrastructure, project vessels and activities may impact marine aggregate dredging operations in the area during the operational phase.

691. In terms of transit to / from marine aggregate dredging areas, there will be no restriction on entry into the array area other than through active safety zones. However, marine aggregate dredgers may choose to deviate to avoid the array area. This aligns with consultation input from CEMEX who stated during consultation (September 2021) their vessels would likely deviate to use the Sunk TSS South lanes without difficulty. The vessel traffic data showed the majority of dredger transits already occur in the TSS lanes, and on this basis it is not considered that there will be notable impacts on transits.

692. In terms of marine aggregate dredging, there is one marine aggregate dredging areas located adjacent to the array area; 524 (“Thames D”) – adjacent to southern array area, operated by DEME. Input from DEME noted a minimum of 25 visits per year or

110,000 tonnes. The six months of AIS data collected during 2023 and the winter vessel traffic survey also identified marine aggregate dredging within Area 524. DEME stated during consultation that operational marine aggregate dredging is unlikely to be notably impacted given the extents of Area 524 are not typically dredged to ensure the activity remains within the licensed boundaries. Five yearly surveys do occur in and around Area 524, and it was confirmed during consultation that liaison between North Falls and DEME would be undertaken in advance of and during any works occurring to ensure operations from both parties can be facilitated.

693. It is noted that the northern array area was located adjacent to dredging Area 507/6 operated by CEMEX which during consultation (Section 4) was of concern given use of the area would be restricted during flood tides noting the size of the area and fast tides as vessels need additional space to turn. With the northern array now removed in its entirety, in which shipping and navigation stakeholders were a driving factor, there is now no proximity hazard with Area 507/6.

16.2.5.1 Frequency of Occurrence

694. Frequency of occurrence is considered to be remote.

16.2.5.2 Severity of Consequence

695. Severity of consequence is considered to be minor.

16.2.5.3 Hazard Significance

696. The hazard is therefore determined to be broadly acceptable under the FSA.

16.2.6 Hazard 6: Hazard On Vessels Transiting To/From Local Ports in The Area, Including Use of Approach Channels, Port Operations and Pilotage

697. Vessels or activities associated with the operation of North Falls may restrict or hinder third party traffic access to local ports and facilities, including approach channels and pilotage.

698. The offshore cable corridor intersects or passes in proximity to the following features:

- Sunk Outer Precautionary Area;
- Charted Sunk Pilot Station;
- Sunk Inner Precautionary Area;
- Harwich DW Channel; and
- Sunk, Trinity, and Harwich approach DW route.

699. As part of Site Selection work (**Chapter 4 Site Selection and Assessment of Alternatives Document Reference 3.1.6)**), the Applicant has engaged with PLA and HHA with regard to cable routeing and has implemented changes to the offshore

cable corridor to minimise impacts on the key areas raised as being of concern. Changes made include:

- Shifting the offshore cable corridor further south from the Sunk Pilot Station;
- Shifting the offshore cable corridor south of the Harwich DW Channel;
- TSS crossing angle moved closer to 90 degrees; and
- Offshore cable corridor moved as far as practicable from the Sunk roundabout feature.

700. The final layout of structures will be agreed with MCA and Trinity House. On this basis, and noting the majority of commercial vessel traffic already utilise the TSS lanes as well as the size of main commercial route deviations due to the presence of the array area (as outlined for the vessel displacement hazard) are small, it is considered unlikely that the array area will notably impact port/pilot access and arrival times and anything that will occur will be minimal and so schedules are not deemed to be impacted.

701. In terms of the export cables, a key output of consultation was that mitigation was needed to manage associated hazards including from cable maintenance, noting the location of the offshore cable corridor intersecting the outer and inner precautionary areas, the Trinity and Sunk DW routes, and the charted Sunk pilotage. North Falls has therefore created a NIP (document reference 7.24) in liaison with the local ports and other key maritime stakeholders which sets out procedures by which associated hazards will be managed, noting any instances of cable maintenance are anticipated be very infrequent.

702. A key area of concern from stakeholders notably local port authorities is the sections of the offshore cable corridor that intersect the Sunk and Trinity DW routes. It is noted that the offshore cable corridor also passes in proximity to the DW route approach to the Harwich DW Channel. These DW routes are crucial as they are the only option for deep draught vessels to access major local ports including the Thames and Medway ports, Harwich Haven, and the Port of Felixstowe. A reduction in water depth resultant of cable protection may therefore prevent port access for larger vessels, and laid cables may also restrict ability to deepen the DW routes in the future, preventing access for larger vessels in the future. This is considered in Section 16.2.7.

703. As per Section 16.2.4, Project vessel movements will be managed via marine coordination including entry / exit points to the array area. All project vessels will also be compliant with all Flag State regulations including the COLREGs, to ensure any impact on third party vessels accessing local ports is minimised. Given the presence of Greater Gabbard and Galloper, whose O&M vessels are operated out of Harwich Haven and Port of Lowestoft, respectively, mariners will already have experience of increased vessel movements associated with offshore wind farms in the area.

704. The most likely consequences of reduced port access in relation to the operational array area will be limited effects on port/pilot schedules. As a worst case, there could be disruption to port/pilot schedules, but with no safety issues.

16.2.6.1 Frequency of Occurrence

705. Frequency of occurrence is considered to be remote.

16.2.6.2 Severity of Consequence

706. Severity of consequence is considered to be moderate.

16.2.6.3 Hazard Significance

707. The hazard is assessed as being tolerable and ALARP assuming the implementation of the NIP.

16.2.7 Hazard 7: Interaction with Subsea Cables Including Cable Protection

708. Up to 103 nm (190km) of array cables/platform interconnector cable will be located within the array area and up to two offshore export cables with a combined total length of 68 nm (125.4km) will be within the offshore cable corridor. Where available, the primary means of cable protection will be by seabed burial, with a target minimum burial depth of 0.6m. Cables may require alternative cable protection with an indicative height of 1.4 m. The burial depth and protection necessary will be informed by the Cable Burial Risk Assessment.

709. Any changes in water depth associated with the installed cable protection could lead to an increase in underkeel interaction risk for third party vessels navigating in the area. This was raised as a key concern by local port authorities notably the HHA and PLA during consultation with the Sunk VTS User Group and in other forums (see Section 4).

710. It is noted that the Applicant has already engaged in consultation with key stakeholders in its offshore cable corridor site selection process, including the MCA, Trinity House, PLA, and HHA. The input received has been fed into the offshore cable corridor selection process to date. Further details are provided in Section 16.2.6 and **Chapter 4 Site Selection and Assessment of Alternatives (Document Reference 3.1.6)**. Of relevance to underkeel clearance is the shifting south of the offshore cable corridor so it sits outside of the Harwich DW Channel.

711. MGN 654 requires that any reduction in water depth of greater than 5% must be discussed with the MCA to agree appropriate mitigation. Changes in water depth within any "areas of critical depths in relation to under keel clearance" including routeing measures and port approaches must also be discussed with the MCA regardless of the extent of the change. This aligns with consultation input received during the cable corridor selection process, with any reductions in water depth near the DW routes in particular raised as being of key concern. As per Section 16.2.6, the

Sunk DW route, Trinity DW route, and the DW route approach to the Harwich DW Channel are crucial as they are only options for deeper draught vessels to access major local ports.

712. Within the DW routes, a maximum vessel draught of 16.9m was recorded using the HHA DW route approach, 15.7m using the Sunk DW route, and 14.1m using the Trinity DW route. On this basis, port access will not be restricted assuming base case vessel draughts, given that the cables will likely be buried in water depths of at least 19m in the areas that intersect the offshore cable corridor, providing in excess of 10% underkeel clearance, noting this assumes no reduction in water depths associated with the export cables over the Sunk or Trinity DW routes. On the basis the project is committing to not reducing water depths in proximity to the intersections between the offshore cable corridor and the DW routes (the Sunk DW Area - West and Trinity DW Area as defined in the Outline NIP, Document Reference: 7.24).

713. General consensus throughout the consultation process indicated that a 20m vessel draught was a reasonable assumption in terms of increased vessel size over the lifetime of the Project (see Section 4), and that an additional 10% was required to ensure suitable underkeel clearance for vessels. This means the channel would need to be excavated to a depth of at least 22m. On this basis additional dredging to install the cables, and over the installed cables would be required (where they intersected the DW routes) and therefore consideration of this and agreement on values would be required as part of the cable burial risk assessment process. It is noted that allowing access for 20m vessels would require dredging along the existing deep-water routes, within turning areas and berths at the relevant ports. Additionally, burial depths should account for tidal constraints associated with larger vessel movements within the areas of concern. It is noted that the current depths over the Sunk and Trinity DW routes do not allow for 20m draught vessels, and substantial future dredging operations would be required to accommodate such vessels regardless of the presence of North Falls.

714. RYA noted during consultation concern over reductions of water depth in the nearshore area where there are large volumes of recreational transits, with particular concern over any reductions in areas where water depths were less than 4m above Chart Datum. Based on MCA requirements under MGN 654 (MCA, 2021) as detailed above, any reduction in water depth of more than 20cm assuming a 4m water depth would require MCA consultation.

715. As part of the Cable Specification and Installation Plan process, the Cable Burial Risk Assessment will set out the proposed burial depths and cable protection (where necessary and permitted), which will take into account areas where deep draught vessels transit, and therefore areas where water depth cannot be compromised. The NIP will be developed in accordance with the Outline NIP (document reference 7.24) to ensure that installation and maintenance methodologies do not compromise safe

vessel access to local ports. Furthermore, where appropriate, burial and protection will consider any foreseeable future spot dredging associated with London Gateway operations around the Sunk and Trinity DW routes to mitigate impacts on such operations. The Cable Burial Risk Assessment and NIP will be conditioned in the deemed Marine Licence.

716. Should an underwater interaction occur, minor damage incurred is the most likely consequence, and foundering the unlikely worst case consequence.

16.2.7.1 Anchor Interaction

717. The offshore cable corridor passes in proximity to the Sunk DW Anchorage and Sunk Inner Anchorage. Based on the vessel traffic survey data, an estimated three vessels per day were at anchor within 2nm of the offshore cable corridor, with the nearest being in the Sunk Inner Anchorage. In the event that a vessel were to drag anchor, it may interact with the offshore export cables.

718. It should also be considered that the offshore cable corridor intersect areas of high commercial vessel density, in particular the Sunk TSS East and South lanes, and the precautionary areas. The route has been designed to minimise impacts, such as by crossing TSS lanes at close to right angles where possible. In an emergency incident it may be necessary for a vessel to drop anchor to avoid drifting into danger e.g., towards wind turbines. The locations of charted cables would be taken into consideration when deciding whether or not to drop anchor in such a situation, however the prevention of an allision or collision incident would likely take priority over the risk of potential cable interaction.

719. As per Section 19, the Applicant will determine suitable cable burial depths and protection measures via the Cable Burial Risk Assessment process. This will consider the vessel densities, types and sizes across and in the vicinity of the offshore cable corridor to ensure protection / burial is sufficient relative to the potential anchor sizes that may be used in the area. As discussed above, the potential need for future dredging over the DW routes will need to be considered within the Cable Burial Risk Assessment process.

720. Should an anchor interaction incident occur with the subsea cables, the most likely consequences will be low based on historical anchor interaction incidents, with no damage incurred to the cable or the vessel. As an unlikely worst case, a snagging incident could occur and/or the vessel’s anchor and the cable could be damaged.

16.2.7.2 Frequency of Occurrence

721. Frequency of occurrence is considered to be reasonably probable.

16.2.7.3 Severity of Consequence

722. Severity of consequence is considered to be moderate.

16.2.7.4 Hazard Significance

723. The hazard is assessed as being tolerable and ALARP assuming the implementation of the NIP.

16.2.8 Hazard 8: Reduction Of Emergency Response Capability Due to Increased Incident Rates and/or Reduced Access for SAR Responders

724. The operation of North Falls will lead to an increased level of vessels and personnel in the area over current baseline levels, noting that numbers are likely to be lower than during construction. The increased vessel and personnel numbers may lead to an increase in the number of incidents requiring an emergency response over baseline rates.

725. It is not anticipated that the operation and maintenance of North Falls will lead to a notable increase in baseline incident rates, noting that as detailed in Section 9.6.1, there have not been a significant number of reported incidents associated with wind farms in the UK. Further, the onsite vessels will form additional resources in the event of an emergency incident, and may be able to assist in liaison with HMCG.

726. As required under MGN 654, the Applicant will produce and submit an ERCoP to the MCA detailing cooperation and assistance procedures in the event of an emergency incident. This will include the anticipated vessel and equipment resources the Project will have available. A SAR checklist will also be produced and agreed with the MCA setting out what additional SAR mitigations are implemented.

727. The final layout will be agreed with the MCA and Trinity House post-consent, as required under the DCO. These discussions will include how the layout will comply with MGN 654 (MCA, 2021) in terms of maintaining SAR access, and will give due consideration to the existing structures associated with Greater Gabbard.

16.2.8.1 Frequency of Occurrence

728. Frequency of occurrence is considered to be extremely unlikely noting low baseline incident rates and the additional Project resources that may be able to assist in an emergency.

16.2.8.2 Severity of Consequence

729. Severity of consequence is considered to be serious given the potential for a notable incident with potential for fatalities.

16.2.8.3 Hazard Significance

730. Given the additional resources associated with the Project and noting layout agreement to ensure suitable SAR access, the hazard is considered tolerable and ALARP.

16.3 Potential Hazards During Decommissioning

16.3.1 Hazard 1: Vessel to Structure Allision Risk

731. Allision risk during decommissioning is likely to be similar to that during the construction phase (see Section 16.1.1), noting similar activities will be occurring and mitigations in place, and a similar scenario in terms of increased vessel numbers. Vessels are expected to comply with international and flag state regulations (including the COLREGs and SOLAS) and will be able to passage plan in advance given the promulgation of information relating to the decommissioning of the Project meaning allision risk will be minimised.

16.3.1.1 Frequency of Occurrence

732. Frequency of occurrence is considered to be remote.

16.3.1.2 Severity of Consequence

733. Severity of consequence is considered to be serious given the potential for a notable incident including fatalities.

16.3.1.3 Hazard Significance

734. The hazard is assessed as being Tolerable and ALARP.

16.3.2 Hazard 2: Vessel Displacement Due to Activities Associated with the Project

735. It is anticipated that this hazard will be similar in nature to the equivalent construction phase hazard (see Section 16.1.2) noting similar activities will be occurring and mitigations in place, and a similar scenario in terms of increased vessel numbers. In particular, any displacement of vessels is likely to be similar.

16.3.2.1 Frequency of Occurrence

736. Frequency of occurrence is considered to be reasonably probable noting limited deviations are anticipated.

16.3.2.2 Severity of Consequence

737. Severity of consequence is considered to be minor given the layout will require MCA and Trinity House approval.

16.3.2.3 Hazard Significance

738. Minor deviations will occur albeit with sufficient searoom for safe navigation and alternate routeing options, the hazard is therefore assessed as being tolerable and ALARP.

16.3.3 Hazard 3: Increased Vessel to Vessel Collision Risk Between Third Party Vessels Due to Vessel Displacement

739. It is anticipated that this hazard will be similar in nature to the equivalent construction phase hazard (see Section 16.1.3) noting similar activities will be occurring and mitigations in place, and a similar scenario in terms of increased vessel numbers. In particular, any displacement of vessels is likely to be similar, and therefore by extension the hazards of collision risk.

16.3.3.1 Frequency of Occurrence

740. Frequency of occurrence is considered to be remote.

16.3.3.2 Severity of Consequence

741. Severity of consequence is considered to be moderate based on consideration of historical incident data.

16.3.3.3 Hazard Significance

742. Noting the embedded mitigation in place and considering the existing traffic management measures, the hazard is assessed as being tolerable and ALARP.

16.3.4 Hazard 4: Vessel to Vessel Collision Risk (Third Party to Project Vessel)

743. It is anticipated that this hazard will be similar in nature to the equivalent construction phase hazard (see Section 16.1.4) noting similar activities will be occurring and mitigations in place, and a similar scenario in terms of increased vessel numbers. In particular, Project vessel movements will be managed via marine coordination.

16.3.4.1 Frequency of Occurrence

744. Frequency of occurrence is considered to be remote.

16.3.4.2 Severity of Consequence

745. Severity of consequence is considered to be moderate based on consideration of historical incident data.

16.3.4.3 Hazard Significance

746. The hazard is therefore determined to be tolerable and ALARP.

16.3.5 Hazard 5: Hazards on Vessels Involved in Marine Aggregate Operations

747. It is anticipated that this hazard will be similar in nature to the equivalent construction phase hazard (see Section 16.1.5) noting similar activities will be occurring and mitigations in place, and a similar scenario in terms of increased vessel

numbers. However, it is noted that status of the local marine aggregate dredging areas will likely have changed.

16.3.5.1 Frequency of Occurrence

748. Frequency of occurrence is considered to be remote noting proximity to existing marine aggregate dredging areas (noting uncertainty over status of marine aggregate dredging areas).

16.3.5.2 Severity of Consequence

749. Severity of consequence is considered to be minor given the layout will require MCA and Trinity House approval.

16.3.5.3 Hazard Significance

750. The hazard is therefore determined to be broadly acceptable under the FSA.

16.3.6 Hazard 6: Hazard On Vessels Transiting To/From Local Ports in The Area, Including Use of Approach Channels, Port Operations and Pilotage

751. It is anticipated that this hazard will be similar in nature to the equivalent construction phase hazard (see Section 16.1.6) noting similar activities will be occurring and mitigations in place, and a similar scenario in terms of increased vessel numbers. As discussed in that section, liaison with HHA and PLA would be undertaken to agree appropriate arrangements for any required works in sensitive areas, including in relation to promulgation of information.

16.3.6.1 Frequency of Occurrence

752. Frequency of occurrence is considered to be reasonably probable.

16.3.6.2 Severity of Consequence

753. Severity of consequence is considered to be moderate.

16.3.6.3 Hazard Significance

754. The hazard is assessed as being tolerable and ALARP assuming the implementation of the NIP.

16.3.7 Hazard 7: Reduction Of Emergency Response Capability Due to Increased Incident Rates and/or Reduced Access for SAR Responders

755. It is anticipated that this hazard will be similar in nature to the equivalent construction phase hazard (see Section 16.1.7) noting similar activities will be occurring and mitigations in place, and a similar scenario in terms of increased vessel numbers.

16.3.7.1 Frequency of Occurrence

756. Frequency of occurrence is considered to be extremely unlikely noting low baseline incident rates and the additional Project resources that may be able to assist in an emergency.

16.3.7.2 Severity of Consequence

757. Severity of consequence is considered to be serious given the potential for a notable incident with potential for fatalities.

16.3.7.3 Hazard Significance

758. Given the additional resources associated with the Project and noting layout agreement to ensure suitable SAR access, the hazard is considered tolerable and ALARP.

17 Cumulative Risk Assessment

17.1 Cumulative Hazard 1: Vessel to Structure Allision Risk

759. The structures within the array area will increase allision risk to vessels passing outside of the WTGs or vessels navigating internally through the WTGs, noting the presence of existing structures associated with the Greater Gabbard and Galloper offshore wind farms. Allision risk is generally localised to adjacent or nearby developments. In the case of North Falls, it is considered there will be a cumulative increase when considered with Five Estuaries in particular (noting other screened in developments are in excess of 15nm from the array area and therefore are not anticipated as contributing to cumulative allision risk).

760. Both the array area and the Five Estuaries array areas are located adjacent to certain Sunk routeing measures, and in proximity to the existing Galloper and Greater Gabbard WTGs. There have been no reported allision incidents to date associated with the existing WTGs, which is likely reflective of the existing mitigation, including the lighting and marking of the WTGs, and the wider traffic management measures in place including the routeing measures and the Sunk VTS.

761. All screened in wind farm developments including Five Estuaries will be required to implement marking and lighting as directed by Trinity House and in compliance with IALA G1162 (IALA, 2021a). All layouts including Five Estuaries will also be required to be agreed with the MCA and Trinity House to ensure they are safe from a surface navigation perspective including on a cumulative basis. Other relevant cumulative developments will be included within MCA and Trinity House lighting and marking and layout agreements.

17.1.1 Frequency of Occurrence

762. Frequency of occurrence is considered to be remote noting the embedded mitigations including layout approval and lighting and marking.

17.1.2 Severity of Consequence

763. Severity of consequence is considered to be serious given the potential for a notable incident including fatalities.

17.1.3 Hazard Significance

764. Noting that the final layout and lighting and marking will be agreed with the MCA and Trinity House and assuming the implementation of the SEZ, the hazard is assessed as being tolerable and ALARP.

17.2 Cumulative Hazard 2: Vessel Displacement Due to Activities Associated with The Project

765. Section 14.4.2 includes quantitative assessment of vessel deviations arising from the array area including on a cumulative basis (considering the screened in surface developments of East Anglia ONE North, East Anglia TWO, Dunkerque and Five Estuaries). As detailed in Section 10.1, the majority of vessel routeing in the vicinity of the array area is defined by the TSS lanes and precautionary areas, and as such the majority of commercial traffic already avoids the array area. However, certain vessels are associated with routes outside of the TSS lanes and precautionary areas that may alter passage as a result of the Project depending on the final build out scenario, and as such may experience cumulative deviation.

766. Two routes were anticipated to deviate cumulatively as follows (see Section 14.4.2 for full details):

- Route 10: three vessels a day, < 1% increase in journey distance within the study area; and
- Route 42: < 1 vessel a day, 3% increase in journey distance within the study area.

767. As shown, vessels on Route 10 will experience a minor deviation of less than 1% in distance within the study area. Vessels on Route 42 will experience a larger albeit still minor deviation of 3%, noting that this route was classed as “low use".

768. On this basis there are considered to be no notable cumulative changes in deviation distance when compared against the pre wind farm and in isolation post wind farm cases and there are no cumulatively screened in developments inshore of the study area, and open searoom including the relevant IMO Routeing Measures to the east. As such further large changes in the wider cumulative area are unlikely. This aligns with discussion at the hazard workshop (see Section 4), with the agreed minutes stating that “Cumulative issues were reviewed for the array but general consensus was that the removal of the northern array had dealt with the key navigational concerns”.

769. There may be some cumulative displacement associated with the works associated with cumulative subsea cables that require surface vessel presence (e.g., cable installation). Any such displacement would be temporary and spatially limited, however does have the potential to impact key vessel routeing options within the precautionary areas. North Falls has therefore created an Outline NIP (document reference 7.24) in liaison with the local ports and other key maritime stakeholders which sets out procedures by which associated hazards will be managed. This is considered in Section 17.5. It is noted that the Five Estuaries project is developing a similar plan (Five Estuaries Offshore Wind Farm (2024)).

17.2.1 Frequency of Occurrence

770. Frequency of occurrence is considered to be reasonably probable noting limited deviations are anticipated.

17.2.2 Severity of Consequence

771. Severity of consequence is considered to be negligible when considering the size of the cumulative area considered.

17.2.3 Hazard Significance

772. Minor deviations will occur albeit with sufficient searoom for safe navigation and alternate routeing options, the hazard is therefore assessed as being Broadly Acceptable.

17.3 Cumulative Hazard 3: Increased Vessel to Vessel Collision Risk Between Third Party Vessels Due to Vessel Displacement

773. The presence of cumulative developments may reduce available searoom and lead to increased encounter rates and collision risk due to cumulative vessel displacement (see Section 17.2).

774. Collision incidents recorded within the study area are detailed in Section 16.1.3, and as discussed in that section are observed to be infrequent.

775. As per Section 17.2, cumulative deviations are not anticipated to be notable, with increases in journey distance limited to just two identified routes, with the change being low for both these routes. This is reflective of the vast majority of vessels in the study area already passing clear of the array area, either via the Sunk TSS South, Sunk TSS East, or to the south.

776. On this basis, given limited anticipated impact on vessel routeing, there is considered unlikely to be a notable change in collision risk.

17.3.1 Frequency of Occurrence

777. Frequency of occurrence is considered to be remote.

17.3.2 Severity of Consequence

778. Severity of consequence is considered to be moderate based on consideration of historical incident data.

17.3.3 Hazard Significance

779. Noting the embedded mitigation in place and considering the existing traffic management measures, the hazard is assessed as being tolerable and ALARP.

17.4 Cumulative Hazard 4: Vessel To Vessel Collision Risk (Third Party to Project Vessel)

780. All Project vessel movements associated with North Falls will be managed via marine coordination for the purposes of ensuring any potential increase in encounter rates with third party vessels is minimised. The Applicant will also ensure effective promulgation including in relation to maintenance activities which will highlight to marine users when and where there may be increased activity. All wind farm developments are expected to be implementing similar appropriate vessel management procedures including via marine coordination to ensure any disruption to third party traffic is minimised. It is also expected that all developers will apply for standard safety zones. All project vessels regardless of developer will also be required to comply with COLREGS which will manage encounter situations.

781. In terms of cable installation, a key output of consultation was that mitigation was needed to manage hazards associated with the cable installation process, noting the location of the offshore cable corridor intersecting the outer and inner precautionary areas, the Trinity and Sunk DW routes, and the charted Sunk pilotage. North Falls has therefore created an Outline NIP (Document Reference: 7.24) in liaison with the local ports and other key maritime stakeholders which sets out procedures by which associated hazards will be managed.

17.4.1 Frequency of Occurrence

782. Frequency of occurrence is considered to be remote.

17.4.2 Severity of Consequence

783. Severity of consequence is considered to be moderate based on consideration of historical incident data.

17.4.3 Hazard Significance

784. The hazard is therefore determined to be tolerable and ALARP assuming the implementation of the NIP.

17.5 Cumulative Hazard 5: Impact On Vessels Transiting To/From Local Ports in The Area, Including Use of Approach Channels, Port Operations and Pilotage

785. Vessels or activities associated with the operation of North Falls may restrict or hinder third party traffic access to local ports and facilities, including approach channels and pilotage. Additional activities and vessels associated with other developments may increase the hazard on a cumulative basis.

786. In particular, should surface activities of cumulative developments associated with subsea cables overlap on a temporal basis with similar activities at North Falls in the

vicinity of the Sunk routeing measures, there may be temporary increased levels of hazard to vessels associated with transits to /from local ports including pilotage. The screened in cumulative cable developments are:

- Five Estuaries export cables;
- NeuConnect Interconnector;
- Nautilus Interconnector;
- Sea Link; and
- Tarchon Energy Interconnector.

787. The Applicant has engaged with PLA and HHA with regard to cable routeing and has implemented changes to the offshore cable corridor to minimise impacts on the key areas raised as being of concern.

788. Liaison has taken place with PLA and HHA to agree appropriate arrangements for cable activities in sensitive areas, including in relation to promulgation of information. This is of particular importance for works required in the vicinity of the Sunk Pilot Station given its location relative to the offshore cable corridor. The key output of this consultation is the Outline NIP (document reference 7.24), which has been drafted in liaison with the local ports and other key maritime stakeholders which sets out procedures by which associated hazards will be managed. The Outline NIP (document reference 7.24) includes consideration of cumulatively screened in cable developments and will be further developed in liaison with the Interested Parties to account for any required additional procedures.

789. As per Section 17.4, Project vessel movements will be managed via marine coordination to ensure any impact on third party vessels accessing local ports is minimised, and other developers should be applying the same measures.

17.5.1 Frequency of Occurrence

790. Frequency of occurrence is considered to be reasonably probable.

17.5.2 Severity of Consequence

791. Severity of consequence is considered to be moderate.

17.5.3 Hazard Significance

792. The cumulative hazard is assessed as being tolerable and ALARP assuming the implementation of the NIP.

17.6 Cumulative Hazard 6: Interaction With Subsea Cables Including Cable Protection

793. Any cumulative changes in water depth associated with the installed cable protection including at cable crossing points could lead to an increase in underkeel interaction risk for third party vessels navigating in the area. This was raised as a key

concern by local port authorities notably the HHA and PLA during consultation with the Sunk VTS User Group and other forums.

794. As discussed in Section 16.2.7, MGN 654 requires that any reduction in water depth of greater than 5% must be discussed with the MCA to agree appropriate mitigation. Changes in water depth within any "areas of critical depths in relation to under keel clearance" including routeing measures and port approaches must also be discussed with the MCA regardless of the extent of the change. The MCA will consider cumulative issues in this regard in terms of acceptability and appropriate mitigation.

795. Any crossings with cumulative cable developments will likely lead to reductions in navigable depth resultant of cable protection, with an indicative height of 1.4m (analogous to the in isolation assessment). Crossings will be considered as part of the Cable Burial Risk Assessment process and Cable Specification and Installation Plan process, to ensure they are appropriately designed to mitigate environmental effects.

796. As per Section 19, the Applicant will determine suitable cable burial depths and protection measures via a cable burial risk assessment process, as will developers of other screened in cumulative developments.

17.6.1 Frequency of Occurrence

797. Frequency of occurrence is considered to be reasonably probable.

17.6.2 Severity of Consequence

798. Severity of consequence is considered to be moderate.

17.6.3 Hazard Significance

799. The cumulative hazard is assessed as being tolerable and ALARP assuming the implementation of the NIP.

17.7 Cumulative Hazard 7: Reduction Of Emergency Response Capability Due to Increased Incident Rates and/or Reduced Access for SAR Responders

800. It is not anticipated that there will be a notable increase in baseline incident rates on a cumulative basis, noting that as per Section 9.6.1, there have not been a significant number of reported incidents associated with wind farms in the UK. Further, the onsite vessels associated with North Falls and other cumulative developments will form additional resources in the event of an emergency incident, and may be able to assist in liaison with the MCA.

801. As required under MGN 654 (MCA, 2021), the Applicant will produce and submit an ERCoP to the MCA detailing cooperation and assistance procedures in the event of an emergency incident, and the same requirement will apply to other developers.

802. The final layouts of all cumulative development will be required to be agreed with the MCA and Trinity House. These discussions will include how the layouts will comply with MGN 654 (MCA, 2021) in terms of maintaining SAR access, and will give due consideration to existing structures.

17.7.1 Frequency of Occurrence

803. Frequency of occurrence is considered to be extremely unlikely noting low baseline incident rates and the additional Project resources that may be able to assist in an emergency.

17.7.2 Severity of Consequence

804. Severity of consequence is considered to be serious given the potential for a notable incident with potential for fatalities.

17.7.3 Hazard Significance

805. Given the additional resources associated with the Project and noting layout agreement to ensure suitable SAR access, the hazard is considered tolerable and ALARP, and therefore not significant in EIA terms.

18 Risk Control Log

806. Table 18.1 presents a summary of the assessment of shipping and navigation hazards scoped into the risk assessment. This includes the proposed embedded mitigation measures, frequency of occurrence, severity of consequence and significance of risk, per hazard. For risks where multiple components were assessed (e.g., powered, drifting and internal allision risk) the component(s) resulting in the worst-case risk is presented.

Table 18.1 Risk Control Log

Potential Hazard	User	Frequency of Occurrence	Severity of Consequence	Significance of Risk	Additional Mitigation measures proposed	Residual Significance of Risk
Construction Phase						
Hazard 1: Vessel to structure allision	Third party traffic	Remote	Serious	Tolerable	SEZ to maintain a distance of at least 1nm from all surface piercing infrastructure to the local IMO routeing measures unless otherwise agreed with the MCA.	Tolerable and ALARP
Hazard 2: Vessel displacement	Third party traffic	Reasonably Probable	Minor	Tolerable	None identified	Tolerable and ALARP
Hazard 3: Increased vessel to vessel collision risk (third party to third party)	Third party traffic	Remote	Moderate	Tolerable	SEZ to maintain a distance of at least 1nm from all surface piercing infrastructure to the local IMO routeing measures unless otherwise agreed with the MCA.	Tolerable and ALARP

Potential Hazard	User	Frequency of Occurrence	Severity of Consequence	Significance of Risk	Additional Mitigation measures proposed	Residual Significance of Risk
Hazard 4: Increased vessel to vessel collision risk (third party to project vessel)	Third party traffic	Remote	Moderate	Tolerable	None identified	Tolerable and ALARP
Hazard 5: Impacts on vessels involved in marine aggregate operations	Marine aggregate dredgers	Remote	Minor	Broadly Acceptable	None identified	Broadly Acceptable
Hazard 6: Impact on vessels transiting to/from local ports in the area, including use of approach	Ports and port users	Reasonably Probable	Moderate	Tolerable	None identified	Tolerable and ALARP

Potential Hazard	User	Frequency of Occurrence	Severity of Consequence	Significance of Risk	Additional Mitigation measures proposed	Residual Significance of Risk
channels, port operations and pilotage						
Hazard 7: Reduction of emergency response capability due to increased incident rates and/or reduced access for SAR responders	Emergency Response Resources	Extremely Unlikely	Serious	Tolerable	None identified	Tolerable and ALARP
Operational Phase						
Hazard 1: Vessel to structure allision	Third party traffic	Remote	Serious	Tolerable	SEZ to maintain a distance of at least 1nm from all surface piercing infrastructure to the local IMO	Tolerable and ALARP

Potential Hazard	User	Frequency of Occurrence	Severity of Consequence	Significance of Risk	Additional Mitigation measures proposed	Residual Significance of Risk
					routeing measures unless otherwise agreed with the MCA.	
Hazard 2: Vessel displacement	Third party traffic	Reasonably Probable	Minor	Tolerable	None identified	Tolerable and ALARP
Hazard 3: Increased vessel to vessel collision risk (third party to third party)	Third party traffic	Remote	Moderate	Tolerable	SEZ to maintain a distance of at least 1nm from all surface piercing infrastructure to the local IMO routeing measures unless otherwise agreed with the MCA.	Tolerable and ALARP
Hazard 4: Increased vessel to vessel collision risk (third party to project vessel)	Third party traffic	Extremely Unlikely	Moderate	Broadly Acceptable	None identified	Broadly Acceptable

Potential Hazard	User	Frequency of Occurrence	Severity of Consequence	Significance of Risk	Additional Mitigation measures proposed	Residual Significance of Risk
Hazard 5: Impacts on vessels involved in marine aggregate operations	Marine aggregate dredgers	Remote	Minor	Broadly Acceptable	None identified	Broadly Acceptable
Hazard 6: Impact on vessels transiting to/from local ports in the area, including use of approach channels, port operations and pilotage	Ports and port users	Remote	Moderate	Tolerable	None identified	Tolerable and ALARP
Hazard 7: Interaction with subsea cables	Third party traffic	Reasonably Probable	Moderate	Tolerable	None identified	Tolerable and ALARP

Potential Hazard	User	Frequency of Occurrence	Severity of Consequence	Significance of Risk	Additional Mitigation measures proposed	Residual Significance of Risk
including cable protection						
Hazard 8: Reduction of emergency response capability due to increased incident rates and/or reduced access for SAR responders	Emergency Response Resources	Extremely Unlikely	Serious	Tolerable	None identified	Tolerable and ALARP
Decommissioning Phase						
Hazard 1: Vessel to structure allision	Third party traffic	Remote	Serious	Tolerable	SEZ to maintain a distance of at least 1nm from all surface piercing infrastructure to the local IMO routeing measures	Tolerable and ALARP

Potential Hazard	User	Frequency of Occurrence	Severity of Consequence	Significance of Risk	Additional Mitigation measures proposed	Residual Significance of Risk
					unless otherwise agreed with the MCA.	
Hazard 2: Vessel displacement	Third party traffic	Reasonably Probable	Minor	Tolerable	None identified	Tolerable and ALARP
Hazard 3: Increased vessel to vessel collision risk (third party to third party)	Third party traffic	Remote	Moderate	Tolerable	SEZ to maintain a distance of at least 1nm from all surface piercing infrastructure to the local IMO routeing measures unless otherwise agreed with the MCA.	Tolerable and ALARP
Hazard 4: Increased vessel to vessel collision risk (third party to project vessel)	Third party traffic	Remote	Moderate	Tolerable	None identified	Tolerable and ALARP

Potential Hazard	User	Frequency of Occurrence	Severity of Consequence	Significance of Risk	Additional Mitigation measures proposed	Residual Significance of Risk
Hazard 5: Impacts on vessels involved in marine aggregate operations	Marine aggregate dredgers	Remote	Minor	Broadly Acceptable	None identified	Broadly Acceptable
Hazard 6: Impact on vessels transiting to/from local ports in the area, including use of approach channels, port operations and pilotage	Ports and port users	Reasonably Probable	Moderate	Tolerable	None identified	Tolerable and ALARP
Hazard 7: Reduction of emergency response	Emergency Response Resources	Extremely Unlikely	Serious	Tolerable	None identified	Tolerable and ALARP

Potential Hazard	User	Frequency of Occurrence	Severity of Consequence	Significance of Risk	Additional Mitigation measures proposed	Residual Significance of Risk
capability due to increased incident rates and/or reduced access for SAR responders						
Cumulative						
Hazard 1: Vessel to structure allision	Third party traffic	Remote	Serious	Tolerable	SEZ to maintain a distance of at least 1nm from all surface piercing infrastructure to the local IMO routeing measures unless otherwise agreed with the MCA.	Tolerable and ALARP
Hazard 2: Vessel displacement	Third party traffic	Reasonably Probable	Negligible	Broadly Acceptable	None identified	Broadly Acceptable

Potential Hazard	User	Frequency of Occurrence	Severity of Consequence	Significance of Risk	Additional Mitigation measures proposed	Residual Significance of Risk
Hazard 3: Increased vessel to vessel collision risk (third party to third party)	Third party traffic	Remote	Moderate	Tolerable	SEZ to maintain a distance of at least 1nm from all surface piercing infrastructure to the local IMO routeing measures unless otherwise agreed with the MCA.	Tolerable and ALARP
Hazard 4: Increased vessel to vessel collision risk (third party to project vessel)	Third party traffic	Remote	Moderate	Tolerable	None identified	Tolerable and ALARP
Hazard 5: Impact on vessels transiting to/from local ports in the area, including use	Ports and port users	Reasonably Probable	Moderate	Tolerable	None identified	Tolerable and ALARP

Potential Hazard	User	Frequency of Occurrence	Severity of Consequence	Significance of Risk	Additional Mitigation measures proposed	Residual Significance of Risk
of approach channels, port operations and pilotage						
Hazard 6: Interaction with subsea cables including cable protection	Third party traffic	Reasonably Probable	Moderate	Tolerable	None identified	Tolerable and ALARP
Hazard 7: Reduction of emergency response capability due to increased incident rates and/or reduced access for	Emergency Response Resources	Extremely Unlikely	Serious	Tolerable	None identified	Tolerable and ALARP

Potential Hazard	User	Frequency of Occurrence	Severity of Consequence	Significance of Risk	Additional Mitigation measures proposed	Residual Significance of Risk
SAR responders						

19 Embedded Mitigation Measures

807. As part of the design process for the Project, a number of embedded mitigation measures have been adopted to reduce the risk of hazards identified, including those relevant to shipping and navigation. These measures include project design measures, compliance with elements of good practice and use of standard protocols. They will continue to evolve over the development process as the EIA progresses and in response to consultation.

808. These measures typically include those that have been identified as good or standard practice and include actions that will be undertaken to meet existing legislation requirements. As there is a commitment to implementing these measures, and also to various standard sectoral practices and procedures, they are considered inherently part of the design of the Project.

809. It is noted that significant reductions to the original array areas at PEIR have been made to arrive at the array area assessed within this NRA. This includes the removal of the northern array area in its entirety, and in excess of a 25% reduction of developable area of the southern array. Full details of this process are provided in Section 1.3.

810. The embedded mitigation measures within the design relevant to shipping and navigation are outlined in Table 19.1.

Table 19.1 Embedded Mitigation Measures Relevant to Shipping and Navigation

Embedded Mitigation Measure	Details
Application for Safety Zones	An application will be made for safety zones post consent including up to 500m around ongoing activities during construction, major maintenance and decommissioning and up to 50m for installed structures pre commissioning.
Buoyed construction/ decommissioning area	The array construction/decommissioning area will be marked by buoyage as required and directed by Trinity House.
Cable Burial Risk Assessment	Assessment of required cable protection measures. This will form part of the cable specification and installation plan (secured by deemed Marine Licence Condition), and will include proposed burial depths and cable protection (where necessary and permitted), noting this will include consideration of the DW routes used by deeper draught vessels locally.
Charting of infrastructure	All infrastructure associated with the Project (including subsea cables) will be shown on appropriately scaled UHKO Admiralty charts.
Compliance with MGN 654	The Project will be compliant with MGN 654 and its annexes including in relation to reductions of no more than 5% in under keel clearance and the SAR Checklist.

Embedded Mitigation Measure	Details
Guard vessel(s)	A guard vessel(s) will be deployed where deemed appropriate by risk assessment.
Lighting and marking	Lights, marks, sounds, signals and other AtoNs will be exhibited as required by Trinity House, MCA and Civil Aviation Authority (CAA).
Layout Approval	Final layout will be discussed and agreed with the MCA and Trinity House.
Marine coordination for project vessels	Marine coordination will be implemented to manage project vessels, including in communication with cumulative project marine coordinators as required. The Applicant also commits to use of entry/exit points and defined routes to and from construction/decommissioning and O&M ports to mitigate interaction between third-party and project vessels.
Minimum blade clearance	There will be a minimum blade tip clearance of at least 27m above MHWS.
Project vessel compliance with international marine regulations	Project vessels will comply with international marine regulations as adopted by the Flag State, including COLREGs and SOLAS.
Promulgation of information	Local Notifications to Mariners and Kingfisher Bulletins will be updated and reissued at weekly intervals during construction and at least five days prior to planned maintenance works.
Emergency Response Cooperation Plan (ERCoP)	Monitoring of vessel traffic will be undertaken for the duration of the construction phase.
Navigation and Installation Plan (NIP)	A NIP will be in place to manage cable installation and maintenance within the Inner and Outer Precautionary Areas. The NIP will be approved by the MMO, and will include: ▪ How information regarding cable installation and maintenance will be provided to Interested Parties and under what timelines; ▪ How the NIP will be updated and implemented throughout its lifespan; ▪ Details of anticipated activities and specific navigational procedures for individual activities; ▪ Contingency plans and emergency procedures; and ▪ Procedures for instances where cumulative works may be present. An outline plan is provided in document reference 7.24.

20 Through Life Safety Management

20.1 Quality, Health, Safety and Environment

811. Quality, Health, Safety and Environment (QHSE) documentation including a Safety Management System (SMS) will be in place for the Project and will be continually updated throughout the development process. The following subsections provide an overview of this documentation and how it will be maintained and reviewed with reference, where required, to specific marine documentation.

812. Monitoring, reviewing, and auditing will be carried out on all procedures and activities and feedback actively sought. Any designated person (identified in QHSE documentation), managers, and supervisors are to maintain continuous monitoring of all marine operations and determine if all required procedures and processes are being correctly implemented.

20.2 Incident Reporting

813. After any incidents, including near misses, an incident report form will be completed in line with the Project QHSE documentation. This will then be assessed for relevant outcomes and reviewed for possible changes required to operations.

814. The Applicant will maintain records of investigation and analyse incidents in order to:

- Determine underlying deficiencies and other factors that may be causing or contributing to the occurrence of incidents;
- Identify the need for corrective action;
- Identify opportunities for preventative action;
- Identify opportunities for continual improvement; and
- Communicate the results of such investigations.

815. All investigations shall be performed in a timely manner.

816. A database (lessons learnt) of all marine incidents will be developed. It will include the outcomes of investigations and any resulting actions. The Applicant will promote awareness of their potential occurrence and provide information to assist monitoring, inspection and auditing of documentation.

817. When appropriate, the designated person (noted within the ERCoP) should inform the MCA of any exercise or incidents including any implications on emergency response. If required, the MCA should be invited to take part in incident debriefs.

20.3 Review of Documentation

818. The Applicant will be responsible for reviewing and updating all documentation including the risk assessments, ERCoP, SMS and, if required, will convene a review panel of stakeholders to quantify risk.

819. Reviews of the risk register should be made after any of the following occurrences:

- Changes to the development, conditions of operation and prior to decommissioning;
- Planned reviews; and
- Following an incident or exercise.

820. A review of potential risks should be carried out annually. A review of the response charts should be undertaken annually to ensure that response procedures are up to date and should include any amendments from audits, incident reports and identified deficiencies.

20.4 Inspection of Resources

821. All vessels, facilities, and equipment necessary for marine operations are to be subject to appropriate inspection and testing to determine fitness for purpose and availability in relation to their performance standards. This will include monitoring and inspection of all AtoNs to determine compliance with the performance standards specified by Trinity House.

20.5 Audit Performance

822. Auditing and performance review are the final steps in QHSE management systems. The feedback loop enables an organisation to reinforce, maintain and develop its ability to reduce risks to the fullest extent, and to ensure the continued effectiveness of the system. The Applicant will carry out audits and periodically evaluate the efficiency of the marine safety documentation.

823. The audits and possible corrective actions should be undertaken in accordance with standard procedures and results of the audits and reviews should be brought to the attention of all personnel having responsibility in the area involved.

20.6 Safety Management System

824. The Applicant will manage the risk associated with the activities undertaken within the Project. An integrated SMS, which ensures that the safety and environmental risks of those activities are ALARP, will be established. This includes the use of remote monitoring and switching for AtoNs to ensure that if a light is faulty a quick fix can be instigated, which will allow IALA availability requirements to be met.

20.7 Cable Monitoring

825. The subsea cable routes will be subject to periodic inspection post-construction to monitor the cable protection, including burial depths. Maintenance of the protection will be undertaken as necessary.

826. If exposed cables or ineffective protection measures are identified during post-construction monitoring, these would be promulgated to relevant sea users including via Notice to Mariners and Kingfisher Bulletins. Where immediate risk was observed, the Applicant would also employ additional temporary measures (such as a guard vessel or temporary buoyage) until such time as the risk was permanently mitigated.

827. Details will be included in full within the assessment of cable burial and protection document, to be produced post-consent.

20.8 Hydrographic Surveys

828. As required by Annex 4 of MGN 654, detailed and accurate hydrographic surveys will be undertaken periodically at intervals agreed with the MCA.

20.9 Decommissioning Plan

829. A Decommissioning Plan will be developed prior to the start of decommissioning works. With regards to hazards to shipping and navigation, this will also include consideration of the scenario where upon decommissioning and completion of removal operations, an obstruction is left on-site (attributable to the Project) which is considered to be a danger to navigation and which it has not proved possible to remove. Such an obstruction may require marking until such time as it is either removed or no longer considered a danger to navigation, the continuing cost of which would need to be met by the Applicant.

21 Summary

21.1 Stakeholder Engagement

830. Key shipping and navigation stakeholders have been engaged with during the Evidence Plan Process including:

- MCA;
- Trinity House;
- UK Chamber of Shipping;
- Cruising Association;
- Sunk VTS;
- HHA;
- PLA;
- London Gateway;
- Port of Felixstowe;
- Stena Line;
- DFDS Seaways;
- CLdN;
- RYA;
- DEME; and
- CEMEX.

21.2 Existing Environment

831. The Galloper and Greater Gabbard developments (both operational) are located directly east of the array area. Excluding these offshore wind farms, the nearest offshore wind farm development to the Project is London Array (operational).

832. The Sunk routeing measure is located directly west and north of the array area, including the Sunk TSS South and Sunk TSS East as well as the Sunk Precautionary Areas. The North Hinder South TSS is located approximately 7nm to the south-east of the array area at the closest point and connects to the North Hinder Junction. The offshore cable corridor passes through the Sunk routeing measure, including passing directly through the Sunk Outer and Inner Precautionary Areas, and intersecting the Sunk and Trinity DW routes.

833. The Galloper Recommended Ferry Route intersects the array area. This routeing measure was originally introduced for use by ferries from Ostend however is no longer used for this purpose noting the relevant ferry routes from Ostend have not been active since 2009.

834. The closest ports to the Project are Felixstowe Port and Harwich Port, both located at the mouth of the Stour and Orwell Estuaries, approximately 22nm and 23nm to the west of the array area, respectively.

835. There are two pilot boarding stations within or in proximity to the offshore cable corridor – the Sunk Pilot Boarding Station and Colne & Crouch Pilot Boarding Station. Three DW routes are located within the Sunk Inner Precautionary Area. The offshore cable corridor also passes in proximity to the Harwich Deep Water Channel.

836. There are two designated anchorage areas in proximity to the offshore cable corridor. These areas are the Sunk Inner and Sunk DW anchorages.

21.3 Maritime Incidents

837. From SAR helicopter tasking data recorded between April 2015 and March 2023 within the study area, there was an average of two taskings per year. The majority of these taskings were "*Rescue/Recovery*" (65%) or "*Search*" (29%), with only one "*Support*" occurred. No tasking were recorded within the array area with the closest, at 0.8nm to the west, a search occurring in 2017.

838. From RNLI incident data recorded between 2013 and 2022 within the study area, there was an average of 10 incidents per year. During the 10-year period, one incident occurred within the array area; a sail failure on a recreational sailing vessel in 2019. "*machinery failure"* (46%) and "*person in danger*" (14%). Excluding "*person in danger*" and non-vessel based incidents, the most common casualty types recorded were powered recreational vessels (54%) and fishing vessels (14%).

839. From MAIB incident data recorded between 2012 and 2021 within the study area, there were on average two incidents per year. During the 10-year period, no incidents occurred within the array area with the closest incident 2.5nm to the north-west; an accident to person involving a marine aggregate dredger in 2014. The most common incident types recorded were "*machinery failure*" (33%), *"accident to person"* (24%) and "*hazardous incident*" (14%). The main casualty types involved in incidents were cargo vessels (43%), other commercial vessels (24%) and fishing vessels (24%).

21.4 Vessel Traffic Movements

840. From 28 days of vessel traffic survey data recorded in winter 2022 within the study area, there was an average of 134 unique vessels recorded per day. Approximately 2% of all vessels recorded during the winter survey period within the study area intersected the array area, or an average of two vessels per day. Throughout the winter survey period, the main vessel types within the study area were cargo vessels (61%) and tankers (24%). No other vessel type equated to more than 5% of all vessels recorded.

841. From 28 days of vessel traffic survey data recorded in summer within the study area, there was an average of 147 unique vessels per day were recorded within the study area during the summer survey period. Approximately 3% of all vessels recorded during the summer survey period within the study area intersected the array area, or an average of five vessels per day. Throughout the summer survey period, the main vessel types were cargo vessels (53%), tankers (21%), wind farm vessels (9%) and recreational vessels (9%).

842. An average of 37 unique vessels per day were recorded within the cable corridor study area during the 28 day winter survey period. Approximately 87% of all vessels recorded during the winter survey period within the cable corridor study area intersected the offshore cable corridor, or an average of 32 vessels per day.

Throughout the winter survey period, the main vessel types within the cable corridor study area were cargo vessels (63%) and tankers (12%).

843. An average of 64 unique vessels per day were recorded within the cable corridor study area during the 28 day summer survey period. Approximately 85% of all vessels recorded during the summer survey period within the study area intersected the array area, or an average of 55 vessels per day. Throughout the summer survey period, the main vessel types were recreational vessels (38%) and cargo vessels (36%).

844. A total of 43 main commercial routes were identified within the study area, with 16 of these routes deemed high use.

21.5 Future Case Vessel Traffic

845. Three distinct bands of vessel traffic growth have been considered for the future case scenario: 10%, 20% and 30% increases in volume. This strikes a balance between the recommendations of various stakeholders during consultation and accounts for current vessel trends and constraints. The increase has been applied across commercial vessels as a whole. Additionally, transits made by vessels involved in the construction and O&M of the Project have been considered.

846. Deviations due to the presence of the Project could be required for two out of the 43 main commercial routes identified (one a high use route and the other a low use route), with the level of deviation no greater than 1%.

21.6 Collision and Allision Risk Modelling

847. Assuming base case traffic levels, the annual collision frequency post wind farm was estimated to be 3.50×10^{-1}, corresponding to a return period of approximately one in 2.87 years. This represents a 0.37% increase in collision frequency compared to the pre wind farm base case result.

848. Assuming base case traffic levels, the annual powered allision frequency was estimated to be 6.84×10^{-3}, corresponding to a return period of approximately one in 146 years.

849. After modelling three drift scenarios it was established that the ebb tide dominated scenario produced the worst case results. Assuming base case traffic levels, the annual drifting allision frequency was estimated to be 1.30×10^{-3}, corresponding to a return period of approximately one in 772 years.

850. Assuming base case traffic levels, the annual fishing allision frequency was estimated to be 7.44×10^{-2}, corresponding to a return period of approximately one in 13 years.

21.7 Risk Statement

851. Using the baseline data, expert opinion, outputs of the Hazard Workshop, stakeholder concerns and lessons learnt from existing offshore developments, shipping and navigation hazards have been risk assessed in line with the FSA methodology. The full risk control log is presented in Section 18.

852. The significance of risk has been determined as either Broadly Acceptable or Tolerable for all shipping and navigation hazards assessed. With additional mitigation measures applied, the residual risk is Broadly Acceptable or Tolerable with Mitigation for all shipping and navigation hazards and ALARP.

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Annex A MGN 654 Checklist

853. The MGN 654 Checklist can be divided into two distinct checklists, one considering the main MGN 654 guidance document and one considering the Methodology for Assessing Marine Navigational Safety and Emergency Response Risks of OREIs (MCA, 2021) which serves as Annex 1 to MGN 654.

854. The checklist for the main MGN 654 guidance document is presented in Table A.1. Following this, the checklist for the MCA's methodology annex is presented in Table A.2. For both checklists, references to where the relevant information and/or assessment is provided in the NRA is given.

Table A.1 MGN 654 checklist

Issue	Compliance	Comments
Site and Installation Coordinates. Developers are responsible for ensuring that formally agreed coordinates and subsequent variations of site perimeters and individual OREI structures are made available, on request, to interested parties at relevant project stages, including application for consent, development, array variation, operation, and decommissioning. This should be supplied as authoritative Geographical Information System (GIS) data, preferably in Environmental Systems Research Institute (ESRI) format. Metadata should facilitate the identification of the data creator, its date and purpose, and the geodetic datum used. For mariners' use, appropriate data should also be provided with latitude and longitude coordinates in WGS84 (European Terrestrial Reference System 1989 (ETRS89)) datum.		
Traffic Survey. Includes:		
All vessel types.	Yes	**Section 10: Vessel Traffic Movements** All vessel types are considered with specific breakdowns by vessel type given within the study area and cable corridor study area
At least 28 days duration, within either 12 or 24 months prior to submission of the ES.	Yes	**Section 5: Data Sources** A total of 56 full days of vessel traffic survey data from seasonal periods in 2022 has been assessed within the respective study areas for the array area and offshore cable corridor. Long term AIS has also been assessed.
Multiple data sources.	Yes	**Section 5: Data Sources** The vessel traffic survey data includes AIS, Radar and visual observations to maximise coverage of vessels not broadcasting on AIS. Long term AIS has also been assessed.
Seasonal variations.	Yes	**Section 5: Data Sources** The NRA is based primarily on 56 days of vessel traffic survey data collected during 2022, with 28 days collected during summer and 28 during winter. **Annex D: Long-Term AIS Assessment** To assist with the assessment of seasonal variation a long-term AIS dataset covering 12 months AIS has also been assessed.
MCA consultation.	Yes	**Section 4: Consultation** The MCA have been consulted as part of the NRA process including through the Hazard Workshop.

Issue	Compliance	Comments
GLA consultation.	Yes	**Section 4: Consultation** Trinity House have been consulted as part of the NRA process.
UK Chamber of Shipping.	Yes	**Section 4: Consultation** Chamber of Shipping have been consulted as part of the NRA process including through a dedicated meeting, the Hazard Workshop and attendance at Sunk User Group meeting.
Recreational and fishing vessel organisations consultation.	Yes	**Section 4: Consultation** The RYA and Cruising Association have been consulted as part of the NRA process via direct meetings. Consultation with fisheries organisations has been undertaken as part of Chapter 14: Commercial Fisheries.
Port and navigation authorities consultation, as appropriate.	Yes	**Section 4: Consultation** Key local port authorities have been consulted including HHA, the PLA, London Gateway, the Port of Felixstowe including through the Hazard Workshop.
Assessment of the cumulative and individual effects of (as appropriate):		
i. Proposed OREI site relative to areas used by any type of marine craft.	Yes	**Section 10: Vessel Traffic Movements** Vessel traffic data in proximity to the project has been analysed.
ii. Numbers, types and sizes of vessels presently using such areas.	Yes	**Section 10: Vessel Traffic Movements** Vessel traffic data in proximity to the project has been analysed and includes breakdowns of daily vessel count, vessel type and vessel size.
iii. Non-transit uses of the areas, e.g., fishing, day cruising of leisure craft, racing, aggregate dredging, personal watercraft, etc.	Yes	**Section 10: Vessel Traffic Movements** Non-transit uses of the areas in proximity to the project have been identified, including marine aggregate dredging, pilotage and anchoring.
iv. Whether these areas contain transit routes used by coastal or deep-draught vessels on passage.	Yes	**Section 10: Vessel Traffic Movements** Vessel traffic data in proximity to the project has been analysed including in terms of vessel draught. **Annex D: Long-Term AIS Assessment** Considers long term AIS data including in terms of vessel routeing.
v. Alignment and proximity of the site relative to adjacent shipping lanes.	Yes	**Section 7: Navigational Features** IMO routeing measures in proximity to Project have been identified.
vi. Whether the nearby area contains prescribed routeing schemes or precautionary areas.	Yes	**Section 7: Navigational Features** IMO routeing measures in proximity to Project have been identified.

Issue	Compliance	Comments
vii. Proximity of the site to areas used for anchorage (charted or uncharted), safe haven, port approaches and pilot boarding or landing areas.	Yes	**Section 7: Navigational Features** Port approaches, pilot boarding stations and anchorages in proximity to the project have been identified.
viii. Whether the site lies within the jurisdiction of a port and/or navigation authority.	Yes	**Section 7: Navigational Features** Ports and port authorities in proximity to the Project have been identified.
ix. Proximity of the site to existing fishing grounds, or to routes used by fishing vessels to such grounds.	Yes	**Section 10: Vessel Traffic Movements** Commercial fishing vessel movements are considered within the respective study areas for the array area and offshore cable corridor. Detailed analysis of dedicated fishing vessel activities is undertaken in Chapter 14: Commercial Fisheries.
x. Proximity of the site to offshore firing/bombing ranges and areas used for any marine military purposes.	Yes	**Section 7: Navigational Features** Military areas in proximity to the Project have been identified.
xi. Proximity of the site to existing or proposed submarine cables or pipelines, offshore oil/gas platforms, marine aggregate dredging, marine archaeological sites or wrecks, Marine Protected Areas or other exploration/exploitation sites.	Yes	**Section 7: Navigational Features** Subsea cables, marine aggregate dredging, charted wrecks, and obstructions in proximity to the Project have been identified.
xii. Proximity of the site to existing or proposed OREI developments, in cooperation with other relevant developers, within each round of lease awards.	Yes	**Section 7: Navigational Features** Other offshore wind developments in proximity to the Project have been identified.
xiii. Proximity of the site relative to any designated areas for the disposal of dredging spoil or other dumping ground.	Yes	**Section 7: Navigational Features** Spoil and dumping grounds in proximity to the Project have been identified.
xiv. Proximity of the site to AtoNs and/or VTS in or adjacent to the area and any impact thereon.	Yes	**Section 7: Navigational Features** Key aids to navigation and VTS in proximity to Project has been identified.

Issue	Compliance	Comments
xv. Researched opinion using computer simulation techniques with respect to the displacement of traffic and, in particular, the creation of 'choke points' in areas of high traffic density and nearby or consented OREI sites not yet constructed.	Yes	**Section 15: Collision and Allision Risk Modelling** Collision and allision risk modelling has been undertaken for the array area.
xvi. With reference to xv. above, the number and type of incidents to vessels which have taken place in or near to the proposed site of the OREI to assess the likelihood of such events in the future and the potential impact of such a situation.	Yes	**Section 9: Emergency Response Overview** Historical vessel incident data published by DfT, RNLI and MAIB in proximity to the project has been considered alongside historical offshore wind farm incident data throughout the UK.
xvii. Proximity of the site to areas used for recreation which depend on specific features of the area.	Yes	**Section 10: Vessel Traffic Movements** Non-transit users were identified in the vessel traffic survey data and included recreational activities.
Predicted effect of OREI on traffic and interactive boundaries. Where appropriate, the following should be determined:		
a. The safe distance between a shipping route and OREI boundaries.	Yes	**Section 14: Future Case Vessel Traffic** A methodology for post wind farm routeing is outlined and includes a minimum distance of 1nm from offshore installations and existing offshore wind farm boundaries.
b. The width of a corridor between sites or OREIs to allow safe passage of shipping.	Yes	A navigational corridor is not required for the Project.
OREI Structures. The following should be determined:		
a. Whether any feature of the OREI, including auxiliary platforms outside the main generator site, mooring and anchoring systems, inter-device and export cabling could pose any type of difficulty or danger to vessels underway, performing normal operations, including fishing, anchoring and emergency response.	Yes	**Section 15: Collision and Allision Risk Modelling** Collision and allision risk modelling has been undertaken for the array area. **Section 16: Risk Assessment** The hazards due to the Project have been assessed for each phase and include consideration of anchoring and emergency response.

Issue	Compliance	Comments
b. Clearances of fixed or floating WTG blades above the sea surface are not less than 22m (above Mean High Water Springs (MHWS) for fixed). Floating WTG allow for degrees of motion.	Yes	**Section 19: Embedded Mitigation Measures** Embedded mitigation measures to be implemented to reduce the significance of risk associated with shipping and navigation hazards are outlined including a minimum blade tip clearance of at least 27m above MHWS.
c. Underwater devices: i. Changes to charted depth; ii. Maximum height above seabed; and iii. Under keel clearance.	Yes	**Section 6: Project Description Relevant to Shipping and Navigation** Array and export cable specifications relevant to the MDS for shipping and navigation are provided.
d. Whether structures block or hinder the view of other vessels or other navigational features.	Yes	**Section 13: Navigation, Communication, and Position Fixing Equipment** Hazards relating to the use of existing aids to navigation are considered. **Section 16: Risk Assessment** The hazards due to the Project have been assessed for each phase and include consideration of visual hindrance to navigation.
The effect of tides, tidal streams and weather. It should be determined whether:		
a. Current maritime traffic flows and operations in the general area are affected by the depth of water in which the proposed installation is situated at various states of the tide, i.e. whether the installation could pose problems at high water which do not exist at low water conditions, and vice versa.	Yes	**Section 6: Project Description Relevant to Shipping and Navigation** The range of water depths within the array area and offshore cable corridor are provided. **Section 8: Meteorological Ocean Data** Various states of the tide local to the Project are provided. **Section 10: Vessel Traffic Movements** Vessel traffic data in proximity to the project has been analysed including vessel draught. **Section 15: Collision and Allision Risk Modelling** Collision and allision risk modelling has accounted for tidal conditions.
b. The set and rate of the tidal stream, at any state of the tide, has a significant effect on vessels in the area of the OREI site.	Yes	**Section 8: Meteorological Ocean Data** Various states of the tide local to the Project are provided. **Section 15: Collision and Allision Risk Modelling**

Issue	Compliance	Comments
c. The maximum rate tidal stream runs parallel to the major axis of the proposed site layout, and, if so, its effect.	Yes	Collision and allision risk modelling has accounted for tidal conditions.
d. The set is across the major axis of the layout at any time, and, if so, at what rate.	Yes	
e. In general, whether engine failure or other circumstance could cause vessels to be set into danger by the tidal stream, including unpowered vessels and small, low speed craft.	Yes	**Section 8: Meteorological Ocean Data** Various states of the tide local to the Project are provided and hazards are not anticipated at high or low water only. **Section 15: Collision and Allision Risk Modelling** Collision and allision risk modelling has accounted for tidal conditions and assesses whether machinery failure could cause vessels to be set into danger.
f. The structures themselves could cause changes in the set and rate of the tidal stream.	Yes	**Section 8: Meteorological Ocean Data** No risks are anticipated.
g. The structures in the tidal stream could be such as to produce siltation, deposition of sediment or scouring, affecting navigable water depths in the windfarm area or adjacent to the area.	Yes	**Section 16: Risk Assessment** The hazards due to the Project have been assessed for each phase and include consideration of reduction in under keel clearance.
h. The site, in normal, bad weather, or restricted visibility conditions, could present difficulties or dangers to craft, including sailing vessels, which might pass in close proximity to it.	Yes	**Section 8: Meteorological Ocean Data** Weather and visibility data local to the Project is provided. **Section 10: Vessel Traffic Movements** Vessel traffic data in proximity to the Project has been analysed including recreational vessels. **Section 11.3: Adverse Weather Routeing** Alternative routeing used during periods of adverse weather has been identified. **Section 16: Risk Assessment** The hazards due to the Project have been assessed for each phase and include consideration of adverse weather routeing.
i. The structures could create problems in the area for vessels under sail, such as wind masking, turbulence or sheer.	Yes	**Section 16: Risk Assessment** The hazards due to the Project have been assessed for each phase and include consideration of vessels under sail.

<table>
<tr><th>Issue</th><th>Compliance</th><th>Comments</th></tr>
<tr><td>j. In general, taking into account the prevailing winds for the area, whether engine failure or other circumstances could cause vessels to drift into danger, particularly if in conjunction with a tidal set such as referred to above.</td><td>Yes</td><td>Section 15: Collision and Allision Risk Modelling
Collision and allision risk modelling has accounted for weather and tidal conditions and assesses whether machinery failure could cause vessels to be set into danger.</td></tr>
<tr><td colspan="3">Assessment of access to and navigation within, or close to, an OREI. To determine the extent to which navigation would be feasible within the OREI site itself by assessing whether:</td></tr>
<tr><td colspan="3">a. Navigation within or close to the site would be safe:</td></tr>
<tr><td>i. For all vessels.</td><td rowspan="5">Yes</td><td rowspan="5">Section 4: Consultation
Regular Operators have been consulted as part of the NRA process including through the Hazard Workshop.

Section 11.3: Adverse Weather Routeing
Alternative routeing used during periods of adverse weather has been identified.

Section 15: Collision and Allision Risk Modelling
Collision and allision risk modelling includes use of post wind farm routeing and accounts for weather and tidal conditions.

Section 16: Risk Assessment
The hazards due to the Project have been assessed for each phase and include consideration of internal navigation.</td></tr>
<tr><td>ii. For specified vessel types, operations and/or sizes.</td></tr>
<tr><td>iii. In all directions or areas.</td></tr>
<tr><td>iv. In specified directions or areas.</td></tr>
<tr><td>v. In specified tidal, weather or other conditions.</td></tr>
<tr><td colspan="3">b. Navigation in and/or near the site should be prohibited or restricted:</td></tr>
<tr><td>i. For specified vessel types, operations and/or sizes.</td><td>Yes</td><td rowspan="4">Section 12: Navigation, Communication, and Position Fixing Equipment
Hazards relating to the use of navigation, communication, and position fixing devices used in and around offshore wind farms are assessed.

Section 15: Collision and Allision Risk Modelling</td></tr>
<tr><td>ii. In respect of specific activities.</td><td>Yes</td></tr>
<tr><td>iii. In all areas or directions.</td><td>Yes</td></tr>
<tr><td>iv. In specified areas or directions.</td><td>Yes</td></tr>
</table>

Issue	Compliance	Comments
v. In specified tidal or weather conditions.	Yes	Collision and allision risk modelling includes use of post wind farm routeing which assumes that commercial vessel traffic avoids the array. **Section 16: Risk Assessment** The hazards due to the Project have been assessed for each phase and include consideration of internal navigation. **Section 19: Embedded Mitigation Measures** Embedded mitigation measures to be implemented to reduce the significance of risk associated with shipping and navigation hazards are outlined including an application for safety zones.
c. Where it is not feasible for vessels to access or navigate through the site it could cause navigational, safety or routeing problems for vessels operating in the area, e.g., by preventing vessels from responding to calls for assistance from persons in distress.	Yes	**Section 15: Collision and Allision Risk Modelling** Collision and allision risk modelling includes use of post wind farm routeing which assumes that commercial vessel traffic avoids the array. **Section 16: Risk Assessment** The hazards due to the Project have been assessed for each phase and include consideration of emergency response capability.
d. Guidance on the calculation of safe distance of OREI boundaries from shipping routes has been considered.	Yes	**Section 14: Future Case Vessel Traffic** A methodology for post wind farm routeing is outlined and includes consideration of the Shipping Route Template.
SAR, maritime assistance service, counter pollution and salvage incident response.		
The MCA, through HM Coastguard, is required to provide SAR and emergency response within the sea area occupied by all OREIs in UK waters. To ensure that such operations can be safely and effectively conducted, certain requirements must be met by developers and operators.		
a. An ERCoP will be developed for the construction, operation and decommissioning phases of the OREI.	Yes	**Section 19: Embedded Mitigation Measures** Embedded mitigation measures to be implemented to reduce the significance of risk associated with shipping and navigation hazards are outlined including compliance with MGN 654, which requires the creation of an ERCoP.
b. The MCA's guidance document *Offshore Renewable Energy Installations: Requirements, Guidance and Operational Considerations for Search and Rescue and Emergency Response* (MCA, 2021) for the design, equipment and operation requirements will be followed.	Yes	**Section 19: Embedded Mitigation Measures** Embedded mitigation measures to be implemented to reduce the significance of risk associated with shipping and navigation hazards are outlined including compliance with MGN 654, which requires fulfilment of requirements in the stated guidance document.

Issue	Compliance	Comments
c. A SAR checklist will be completed to record discussions regarding the requirements, recommendations and considerations outlined in Annex 5 (to be agreed with MCA).	Yes	**Section 19: Embedded Mitigation Measures** Embedded mitigation measures to be implemented to reduce the significance of risk associated with shipping and navigation hazards are outlined including compliance with MGN 654, which requires the completion of the SAR checklist.
6. Hydrography. In order to establish a baseline, confirm the safe navigable depth, monitor seabed mobility and to identify underwater hazards, detailed and accurate hydrographic surveys are included or acknowledged for the following stages and to MCA specifications:		
i. Pre-construction: The proposed generating assets area and proposed cable route.	Yes	**Section 19: Embedded Mitigation Measures** Embedded mitigation measures to be implemented to reduce the significance of risk associated with shipping and navigation hazards are outlined including compliance with MGN 654, which requires the specified hydrographic surveys to be completed.
ii. On a pre-established periodicity during the life of the development.	Yes	
iii. Post construction: Cable route(s).	Yes	
iv. Post decommissioning of all or part of the development: the installed generating assets area and cable route.	Yes	
Communications, Radar and positioning systems. To provide researched opinion of a generic and, where appropriate, site specific nature concerning whether:		
a. The structures could produce radio interference such as shadowing, reflections or phase changes, and emissions with respect to any frequencies used for marine positioning, navigation and timing (PNT) or communications, including GMDSS and AIS, whether ship borne, ashore or fitted to any of the proposed structures, to:		
i. Vessels operating at a safe navigational distance.	Yes	**Section 12: Navigation, Communication, and Position Fixing Equipment** Hazards relating to the use of navigation, communication, and position fixing devices used in and around offshore wind farms are assessed.
ii. Vessels by the nature of their work necessarily operating at less than the safe navigational distance to the OREI, e.g., support vessels, survey vessels, SAR assets.	Yes	
iii. Vessels by the nature of their work necessarily operating within the OREI.	Yes	
b. The structures could produce Radar reflections, blind spots, shadow areas or other adverse effects:		
i. Vessel to vessel.	Yes	

Issue	Compliance	Comments
ii. Vessel to shore.	Yes	**Section 12: Navigation, Communication, and Position Fixing Equipment** Hazards relating to the use of navigation, communication, and position fixing devices used in and around offshore wind farms are assessed.
iii. VTS Radar to vessel.	Yes	
iv. Racon to/from vessel.	Yes	
c. The structures and generators might produce SONAR interference affecting fishing, industrial or military systems used in the area.	Yes	**Section 12: Navigation, Communication, and Position Fixing Equipment** Hazards relating to the risk of SONAR interference due to the Project are assessed.
d. The site might produce acoustic noise which could mask prescribed sound signals.	Yes	**Section 12: Navigation, Communication, and Position Fixing Equipment** Hazards relating to the risk of noise due to the Project are assessed.
e. Generators and the seabed cabling within the site and onshore might produce EMFs affecting compasses and other navigation systems.	Yes	**Section 12: Navigation, Communication, and Position Fixing Equipment** Hazards relating to the risk of electromagnetic interference due to the Project are assessed.
Risk mitigation measures recommended for OREI during construction, operation and decommissioning.		
Mitigation and safety measures will be applied to the OREI development appropriate to the level and type of risk determined during the EIA. The specific measures to be employed will be selected in consultation with the MCA and will be listed in the developer's ES. These will be consistent with international standards contained in, for example, SOLAS Chapter V (IMO, 1974), and could include any or all of the following:		
i. Promulgation of information and warnings through notices to mariners and other appropriate MSI dissemination methods.	Yes	**Section 19: Embedded Mitigation Measures** Embedded mitigation measures to be implemented to reduce the significance of risk associated with shipping and navigation hazards are outlined including the promulgation of information.
ii. Continuous watch by multi-channel VHF, including DSC.	Yes	**Section 19: Embedded Mitigation Measures** Embedded mitigation measures to be implemented to reduce the significance of risk associated with shipping and navigation hazards are outlined including marine coordination for project vessels.
iii. Safety zones of appropriate configuration, extent and application to specified vessels[12].	Yes	**Section 19: Embedded Mitigation Measures** Embedded mitigation measures to be implemented to reduce the significance of risk associated with shipping and navigation hazards are outlined including an application for safety zones.
iv. Designation of the site as an Area to be Avoided (ATBA).	Yes	**Section 6: Project Description Relevant to Shipping and Navigation** It is not planned to designate the array area as ATBA.

[12] As per SI 2007 No 1948 "The Electricity (Offshore Generating Stations) (Safety Zones) (Application Procedures and Control of Access) Regulations 2007.

Issue	Compliance	Comments
v. Provision of AtoNs as determined by the GLA.	Yes	**Section 19: Embedded Mitigation Measures** Embedded mitigation measures to be implemented to reduce the significance of risk associated with shipping and navigation hazards are outlined including lighting and marking as required by Trinity House, MCA, and CAA.
vi. Implementation of routeing measures within or near to the development.	Yes	**Section 16: Risk Assessment** It is not planned to implement any new routeing measures in proximity to the Project.
vii. Monitoring by Radar, AIS, Closed Circuit Television (CCTV) or other agreed means.	Yes	**Section 19: Embedded Mitigation Measures** Embedded mitigation measures to be implemented to reduce the significance of risk associated with shipping and navigation hazards are outlined including compliance with MGN 654, which requires discussions with the MCA regarding monitoring as part of the SAR checklist.
viii. Appropriate means for OREI operators to notify, and provide evidence of, the infringement of Safety Zones.	Yes	**Section 19: Embedded Mitigation Measures** Embedded mitigation measures to be implemented to reduce the significance of risk associated with shipping and navigation hazards are outlined including an application for safety zones. The means for notifying and providing evidence of the infringement of safety zones will be provided in the safety zone application, submitted post consent.
ix. Creation of an ERCoP with the MCA's SAR Branch for the construction phase onwards.	Yes	**Section 19: Embedded Mitigation Measures** Embedded mitigation measures to be implemented to reduce the significance of risk associated with shipping and navigation hazards are outlined including compliance with MGN 654, which requires the creation of an ERCoP.
x. Use of guard vessels, where appropriate.	Yes	**Section 19: Embedded Mitigation Measures** Embedded mitigation measures to be implemented to reduce the significance of risk associated with shipping and navigation hazards are outlined including the use of guard vessels.
xi. Update NRAs every two years, e.g. at testing sites.	Yes	Not applicable to the Project.
xii. Device-specific or array-specific NRAs.	Yes	**Section 6: Project Description Relevant to Shipping and Navigation** All offshore elements of the Project are considered in this NRA including the array area and offshore cable corridor infrastructure. **Section 19: Embedded Mitigation Measures** Embedded mitigation measures to be implemented to reduce the significance of risk associated with shipping and navigation hazards are outlined including a Cable Burial Risk Assessment which will serve as additional assessment relating to shipping and navigation.

Issue	Compliance	Comments
xiii. Design of OREI structures to minimise risk to contacting vessels or craft.	Yes	There is no additional risk posed to craft compared to previous offshore wind farms and so no additional measures are identified.
xiv. Any other measures and procedures considered appropriate in consultation with other stakeholders.	Yes	**Section 19: Embedded Mitigation Measures** Additional mitigation measures to be implemented to reduce the significance of risk associated with shipping and navigation hazards are outlined and have been informed by consultation.

Table A.2 MGN 654 Annex 1 Checklist

Item	Compliance	Comments
A risk claim is included that is supported by a reasoned argument and evidence.	Yes	**Section 18: Introduction to Risk Assessment** The risk assessment provides a risk claim for a range of hazards based on a number of inputs including baseline data, expert opinion, outputs of the Hazard Workshop, stakeholder concerns and lessons learnt from existing offshore developments.
Description of the marine environment.	Yes	Section **7: Navigational Features** Navigational features in proximity to the Project have been described including (but not limited to) other offshore wind farm developments, IMO routeing measures, ports, harbours and related facilities, designated anchorage areas, marine aggregate dredging areas, subsea cables, key aids to navigation, and charted wrecks. **Section 13: Cumulative and Transboundary Overview** Potential future offshore developments have been screened into the cumulative risk assessment where a cumulative or in combination activity has been identified based upon the location and distance from the Project.
SAR overview and assessment.	Yes	**Section 9: Emergency Response and Incident Overview** Existing SAR resources in proximity to the Project are summarised including the UK SAR operations contract, RNLI stations, and HMCG stations. **Section 16: Risk Assessment** The risk assessment includes consideration of how activities associated with the Project may restrict emergency response capability.
Description of the OREI development and how it changes the marine environment.	Yes	**Section 6: Project Description Relevant to Shipping and Navigation** The maximum extent of the Project for which any shipping and navigation hazards are assessed is provided including a description of the array area and offshore cable corridor, associated infrastructure, construction phase programme, and indicative vessel and helicopter numbers during the construction and O&M phases.

Item	Compliance	Comments
Analysis of the marine traffic, including base case and future traffic densities and types.	Yes	**Section 10: Vessel Traffic Movements** Vessel traffic data in proximity to the Project has been analysed and includes vessel density and breakdowns of vessel type. **Section 14: Future Case Vessel Traffic** Future vessel traffic levels have been considered, with consideration of increases in commercial vessel activity, commercial fishing vessel and recreational vessel activity, traffic associated with the Project operations, and changes in marine aggregate dredging activities. Additionally, worst case alternative routeing for commercial traffic has been considered.
Status of the hazard log: ▪ Hazard identification; ▪ Risk assessment; ▪ Influences on level of risk; ▪ Tolerability of risk; and ▪ Risk matrix.	Yes	**Section 3: Navigational Risk Assessment Methodology** A tolerability matrix has been defined to determine the tolerability (significance) of risks. **Annex B: Hazard Log** The complete hazard log is presented and includes a description of the hazards considered, possible causes, consequences (most likely and worst case) and relevant embedded mitigation measures. Using this information, each hazard is then ranked in terms of frequency of occurrence and severity of consequence to give a tolerability (significance) level.
NRA: ▪ Appropriate risk assessment; ▪ MCA acceptance for assessment techniques and tools; ▪ Demonstration of results; and ▪ Limitations.	Yes	**Section 2: Guidance and Legislation** MGN 654 and the IMOs FSA guidelines are the primary guidance documents used for the assessment. **Section 15: Collision and Allision Risk Modelling** Provides quantification of collision and allision risk resulting from the future case vessel traffic including deviated main commercial routes. Numerical and graphical results are provided, where appropriate.
Risk control log	Yes	**Section 18: Risk Control Log** Provides the risk control log which summarises the assessment of shipping and navigation hazards scoped into the risk assessment. This includes the embedded mitigation measures, frequency of occurrence, severity of consequence, and significance of risk, per hazard.

Annex B Consequences

855. This appendix presents the assessment of the consequences of collision and allision incidents, in terms of people and the environment, due to the presence of the Project.

856. The significance of the impact due to the presence of the Project is also assessed based on risk evaluation criteria and comparison with historical incident data in UK waters[13].

B.1 Risk Evaluation Criteria

B.1.1 Risk to People

857. Regarding the assessment of risk to people two measures are considered, namely:

- Individual risk; and
- Societal risk.

B.1.1.1 Individual Risk

858. Individual risk considers whether the risk from an incident to a particular individual changes significantly due to the presence of the Project. Individual risk considers not only the frequency of the incident and the consequences (e.g. likelihood of death), but also the individual's fractional exposure to that risk, i.e. the probability of the individual being in the given location at the time of the incident.

859. The purpose of estimating the individual risk is to ensure that individuals who may be affected by the presence of the Project are not exposed to excessive risks. This is achieved by considering the significance of the change in individual risk resulting from the presence of the Project relative to the UK background individual risk levels.

860. Annual risk levels to crew (the annual risk to an average crew member) for different vessel types are presented in Figure B.1, which also includes the upper and lower bounds for risk acceptance criteria as suggested in IMO Maritime Safety Committee 72/16 (IMO, 2001). The annual individual risk level to crew falls within the ALARP region for each of the vessel types presented.

[13] For the purposes of this assessment, UK waters is defined as the UK EEZ and UK territorial waters refers to the 12 nm limit from the British Isles, excluding the Republic of Ireland.

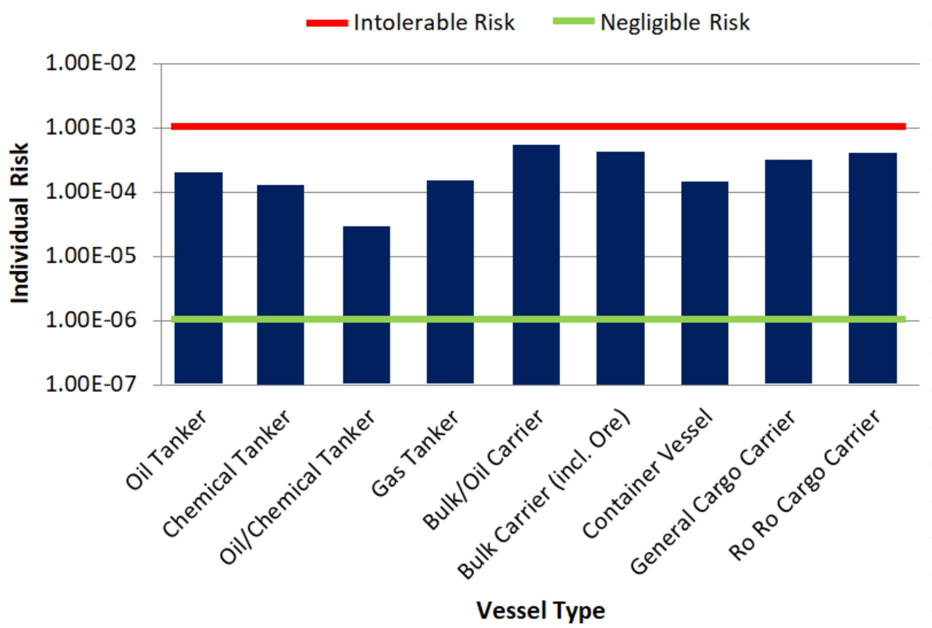

Figure B.1 Individual Risk Levels and Acceptance Criteria per Vessel Type

861. The typical bounds defining the ALARP regions for decision making within shipping are presented in Table B.1. For a new vessel, the target upper bound for ALARP is set lower since new vessels are expected to benefit from (in terms of design) from changes in legislation and improved maritime safety.

Table B.1 Individual Risk ALARP Criteria

Individual	Lower bound for ALARP	Upper bound for ALARP
Crew member	10^{-6}	10^{-3}
Passenger	10^{-6}	10^{-4}
Third-party	10^{-6}	10^{-4}
New vessel target	10^{-6}	Above values reduced by one order of magnitude

862. On a UK basis, the MCA have presented individual risks for various UK industries based on HSE data from 1987 to 1991. The risks for different industries are presented in Figure B.2.

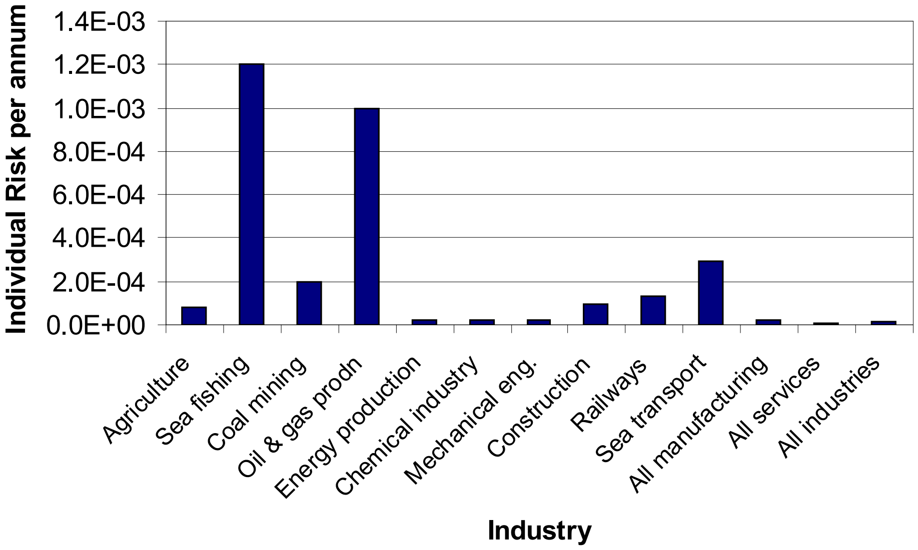

Figure B.2 Individual Risk per Year for Various UK Industries.

863. The individual risk for sea transport of 2.9×10^{-4} per year is consistent with the worldwide data presented in Figure B.1, whilst the individual risk for sea fishing of 1.2×10^{-3} per year is the highest across all of the industries included.

B.1.1.2 Societal Risk

864. Societal risk is used to estimate risks of incidents affecting many persons (catastrophes) and acknowledging risk adverse or neutral attitudes. Societal risk includes the risk to every person, even if a person is only exposed to risk on one brief occasion. For assessing the risk to a large number of affected people, societal risk is desirable because individual risk is insufficient in evaluating risks imposed on large numbers of people.

865. Within this assessment, societal (navigation based) risk can be assessed for the Project, giving account to the change in risk associated with each incident scenario caused by the introduction of the wind farm structures. Societal risk may be expressed as:

- Annual fatality rate where frequency and fatality are combined into a convenient one-dimensional measure of societal risk (also known as PLL); and
- F-N diagrams showing explicitly the relationship between the cumulative frequency of an accident and the number of fatalities in a multi-dimensional diagram.

866. When assessing societal risk this study focuses on PLL, which accounts for the number of people likely to be involved in an incident (which is higher for certain vessel types) and assesses the significance of the change in risk compared to the UK background risk levels.

B.1.2 Risk to Environment

867. For risk to the environment the key criteria considered in terms of the risk due to the Project is the potential quantity of oil spilled from a vessel involved in an incident.

868. It is recognised that there will be other potential pollution, e.g. hazardous containerised cargoes; however, oil is considered the most likely pollutant, and the extent of predicted oil spills will provide an indication of the significance of pollution risk due to the Project compared to UK background pollution risk levels.

B.2 MAIB Incident Data

B.2.1 All Incidents in UK Waters

869. All British flagged commercial vessels are required to report incidents to the MAIB. Non-British flagged vessels do not have to report an incident to the MAIB unless located at a UK port or within 12nm territorial waters and carrying passengers to a UK port. There are no requirements for non-commercial recreational craft to report incidents to the MAIB; however; a significant proportion of such incidents are reported to and investigated by the MAIB.

870. The MCA, harbour authorities and inland waterway authorities also hava duty to report incidents to the MAIB. Therefore, whilst there may be a degree of underreporting of incidents with minor consequences, those resulting in more serious consequences, such as fatalities, are likely to be reported.

871. Only incidents occurring in UK waters have been considered within this assessment for which the MAIB data is most comprehensive. It is also noted that incidents occurring in ports/harbours and rivers/canals have been excluded since the causes and consequences may differ considerably from an incident occurring offshore, which is the location of most relevance to the Project.

872. Accounting for these criteria, a total of 11,773 accident, injuries, and hazardous incidents were reported to the MAIB in the 20-year period between 2002 and 2021 involving 13,415 vessels (some incidents, such as collision, involved more than one vessel).

873. The location of all incidents in proximity to the UK are presented in Figure B.3. The majority of incidents occurred in coastal waters. Following this, Figure B.4 presents the distribution of incidents by year within UK waters. Figure B.5 presents the distribution of incidents within UK waters by the incident type and Figure B.6 presents the distribution of vessel type involved in incidents within UK waters.

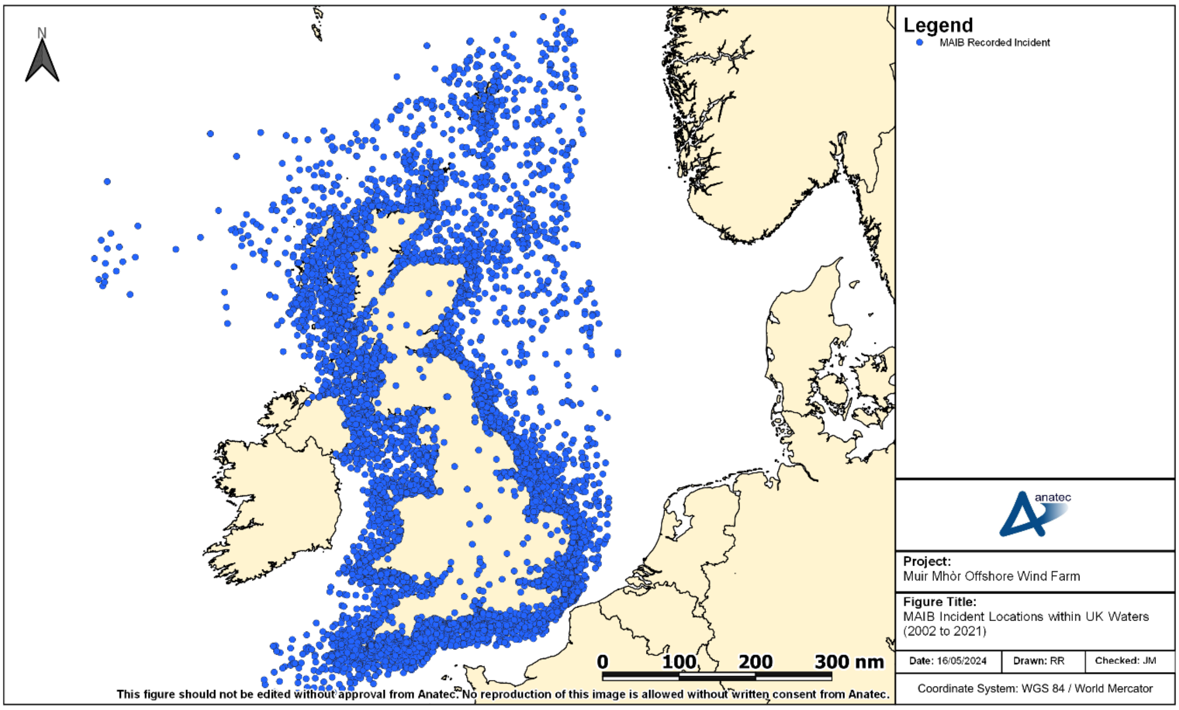

Figure B.3 MAIB Incident Locations within UK Waters (2002 to 2021)

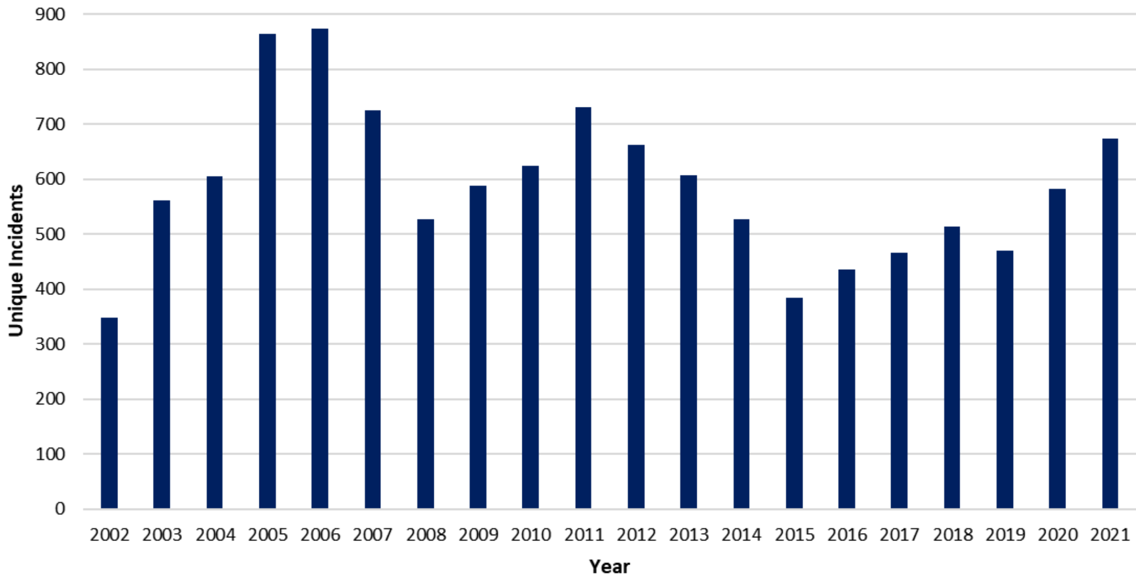

Figure B.4 MAIB Unique Incidents per Year Within UK Waters (2002 to 2021)

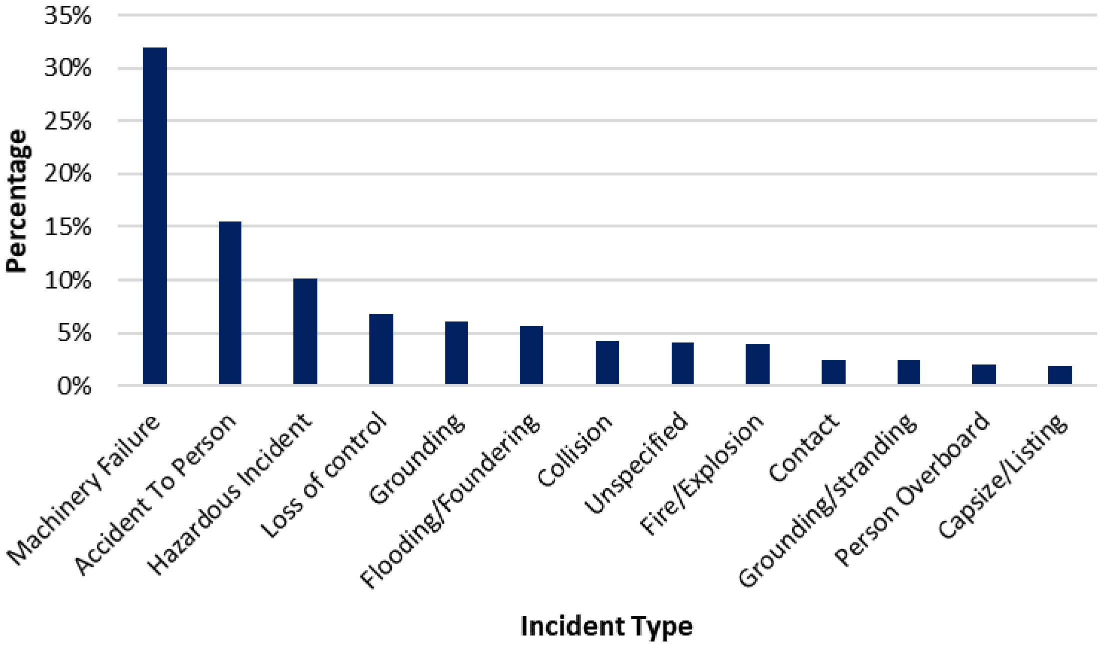

Figure B.5 MAIB Incidents Type Breakdown Within UK Waters (2002 to 2021)

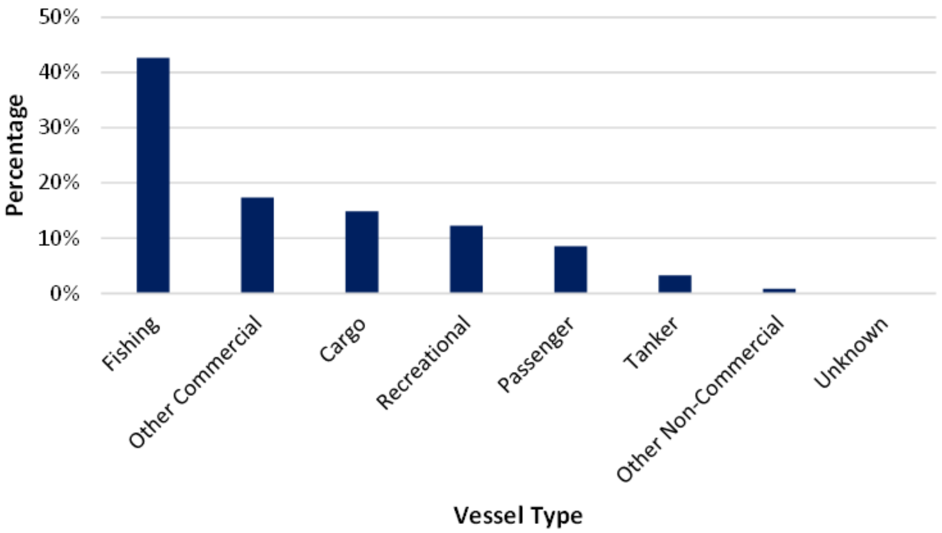

Figure B.6 MAIB Vessel Type Breakdown Within UK Waters (2002 to 2021)

874. The average number of unique incidents per year was 589. There has generally been a fluctuating trend in incidents over the 20-year period.

875. The most frequent incident types were "machinery failure" (32%), "accident to person" (16%) and "hazardous incident" (10%). "Collision" and "contact" incidents represented 4% and 2% of total incidents, respectively.

876. The most frequent vessel types involved in incidents were fishing vessels (43%), other commercial vessels (17%) (including offshore industry vessels, tugs, workboats and pilot vessels) and cargo vessels (15%).

877. A total of 414 fatalities were reported in the MAIB incidents within UK waters between 2002 and 2021, corresponding to an average of 21 fatalities per year.

878. The distribution of fatalities in UK waters by vessel type and person category (crew, passenger and other) is presented in Figure B.7. The majority of fatalities occurred to recreational vessels (51%) and fishing vessels (35%), with crew members the main people involved (83%).

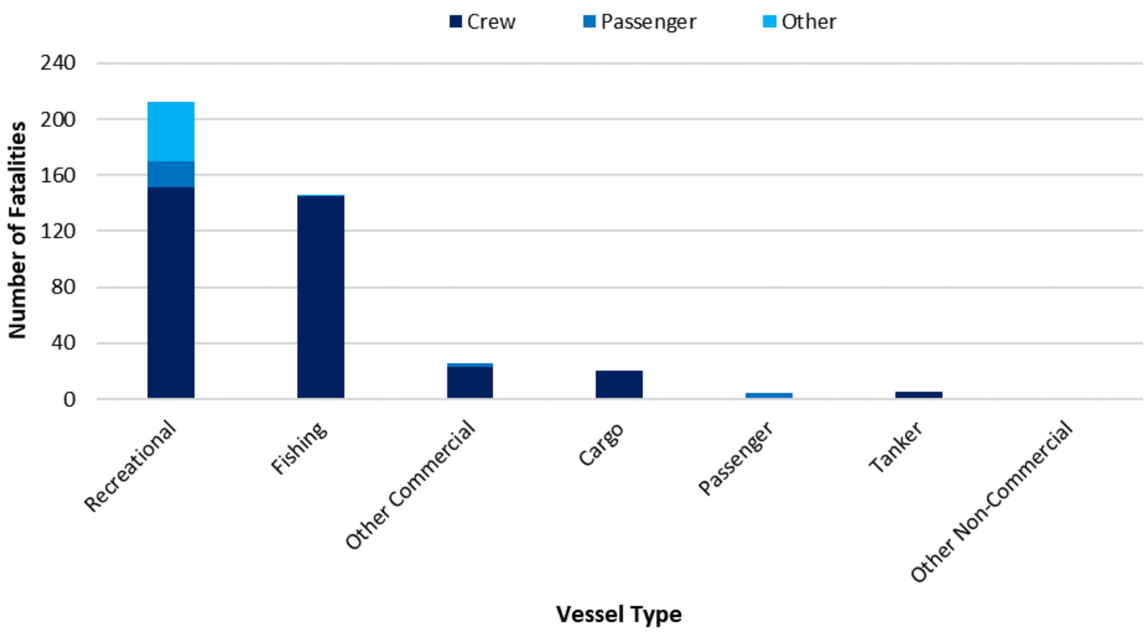

Figure B.7 MAIB Fatalities by Vessel Type within UK Waters (2002 to 2021)

B.2.2 Collision Incidents

879. The MAIB define a collision incident as "*ships striking or being struck by another ship, regardless of whether the ships are underway, anchored or moored*" (MAIB, 2013).

880. A total of 504 collision incidents were reported to the MAIB in UK waters between 2022 and 2021 involving 1,068 vessels (in a small number of cases, the other vessel involved was not logged).

881. The locations of collision incidents reports in proximity to the UK are presented in Figure B.8. Following this, Figure B.9 presents the distribution of collision incidents per year.

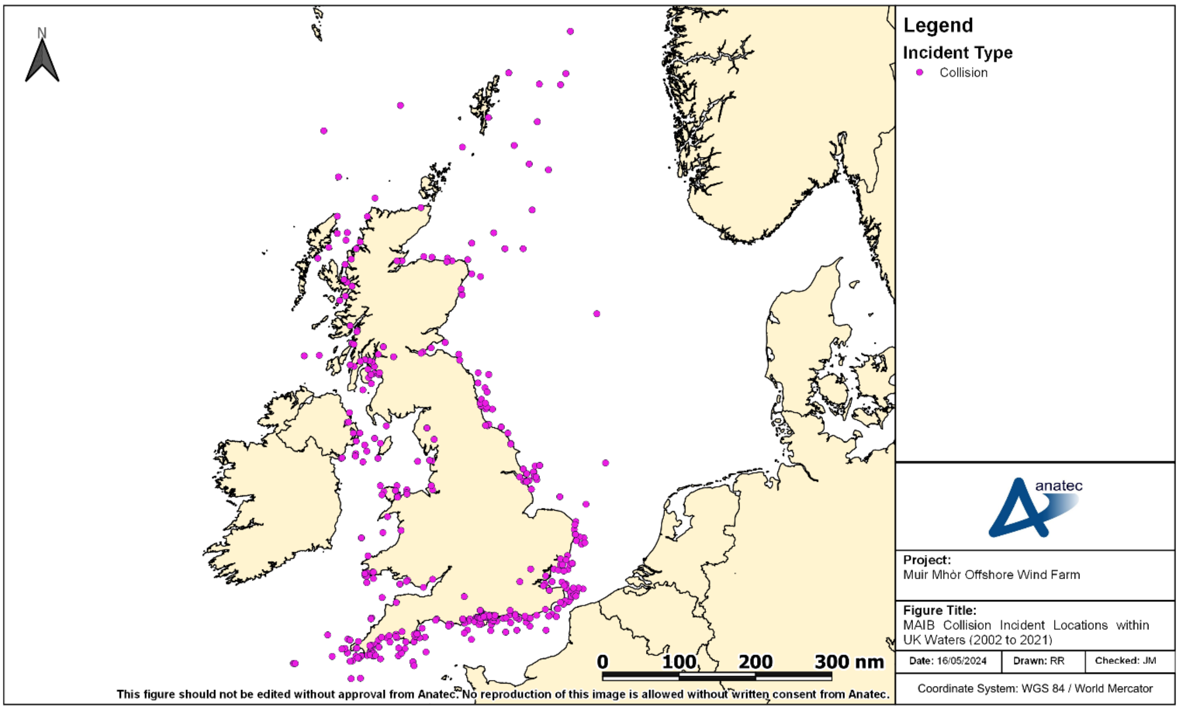

Figure B.8 MAIB Collision Incident Locations within UK Waters (2002 to 2021).

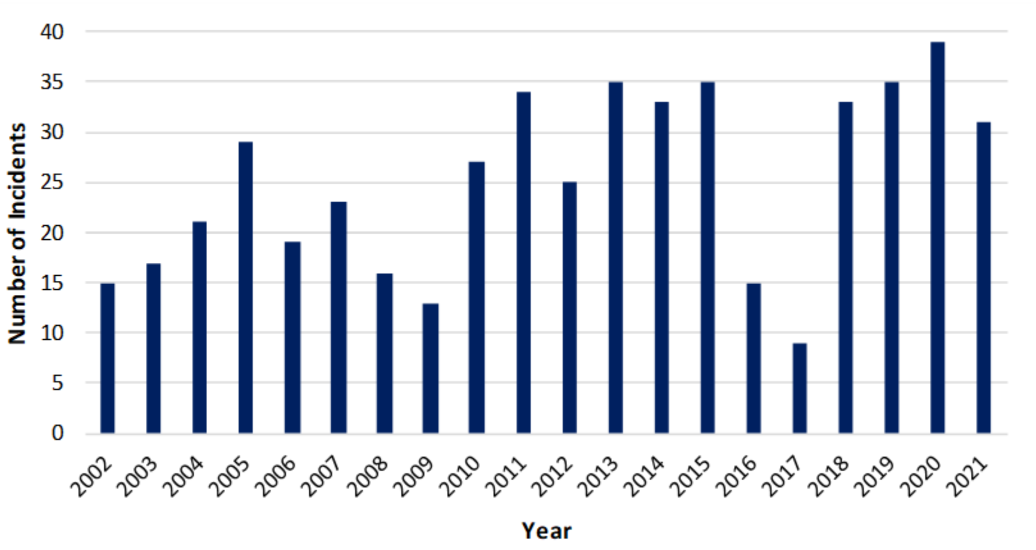

Figure B.9 MAIB Annual Collision Incidents within UK Waters (2002 to 2021).

882. The average number of collision incidents per year was 25. There has been an overall slight increasing trend in collision incidents over the 20-year period, which may be due to better reporting of less serious incidents in recent years.

883. The distribution of vessel types involved in collision incidents is presented in Figure B.10.

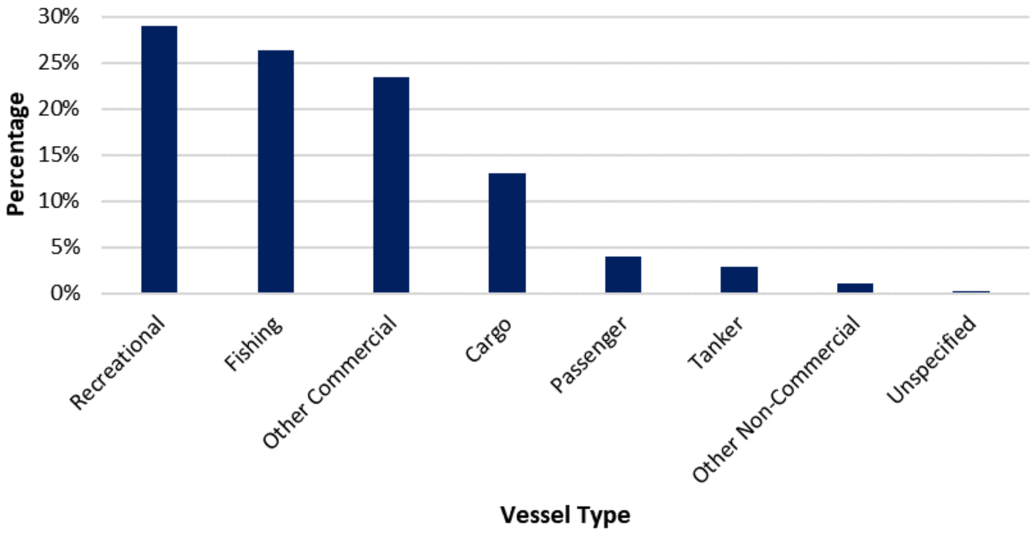

Figure B.10 MAIB Collision Incidents by Vessel Type within UK Waters (2002 to 2021)

884. The most frequent vessel types involved in collision incidents were recreational vessels (29%), fishing vessels (26%), other commercial vessels (24%) and cargo vessels (13%).

885. A total of five fatalities were reported in MAIB collision incidents within UK waters between 2002 and 2021. Details of each of these fatal incidents reported by the MAIB are presented in Table B.2.

Table B.2 Fatal Incidents Reported by the MAIB

Date	Description	Fatalities
July 2005	Collision between two powerboats at night. Both vessels were unlit and both helmsmen had consumed alcohol. One of the helmsmen died.	1
October 2007	Collision between fishing vessel and coastal general cargo vessel following failure to keep an effective lookout. Fishing vessel sank with three of the four crew members abandoning ship into a life raft but the fourth crew member was not recovered.	1
August 2010	Collision between passenger ferry and fishing vessel. Fishing vessel sank with one of the two crew members recovered from the sea but the other member was not recovered despite an extensive search.	1
June 2015	Collision between Rigid-hulled Inflatable Boat and yacht. Believed that around a dozen persons were onboard the motorboat with the majority taken ashore by lifeboat. One person seriously	1

Date	Description	Fatalities
	injured and airlifted to hospital before being pronounced dead later.	
June 2018	Collision between power boats during a race. One of the vessels overturned with the pilot pronounced dead at the scene.	1

B.2.3 Allision Incidents

886. The MAIB define a contact incident as "*ships striking or being struck by an external object. The objects can be: floating object (cargo, ice, other, or unknown); fixed object, but not the sea bottom; or flying object*" (MAIB, 2013). In line with the NRA as a whole, an allision is considered to involve a moving object and a stationary object at sea, with port infrastructure excluded form consideration; the MAIB contact incidents have been individually inspected and filtered in line with the NRA definition.

887. A total of 119 allision incidents were reported to the MAIB within UK waters between 2002 and 2021 involving 119 vessels.

888. The locations of allision incidents reported in proximity to the UK are presented in Figure B.11. Following this, Figure B.13 presents the distribution of allision incidents per year.

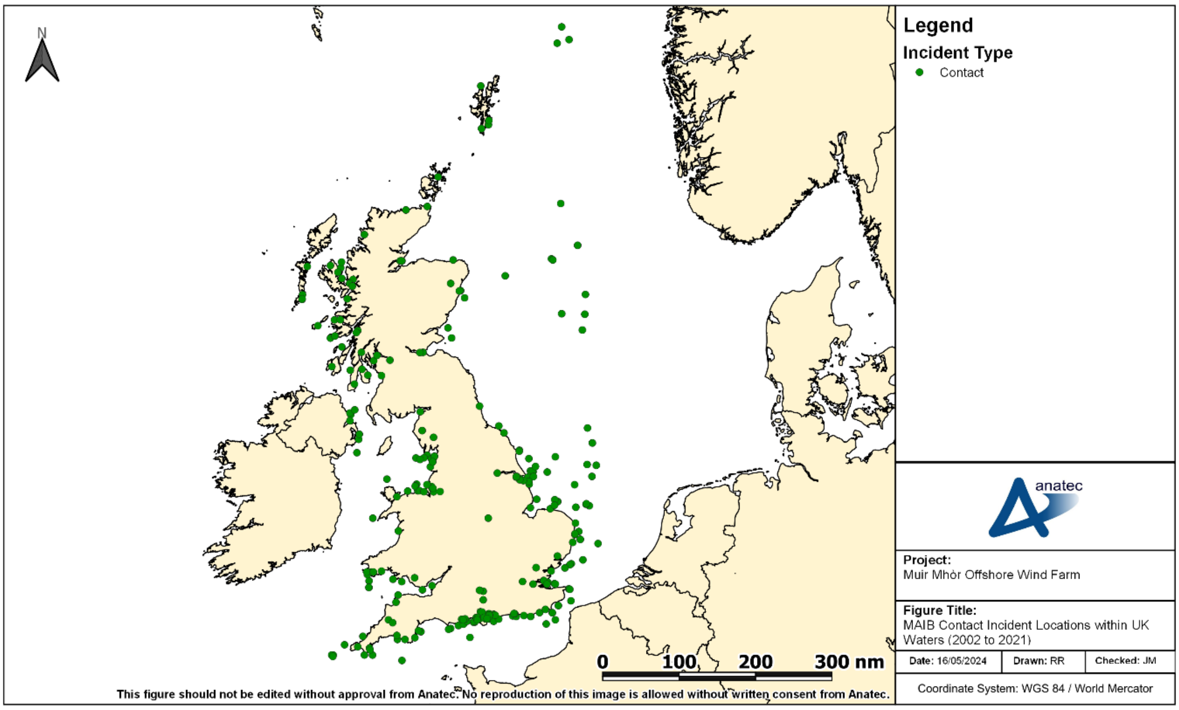

Figure B.11 MAIB Alliison Incident Locations Within UK Waters (2002 to 2021)

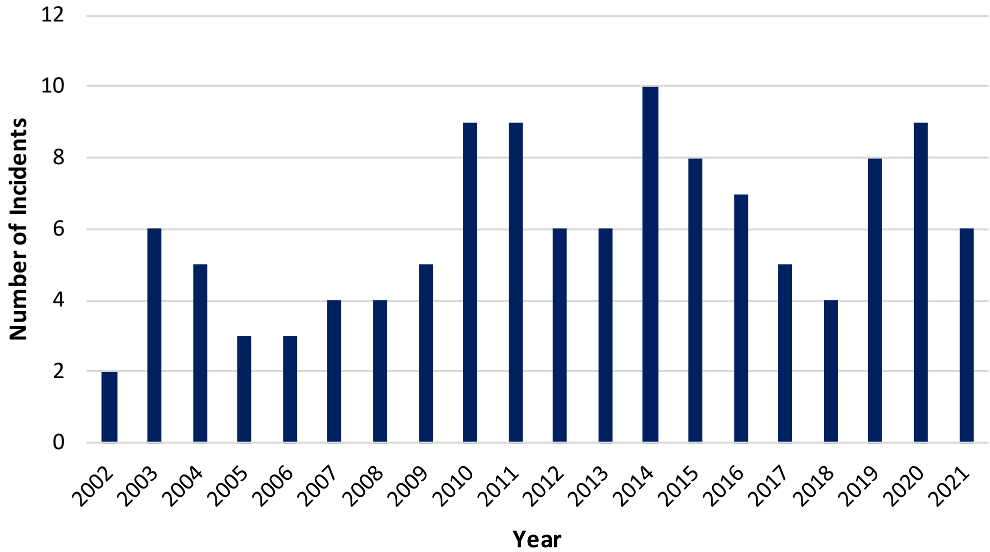

Figure B.12 MAIB Allision Incidents per Year Within UK Waters (2002 to 2021)

889. The average number of allision incidents per year was six. As with collision incidents, there has been an overall slight increasing trend in allision incidents over the 20-year period, which may be due to better reporting of less serious incidents in recent years.

890. The distribution of vessel types involved in allision incidents is presented in Figure B.13.

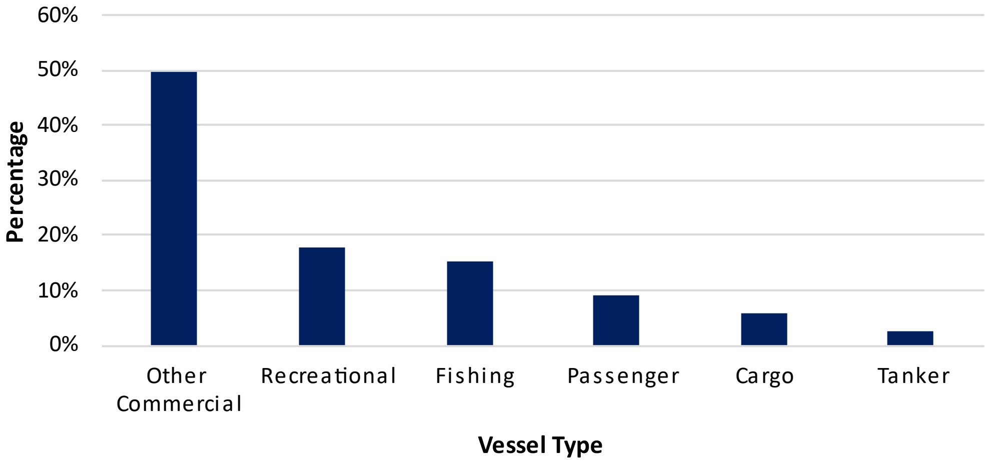

Figure B.13 MAIB Allision Incidents by Vessel Type Within UK Waters (2002 to 2021).

891. The most frequent vessel types involved in allision incidents were other commercial vessels (50%), recreational vessels (18%) and fishing vessels (15%).

892. No fatalities were reported in MAIB allision incidents within offshore UK waters between 2002 and 2021.

B.3 Fatality Risk

B.3.1 Incident Data

893. This section uses the MAIB incident data along with information on average manning levels per vessel type to estimate the probability of a fatality in a maritime incident associated with the Project.

894. The Project is assessed to have the potential to affect the following incidents:

- Vessel to vessel collision;
- Powered vessel to structure allision;
- Drifting vessel to structure allision; and
- Fishing vessel to structure allision.

895. Of these incident types, only vessel to vessel collisions match the MAIB definition of collisions and hence the fatality analysis presented in Section B.3.2 is considered directly applicable to these types of incidents.

896. The other scenarios of powered vessel to structure allision, drifting vessel to structure allision, and fishing vessel to structure allision are not clearly represented by the MAIB data (as discussed in Section 9.5.

B.3.2 Fatality Probability

897. Five of the 504 collision incidents reported by the MAIB within UK waters between 2002 and 2021 resulted in one or more fatalities. This gives a 0.99% probability that a collision incident will lead to a fatal accident.

898. To assess the fatality risk for personnel onboard a vessel (crew, passenger or other) the number of persons involved in the incidents needs to be estimated. Table B.3 presents the average number of persons on board (POB) estimated for each category of vessel navigating in proximity to the Project. For passenger vessels this is based upon information available for the specific vessels recorded in the vessel traffic survey data. For other vessel categories, this is based upon information available from the MAIB incident data.

Table B.3 Estimated Average POB by Vessel Category

Vessel category	Sub categories	Source of estimated average POB	Estimated average POB
Cargo/freight	Dry cargo, other commercial, service ship, etc.	MAIB incident data	15
Tanker	Tanker/combination carrier	MAIB incident data	23
Passenger	RoRo passenger, cruise liner, etc.	Vessel traffic survey data / online information	2,024

Vessel category	Sub categories	Source of estimated average POB	Estimated average POB
Fishing	Trawler, potter, dredger, etc.	MAIB incident data	3.3

899. It is recognised that these average POB numbers can be substantially higher or lower on an individual vessel basis depending upon the size, subtype, etc. but applying reasonable averages is considered sufficient for this analysis, particularly when noting that the average POB for the dominant vessel category (passenger) is based upon the vessel traffic survey data where possible.

900. Using the average POB, along with the vessel type information involved in collision incidents reported by the MAIB (see Section 9.5), there was an estimated 89,774 POB the vessels involved in the collision incidents.

901. Based upon five fatalities during the period 2002 to 2021, the overall fatality probability in a collision for any individual onboard is approximately 1.17×10-4 per collision.

902. It is considered inappropriate to apply this rate uniformly as the statistics indicate that the fatality probability associated with smaller craft, such as fishing vessels and recreational vessels, is higher. Therefore, the fatality probability has been subdivided into three categories of vessel as presented in Table B.4. In addition, due to zero fatalities resulting from commercial vessel collisions between 2002 and 2021, the time period used to assess the fatality probability for commercial vessels has been extended by five years to ensure a meaningful probability is captured.

Table B.4 Collision Incident Fatality Probability by Vessel Category

Vessel Category	Sub Categories	Fatalities	People Involved	Fatality Probability	Time Period
Commercial	Dry cargo, passenger, tanker, etc.	1	87,824	1.14×10^{-5}	1997 to 2021 (25 years)
Fishing	Trawler, potter, dredger, etc.	2	927	2.2×10^{-3}	2002 to 2021 (20 years)
Recreational	Yacht, small commercial motor yacht, etc.	3	1,023	2.9×10^{-3}	2002 to 2021 (20 years)

B.3.3 Fatality Risk Due to the Project

903. The base case and future case annual collision frequency levels pre and post wind farm for the Project are summarised in Table B.5.

Table B.5 Summary of Annual Collision and Allision Risk Results

Risk	Scenario	Annual Frequency (Return Period)		
		Pre Wind Farm	Post Wind Farm	Change
Vessel to vessel collision	Base case	3.48×10^{-1} (1 in 2.87 years)	3.50×10^{-1} (1 in 2.86 years)	1.29×10^{-3} (1 in 777 years)
	Future case (10%)	4.22×10^{-1} (1 in 2.37 years)	4.23×10^{-1} (1 in 2.36 years)	1.56×10^{-3} (1 in 640 years)
	Future case (20%)	5.02×10^{-1} (1 in 1.99 years)	5.04×10^{-1} (1 in 1.99 years)	1.96×10^{-3} (1 in 511 years)
	Future case (30%)	5.89×10^{-1} (1 in 1.70 years	5.91×10^{-1} (1 in 1.69 years	2.18×10^{-3} (1 in 458 years)
Powered vessel to structure allision	Base case	N/A	6.84×10^{-3} (1 in 146 years)	6.84×10^{-3} (1 in 146 years)
	Future case (10%)	N/A	7.52×10^{-3} (1 in 133 years)	7.52×10^{-3} (1 in 133 years)
	Future case (20%)	N/A	8.21×10^{-3} (1 in 122 years)	8.21×10^{-3} (1 in 122 years)
	Future case (30%)	N/A	8.90×10^{-3} (1 in 112 years)	8.90×10^{-3} (1 in 112 years)
Drifting vessel to structure allision	Base case	N/A	1.30×10^{-3} (1 in 772 years)	1.30×10^{-3} (1 in 772 years)
	Future case (10%)	N/A	1.43×10^{-3} (1 in 702 years)	1.43×10^{-3} (1 in 702 years)
	Future case (20%)	N/A	1.55×10^{-3} (1 in 643 years)	1.55×10^{-3} (1 in 643 years)
	Future case (30%)	N/A	1.68×10^{-3} (1 in 594 years)	1.68×10^{-3} (1 in 594 years)
Fishing vessel to structure allision	Base case	N/A	7.44×10^{-2} (1 in 13.4 years)	7.44×10^{-2} (1 in 13.4 years)
	Future case (10%)	N/A	8.18×10^{-2} (1 in 12.2 years)	8.18×10^{-2} (1 in 12.2 years)
	Future case (20%)	N/A	8.92×10^{-2} (1 in 11.2 years)	8.92×10^{-2} (1 in 11.2 years)
	Future case (30%)	N/A	$9.67\text{x}10^{-2}$ (1 in 10.3 years)	$9.67\text{x}10^{-2}$ (1 in 10.3 years)
Total	**Base case**	3.48×10^{-1} (1 in 2.87 years)	4.32×10^{-1} (1 in 2.31 years)	8.38×10^{-2} (1 in 11.9 years)
	Future case (10%)	4.22×10^{-1} (1 in 2.37 years)	5.14×10^{-1} (1 in 1.95 years)	9.23×10^{-2} (1 in 10.83 years)
	Future case (20%)	5.02×10^{-1} (1 in 1.99 years)	6.03×10^{-1} (1 in 1.66 years)	1.01×10^{-1} (1 in 9.90 years)

Risk	Scenario	Annual Frequency (Return Period)		
		Pre Wind Farm	Post Wind Farm	Change
	Future case (30%)	5.89×10^{-1} (1 in 1.70 years	6.99×10^{-1} (1 in 1.43 years)	1.09×10^{-1} (1 in 9.13 years)

904. From the details results of the collision and allision risk modelling, the distribution of the predicted change in annual collision and allision frequency by vessel type due to the Project for the base case and future case are presented in Figure B.14. For clarity, the same distribution is presented in Figure B.15 with fishing vessels excluded.

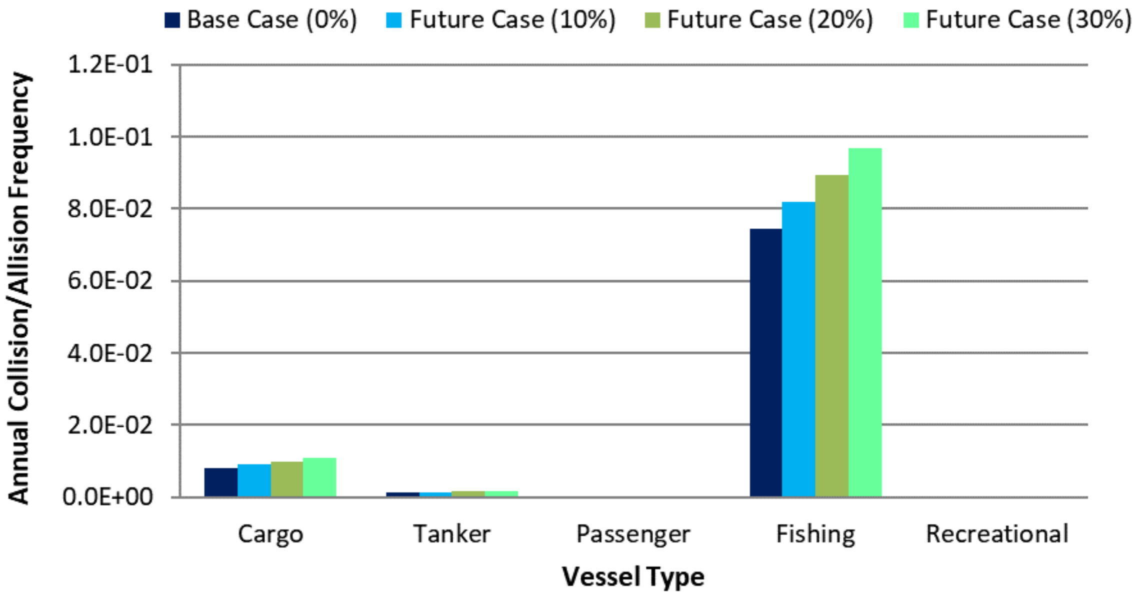

Figure B.14 Estimated Change in Annual Collision and Allision Frequency by Vessel Type

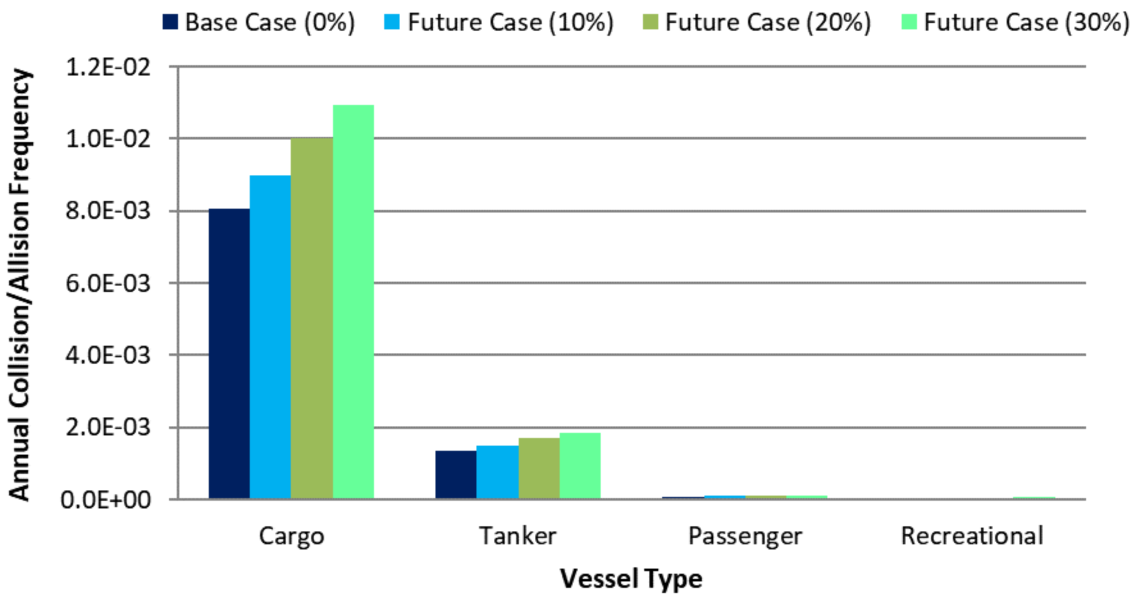

Figure B.15 Estimated Change in Annual Collision and Allision Frequency by Vessel Type (Excluding Fishing Vessels)

905. The change in collision and allision frequency is dominated by fishing vessels due to their active presence within and in proximity to the Array Area and the conservative nature of Anatec's COLLRISK model for fishing vessel allisions.

906. The second greatest collision and allision frequency change was associated with cargo vessels but was significantly lower than fishing vessels.

907. Combining the annual collision and allision frequency (Table B.5), estimated number of POB for each vessel type (Table B.3) and the estimated fatality probability for each vessel type category (Table B.4), the annual increase in PLL due to the presence of the Project for the base case is estimated to be 5.05×10^{-4}, equating to one additional fatality every 1,980 years.

908. The estimated incremental increases in PLL due to the Project, distributed by vessel type and for the base case and future case, are presented in Figure B.16. For clarity, the same distribution is presented in Figure B.17 with fishing vessels excluded.

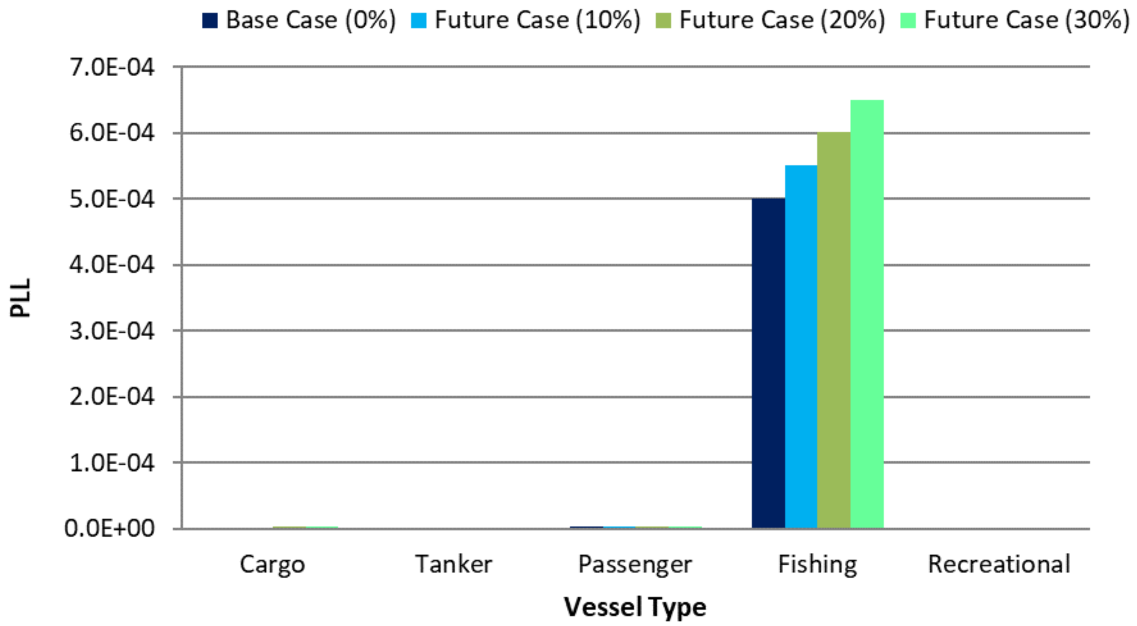

Figure B.16 Estimated Change in Annual PLL by Vessel Type

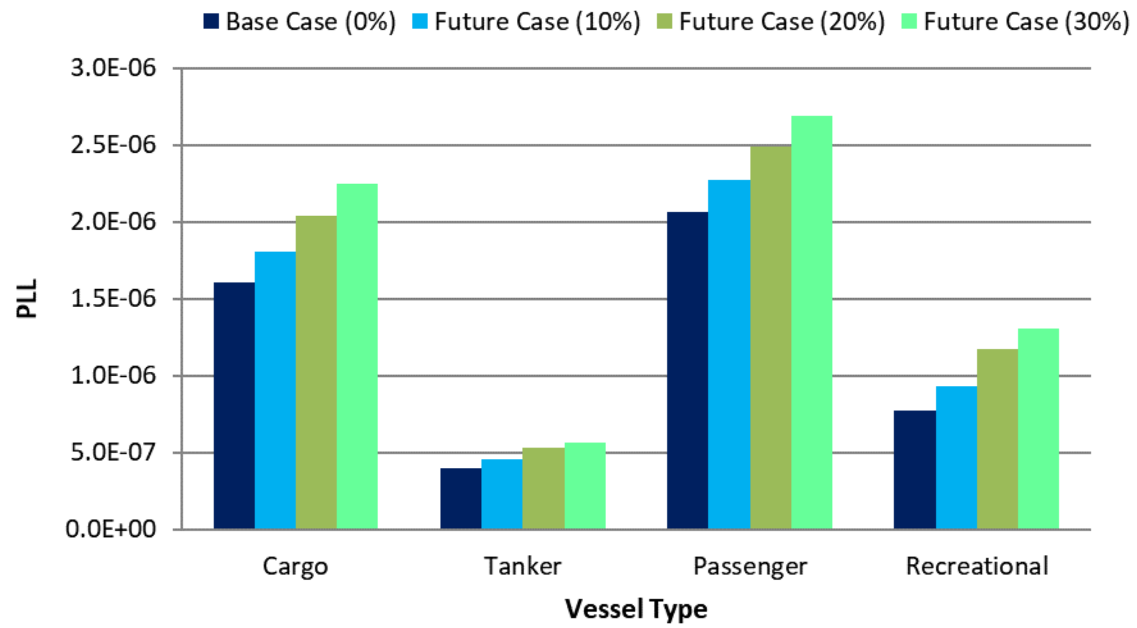

Figure B.17 Estimated Change in Annual PLL by Vessel Type (Excluding Fishing Vessels)

909. As with the change in collision and allision frequency, the change in annual PLL is dominated by fishing vessels which historically have a higher fatality probability than commercial vessels.

910. The second greatest annual PLL change was associated with passenger vessels due to much greater numbers of POB associated with this vessel type compared to others.

911. Converting the PLL to individual risk based upon the average number of people exposed by vessel type, the results are presented in Figure B.18. For clarity, the same distribution is presented in Figure B.19 with fishing vessels excluded.

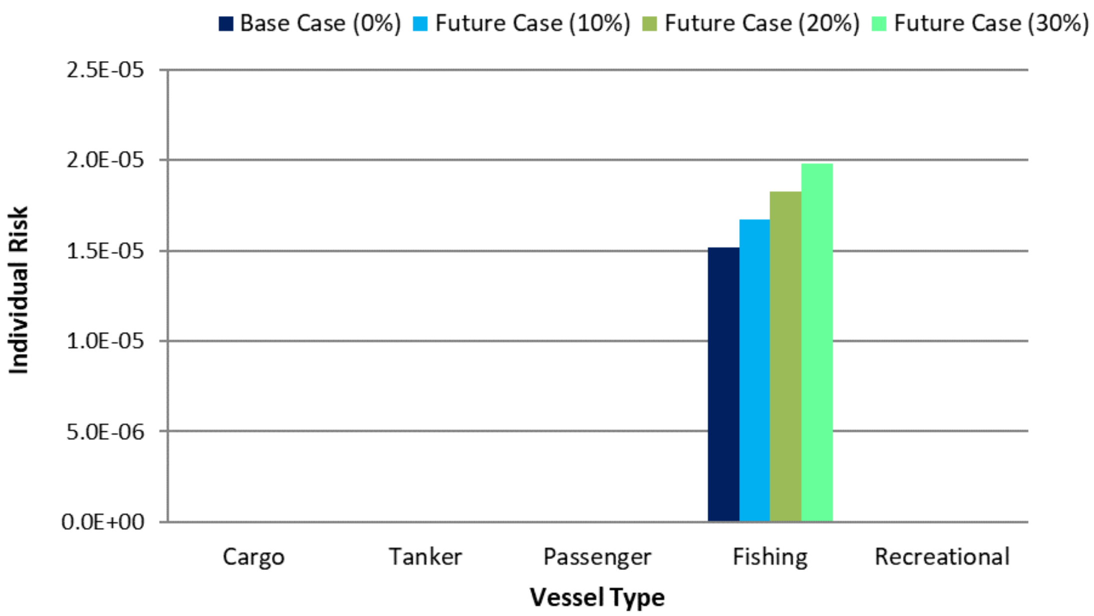

Figure B.18 Estimated Change in Individual Risk by Vessel Type

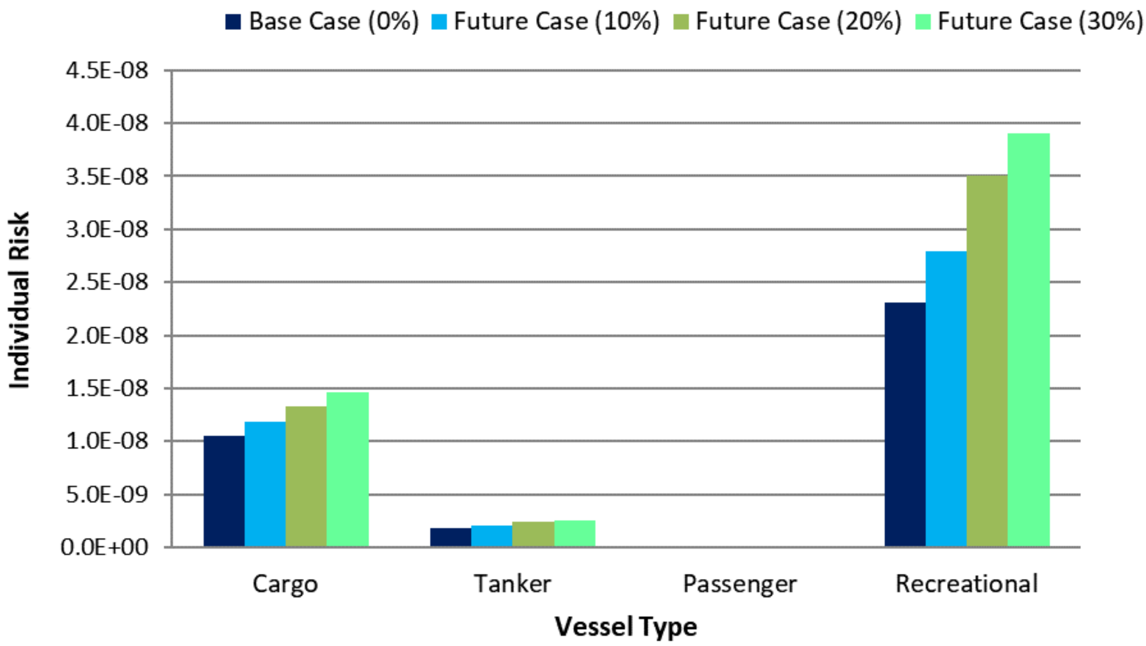

Figure B.19 Estimated Change in Individual Risk by Vessel Type (Excluding Fishing Vessels)

912. The change in individual risk to people is dominated by fishing vessels, again reflecting the higher probability of a fatality occurring in the event of an incident involving a fishing vessel compared to other vessel types.

B.3.4 Significance of increase in Fatality Risk

913. In comparison to MAIB statistics, which indicate an average of 18 to 19 fatalities per year in UK territorial waters during the 20-year period between 2002 and 2021, the overall increase for the base case in PLL of one additional fatality per 1,980 years represents a very small change.

914. In terms of individual risk to people, the change for commercial vessels attributed to the Project (approximately 1.24×10^{-8} for base case) is very low to the background risk level for the UK sea transport industry of 2.9×10^{-3} per year.

915. For fishing vessels, the change in individual risk attributed to the Project (approximately 1.52×10^{-5} for base case) is very low compared to the background risk level for the UK sea fishing industry of 1.2×10^{-3} per year.

B.4 Pollution Risk

B.4.1 Historical Analysis

916. The pollution consequences of a collision in terms of oil spill depend upon the following criteria:

- Spill probability (i.e. the likelihood of outflow following an incident); and
- Spill size (quantity of oil).

917. Two types of oil spill are considered in this assessment:

- Fuel oil spills from bunkers (all vessel types); and
- Cargo oil spills (laden tankers).

918. The research undertaken as part of the DfT's MEHRAs project (DfT, 2001) has been used as it was comprehensive and based upon worldwide marine oil spill data analysis. From this research, the overall probability of a spill per incident was calculated based upon historical incident data for each incident type as presented in Figure B.20.

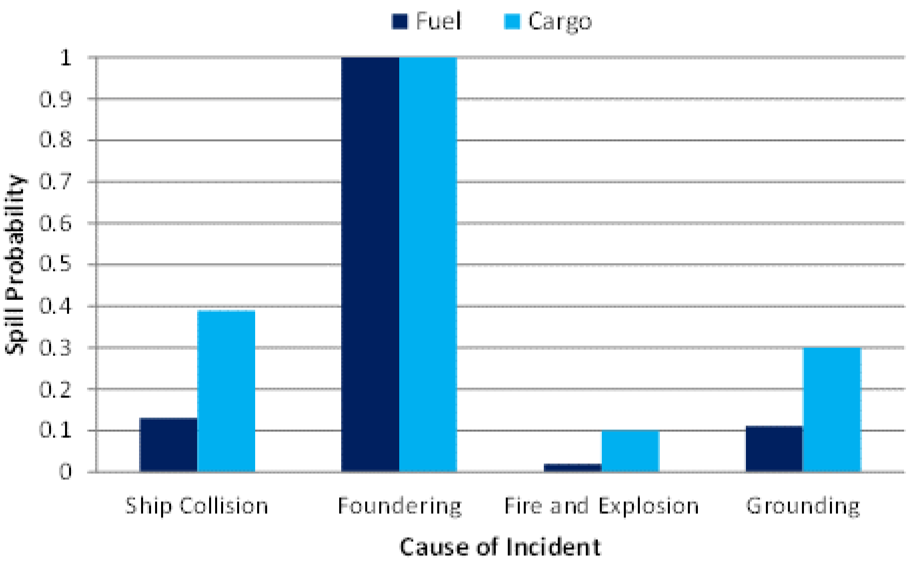

Figure B.20 Probability of an Oil Spill Resulting from an Accident

919. Therefore, it was estimated that 13% of vessel collisions resulted in a fuel oil spill and 39% of collisions involving a laden tanker result in a cargo oil spill.

920. In the event of a bunker spill, the potential outflow of oil depends upon the bunker capacity of the vessel. Historical bunker spills from vessels have generally been limited to a size below 50% of bunker capacity, and in most incidents much lower.

921. For the types and sizes of vessels exposed to the Project, an average spill size of 100 tonnes of fuel oil is considered a conservative assumption.

922. For cargo spills from laden tankers, the spill size can vary significantly. The ITOPF reported the following spill size distribution for tanker collisions between 1974 and 2004:

- 31% of spills below seven tonnes;
- 52% of spills between seven and 700 tonnes; and

- 17% of spills greater than 700 tonnes.

923. Based upon this data and the tankers transiting in proximity to the Project, an average spill size of 400 tonnes is considered a conservative assumption.

924. For fishing vessel collisions, comprehensive statistical data is not available. Consequently, it is conservatively assumed that 50% of all collisions involving fishing vessels will lead to oil spill with the quantity spilled being on average five tonnes. Similarly for recreational vessels, due to a lack of data 50% of collisions are conservatively assumed to lead to a spill with an average size of one tonne.

B.4.2 Pollution Risk due to the Project

925. Applying the above probabilities to the annual collision and allision frequency by vessel type presented in Table B.5 and the average spill size per vessel, the amount of oil spilled per year due to the impact of the Project is estimated to be 0.50 tonnes for the base case, rising to 0.67 tonnes per year for the 30% future case.

926. The estimated increase in tonnes of oil spilled, distributed by vessel type, for the base case and future case are presented in Figure B.21.

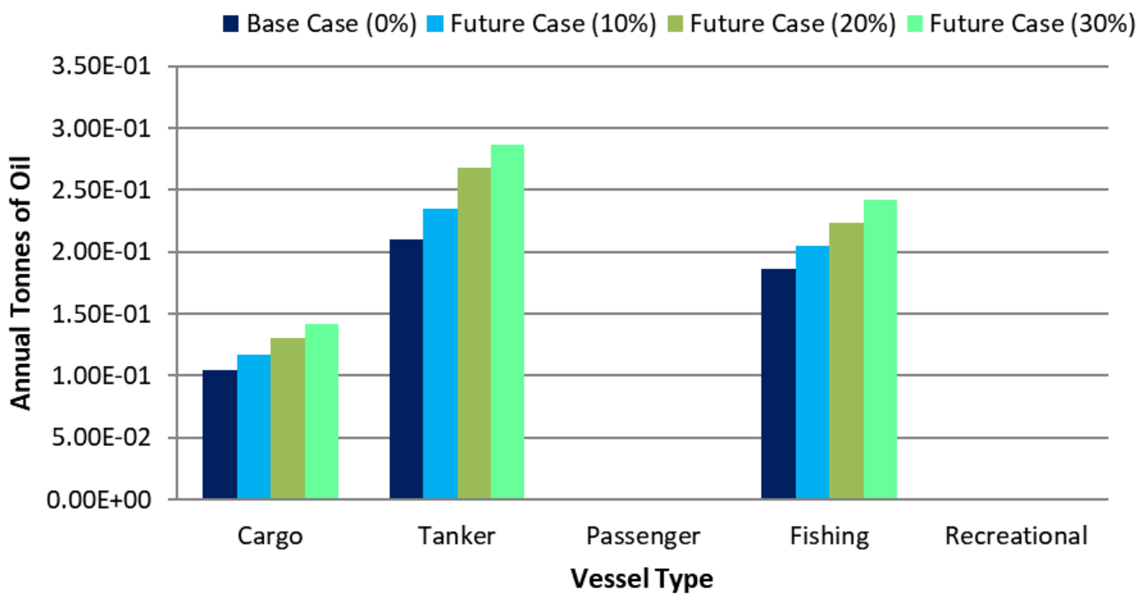

Figure B.21 Estimated Change in Pollution by Vessel Type

927. The annual oil spill results were the greatest for tankers, reflecting the greater oil spill volume per incident associated with tankers, followed by fishing vessels due to their high associated annual collision and allision frequency.

B.4.3 Significance of Increase in Pollution Risk

928. To assess the significance of the increased pollution risk from vessels caused by the Project, historical oil spill data for the UK has been used as a benchmark.

929. From the MEHRAs research, the annual average tonnes of oil spilled in UK waters due to maritime incidents in the 10-year period from 1989 to 1998 was 16,111. This is based upon a total of 146 reported oil pollution incidents of greater than one tonne (smaller spills are excluded as are incidents which occurred within port or harbour areas or resulting from operational errors or equipment failure). Commercial vessel spills accounted for approximately 99% of the total while fishing vessel incidents accounted for less than 1%.

930. The overall increase in pollution estimated due to the Project of 0.50 tonnes for the base case represents a 0.003% increase compared to the historical average pollution quantities from maritime incidents in UK waters. This may also be conservative given the potential for future changes towards less polluting vessel fuels.

B.5 Conclusion

931. This annex has quantitively assessed the fatality and pollution risk associated with the Project in the event of a collision or allision incident occurring. The assessment indicates that the fatality and pollution risk associated with fishing vessels is greatest.

932. Overall, the impact of the Project on people and the environment is relatively low compared to the existing background risk levels in UK waters. However, this is the localised impact of a single offshore wind farm development and there will be additional maritime risks associated with other offshore wind farm developments in the southern North Sea and the UK as a whole.

933. Discussion of relevant mitigation measures and monitoring is provided in Section 19 of the NRA.

Annex C Hazard Log

User	Isolation / Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Separate Sheet)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences: Frequency	Consequences: People	Consequences: Environment	Consequences: Property	Consequences: Business	Consequences: Average Consequence	Risk	Worst Case Consequences	Realistic Worst Case Consequences: Frequency	Consequences: People	Consequences: Environment	Consequences: Property	Consequences: Business	Consequences: Average Consequence	Risk	Further Mitigation Required	Additional Comments
Vessel Displacement including in adverse weather																							
Commercial vessels	Isolation	Array area	C/D	Lighting and Marking COLREGS and SOLAS Layout Approval MGN 654 ERCoP Promulgation of information Display on charts Minimum blade clearance	• Presence of buoyed construction/ decommissioning area • Adverse weather • Construction/ decommissioning vessels which are RAM	Increased journey time/distance but does not impact on schedules or compliance with COLREGs	4	1	1	1	2	1.3	Broadly Acceptable	Increased journey time/distance which impacts on schedules or compliance with COLREGs	3	1	2	1	3	1.8	Broadly Acceptable		The hazard workshop included discussion of the Recommended Ferry Route. Route is used infrequently including for adverse weather preference, consultation has indicated that the Sunk TSS South or East could be used instead noting this would involve a minor deviation.
			O		• Presence of surface structures • Adverse weather • Maintenance vessels which are RAM		4	1	1	1	2	1.3	Broadly Acceptable		3	1	2	1	3	1.8	Broadly Acceptable		

User	Isolation / Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Separate Sheet)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst Case Consequences	Realistic Worst Case Consequences							Further Mitigation Required	Additional Comments
							Frequency	Consequences: People	Consequences: Environment	Consequences: Property	Consequences: Business	Consequences: Average Consequence	Risk		Frequency	Consequences: People	Consequences: Environment	Consequences: Property	Consequences: Business	Consequences: Average Consequence	Risk		
		Offshore export cable corridor	C/D		• Installation vessel which is RAM blocking access channel		5	1	1	1	2	1.3	Tolerable		2	1	2	1	3	1.8	Broadly Acceptable	Management procedures for cable installation including pre - works and maintenance	
			O		• Maintenance vessel which is RAM blocking access channel		4	1	1	1	2	1.3	Broadly Acceptable		2	1	2	1	3	1.8	Broadly Acceptable		
	Cumulative	Array area	C/D	Lighting and Marking COLREGS and SOLAS Layout Approval MGN 654 ERCoP Promulgation of information Display on charts Minimum blade clearance	• Presence of cumulative buoyed construction/ decommissioning areas associated with North Falls and Five Estuaries • Adverse weather • Construction/ decommissioning vessels which are RAM	Increased journey time/distance but does not impact on schedules or compliance with COLREGs	4	1	1	1	2	1.3	Broadly Acceptable	Increased journey time/distance which impacts on schedules or compliance with COLREGs	3	1	2	1	3	1.8	Broadly Acceptable		General consensus was that the removal of the Northern Array has dealt with key cumulative routeing concerns.

User	Isolation / Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Separate Sheet)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences: Frequency	Realistic Most Likely Consequences: People	Realistic Most Likely Consequences: Environment	Realistic Most Likely Consequences: Property	Realistic Most Likely Consequences: Business	Realistic Most Likely Consequences: Average Consequence	Realistic Most Likely Consequences: Risk	Worst Case Consequences	Realistic Worst Case Consequences: Frequency	Realistic Worst Case Consequences: People	Realistic Worst Case Consequences: Environment	Realistic Worst Case Consequences: Property	Realistic Worst Case Consequences: Business	Realistic Worst Case Consequences: Average Consequence	Realistic Worst Case Consequences: Risk	Further Mitigation Required	Additional Comments
			O		• Presence of cumulative surface structures associated with North Falls and Five Estuaries • Adverse weather • Maintenance vessels which are RAM		4	1	1	1	2	1.3	Broadly Acceptable		3	1	2	1	3	1.8	Broadly Acceptable		
		Offshore export cable corridor	C/D		• Installation vessel which is RAM blocking access channel		5	1	1	1	2	1.3	Tolerable		2	1	2	1	3	1.8	Broadly Acceptable	Management procedures for cable installation including pre - works and maintenance	

User	Isolation / Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Separate Sheet)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst Case Consequences	Realistic Worst Case Consequences							Further Mitigation Required	Additional Comments
								Consequences					Risk			Consequences					Risk		
							Frequency	People	Environment	Property	Business	Average Consequence			Frequency	People	Environment	Property	Business	Average Consequence			
			O		• Maintenance vessel which is RAM blocking access channel		4	1	1	1	2	1.3	Broadly Acceptable		2	1	2	1	3	1.8	Broadly Acceptable		
Commercial fishing vessels in transit	Isolation	Array area	C/D	Lighting and Marking COLREGS and SOLAS Layout Approval MGN 654 ERCoP Promulgation of information Display on charts Minimum	• Presence of buoyed construction/ decommissioning area • Adverse weather • Construction/ decommissioning vessels which are RAM	Increased journey time/distance but does not impact on compliance with COLREGs	4	1	1	1	2	1.3	Broadly Acceptable	Increased journey time/distance which impacts on compliance with COLREGs	3	1	2	1	3	1.8	Broadly Acceptable		

User	Isolation / Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Separate Sheet)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences – Frequency	Consequences – People	Consequences – Environment	Consequences – Property	Consequences – Business	Consequences – Average Consequence	Risk	Worst Case Consequences	Realistic Worst Case Consequences – Frequency	Consequences – People	Consequences – Environment	Consequences – Property	Consequences – Business	Consequences – Average Consequence	Risk	Further Mitigation Required	Additional Comments
			O	blade clearance	• Presence of surface structures • Adverse weather • Maintenance vessels which are RAM		4	1	1	1	2	1.3	Broadly Acceptable		3	1	2	1	3	1.8	Broadly Acceptable		
		Offshore export cable corridor	C/D		• Installation vessel which is RAM blocking access channel		5	1	1	1	2	1.3	Tolerable		2	1	2	1	3	1.8	Broadly Acceptable		
			O		• Maintenance vessel which is RAM blocking access channel		4	1	1	1	2	1.3	Broadly Acceptable		2	1	2	1	3	1.8	Broadly Acceptable		

User	Isolation / Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Separate Sheet)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst Case Consequences	Realistic Worst Case Consequences							Further Mitigation Required	Additional Comments
								Consequences					Risk			Consequences					Risk		
							Frequency	People	Environment	Property	Business	Average Consequence			Frequency	People	Environment	Property	Business	Average Consequence			
	Cumulative	Array area	C/D	Lighting and Marking COLREGS and SOLAS Layout Approval MGN 654 ERCoP Promulgation of information Display on charts Minimum blade clearance	• Presence of cumulative buoyed construction/ decommissioning areas associated with North Falls and Five Estuaries • Adverse weather • Construction/ decommissioning vessels which are RAM	Increased journey time/distance but does not impact on compliance with COLREGs	4	1	1	1	2	1.3	Broadly Acceptable	Increased journey time/distance which impacts on compliance with COLREGs	3	1	2	1	3	1.8	Broadly Acceptable		
			O		• Presence of cumulative surface structures associated with North Falls and Five Estuaries • Adverse weather • Maintenance vessels which are RAM		4	1	1	1	2	1.3	Broadly Acceptable		3	1	2	1	3	1.8	Broadly Acceptable		

User	Isolation / Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Separate Sheet)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst Case Consequences	Realistic Worst Case Consequences							Further Mitigation Required	Additional Comments
								Consequences					Risk			Consequences					Risk		
							Frequency	People	Environment	Property	Business	Average Consequence			Frequency	People	Environment	Property	Business	Average Consequence			
		Offshore export cable corridor	C/D		• Installation vessel which is RAM blocking access channel		5	1	1	1	2	1.3	Tolerable		2	1	2	1	3	1.8	Broadly Acceptable		
			O		• Maintenance vessel which is RAM blocking access channel		4	1	1	1	2	1.3	Broadly Acceptable		2	1	2	1	3	1.8	Broadly Acceptable		
Recreational vessels (2.5 to 24m length)	Isolation	Array area	C/D	Lighting and Marking COLREGS and SOLAS Layout Approval MGN 654 ERCoP Promulgation of information Display on charts	• Presence of buoyed construction/ decommissioning area • Adverse weather • Construction/ decommissioning vessels which are RAM	Increased journey time/distance but does not impact on compliance with COLREGs	3	1	1	1	2	1.3	Broadly Acceptable	Increased journey time/distance which impacts on compliance with COLREGs	2	1	1	1	3	1.5	Broadly Acceptable	Post workshop consultation with RYA and Cruising Association indicated layout design sympathetic to internal navigation would alleviate	The MCA noted concern that recreational vessels would be displaced into the TSS lanes and therefore increase potential for encounters with

User	Isolation / Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Separate Sheet)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst Case Consequences	Realistic Worst Case Consequences							Further Mitigation Required	Additional Comments
								Consequences					Risk			Consequences					Risk		
							Frequency	People	Environment	Property	Business	Average Consequence			Frequency	People	Environment	Property	Business	Average Consequence			
			O	Minimum blade clearance	• Presence of surface structures • Adverse weather • Maintenance vessels which are RAM		3	1	1	1	2	1.3	Broadly Acceptable		2	1	1	1	3	1.5	Broadly Acceptable	displacement e.g., a marked channel or line of orientation aligning with typical recreational vessel transits.	commercial vessels. The potential for a marked channel for recreational vessel use was discussed.
		Offshore export cable corridor	C/D		• Installation vessel which is RAM blocking access channel		3	1	1	1	2	1.3	Broadly Acceptable		2	1	1	1	3	1.5	Broadly Acceptable		
			O		• Maintenance vessel which is RAM blocking access channel		3	1	1	1	2	1.3	Broadly Acceptable		2	1	1	1	3	1.5	Broadly Acceptable		

User	Isolation / Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Separate Sheet)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences: Frequency	Realistic Most Likely Consequences: People	Realistic Most Likely Consequences: Environment	Realistic Most Likely Consequences: Property	Realistic Most Likely Consequences: Business	Realistic Most Likely Consequences: Average Consequence	Realistic Most Likely Consequences: Risk	Worst Case Consequences	Realistic Worst Case Consequences: Frequency	Realistic Worst Case Consequences: People	Realistic Worst Case Consequences: Environment	Realistic Worst Case Consequences: Property	Realistic Worst Case Consequences: Business	Realistic Worst Case Consequences: Average Consequence	Realistic Worst Case Consequences: Risk	Further Mitigation Required	Additional Comments
	Cumulative	Array area	C/D	Lighting and Marking COLREGS and SOLAS Layout Approval MGN 654 ERCoP Promulgation of information Display on charts Minimum blade clearance	• Presence of cumulative buoyed construction/ decommissioning areas associated with North Falls and Five Estuaries • Adverse weather • Construction/ decommissioning vessels which are RAM		3	1	1	1	2	1.3	Broadly Acceptable		2	1	1	1	3	1.5	Broadly Acceptable		
			O		• Presence of cumulative surface structures associated with North Falls and Five Estuaries • Adverse weather • Maintenance vessels which are RAM		3	1	1	1	2	1.3	Broadly Acceptable		2	1	1	1	3	1.5	Broadly Acceptable		

User	Isolation / Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Separate Sheet)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst Case Consequences	Realistic Worst Case Consequences							Further Mitigation Required	Additional Comments
								Consequences					Risk			Consequences					Risk		
							Frequency	People	Environment	Property	Business	Average Consequence			Frequency	People	Environment	Property	Business	Average Consequence			
		Offshore export cable corridor	C/D		• Installation vessel which is RAM blocking access channel		3	1	1	1	2	1.3	Broadly Acceptable		2	1	1	1	3	1.5	Broadly Acceptable		
			O		• Maintenance vessel which is RAM blocking access channel		3	1	1	1	2	1.3	Broadly Acceptable		2	1	1	1	3	1.5	Broadly Acceptable		
Potential for Collision Risk																							
Commercial vessels	Isolation	Array area	C/D	Lighting and Marking COLREGS and SOLAS Layout Approval MGN 654 ERCoP Promulgation of information	• Presence of buoyed construction/ decommissioning area • Adverse weather • Construction/ decommissioning vessels which are RAM	Displacement with effects on schedule and low impact collision event occurs involving minor vessel damage	3	2	2	2	2	2.0	Broadly Acceptable	Displacement with effects on schedule and collision event occurs involving vessel damage, fatality and/or pollution	2	4	4	4	4	4.0	Tolerable		The hazard workshop included discussion of the Recommended Ferry Route. Route is used infrequently including for adverse

User	Isolation / Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Separate Sheet)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences								Worst Case Consequences	Realistic Worst Case Consequences								Further Mitigation Required	Additional Comments
								Consequences					Risk				Consequences					Risk			
							Frequency	People	Environment	Property	Business	Average Consequence				Frequency	People	Environment	Property	Business	Average Consequence				
			O	Display on charts Minimum blade clearance	• Presence of surface structures • Adverse weather • Maintenance vessels which are RAM		3	2	2	2	2	2.0	Broadly Acceptable		Displacement with effects on schedule and collision event occurs involving vessel damage, fatality and/or pollution	2	4	4	4	4	4.0	Tolerable		weather preference, consultation has indicated that the Sunk TSS South or East could be used instead noting this would involve a minor deviation. CoS stated view that all WC consequence rankings should be 5.
		Offshore export cable corridor	C/D		• Installation vessel which is RAM blocking access channel	Displacement with effects on schedule and low impact collision event occurs involving minor vessel damage	3	2	2	2	2	2.0	Broadly Acceptable		Displacement with effects on schedule, causing congestion and subsequently collision event occurs involving vessel damage,	2	4	4	4	4	4.0	Tolerable	Management procedures for cable installation including pre - works and maintenance	

User	Isolation / Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Separate Sheet)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst Case Consequences	Realistic Worst Case Consequences							Further Mitigation Required	Additional Comments
								Consequences					Risk			Consequences					Risk		
							Frequency	People	Environment	Property	Business	Average Consequence			Frequency	People	Environment	Property	Business	Average Consequence			
			O		• Maintenance vessel which is RAM blocking access channel		3	2	2	2	2	2.0	Broadly Acceptable	fatality and/or pollution	2	4	4	4	4	4.0	Tolerable		
	Cumulative	Array area	C/D	Lighting and Marking COLREGS and SOLAS Layout Approval MGN 654 ERCoP Promulgation of information Display on charts Minimum blade clearance	• Presence of cumulative buoyed construction/ decommissioning areas associated with North Falls and Five Estuaries • Adverse weather • Construction/ decommissioning vessels which are RAM	Displacement with effects on schedule and low impact collision event occurs involving minor vessel damage	3	2	2	2	2	2.0	Broadly Acceptable	Displacement with effects on schedule and collision event occurs involving vessel damage, fatality and/or pollution	2	4	4	4	4	4.0	Tolerable		General consensus was that the removal of the Northern Array has dealt with key cumulative routeing concerns. CoS stated view that all WC consequence rankings should be 5

User	Isolation / Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Separate Sheet)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst Case Consequences	Realistic Worst Case Consequences							Further Mitigation Required	Additional Comments
							Frequency	Consequences: People	Environment	Property	Business	Average Consequence	Risk		Frequency	Consequences: People	Environment	Property	Business	Average Consequence	Risk		
			O		• Presence of cumulative surface structures associated with North Falls and Five Estuaries • Adverse weather • Maintenance vessels which are RAM		3	2	2	2	2	2.0	Broadly Acceptable	Displacement with effects on schedule and collision event occurs involving vessel damage, fatality and/or pollution	2	4	4	5	4	4.3	Tolerable		
		Offshore export cable corridor	C/D		• Installation vessel which is RAM blocking access channel	Displacement with effects on schedule and low impact collision event occurs involving minor vessel damage	4	2	2	2	2	2.0	Tolerable	Displacement with effects on schedule, causing congestion and subsequently collision event occurs involving vessel damage, fatality and/or pollution	3	4	4	3	4	3.8	Tolerable	Management procedures for cable installation including pre - works and maintenance	
			O		• Maintenance vessel which is RAM blocking access channel		3	2	2	2	2	2.0	Broadly Acceptable		2	4	4	3	4	3.8	Broadly Acceptable		

User	Isolation / Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Separate Sheet)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst Case Consequences	Realistic Worst Case Consequences							Further Mitigation Required	Additional Comments
								Consequences					Risk			Consequences					Risk		
							Frequency	People	Environment	Property	Business	Average Consequence			Frequency	People	Environment	Property	Business	Average Consequence			
Commercial fishing vessels in transit	Isolation	Array area	C/D	Lighting and Marking COLREGS and SOLAS Layout Approval MGN 654 ERCoP Promulgation of information Display on charts Minimum blade clearance	• Presence of buoyed construction/ decommissioning area • Adverse weather • Construction/ decommissioning vessels which are RAM	Displacement with effects on schedule and low impact collision event occurs involving minor vessel damage	3	2	2	2	2	2.0	Broadly Acceptable	Displacement with effects on routine and collision event occurs involving vessel damage, injury to person and/or pollution	1	4	2	3	3	3.0	Broadly Acceptable		
			O		• Presence of surface structures • Adverse weather • Maintenance vessels which are RAM		3	2	2	2	2	2.0	Broadly Acceptable	Displacement with effects on routine and collision event occurs involving vessel damage, injury to person and/or pollution	1	4	2	3	3	3.0	Broadly Acceptable		

User	Isolation / Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Separate Sheet)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst Case Consequences	Realistic Worst Case Consequences							Further Mitigation Required	Additional Comments
								Consequences					Risk			Consequences					Risk		
							Frequency	People	Environment	Property	Business	Average Consequence			Frequency	People	Environment	Property	Business	Average Consequence			
		Offshore export cable corridor	C/D		• Installation vessel which is RAM blocking access channel	Displacement with effects on schedule and low impact collision event occurs involving minor vessel damage	3	2	2	2	2	2.0	Broadly Acceptable	Displacement with effects on routine, causing congestion and subsequently collision event occurs involving vessel damage, injury to person and/or pollution	1	4	2	3	3	3.0	Broadly Acceptable		
			O		• Maintenance vessel which is RAM blocking access channel		3	2	2	2	2	2.0	Broadly Acceptable		1	4	2	3	3	3.0	Broadly Acceptable		

User	Isolation / Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Separate Sheet)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst Case Consequences	Realistic Worst Case Consequences							Further Mitigation Required	Additional Comments
								Consequences					Risk			Consequences					Risk		
							Frequency	People	Environment	Property	Business	Average Consequence			Frequency	People	Environment	Property	Business	Average Consequence			
	Cumulative	Array area	C/D	Lighting and Marking COLREGS and SOLAS Layout Approval MGN 654 ERCoP Promulgation of information Display on charts Minimum blade clearance	• Presence of cumulative buoyed construction/ decommissioning areas associated with North Falls and Five Estuaries • Adverse weather • Construction/ decommissioning vessels which are RAM	Displacement with effects on schedule and low impact collision event occurs involving minor vessel damage	3	2	2	2	2	2.0	Broadly Acceptable	Displacement with effects on routine and collision event occurs involving vessel damage, injury to person and/or pollution	2	4	2	3	3	3.0	Broadly Acceptable		
			O		• Presence of cumulative surface structures associated with North Falls and Five Estuaries • Adverse weather • Maintenance vessels which are RAM		3	2	2	2	2	2.0	Broadly Acceptable	Displacement with effects on routine and collision event occurs involving vessel damage, injury to person and/or pollution	1	4	2	3	3	3.0	Broadly Acceptable		

User	Isolation / Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Separate Sheet)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst Case Consequences	Realistic Worst Case Consequences							Further Mitigation Required	Additional Comments
								Consequences					Risk			Consequences					Risk		
							Frequency	People	Environment	Property	Business	Average Consequence			Frequency	People	Environment	Property	Business	Average Consequence			
		Offshore export cable corridor	C/D		• Installation vessel which is RAM blocking access channel	Displacement with effects on schedule and low impact collision event occurs involving minor vessel damage	4	2	2	2	2	2.0	Tolerable	Displacement with effects on routine, causing congestion and subsequently collision event occurs involving vessel damage, injury to person and/or pollution	3	4	2	3	3	3.0	Tolerable		
			O		• Maintenance vessel which is RAM blocking access channel		2	2	2	2	2	2.0	Broadly Acceptable		1	4	2	3	3	3.0	Broadly Acceptable		
Recreational vessels (2.5 to 24m length)	Isolation	Array area	C/D	Lighting and Marking COLREGS and SOLAS Layout Approval MGN 654 ERCoP Promulgation of information Display on charts Minimum	• Presence of buoyed construction/ decommissioning area • Adverse weather • Construction/ decommissioning vessels which are RAM	Displacement with effects on schedule and low impact collision event occurs involving minor vessel damage	3	2	2	2	2	2.0	Broadly Acceptable	Displacement with effects on schedule and collision event occurs involving vessel damage, fatality and/or pollution	1	4	1	2	2	2.3	Broadly Acceptable	Post workshop consultation with RYA and Cruising Association indicated layout design sympathetic to internal navigation would alleviate displacement	The MCA noted concern that recreational vessels would be displaced into the TSS lanes and therefore increase potential for encounters with commercial

User	Isolation / Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Separate Sheet)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst Case Consequences	Realistic Worst Case Consequences							Further Mitigation Required	Additional Comments
								Consequences					Risk			Consequences					Risk		
							Frequency	People	Environment	Property	Business	Average Consequence			Frequency	People	Environment	Property	Business	Average Consequence			
			O	blade clearance	• Presence of surface structures • Adverse weather • Maintenance vessels which are RAM		3	2	2	2	2	2.0	Broadly Acceptable	Displacement with effects on schedule and collision event occurs involving vessel damage, fatality and/or pollution	1	4	1	2	2	2.3	Broadly Acceptable	e.g., a marked channel or line of orientation aligning with typical recreational vessel transits.	vessels. The potential for a marked channel for recreational vessel use was discussed.
		Offshore export cable corridor	C/D		• Installation vessel which is RAM blocking access channel	Displacement with effects on schedule and low impact collision event occurs involving minor vessel damage	3	2	2	2	2	2.0	Broadly Acceptable	Displacement with effects on routine, causing congestion and subsequently collision event occurs involving vessel damage, injury to person and/or pollution	1	4	1	2	2	2.3	Broadly Acceptable		
			O		• Maintenance vessel which is RAM blocking access channel		3	2	2	2	2	2.0	Broadly Acceptable		1	4	1	2	2	2.3	Broadly Acceptable		

User	Isolation / Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Separate Sheet)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences								Worst Case Consequences	Realistic Worst Case Consequences								Further Mitigation Required	Additional Comments
								Consequences					Risk				Consequences					Risk			
							Frequency	People	Environment	Property	Business	Average Consequence				Frequency	People	Environment	Property	Business	Average Consequence				
	Cumulative	Array area	C/D	Lighting and Marking COLREGS and SOLAS Layout Approval MGN 654 ERCoP Promulgation of information Display on charts Minimum blade clearance	• Presence of cumulative buoyed construction/ decommissioning areas associated with North Falls and Five Estuaries • Adverse weather • Construction/ decommissioning vessels which are RAM	Displacement with effects on schedule and low impact collision event occurs involving minor vessel damage	3	2	2	2	2	2.0	Broadly Acceptable	Displacement with effects on schedule and collision event occurs involving vessel damage, fatality and/or pollution	2	4	1	2	2	2.3	Broadly Acceptable				
			O		• Presence of cumulative surface structures associated with North Falls and Five Estuaries • Adverse weather • Maintenance vessels which are RAM		3	2	2	2	2	2.0	Broadly Acceptable	Displacement with effects on schedule and collision event occurs involving vessel damage, fatality and/or pollution	1	4	1	2	2	2.3	Broadly Acceptable				

User	Isolation / Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Separate Sheet)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst Case Consequences	Realistic Worst Case Consequences							Further Mitigation Required	Additional Comments
								Consequences					Risk			Consequences					Risk		
							Frequency	People	Environment	Property	Business	Average Consequence			Frequency	People	Environment	Property	Business	Average Consequence			
		Offshore export cable corridor	C/D		• Installation vessel which is RAM blocking access channel	Displacement with effects on schedule and low impact collision event occurs involving minor vessel damage	3	2	2	2	2	2.0	Broadly Acceptable	Displacement with effects on routine, causing congestion and subsequently collision event occurs involving vessel damage, injury to person and/or pollution	2	4	1	2	2	2.3	Broadly Acceptable		
			O		• Maintenance vessel which is RAM blocking access channel		3	2	2	2	2	2.0	Broadly Acceptable		2	4	1	2	2	2.3	Broadly Acceptable		
Collision Risk (Third-Party with Project Vessel in Transit)																							
Commercial vessels	Isolation	Array Area	C/D	Lighting and Marking Safety Zones COLREGS and SOLAS ERCoP Promulgation of information Guard Vessels where appropriate	• Project vessels in transit • Lack of third-party awareness	Low impact collision event occurs involving vessel damage, injury to person and/or pollution	3	2	2	2	2	2.0	Broadly Acceptable	Collision event occurs involving vessel damage, injury to person and/or pollution	2	4	4	4	4	4.0	Tolerable	Entry/exit points for project vessels	

User	Isolation / Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Separate Sheet)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst Case Consequences	Realistic Worst Case Consequences							Further Mitigation Required	Additional Comments
								Consequences					Risk			Consequences					Risk		
							Frequency	People	Environment	Property	Business	Average Consequence			Frequency	People	Environment	Property	Business	Average Consequence			
			O	Display on charts Buoyed construction area Marine coordination			2	2	2	2	2	2.0	Broadly Acceptable		1	4	4	4	4	4.0	Tolerable		
		Offshore export cable corridor	C/D		• Project vessels in transit • Lack of third-party awareness	Low impact collision event occurs involving vessel damage, injury to person and/or pollution	3	2	2	2	2	2.0	Broadly Acceptable	Collision event occurs involving vessel damage, injury to person and/or pollution	2	4	4	4	4	4.0	Tolerable	Management procedures for cable installation including pre - works and maintenance	
			O				2	2	2	2	2	2.0	Broadly Acceptable		1	4	4	4	4	4.0	Tolerable		

User	Isolation / Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Separate Sheet)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst Case Consequences	Realistic Worst Case Consequences							Further Mitigation Required	Additional Comments
								Consequences					Risk			Consequences					Risk		
							Frequency	People	Environment	Property	Business	Average Consequence			Frequency	People	Environment	Property	Business	Average Consequence			
	Cumulative	Array Area	C/D		• Project vessels in transit associated with North Falls and other cumulative developments • Lack of third-party awareness	Low impact collision event occurs involving vessel damage, injury to person and/or pollution	3	2	2	2	2	2.0	Broadly Acceptable	Collision event occurs involving vessel damage, injury to person and/or pollution	3	4	4	4	4	4.0	Tolerable	Entry/exit points for project vessels	
			O				2	2	2	2	2	2.0	Broadly Acceptable		2	4	4	4	4	4.0	Tolerable		

User	Isolation / Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Separate Sheet)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences: Frequency	Consequences: People	Consequences: Environment	Consequences: Property	Consequences: Business	Consequences: Average Consequence	Risk	Worst Case Consequences	Realistic Worst Case Consequences: Frequency	Consequences: People	Consequences: Environment	Consequences: Property	Consequences: Business	Consequences: Average Consequence	Risk	Further Mitigation Required	Additional Comments
		Offshore export cable corridor	C/D		• Project vessels in transit associated with North Falls and other cumulative developments • Lack of third-party awareness	Low impact collision event occurs involving vessel damage, injury to person and/or pollution	3	2	2	2	2	2.0	Broadly Acceptable	Collision event occurs involving vessel damage, injury to person and/or pollution	3	4	4	4	4	4.0	Tolerable	Management procedures for cable installation including pre - works and maintenance	
			O				2	2	2	2	2	2.0	Broadly Acceptable		2	4	4	4	4	4.0	Tolerable		

User	Isolation / Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Separate Sheet)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst Case Consequences	Realistic Worst Case Consequences							Further Mitigation Required	Additional Comments
								Consequences					Risk			Consequences					Risk		
							Frequency	People	Environment	Property	Business	Average Consequence			Frequency	People	Environment	Property	Business	Average Consequence			
Commercial fishing vessels in transit	Isolation	Array Area	C/D	Lighting and Marking Safety Zones COLREGS and SOLAS ERCoP Promulgation of information Guard Vessels where appropriate Display on charts Buoyed construction area Marine coordination	• Project vessels in transit • Lack of third-party awareness	Low impact collision event occurs involving vessel damage, injury to person and/or pollution	3	2	2	2	2	2.0	Broadly Acceptable	Collision event occurs involving vessel damage, injury to person and/or pollution	1	4	2	3	2	2.8	Broadly Acceptable	Entry/exit points for project vessels	
			O				2	2	2	2	2	2.0	Broadly Acceptable		1	4	2	3	2	2.8	Broadly Acceptable		
		Offshore export cable corridor	C/D		• Project vessels in transit • Lack of third-party awareness	Low impact collision event occurs involving vessel damage,	3	2	2	2	2	2.0	Broadly Acceptable	Collision event occurs involving vessel damage, injury to person and/or pollution	1	4	2	3	2	2.8	Broadly Acceptable		

User	Isolation / Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Separate Sheet)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences: Frequency	Consequences: People	Consequences: Environment	Consequences: Property	Consequences: Business	Consequences: Average Consequence	Risk	Worst Case Consequences	Realistic Worst Case Consequences: Frequency	Consequences: People	Consequences: Environment	Consequences: Property	Consequences: Business	Consequences: Average Consequence	Risk	Further Mitigation Required	Additional Comments
			O			injury to person and/or pollution	2	2	2	2	2	2.0	Broadly Acceptable		1	4	2	3	2	2.8	Broadly Acceptable		
	Cumulative	Array Area	C/D		• Project vessels in transit associated with North Falls and other cumulative developments • Lack of third-party awareness	Low impact collision event occurs involving vessel damage, injury to person and/or pollution	3	2	2	2	2	2.0	Broadly Acceptable	Collision event occurs involving vessel damage, injury to person and/or pollution	2	4	2	3	2	2.8	Broadly Acceptable	Management procedures for cable installation including pre - works and maintenance	
			O				2	2	2	2	2	2.0	Broadly Acceptable		1	4	2	3	2	2.8	Broadly Acceptable		
		Offshore export cable corridor	C/D		• Project vessels in transit associated with North Falls and other cumulative developments • Lack of third-party awareness	Low impact collision event occurs involving vessel damage, injury to person and/or pollution	3	2	2	2	2	2.0	Broadly Acceptable	Collision event occurs involving vessel damage, injury to person and/or pollution	3	4	2	3	2	2.8	Broadly Acceptable		

User	Isolation / Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Separate Sheet)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst Case Consequences	Realistic Worst Case Consequences							Further Mitigation Required	Additional Comments
								Consequences					Risk			Consequences					Risk		
							Frequency	People	Environment	Property	Business	Average Consequence			Frequency	People	Environment	Property	Business	Average Consequence			
			O				2	1	1	1	1	1.0	Broadly Acceptable		1	4	2	3	2	2.8	Broadly Acceptable		
Recreational vessels (2.5 to 24m length)	Isolation	Array area	C/D	Lighting and Marking Safety Zones COLREGS and SOLAS ERCoP Promulgation of information Guard Vessels where appropriate Display on charts Buoyed construction area Marine coordination	• Project vessels in transit • Lack of third-party awareness	Low impact collision event occurs involving vessel damage, injury to person and/or pollution	3	1	1	1	1	1.0	Broadly Acceptable	Collision event occurs involving vessel damage, injury to person and/or pollution	1	4	1	2	2	2.3	Broadly Acceptable	Entry/exit points for project vessels	
			O				2	1	1	1	1	1.0	Broadly Acceptable		1	4	1	2	2	2.3	Broadly Acceptable		
		Offshore export cable corridor	C/D		• Project vessels in transit • Lack of third-party awareness	Low impact collision event occurs involving vessel damage, injury to person and/or pollution	3	1	1	1	1	1.0	Broadly Acceptable	Collision event occurs involving vessel damage, injury to person and/or pollution	1	4	1	2	2	2.3	Broadly Acceptable		

User	Isolation / Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Separate Sheet)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences: Frequency	Consequences: People	Consequences: Environment	Consequences: Property	Consequences: Business	Consequences: Average Consequence	Risk	Worst Case Consequences	Realistic Worst Case Consequences: Frequency	Consequences: People	Consequences: Environment	Consequences: Property	Consequences: Business	Consequences: Average Consequence	Risk	Further Mitigation Required	Additional Comments
			O				2	1	1	1	1	1.0	Broadly Acceptable		1	4	1	2	2	2.3	Broadly Acceptable		
	Cumulative	Array area	C/D		• Project vessels in transit associated with North Falls and other cumulative developments • Lack of third-party awareness	Low impact collision event occurs involving vessel damage, injury to person and/or pollution	3	1	1	1	1	1.0	Broadly Acceptable	Collision event occurs involving vessel damage, injury to person and/or pollution	2	4	1	2	2	2.3	Broadly Acceptable	Management procedures for cable installation including pre - works and maintenance	
			O				2	1	1	1	1	1.0	Broadly Acceptable		1	4	1	2	2	2.3	Broadly Acceptable		

User	Isolation / Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Separate Sheet)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst Case Consequences	Realistic Worst Case Consequences							Further Mitigation Required	Additional Comments
							Frequency	Consequences					Risk		Frequency	Consequences					Risk		
								People	Environment	Property	Business	Average Consequence				People	Environment	Property	Business	Average Consequence			
		Offshore export cable corridor	C/D		• Project vessels in transit associated with North Falls and other cumulative developments • Lack of third-party awareness	Low impact collision event occurs involving vessel damage, injury to person and/or pollution	3	1	1	1	1	1.0	Broadly Acceptable	Collision event occurs involving vessel damage, injury to person and/or pollution	2	4	1	2	2	2.3	Broadly Acceptable		
			O				2	1	1	1	1	1.0	Broadly Acceptable		1	4	1	2	2	2.3	Broadly Acceptable		
Restrictions in Port Access from Surface Works																							

User	Isolation / Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Separate Sheet)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst Case Consequences	Realistic Worst Case Consequences							Further Mitigation Required	Additional Comments
								Consequences					Risk			Consequences					Risk		
							Frequency	People	Environment	Property	Business	Average Consequence			Frequency	People	Environment	Property	Business	Average Consequence			
Commercial vessels	Isolation	Array area	C/D	COLREGS and SOLAS Layout Approval Promulgation of information Display on charts Cable Burial Risk Assessment	• Presence of buoyed construction/ decommissioning area • Adverse weather • Construction/ decommissioning vessels which are RAM	Displacement with limited effects on port schedule	3	1	1	1	1	1.0	Broadly Acceptable	Displacement with effects on port schedule	3	1	1	1	4	1.8	Broadly Acceptable		
			O		• Presence of surface structures • Adverse weather • Maintenance vessels which are RAM		2	1	1	1	1	1.0	Broadly Acceptable		2	1	1	1	4	1.8	Broadly Acceptable		

User	Isolation / Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Separate Sheet)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst Case Consequences	Realistic Worst Case Consequences							Further Mitigation Required	Additional Comments
								Consequences					Risk			Consequences					Risk		
							Frequency	People	Environment	Property	Business	Average Consequence			Frequency	People	Environment	Property	Business	Average Consequence			
		Offshore export cable corridor	C/D		• Installation vessel which is RAM blocking access channel or in proximity to Sunk pilotage	Displacement with limited effects on port schedule	5	1	1	1	1	1.0	Tolerable	Displacement with effects on port schedule causing congestion and potential for subsequent safety risks	4	2	4	4	5	3.8	Tolerable	Management procedures for cable installation including pre - works and maintenance	CoS stated view that WC property ranking should be a 5.
			O		• Maintenance vessel which is RAM blocking access channel or in proximity to Sunk pilotage		4	1	1	1	1	1.0	Broadly Acceptable		3	2	4	4	5	3.8	Tolerable		

User	Isolation / Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Separate Sheet)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst Case Consequences	Realistic Worst Case Consequences							Further Mitigation Required	Additional Comments
								Consequences					Risk			Consequences					Risk		
							Frequency	People	Environment	Property	Business	Average Consequence			Frequency	People	Environment	Property	Business	Average Consequence			
	Cumulative	Array area	C/D	COLREGS and SOLAS Layout Approval Promulgation of information Display on charts Cable Burial Risk Assessment	• Presence of buoyed construction/ decommissioning areas associated with North Falls and Five Estuaries • Adverse weather • Construction/ decommissioning vessels which are RAM	Displacement with limited effects on port schedule	5	1	1	1	2	1.3	Tolerable	Displacement with effects on port schedule	3	1	1	1	5	2.0	Broadly Acceptable		
			O		• Presence of surface structures associated with North Falls and Five Estuaries • Adverse weather • Maintenance vessels which are RAM		3	1	1	1	2	1.3	Broadly Acceptable		2	1	1	1	5	2.0	Broadly Acceptable		

User	Isolation / Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Separate Sheet)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst Case Consequences	Realistic Worst Case Consequences							Further Mitigation Required	Additional Comments
								Consequences					Risk			Consequences					Risk		
							Frequency	People	Environment	Property	Business	Average Consequence			Frequency	People	Environment	Property	Business	Average Consequence			
		Offshore export cable corridor	C/D		• Installation vessel which is RAM blocking access channel or in proximity to Sunk pilotage	Displacement with limited effects on port schedule	5	1	1	1	5	2.0	Tolerable	Displacement with effects on port schedule causing congestion and potential for subsequent safety risks	4	2	4	4	5	3.8	Tolerable	Management procedures for cable installation including pre - works and maintenance	CoS stated view that WC property ranking should be a 5.
			O		• Maintenance vessel which is RAM blocking access channel or in proximity to Sunk pilotage		4	1	1	1	3	1.5	Broadly Acceptable		3	2	4	4	5	3.8	Tolerable		

User	Isolation / Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Separate Sheet)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences: Frequency	Consequences: People	Consequences: Environment	Consequences: Property	Consequences: Business	Consequences: Average Consequence	Risk	Worst Case Consequences	Realistic Worst Case Consequences: Frequency	Consequences: People	Consequences: Environment	Consequences: Property	Consequences: Business	Consequences: Average Consequence	Risk	Further Mitigation Required	Additional Comments
Commercial fishing vessels in transit	Isolation	Array area	C/D	COLREGS and SOLAS Layout Approval Promulgation of information Display on charts Cable Burial Risk Assessment	• Presence of buoyed construction/ decommissioning area • Adverse weather • Construction/ decommissioning vessels which are RAM	Displacement with limited effects on port schedule	3	1	1	1	1	1.0	Broadly Acceptable	Displacement with effects on port schedule	1	2	2	3	2	2.3	Broadly Acceptable		
			O		• Presence of surface structures • Adverse weather • Maintenance vessels which are RAM		2	1	1	1	1	1.0	Broadly Acceptable		1	2	2	3	2	2.3	Broadly Acceptable		
		Offshore export cable corridor	C/D		• Installation vessel which is RAM blocking access channel	Displacement with limited effects on port schedule	3	1	1	1	1	1.0	Broadly Acceptable	Displacement with effects on port schedule causing congestion and potential for subsequent safety risks	1	2	2	3	2	2.3	Broadly Acceptable		

User	Isolation / Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Separate Sheet)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst Case Consequences	Realistic Worst Case Consequences							Further Mitigation Required	Additional Comments
								Consequences					Risk			Consequences					Risk		
							Frequency	People	Environment	Property	Business	Average Consequence			Frequency	People	Environment	Property	Business	Average Consequence			
			O		• Maintenance vessel which is RAM blocking access channel		2	1	1	1	1	1.0	Broadly Acceptable		1	2	2	3	2	2.3	Broadly Acceptable		
	Cumulative	Array area	C/D	COLREGS and SOLAS Layout Approval Promulgation of information Display on charts Cable Burial Risk Assessment	• Presence of buoyed construction/ decommissioning areas associated with North Falls and Five Estuaries • Adverse weather • Construction/ decommissioning vessels which are RAM	Displacement with limited effects on port schedule	3	1	1	1	1	1.0	Broadly Acceptable	Displacement with effects on port schedule	2	2	2	3	2	2.3	Broadly Acceptable		

User	Isolation / Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Separate Sheet)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst Case Consequences	Realistic Worst Case Consequences							Further Mitigation Required	Additional Comments
								Consequences					Risk			Consequences					Risk		
							Frequency	People	Environment	Property	Business	Average Consequence			Frequency	People	Environment	Property	Business	Average Consequence			
			O		• Presence of surface structures associated with North Falls and Five Estuaries • Adverse weather • Maintenance vessels which are RAM		2	1	1	1	1	1.0	Broadly Acceptable		1	2	2	3	2	2.3	Broadly Acceptable		
		Offshore export cable corridor	C/D		• Installation vessel which is RAM blocking access channel	Displacement with limited effects on port schedule	4	1	1	1	1	1.0	Broadly Acceptable	Displacement with effects on port schedule causing congestion and potential for subsequent safety risks	3	2	2	3	2	2.3	Broadly Acceptable		
			O		• Maintenance vessel which is RAM blocking access channel		3	1	1	1	1	1.0	Broadly Acceptable		1	2	2	3	2	2.3	Broadly Acceptable		
Allision Risk (Powered, Drifting or Internal)																							

User	Isolation / Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Separate Sheet)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst Case Consequences	Realistic Worst Case Consequences							Further Mitigation Required	Additional Comments
								Consequences					Risk			Consequences					Risk		
							Frequency	People	Environment	Property	Business	Average Consequence			Frequency	People	Environment	Property	Business	Average Consequence			
Commercial vessels	Isolation	Array area	O	Lighting and Marking Layout Approval MGN 654 ERCoP Promulgation of information Guard Vessels where appropriate Display on charts	• Presence of surface structures • Human/navigation error • Mechanical/technical failure • Adverse weather • Aid to navigation failure	Vessel passes at an unsafe distance resulting in a need to make a late adjustment to course/speed	4	1	1	1	2	1.3	Broadly Acceptable	Allision event occurs involving vessel damage, injury to person and/or pollution	2	4	4	4	4	4.0	Tolerable	Layout agreement with the MCA 1nm buffer from routeing to measures to surface piercing infrastructure.	MCA and CoS position is that there should be a minimum 1nm separation between IMO routeing measures and all surface piercing infrastructure CoS noted there have been several machinery failure incidents in the vicinity of Greater Gabbard and suggested discussions on lessons learned should be held. CoS noted consequences of an allision with a peripheral substation would likely be
	Cumulative				• Presence of surface structures associated with North Falls and Five Estuaries • Human/navigation error • Mechanical/technical failure • Adverse weather • Aid to navigation failure		4	1	1	1	2	1.3	Broadly Acceptable		3	4	4	4	4	4.0	Tolerable		

User	Isolation / Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Separate Sheet)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst Case Consequences	Realistic Worst Case Consequences							Further Mitigation Required	Additional Comments
								Consequences					Risk			Consequences					Risk		
							Frequency	People	Environment	Property	Business	Average Consequence			Frequency	People	Environment	Property	Business	Average Consequence			
																							greater than for a WTG
Commercial fishing vessels in transit	Isolation	Array area	O	Lighting and Marking Layout Approval MGN 654 ERCoP Promulgation of information Guard Vessels where	• Presence of surface structures • Human/navigation error • Mechanical/technical failure • Adverse weather • Aid to navigation failure	Vessel passes at an unsafe distance resulting in a need to make a late adjustment to course/speed	4	1	1	1	1	1.0	Broadly Acceptable	Allision event occurs involving vessel damage, injury to person and/or pollution	2	4	3	3	3	3.3	Broadly Acceptable	Layout agreement with the MCA 1nm buffer from routeing to measures to surface piercing infrastructure.	MCA and CoS position is that there should be a minimum 1nm separation between IMO routeing measures and all surface piercing infrastructure

User	Isolation / Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Separate Sheet)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences – Frequency	Realistic Most Likely Consequences – Consequences – People	Realistic Most Likely Consequences – Consequences – Environment	Realistic Most Likely Consequences – Consequences – Property	Realistic Most Likely Consequences – Consequences – Business	Realistic Most Likely Consequences – Consequences – Average Consequence	Realistic Most Likely Consequences – Risk	Worst Case Consequences	Realistic Worst Case Consequences – Frequency	Realistic Worst Case Consequences – Consequences – People	Realistic Worst Case Consequences – Consequences – Environment	Realistic Worst Case Consequences – Consequences – Property	Realistic Worst Case Consequences – Consequences – Business	Realistic Worst Case Consequences – Consequences – Average Consequence	Realistic Worst Case Consequences – Risk	Further Mitigation Required	Additional Comments
	Cumulative			appropriate Display on charts	• Presence of surface structures associated with North Falls and Five Estuaries • Human/navigation error • Mechanical/technical failure • Adverse weather • Aid to navigation failure		4	1	1	1	1	1.0	Broadly Acceptable		3	4	3	3	3	3.3	Tolerable		
Recreational vessels (2.5 to 24m length)	Isolation	Array area	O	Lighting and Marking Minimum blade clearance Layout Approval MGN 654 ERCoP Promulgation of information Guard	• Presence of surface structures • Human/navigation error • Mechanical/technical failure • Adverse weather • Aid to navigation failure	Vessel passes at an unsafe distance resulting in a need to make a late adjustment to course/speed	4	1	1	1	1	1.0	Broadly Acceptable	Allision event occurs involving vessel damage, injury to person and/or pollution	2	4	2	3	3	3.0	Broadly Acceptable	Layout agreement with the MCA 1nm buffer from routeing to measures to surface piercing infrastructure.	MCA and CoS position is that there should be a minimum 1nm separation between IMO routeing measures and all surface piercing infrastructure

User	Isolation / Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Separate Sheet)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst Case Consequences	Realistic Worst Case Consequences							Further Mitigation Required	Additional Comments
								Consequences					Risk			Consequences					Risk		
							Frequency	People	Environment	Property	Business	Average Consequence			Frequency	People	Environment	Property	Business	Average Consequence			
	Cumulative			Vessels where appropriate Display on charts	• Presence of surface structures associated with North Falls and Five Estuaries • Human/navigation error • Mechanical/technical failure • Adverse weather • Aid to navigation failure		4	1	1	1	1	1.0	Broadly Acceptable		3	4	2	3	3	3.0	Tolerable		
Anchor Interaction with Subsea Cables																							
Commercial vessels	Isolation	Array area (inter array cables)	O	MGN 654 Promulgation of information Guard Vessels where appropriate Display on charts Cable Burial Risk	• Presence of subsea cables • Human/navigation error • Mechanical/technical failure • Adverse weather	Vessel anchors on or drags anchor over a cable/protection but no interaction occurs	2	1	1	1	2	1.3	Broadly Acceptable	Vessel anchors on or drags anchor over a cable/protection resulting in damage to the cable/protection and/or anchor	1	1	1	2	2	1.5	Broadly Acceptable		CoS noted importance of monitoring cable burial depths during operational phase.
		Offshore export cable corridor					3	1	1	1	2	1.3	Broadly Acceptable		1	1	1	2	3	1.8	Broadly Acceptable		

User	Isolation / Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Separate Sheet)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst Case Consequences	Realistic Worst Case Consequences							Further Mitigation Required	Additional Comments
								Consequences					Risk			Consequences					Risk		
							Frequency	People	Environment	Property	Business	Average Consequence			Frequency	People	Environment	Property	Business	Average Consequence			
	Cumulative	Array area (inter array cables)	O	Assessment Buoyed construction area	• Presence of subsea cables associated with North Falls and other cumulative developments • Human/navigation error • Mechanical/technical failure • Adverse weather	Vessel is unable to anchor due to the presence of cables or drags/drops anchor over cables bit no interaction occurs	4	1	1	1	2	1.3	Broadly Acceptable	Vessel is unable to anchor due to presence of cables resulting in allision (due to vessel malfunction leading to drift)	2	4	4	3	4	3.8	Broadly Acceptable		
		Offshore export cable corridor					5	1	1	1	3	1.5	Tolerable		3	4	4	3	4	3.8	Tolerable		
Commercial fishing vessels in transit	Isolation	Array area (inter array cables)	O	MGN 654 Promulgation of information Guard Vessels where appropriate Display on charts Cable Burial Risk Assessment	• Presence of subsea cables • Human/navigation error • Mechanical/technical failure • Adverse weather	Vessel anchors on or drags anchor over a cable/protection but no interaction occurs	3	1	1	1	1	1.0	Broadly Acceptable	Vessel anchors on or drags anchor over a cable/protection resulting in damage to the cable/protection and/or anchor	2	4	2	3	2	2.8	Broadly Acceptable		
		Offshore export cable corridor					4	1	1	1	2	1.3	Broadly Acceptable		3	4	2	3	3	3.0	Tolerable		

User	Isolation / Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Separate Sheet)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst Case Consequences	Realistic Worst Case Consequences							Further Mitigation Required	Additional Comments
							Frequency	Consequences: People	Environment	Property	Business	Average Consequence	Risk		Frequency	Consequences: People	Environment	Property	Business	Average Consequence	Risk		
	Cumulative	Array area (inter array cables)	O	Buoyed construction area	• Presence of subsea cables associated with North Falls and other cumulative developments • Human/navigation error • Mechanical/technical failure • Adverse weather	Vessel is unable to anchor due to the presence of cables but no safety risks	3	1	1	1	2	1.3	Broadly Acceptable	Vessel is unable to anchor due to presence of cables resulting in allision (due to vessel malfunction leading to drift)	2	4	2	3	2	2.8	Broadly Acceptable		
		Offshore export cable corridor					4	1	1	1	3	1.5	Broadly Acceptable		3	4	2	3	3	3.0	Tolerable		
Interference with Marine Navigation, Communication and Position Fixing Equipment																							
All vessels	Isolation	Array area	O	Lighting and Marking Layout Approval MGN 654 Promulgation of information Display on charts Cable Burial Risk Assessment	• Human error relating to adjustment of Radar controls • Presence of surface structures	Structures have no material effect upon the Radar, communications and navigation equipment on a vessel	4	1	1	1	1	1.0	Broadly Acceptable	Minor level of Radar interference due to the structures	3	1	1	1	1	1.0	Broadly Acceptable		
		Offshore export cable corridor	O		• EMF from cables	Cables have no material effect upon the Radar,	4	1	1	1	1	1.0	Broadly Acceptable	Minor level of EMF interference due	3	1	1	1	1	1.0	Broadly Acceptable		

User	Isolation / Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Separate Sheet)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst Case Consequences	Realistic Worst Case Consequences							Further Mitigation Required	Additional Comments
								Consequences					Risk			Consequences					Risk		
							Frequency	People	Environment	Property	Business	Average Consequence			Frequency	People	Environment	Property	Business	Average Consequence			
						communications and navigation equipment on a vessel								to the wind farm infrastructure									
Reduction in Under Keel Clearance																							
All vessels	Isolation	Array area	O	MGN 654 Promulgation of information Display on charts Cable Burial Risk Assessment	• Reduced depth due to cable protection	Vessels required to regularly transit over an area of reduced under keel clearance from previous levels	3	1	1	1	2	1.3	Broadly Acceptable	Grounding on cable protection resulting in vessel damage, pollution and/or prevention of future access to port for deeper draught vessels	2	3	3	4	4	3.5	Broadly Acceptable		Assumes adequate burial depth of cables to allow for future DW route dredging. CoS stated that "Unless sufficient cable burial depth the long term viability of Felixstowe or Gateway could be seriously impacted to point of loss of container trade. Needs
		Offshore export cable corridor					4	1	1	1	3	1.5	Broadly Acceptable		3	3	3	4	4	3.5	Tolerable		

User	Isolation / Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Separate Sheet)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences: Frequency	Realistic Most Likely Consequences: People	Realistic Most Likely Consequences: Environment	Realistic Most Likely Consequences: Property	Realistic Most Likely Consequences: Business	Realistic Most Likely Consequences: Average Consequence	Realistic Most Likely Consequences: Risk	Worst Case Consequences	Realistic Worst Case Consequences: Frequency	Realistic Worst Case Consequences: People	Realistic Worst Case Consequences: Environment	Realistic Worst Case Consequences: Property	Realistic Worst Case Consequences: Business	Realistic Worst Case Consequences: Average Consequence	Realistic Worst Case Consequences: Risk	Further Mitigation Required	Additional Comments
																							careful consideration"
	Cumulative	Array area			• Reduced depth due to cable protection	Vessels required to regularly transit over an area of reduced under keel clearance from previous levels	4	1	1	1	2	1.3	Broadly Acceptable	Grounding on cable protection resulting in vessel damage, pollution and/or prevention of future access to port for deeper draught vessels	2	3	3	4	5	3.8	Broadly Acceptable		Assumes adequate burial depth of cables to allow for future DW route dredging. CoS stated that "Unless sufficient cable burial depth the long term viability of Felixstowe or Gateway could be seriously impacted to point of loss of container trade. Needs careful consideration"
		Offshore export cable corridor					5	1	1	1	3	1.5	Tolerable		3	3	3	4	5	3.8	Tolerable		

User	Isolation / Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Separate Sheet)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst Case Consequences	Realistic Worst Case Consequences							Further Mitigation Required	Additional Comments
								Consequences					Risk			Consequences					Risk		
							Frequency	People	Environment	Property	Business	Average Consequence			Frequency	People	Environment	Property	Business	Average Consequence			
Prevention of Use of Existing Aids to Navigation																							
All vessels	Isolation	Array area	C/D	Lighting and Marking Layout Approval Promulgation of information Display on charts Buoyed construction area	• Visual presence of surface structures • Lighting and marking confusion	Short-term inability to effectively use an aid to navigation but no safety risks	3	1	1	1	1	1.0	Broadly Acceptable	Short-term inability to effectively use an aid to navigation resulting in an allision or grounding incident with vessel damage, injury to person and/or pollution	2	1	1	1	1	1.0	Broadly Acceptable		
			O				2	1	1	1	1	1.0	Broadly Acceptable		1	3	3	3	3	3.0	Broadly Acceptable		
	Cumulative	Array area	C/D		• Visual presence of surface structures • Lighting and marking confusion	Short-term inability to effectively use an aid to navigation but no safety risks	4	1	1	1	1	1.0	Broadly Acceptable	Short-term inability to effectively use an aid to navigation resulting in an allision or grounding incident with vessel damage, injury to person and/or pollution	3	1	1	1	1	1.0	Broadly Acceptable		
			O				3	1	1	1	1	1.0	Broadly Acceptable		2	3	3	3	3	3.0	Broadly Acceptable		
Reduction in Emergency Response Capability																							

User	Isolation / Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Separate Sheet)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst Case Consequences	Realistic Worst Case Consequences							Further Mitigation Required	Additional Comments
								Consequences					Risk			Consequences					Risk		
							Frequency	People	Environment	Property	Business	Average Consequence			Frequency	People	Environment	Property	Business	Average Consequence			
Emergency responders	Isolation	Array area	C/D	Lighting and Marking COLREGS and SOLAS Layout Approval MGN 654 ERCoP Promulgation of information Guard Vessels where appropriate Display on charts	• Under construction array does not facilitate responder access • Limited resource capability • Adverse weather	Delay to emergency response request Effectiveness of response is reduced	2	1	1	1	2	1.3	Broadly Acceptable	Delay to response request leading to injury to person or loss of life Effective response not possible	1	4	5	5	5	4.8	Tolerable		
			O		• Array presents a hazard to SAR craft and aircraft Array does not facilitate responder access • Limited resource capability • Adverse weather		2	1	1	1	2	1.3	Broadly Acceptable		1	4	5	5	5	4.8	Tolerable		
		Offshore export cable corridor	C/D		• Limited resource capability		2	1	1	1	1	1.0	Broadly Acceptable		1	4	5	5	5	4.8	Tolerable		

User	Isolation / Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Separate Sheet)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst Case Consequences	Realistic Worst Case Consequences							Further Mitigation Required	Additional Comments
								Consequences					Risk			Consequences					Risk		
							Frequency	People	Environment	Property	Business	Average Consequence			Frequency	People	Environment	Property	Business	Average Consequence			
	Cumulative	Array area	C/D		• Under construction cumulative arrays do not facilitate responder access • Limited resource capability • Adverse weather		3	1	1	1	3	1.5	Broadly Acceptable		2	4	5	5	5	4.8	Tolerable		
			O		• Cumulative arrays do not facilitate responder access • Limited resource capability • Adverse weather		3	1	1	1	3	1.5	Broadly Acceptable		2	4	5	5	5	4.8	Tolerable		
		Offshore export cable corridor	C/D		• Limited resource capability		2	1	1	1	3	1.5	Broadly Acceptable		1	4	3	3	3	3.3	Broadly Acceptable		

Annex D Long-term AIS Assessment 2019/2020

D.1 Introduction

934. This annex assesses additional long-term vessel traffic data for the array area. In agreement with the MCA and Trinity House, a total of 56 days of vessel traffic survey data (2 x 28 days) has been collected (see section 5.2). However, it should be considered that studying 8 weeks in isolation may exclude certain activities or periods of pertinence to shipping and navigation. Therefore, in line with good practice assessment procedures, the NRA baseline has also considered a longer-term dataset covering a 12-month period from March 2019 to February 2020 to ensure a comprehensive characterisation of vessel traffic movements can be established, including the capture of any wider seasonal variations and weather routeing.

935. This approach (i.e., the use of both short-term and long-term data) has been agreed with the MCA and Trinity House.

D.2 Methodology

D.2.1 Study Area

936. This annex has assessed the long-term vessel traffic data within the same study area introduced in Section 3.4.

D.2.2 Data Period and Temporary Vessel Traffic

937. The long-term vessel traffic data was collected from 1st March 2019 to 29th February 2020 inclusive.

938. As per the vessel traffic surveys, a number of vessel tracks recorded during the data period were classified as temporary (non-routine) and have been excluded from the characterisation of the vessel traffic baseline, including tracks of guard and survey vessels. These tracks are presented in Figure D.1.

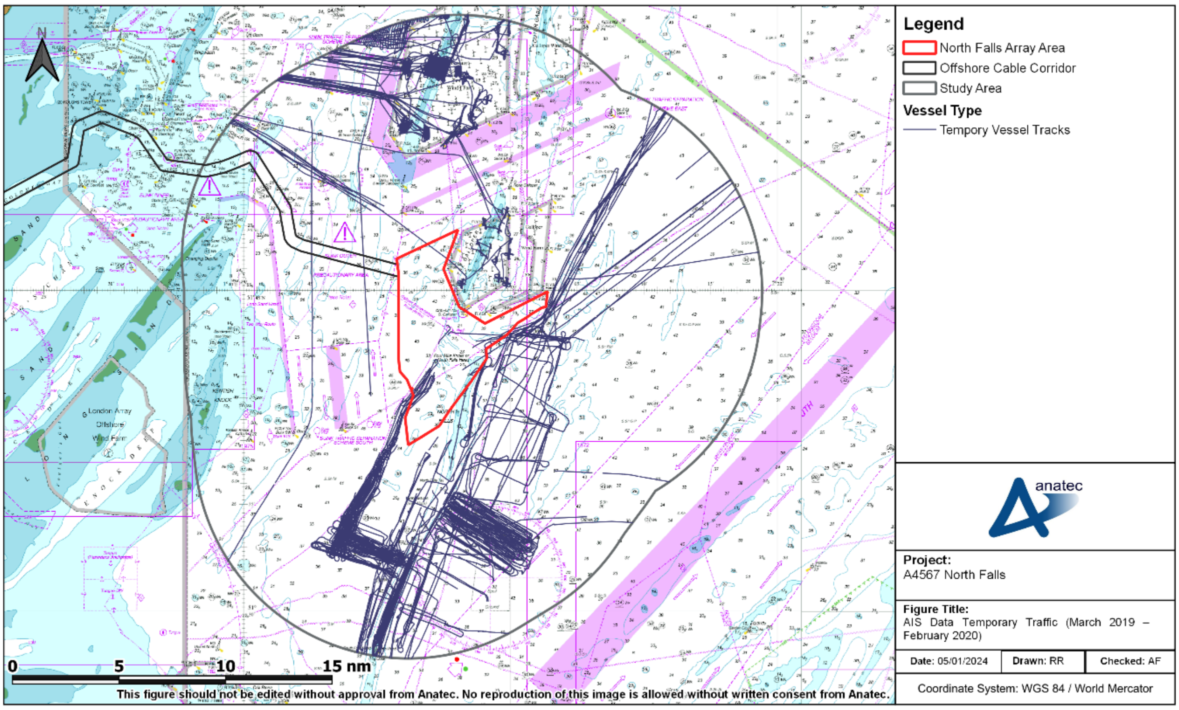

Figure D.1 AIS Data Temporary Traffic (March 2019 – February 2020)

D.2.3 AIS Carriage

939. General limitations associated with the use of AIS data (for example, carriage requirements) are discussed in full within section 5.4.1.

D.3 Long-Term Vessel Traffic Movements

940. This section assesses the long-term vessel traffic dataset, noting that temporary traffic as detailed in section D.2.2 has been excluded from the analysis.

D.3.1 Overview

941. A plot of the vessel tracks recorded within the study area during the data period, colour-coded by vessel type, is presented in Figure D.2. Following this, Figure D.3 presents the same data as a vessel density heat map.

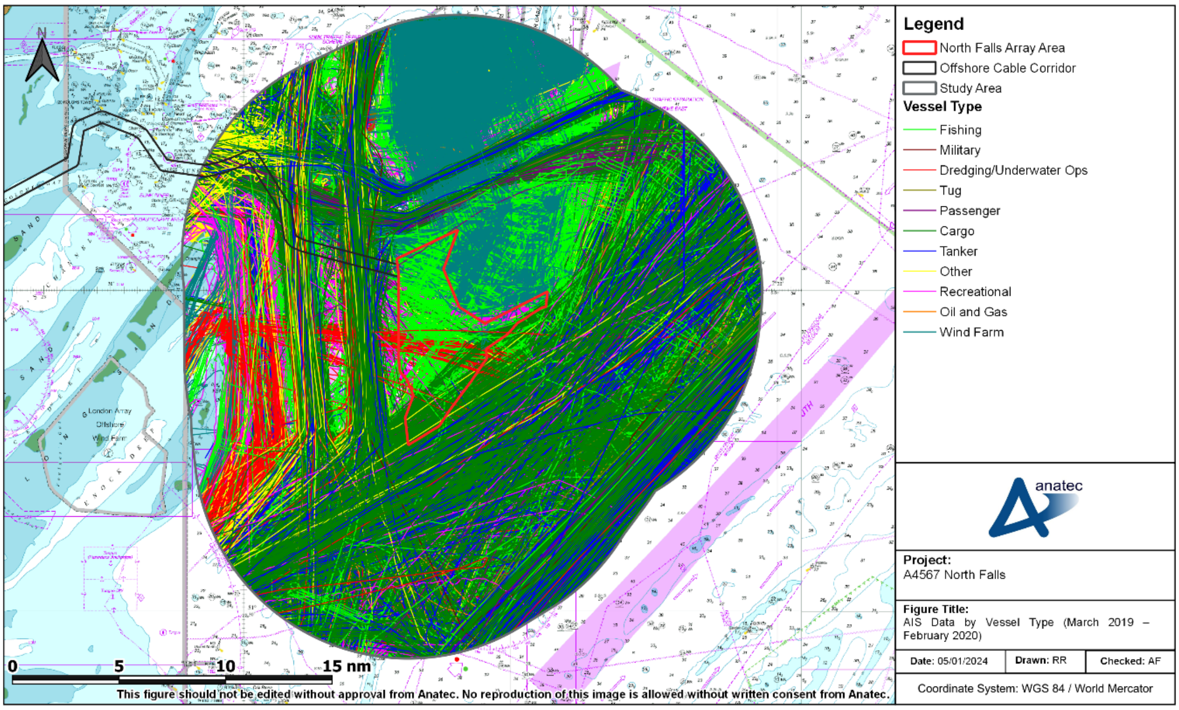

Figure D.2 AIS Data by Vessel Type (March 2019 – February 2020)

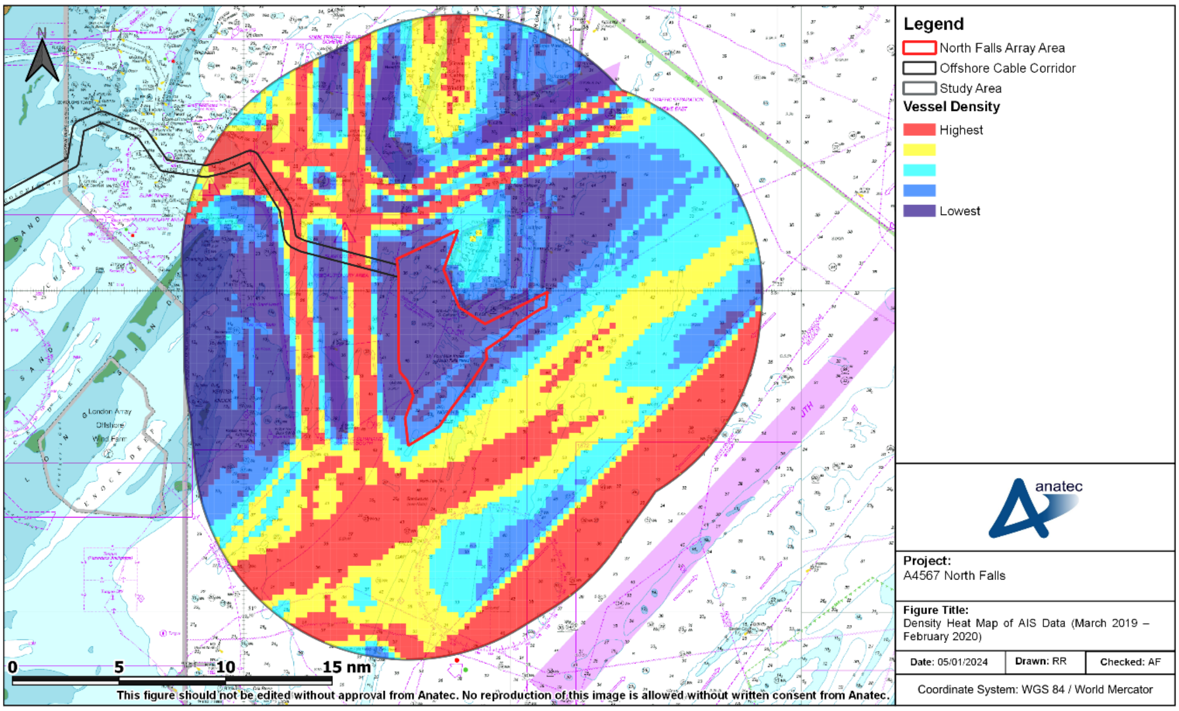

Figure D.3 AIS Data Vessel Density Heat Map (March 2019 – February 2020)

D.3.2 Vessel Count

942. The average daily number of vessels within the study area for each month during the period are presented in Figure D.4. No significant downtime was recorded during the long-term data period.

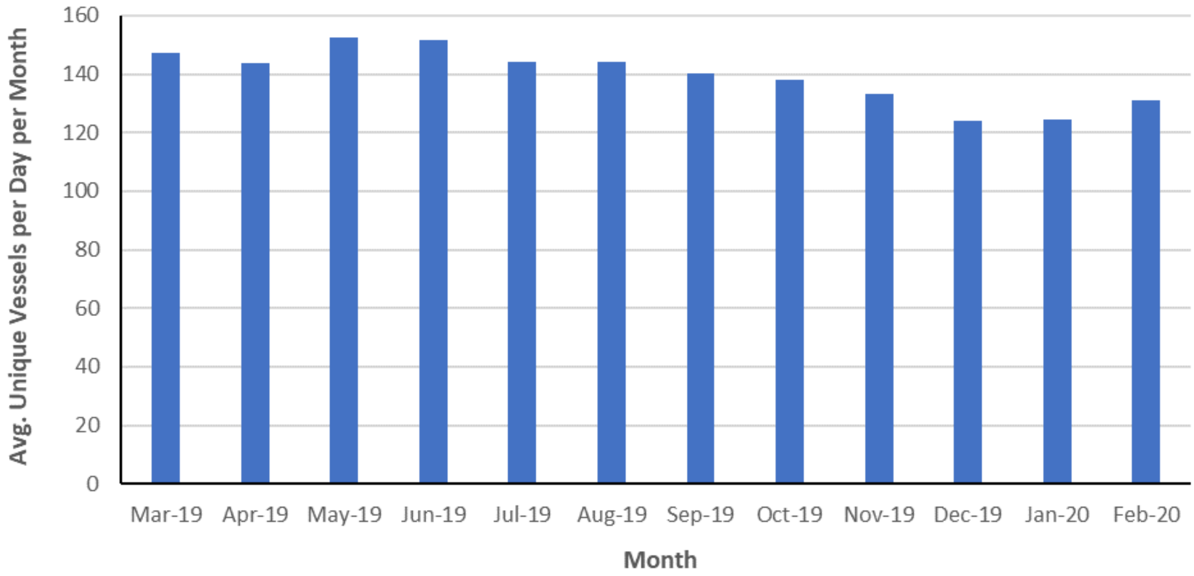

Figure D.4 Average Unique Daily Vessels

943. An average of 140 unique vessels were recorded per day within the study area during the long-term data period. The busiest month recorded was May 2019 with approximately 153 unique vessels per day during the month. Vessel traffic recorded during the busiest month is illustrated in Figure D.5. The quietest month was December 2019 with approximately 124 unique vessels per day recorded.

944. The busiest day overall was 31st May 2019 with 231 unique vessels recorded, with vessel tracks recorded on this day illustrated in Figure D.6. It is noted that the North Sea Race took place on the 31st May 2019 from Harwich to Scheveningen resulting in a much higher volume of recreational vessels.

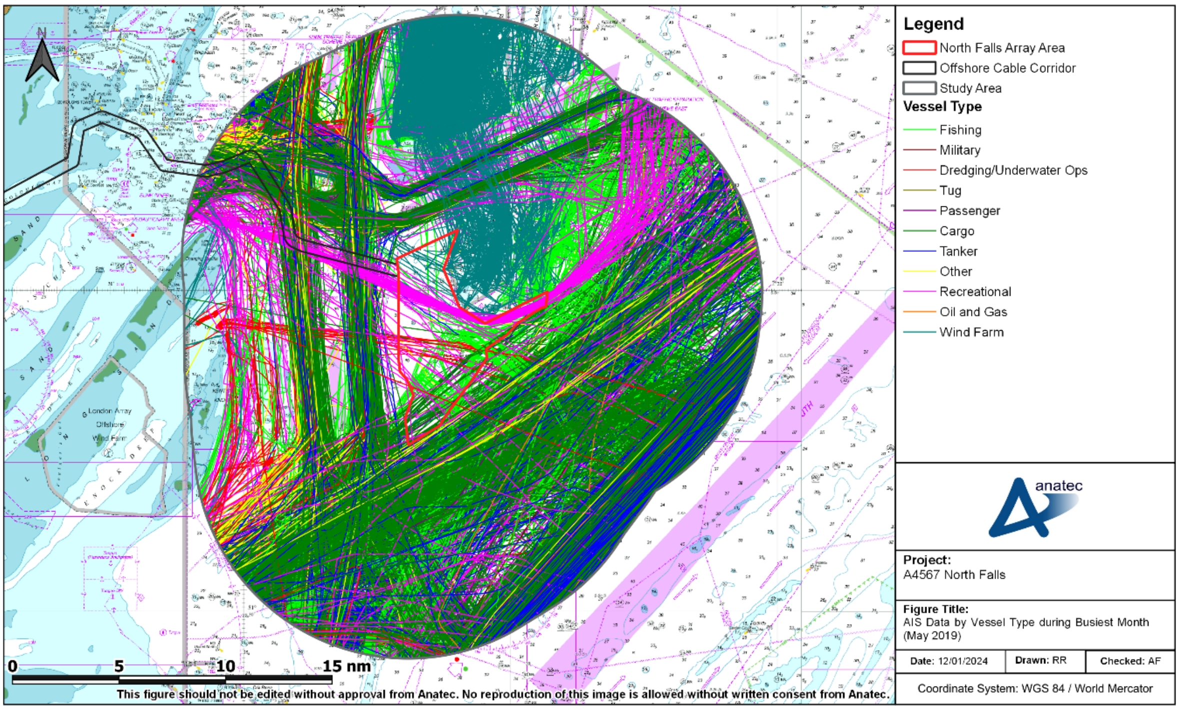

Figure D.5 AIS Data by Vessel Type During Busiest Month (May 2019)

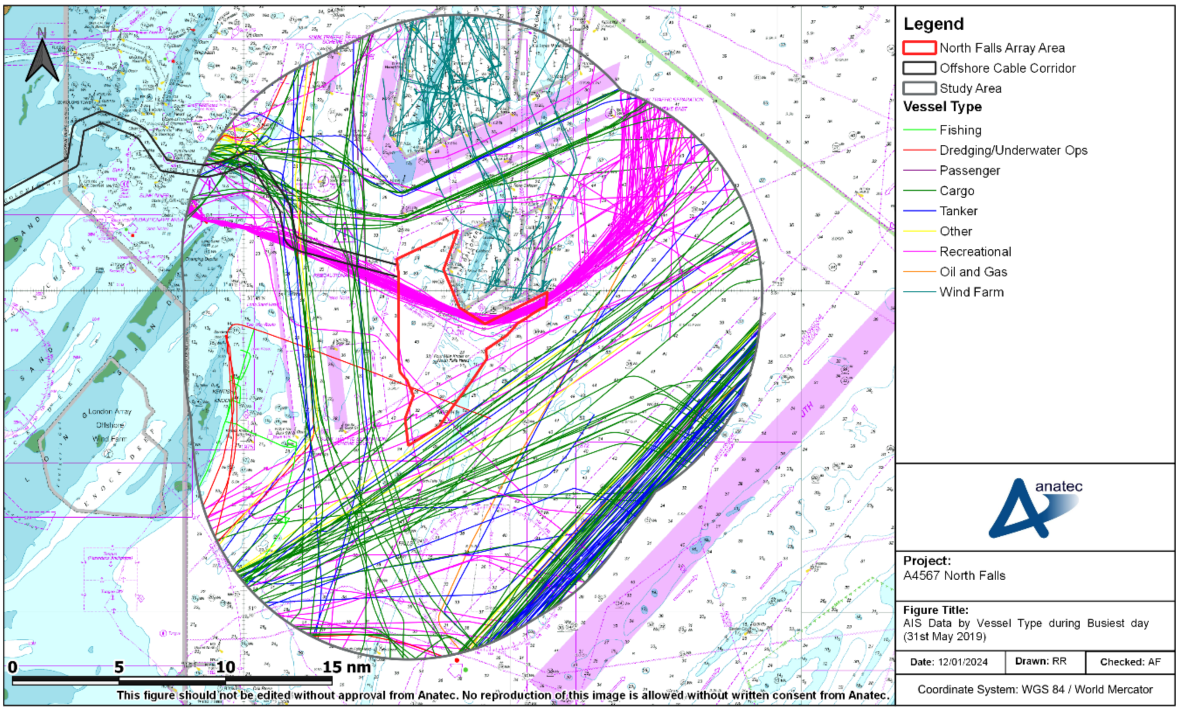

Figure D.6 AIS Data During Busiest Day (31st May 2019)

D.3.3 Vessel Length

945. The vessel traffic recorded during the long-term data period within the study area is shown in Figure D.7, colour-coded by vessel length. The same data is then presented in in Figure D.8 by vessel length distribution.

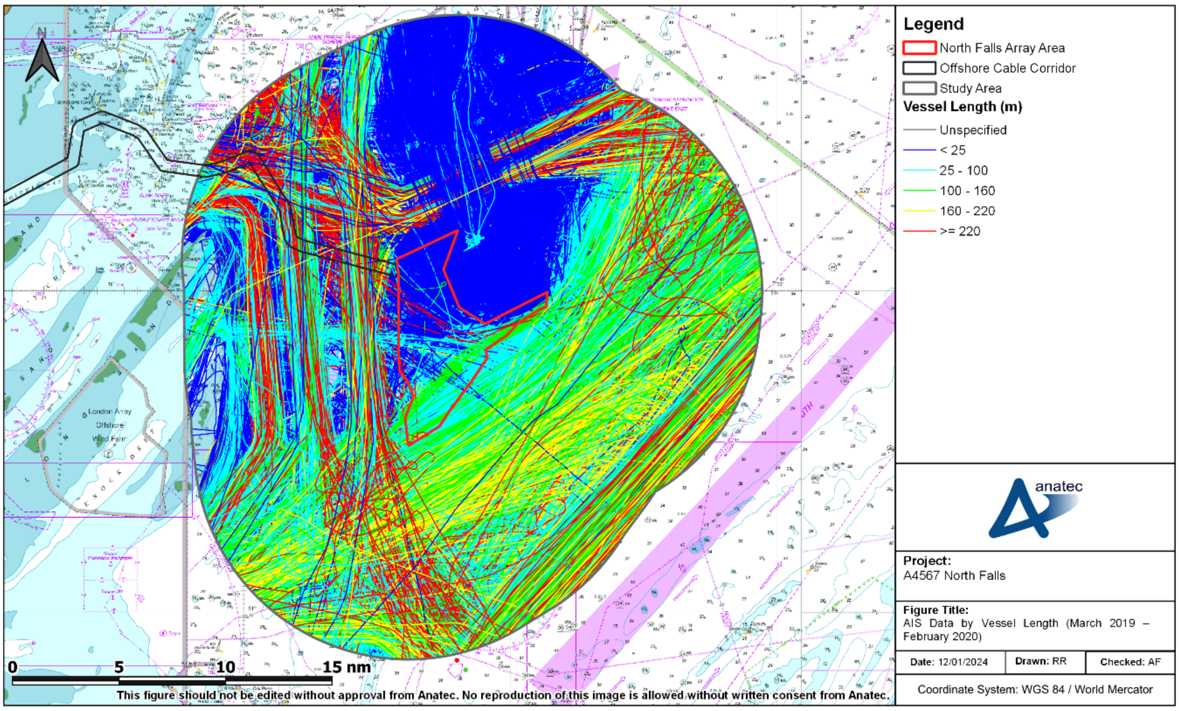

Figure D.7 AIS Data by Vessel Length (March 2019 – February 2020)

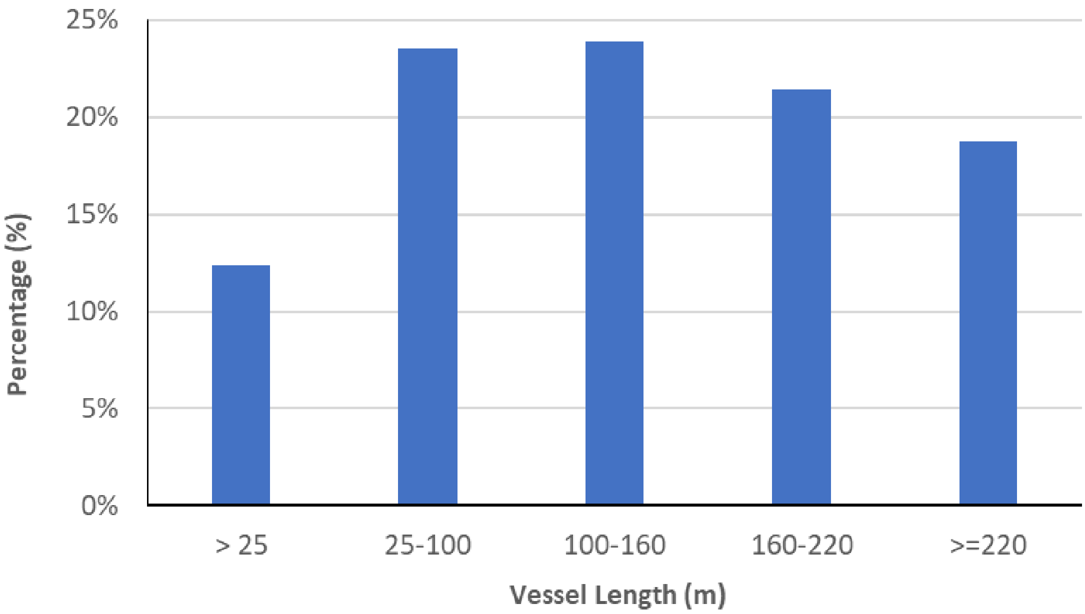

Figure D.8 AIS Vessel Length Distribution (March 2019 – February 2020)

946. The majority of Recreational vessels and wind farm vessels, which were operating at the Greater Gabbard and Galloper, were generally under 25m in length. Vessels transiting on the Sunk TSSs were larger, with vessels over 200m frequently recorded.

947. The average vessel length recorded during the long-term data period was 145m. The largest vessels recorded measured 400m, which was recorded for 53 unique container cargo vessels.

D.3.4 Vessel Type

948. The vessel type distribution during the long-term data period is presented in Figure D.9.

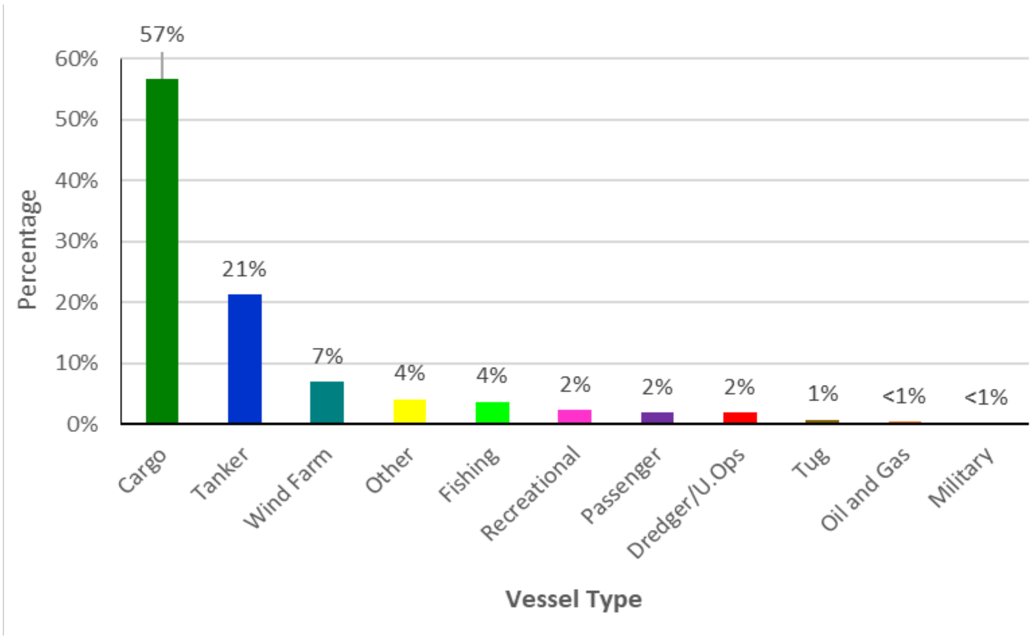

Figure D.9 Vessel Type Distribution (March 2019 – February 2020)

949. Cargo vessels and tankers were the most common vessel type recorded within the study area during the 12-month period (57% and 21%, respectively). Wind farm vessels accounted for 7% of vessel traffic.

D.3.4.2 Cargo Vessels

950. Figure D.10 presents the cargo vessels recorded on AIS within the study area during the long-term data period, colour-coded by vessel length.

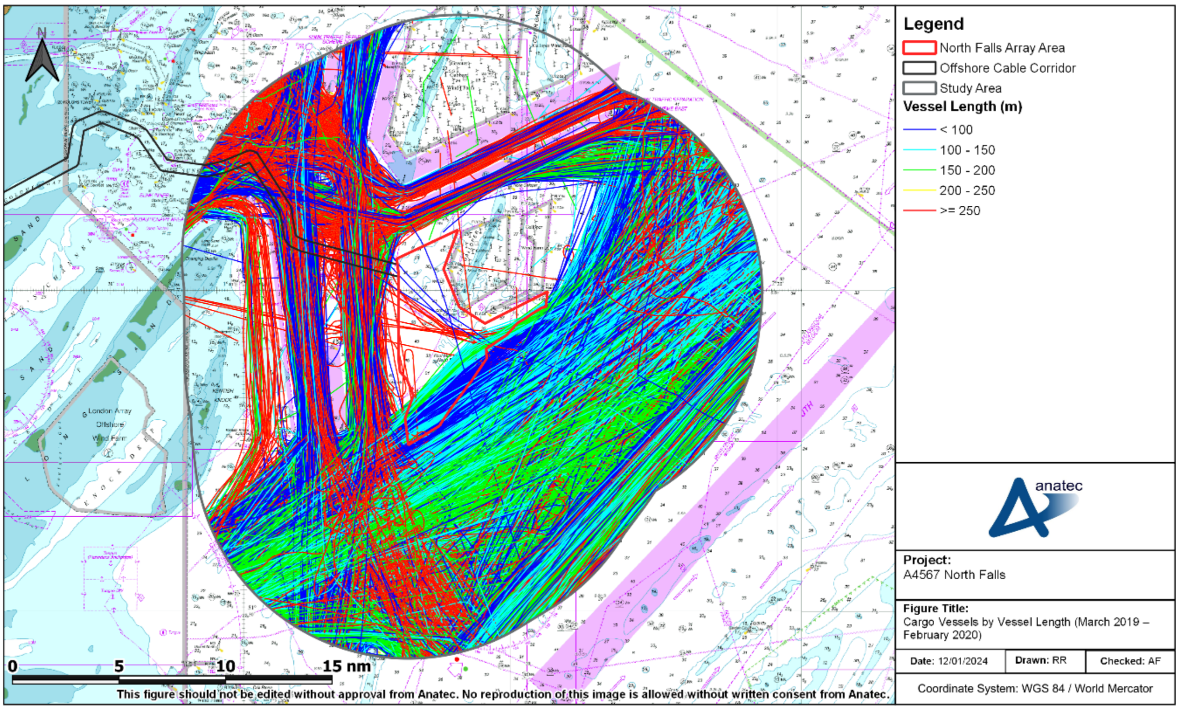

Figure D.10 Cargo Vessels by Vessel Length (March 2019 – February 2020)

951. Figure D.11 presents the same data displayed as the average number of unique cargo vessels per day per month within the study area.

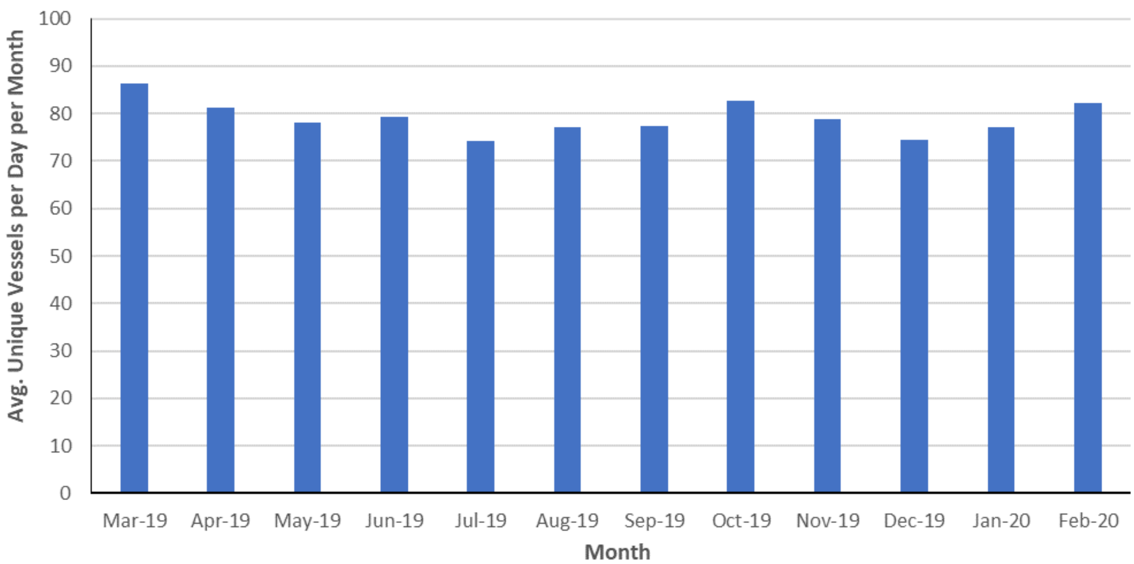

Figure D.11 Average Cargo Vessels per Day per Month

952. On average there were 79 unique cargo vessels recorded per day within the study area with March being the busiest month recorded with an average of 86 unique vessels per day. Of these, an average of one to two unique cargo vessels per day intersected the array area, mainly to the south east.

D.3.4.3 Tankers

953. Figure D.12 presents the tankers recorded on AIS within the study area during the long-term data period.

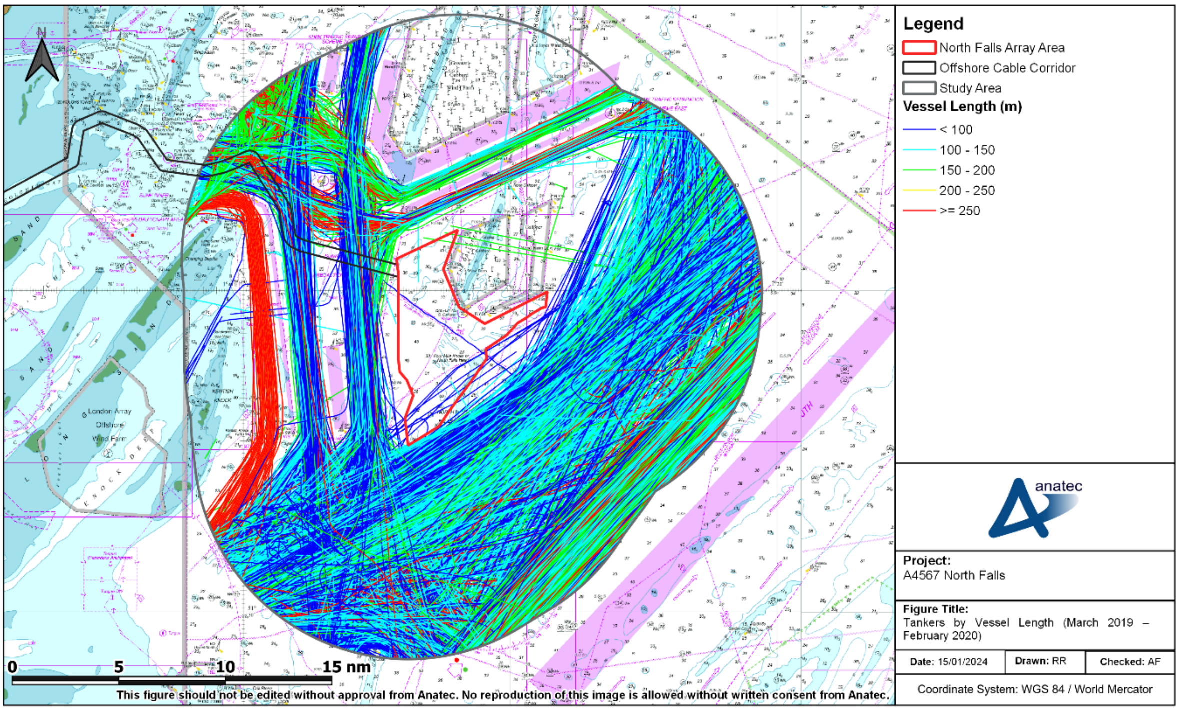

Figure D.12 Tankers by Length (March 2019 – February 2020)

954. Figure D.13 presents the same data displayed as the average number of unique tankers per day per month within the study area.

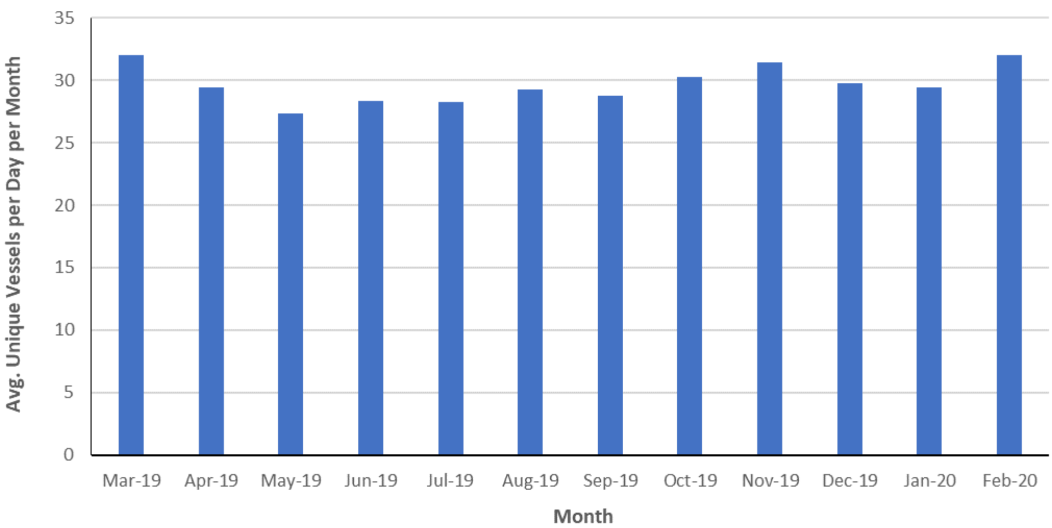

Figure D.13 Average Tankers per Day per Month

955. On average there were 30 unique tankers per day within the study area with March and February being the busiest months recorded with an average of 32 unique vessels per day. Of these, only 15 unique instances of a tanker intersecting the array area occurred across the long-term data period. Again, like cargo vessels, these were all mainly to the south-east.

D.3.4.4 Passenger Vessels

956. Figure D.14 presents the passenger vessels recorded on AIS within the study area during the long-term data period.

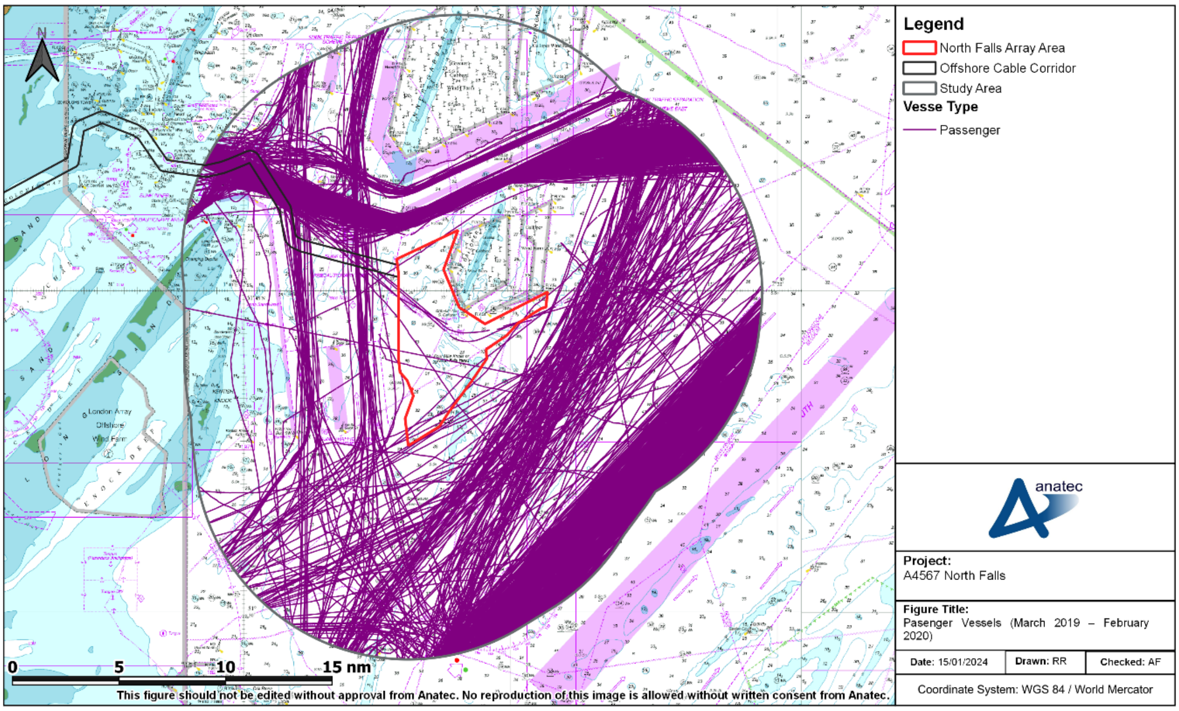

Figure D.14 Passenger Vessels (March 2019 – February 2020)

957. Figure D.15 presents the same data displayed as the average number of unique passenger vessels per day per month within the study area.

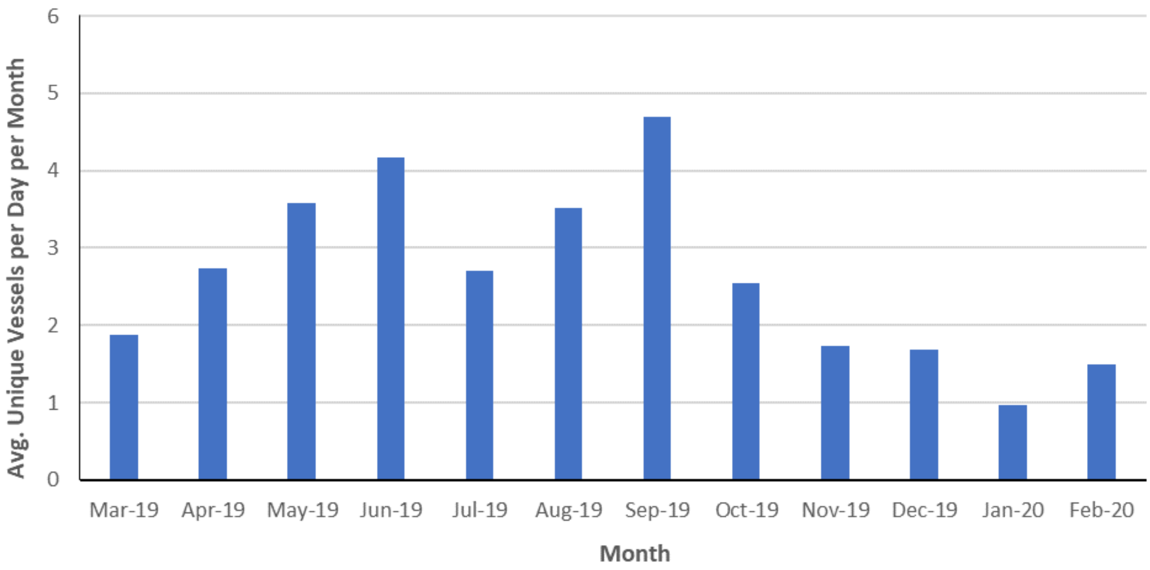

Figure D.15 Average Passenger Vessels per Day per Month

958. On average there were two to three unique passenger vessels per day within the study area with September being the busiest month recorded with an average of five unique vessels per day. Of these, only eight unique instances of a passenger vessel intersecting the array area occurred across the long-term data period. Passenger vessels showed slight seasonal variation with greater vessel numbers recorded during the summer months when compared to winter.

959. It is noted that the Galloper Recommended Route was established for use by ferries routeing to and from Ostend. There was no evidence of ferries using the route, although a small number of passenger vessel tracks, including Stena Line ferries to The Netherlands, intersected the array area in a similar bearing during February 2020. Consultation with Stena Line indicated this route is used occasionally in strong, southerly winds and high swell for the comfort of passengers and safety of cargo but also noting that alternative routes are available.

D.3.4.5 Wind Farm Vessels

960. Figure D.16 presents the wind farm vessels recorded on AIS within the study area during the long-term data period.

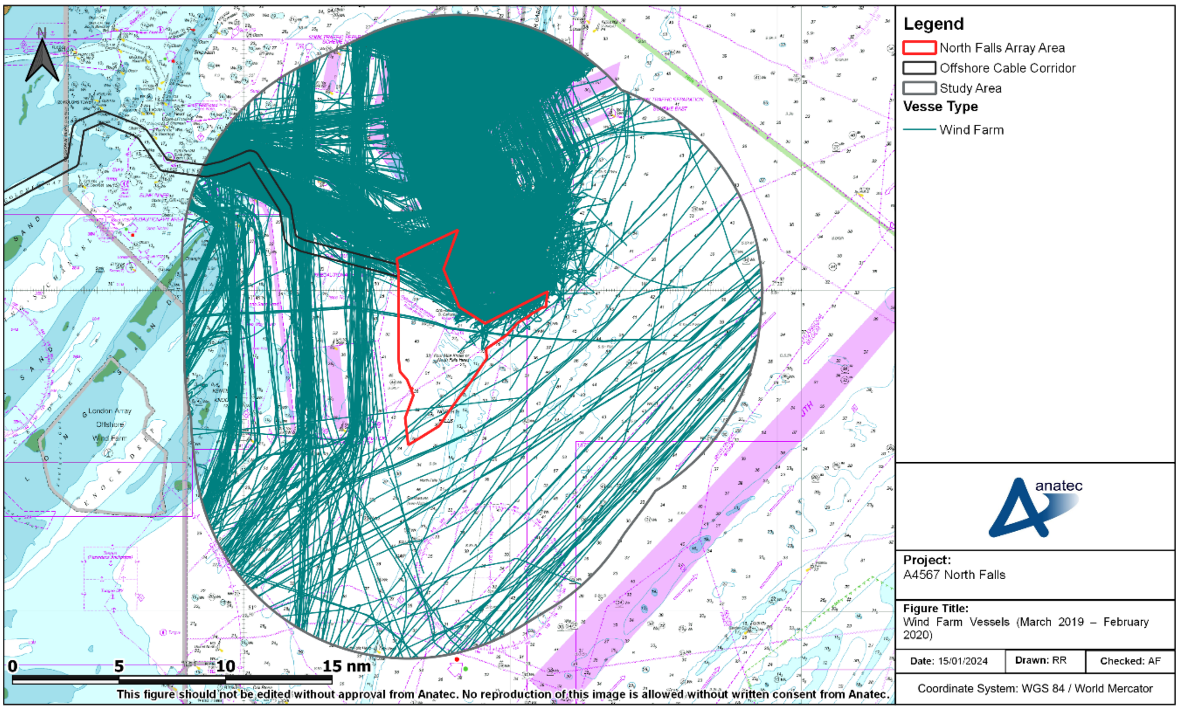

Figure D.16 Wind Farm Vessels (March 2019 – February 2020)

961. Figure D.17 presents the same data displayed as the average number of unique wind farm vessels per day per month within the study area.

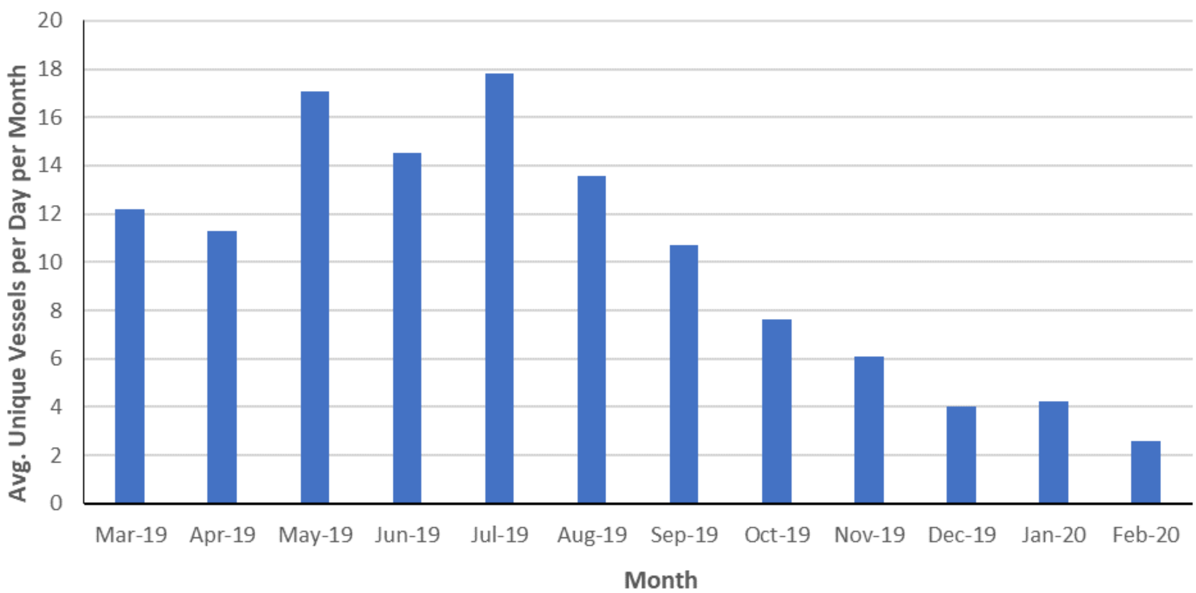

Figure D.17 Average Wind Farm Vessels per Day per Month

962. Wind farm vessels were typically observed at the existing Galloper and Greater Gabbard wind farms and routeing to/from Harwich and Great Yarmouth. Other wind

farm vessels were noted transiting the Sunk TSS North, East and South, as well as TSS North Hinder South.

963. On average there were 10 unique wind farm vessels recorded per day within the study area with July being the busiest month recorded with an average of 18 unique vessels per day. Wind farm vessels showed considerable seasonal variation, with the summer months being significantly busier than the winter months. One unique wind farm vessel intersected the array area on average every three days across the long-term data period, all to the north-east of the array area.

D.3.4.6 Fishing Vessels

964. Figure D.18 presents the fishing vessels recorded on AIS within the study area during the long-term data period, colour-coded by average vessel speed (fishing vessels transiting at speeds of less than 6kt are likely to be engaged in active fishing). As noted previously, AIS carriage is only mandatory for fishing vessels of 15m length and over.

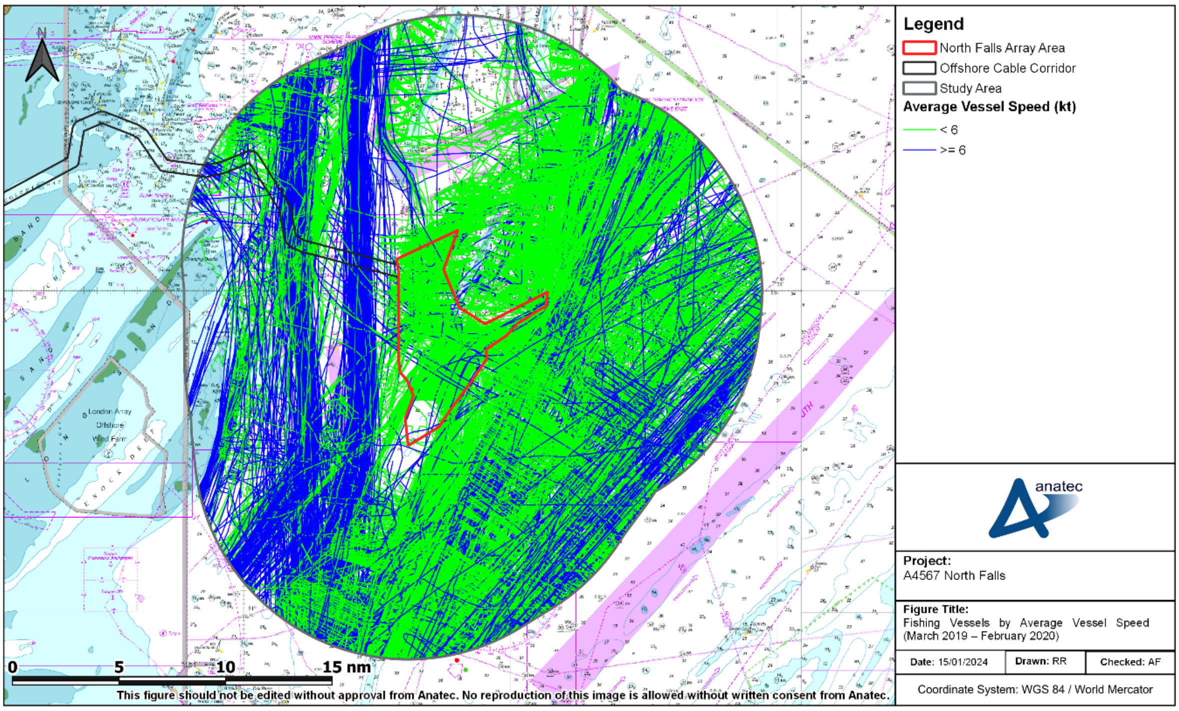

Figure D.18 Fishing Vessels by Average Vessel Speed (March 2019 – February 2020)

965. Figure D.19 presents the same data displayed as the average number of unique fishing vessels per day per month within the study area.

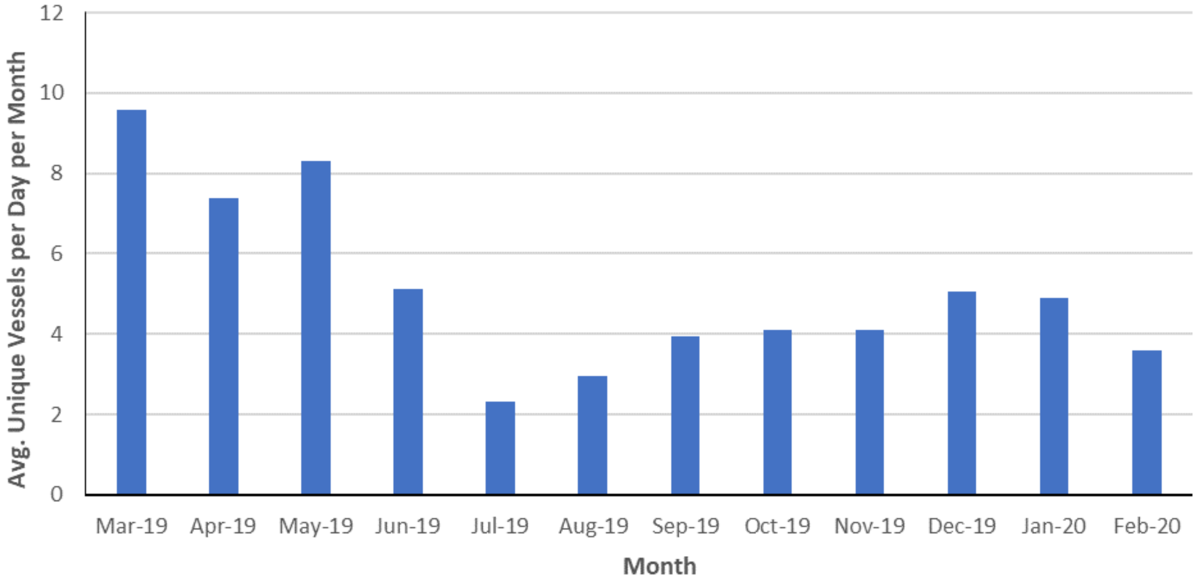

Figure D.19 Average Fishing Vessels per Day per Month

966. On average there were five unique fishing vessels recorded per day within the study area with March being the busiest month recorded with an average of 10 unique vessels per day. Fishing vessels showed considerable seasonal variation, with winter and spring months being significantly busier than the summer and autumn months. One unique fishing vessel intersected the array area on average every three days across the long-term data period.

967. Approximately 70% of fishing vessels were transiting at speeds of less than 6 kts. These vessels may be engaged in active fishing with likely activity also occurring within the array area.

D.3.4.7 Recreational Vessels

968. Figure D.20 presents the recreational vessels recorded on AIS within the study area during the long-term data period.

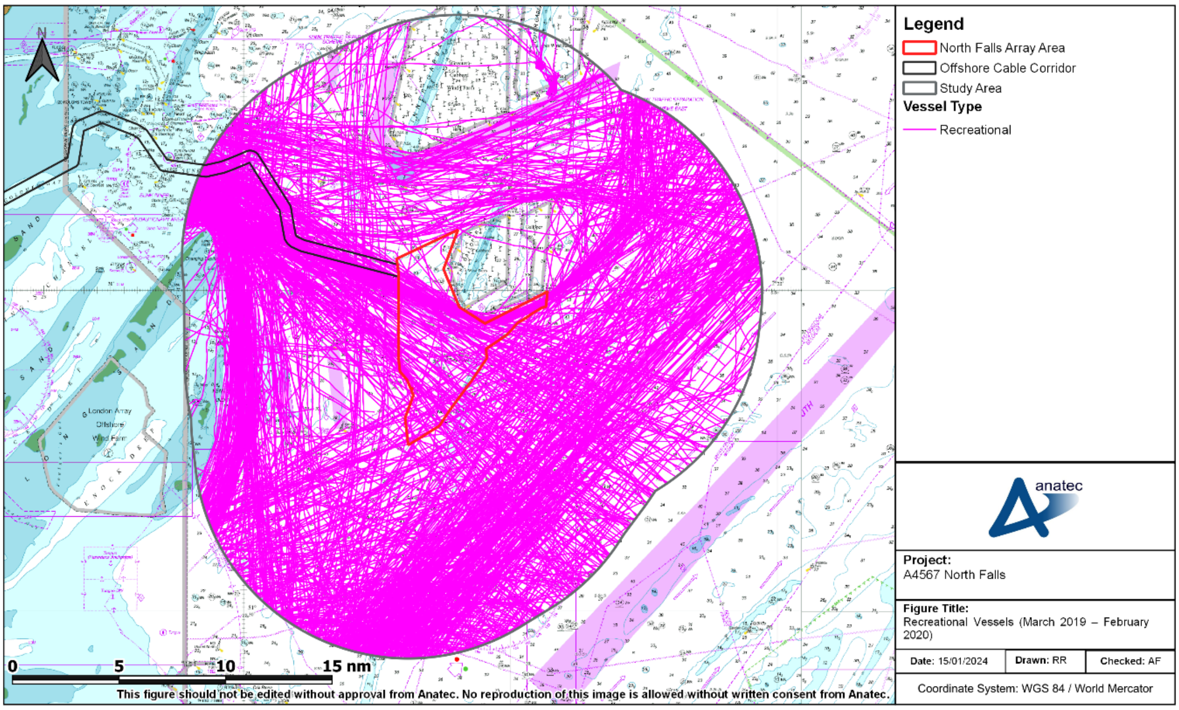

Figure D.20 Recreational Vessels (March 2019 – February 2020)

969. Figure D.21 presents the same data displayed as the average number of unique recreational vessels per day per month within the study area.

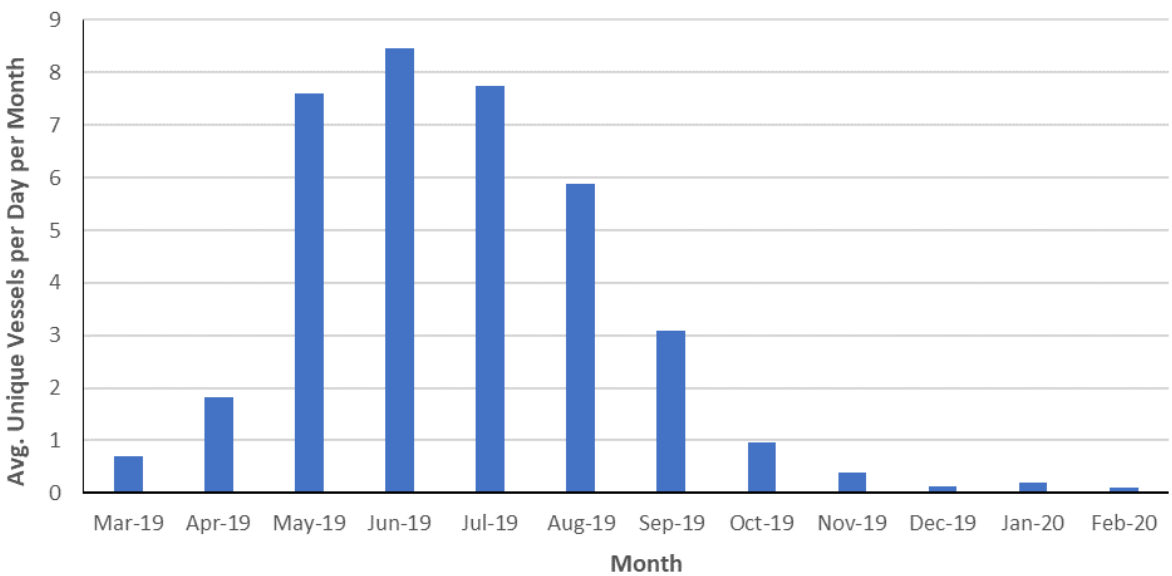

Figure D.21 Average Recreational Vessels per Day per Month

970. On average there were three unique recreational vessels recorded per day within the study area with May, June, and July being the busiest months recorded with an average of eight unique vessels per day each month. Recreational vessels showed

considerable seasonal variation, with summer months being significantly busier than the winter months. An average of one unique recreational vessel intersected the array area every two to three days across the long-term data period, all transiting on a north-west south-east bearing.

971. As aforementioned in Section D.3.2, the 31st May 2019 recorded an influx of recreational vessels (89 unique vessels) due to the North Sea Race which saw vessels routeing through the array area.

D.3.4.8 Marine Aggregate Dredgers

972. Figure D.22 presents the marine aggregate dredgers recorded on AIS within the study area during the long-term data period.

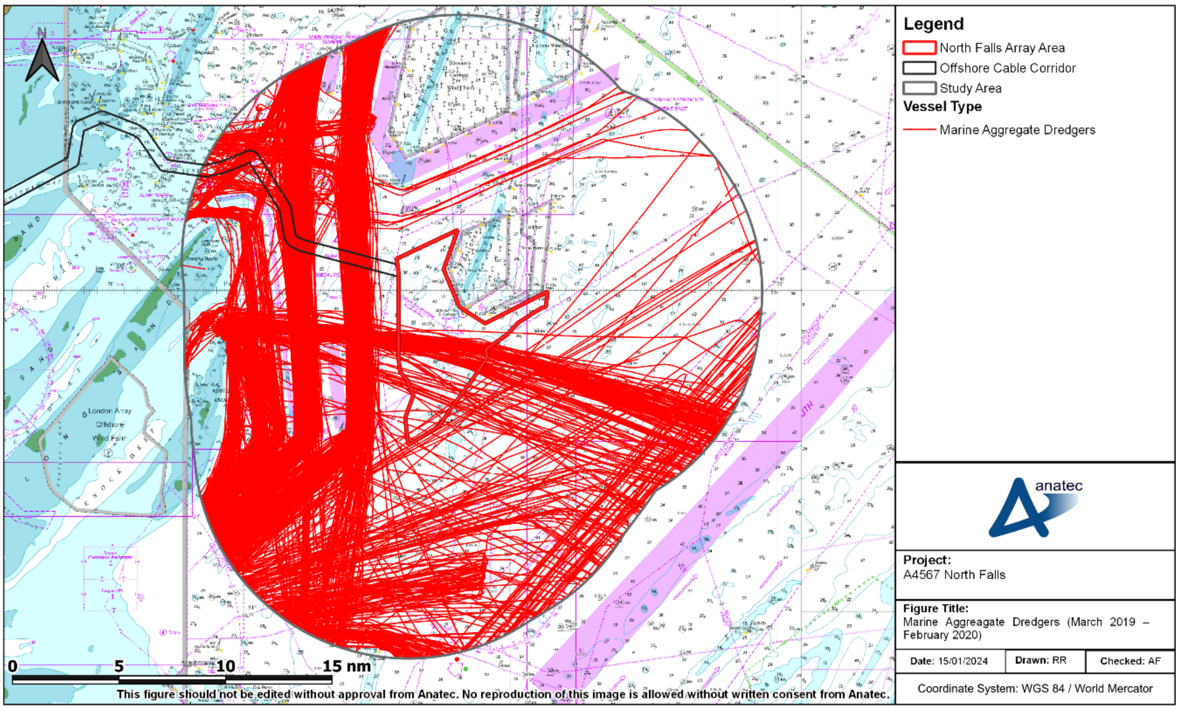

Figure D.22 Marine Aggregate Dredgers (March 2019 – February 2020)

973. Figure D.23 presents the same data displayed as the average number of unique marine aggregate dredgers per day per month within the study area.

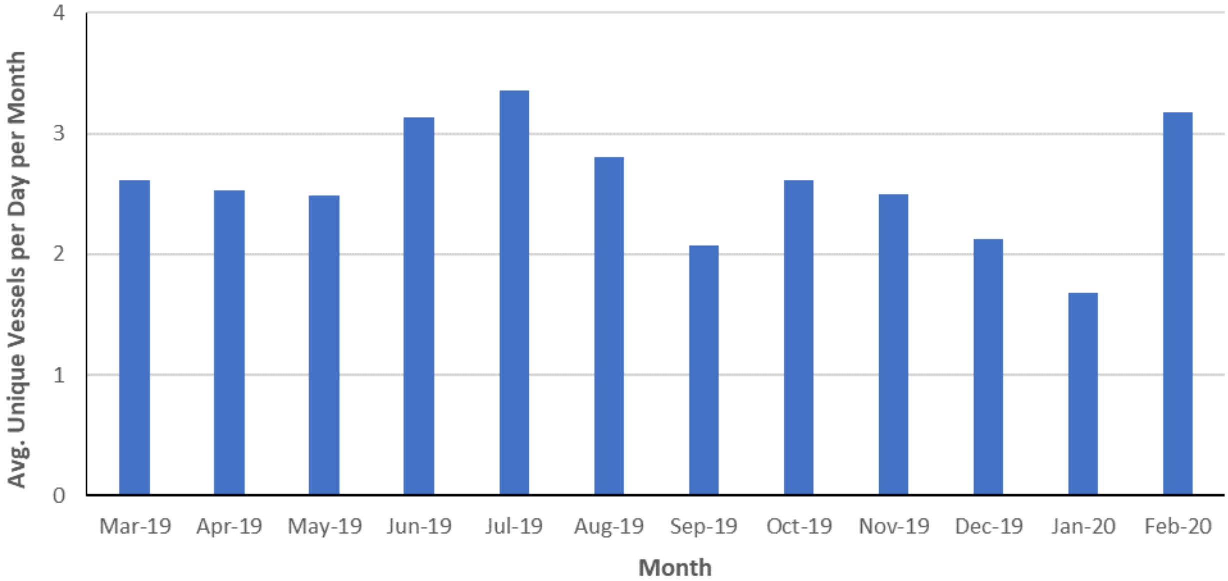

Figure D.23 Average Marine Aggregate Dredgers per Day per Month

974. On average there were two to three unique marine aggregate dredgers recorded per day within the study area. Vessels were consistent across the period with an average of three vessels per day were recorded over eight of the twelve months with July being the busiest month for marine aggregate dredgers. An average of one unique marine aggregate dredger intersected the array area every four to five days across the long-term data period, all transiting on a north-west south-east bearing.

975. Marine aggregate dredgers were observed to be engaged in active dredging at extraction areas north and west of the array area. Dredgers were also recorded dumping spoil north and south of the array area. Transiting dredgers were mostly recorded using the Sunk TSS South.

D.3.4.9 Summary of Intersecting Traffic

976. Figure D.24 presents only the vessel tracks intersecting the array area during the long-term data period.

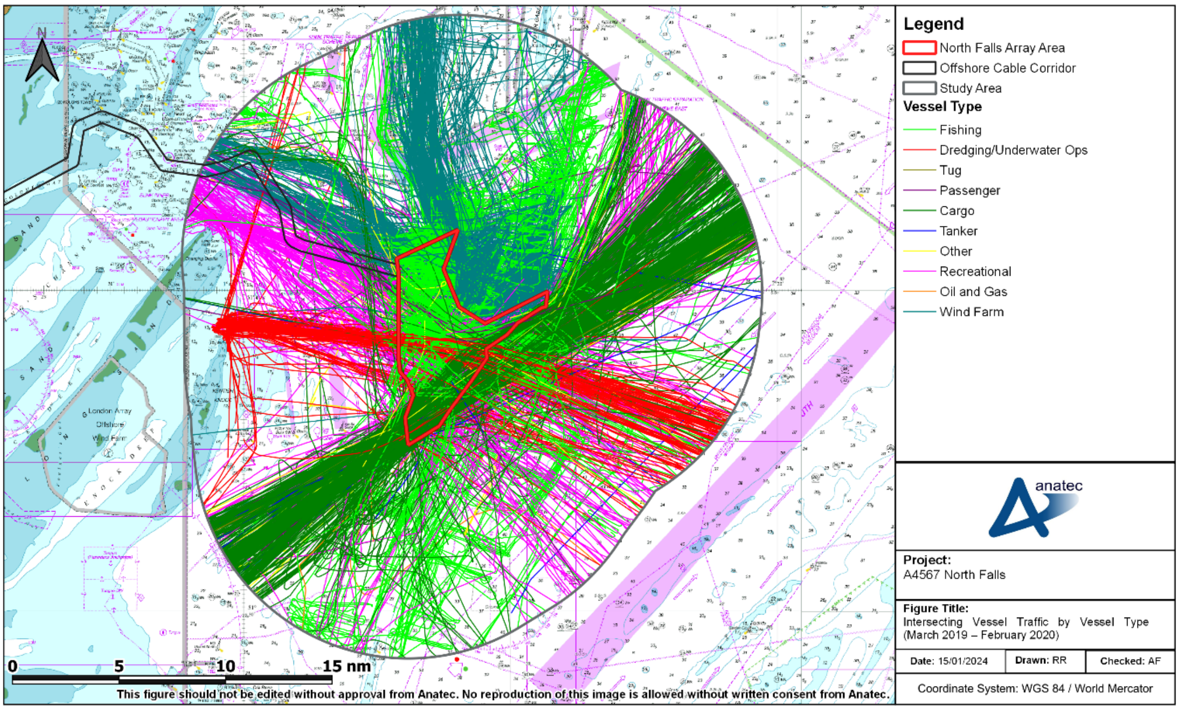

Figure D.24 Intersecting Vessel Traffic by Vessel Type (March 2019 – February 2020)

977. On average, four vessels per day were recorded intersecting the array area. May 2019 was the highest month recorded for vessels intersecting the array area but again, as aforementioned, this is due to the North Sea Race resulting in recreational traffic routeing through the array area.

978. The vessel type distribution of vessels intersecting the array area during the long-term data period is presented in Figure D.25.

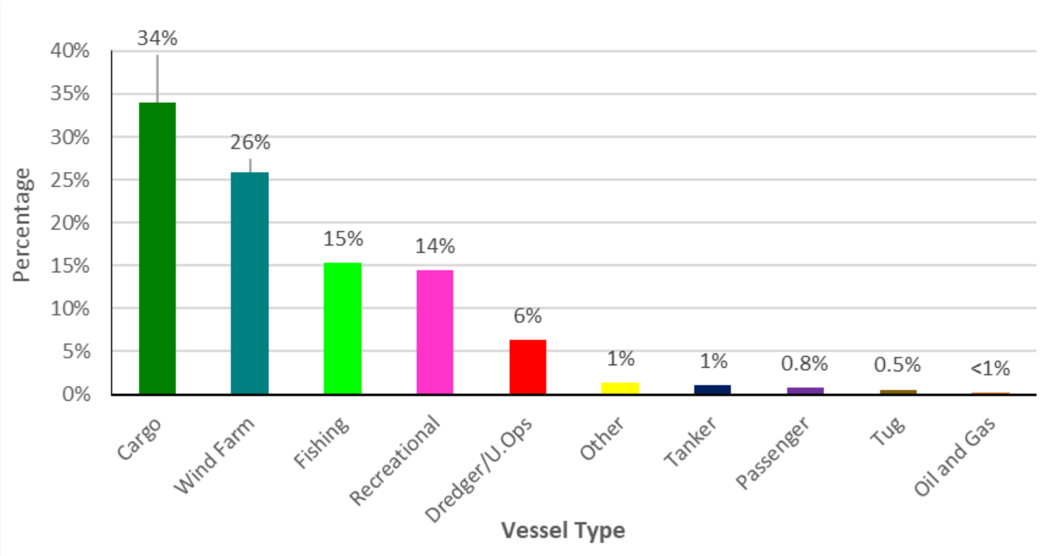

Figure D.25 Vessel Type Distribution of Vessels Intersecting the Array Area

979. Cargo vessels and wind farm vessels were responsible for 60% of all intersections with the array area (34% and 26%, respectively). Fishing vessels (15%) and recreational vessels (14%) were also commonly recorded intersecting the array area.

D.3.4.10 Weather Routeing

980. Twelve months of metocean data for the period March 2019 to February 2020 were reviewed to identify days with strong winds, particularly speeds over 34 kt corresponding to Beaufort Force 8 (gales) and above.

981. This confirmed that the days when ferries were observed using the route through the array area were all in February 2020 during periods of strong winds, generally from the south and south-west.

982. The 29th February 2020 had wind speeds ranging from 21.7 to 40.8 kt, generally from the south-west. Figure D.26 presents the vessel tracks recorded on 29th February 2020, and Figure D.27 contrasts this with tracks recorded on 19th July 2019 when wind speeds were light to moderate (5 to 17 kt).

983. It can be observed that on the February day with strong winds, no wind farm vessels were recorded working as wind speeds (and/or wave heights) will have exceeded their allowable weather limits. Commercial shipping is seen using the TSSs on both days, however, on the February day there were tanker and cargo vessels that appeared to be waiting in the southern part of the study area, rather than transiting on passage. It is possible these vessels were delayed from entering port due to the weather affecting pilot availability.

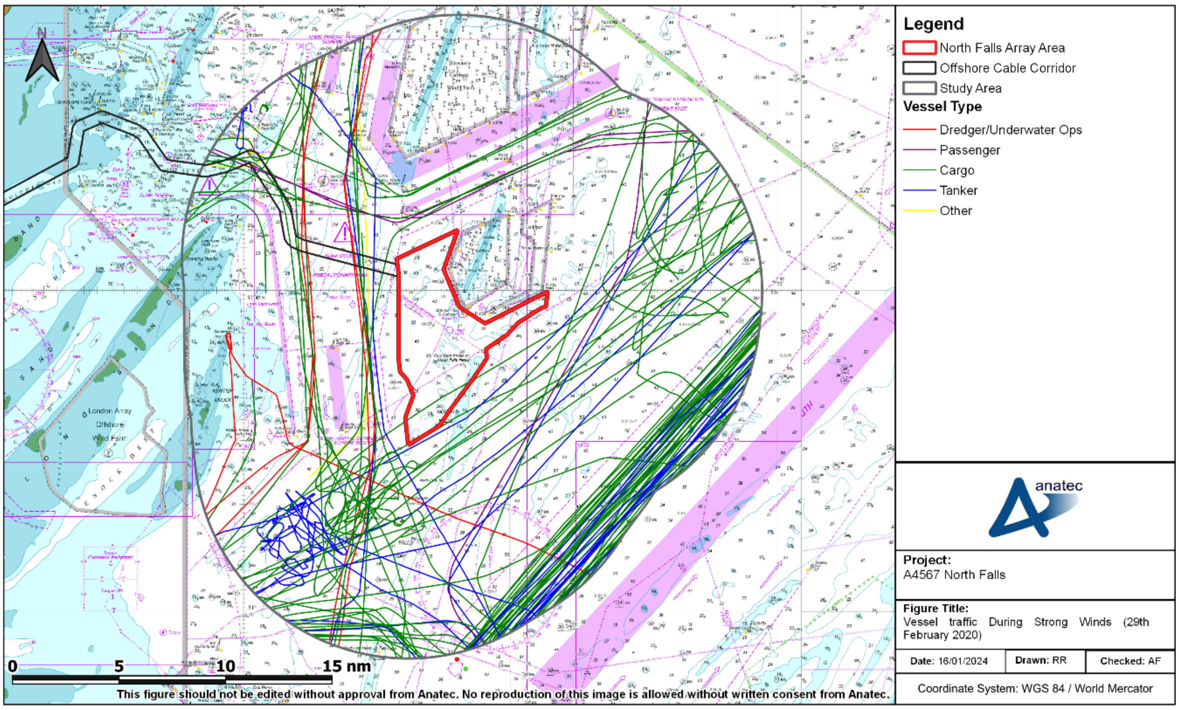

Figure D.26 Vessel Traffic During Strong Winds (29th February 2020)

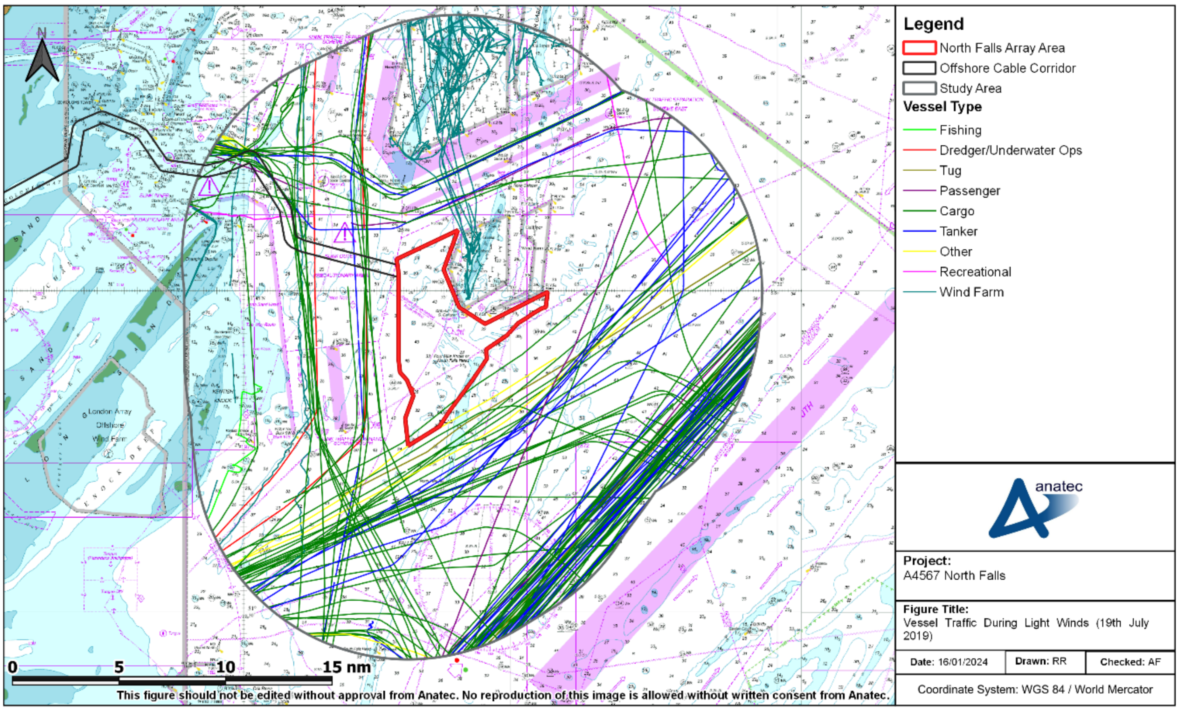

Figure D.27 Vessel Traffic During Light Winds (19th July 2019)

D.4 Survey Data Comparison

984. The routeing of vessels during the vessel traffic surveys was similar overall to the long-term vessel traffic survey data (see Section 10.3).

985. Fishing vessels were observed both transiting and engaged in fishing during both periods; notably, fishing activity was recorded within the array area during the winter data period. The long-term vessel traffic data analysis also highlighted active fishing within the array area. Fishing vessel levels were comparable for both periods.

986. Recreational vessel activity presence was high during the summer months of 2022, with little recreational activity recorded during the winter months. This is due to the favourable sailing conditions that summer provides. This was reflected in the difference in recreational traffic levels in the two vessel traffic surveys.

987. A comparison of the average daily counts broken down by type and period is presented in Table D.1.

Table D.1 Average Daily Vessel Counts by Vessel Type and Period

Vessel Type	Average Vessels per Day		
	Long-term	Winter	Summer
Cargo vessels	79	82	78

Vessel Type	Average Vessels per Day		
	Long-term	Winter	Summer
Tankers	30	32	30
Wind farm vessels	10	4	13
Fishing vessels	5	4	3
Marine aggregate dredgers	3	4	6
Recreational vessels	3	< 1	8
Passenger vessels	3	2	3

988. The vessel type with the greatest difference in count between the winter and summer survey periods was recreational, due to the more favourable weather during the summer season. The long-term vessel counts generally aligned well with the winter and summer counts.

D.5 Conclusion

989. Twelve months of AIS data from March 2019 to February 2020 has been analysed to validate the 2022 vessel traffic survey data recorded within the study area.

990. Routeing within the study area during the 12-month period broadly agreed with routeing as seen in the survey data, with the main routes including routes within the nearby TSS lanes associated with Sunk and North Hinder South.

991. There was general agreement between the three periods in terms of daily average vessel counts as seen in Table D.1. Seasonal variation of recreational vessel levels in particular is highlighted by the counts.