CONTENTS

14 SHIPPING AND NAVIGATION

14.1 Introduction

This section describes the baseline for shipping and navigation in the vicinity of the Thanet Offshore Wind Farm (Thanet) project upon which an assessment of the potential impacts associated with the construction, operation and decommissioning phases of the Thanet project are discussed and mitigation measures proposed.

14.2 Assessment Methodology

14.2.1 Data collection

MARICO Marine was commissioned by Thanet Offshore Wind Limited (TOW) to conduct a maritime traffic survey, navigation assessment and a Navigation Risk Assessment (NRA) of the Thanet project in accordance with the requirements of the Maritime and Coastguard Agency's (MCA) Marine Guidance Note MGN 275 (M).

14.2.2 Marine traffic survey

In response to the requirement in MGN 275(M) for an up to date vessel traffic survey to be undertaken of the area, a variety of traffic data was collected. Initially, vessel traffic data for the wider area was obtained from the Channel Navigation Information Service (CNIS) at Dover, covering a selection of weeks and weather conditions throughout 2004 and 2005. The full survey report is included in **Appendix 14.1**.

The objectives of the survey were to identify and assess:

- Location of the wind farm site relative to areas used by any type of marine craft;
- Validate the findings of the initial CNIS radar data;
- Numbers, types and sizes of vessels presently using such areas, including course, name, IMO classification, nationality where possible;
- Non-transit uses of the areas such as fishing, and including gear type, day cruising of leisure craft, racing, aggregate dredging etc;
- Whether these areas contain transit routes used by coastal or deep draught vessels on passage; and
- Alignment and proximity of the wind farm site relative to adjacent shipping lanes

TOW also commissioned MARICO Marine to conduct two offshore vessel traffic surveys using the survey vessel 'FPV MORVEN' to assist in assessing the impacts that the Thanet project may have on navigational users within the site and the surrounding sea area. The surveys were carried out by AIS, radar and direct observation to record all vessel types, in accordance with MGN 275(M) and the data gathered was used to compliment the CNIS radar and other traffic data sources.

The offshore surveys took into account potential peak seasonal variations in small vessel movements, which were not possible to be picked up from the CNIS data. Following detailed consultation with representative fishermen's and recreational vessel organisations and the appropriate port and navigation authorities, it was agreed that the boat based traffic surveys would cover the peak holiday periods when small vessel movements were likely to be at their highest.

Vessel traffic was recorded on a 24 hours basis from 'FPV MORVEN' operating within the Thanet site for two periods of four days covering holiday weekends. Tracks were recorded out to a distance of 24 miles by radar and up to 50 miles, depending on prevailing weather conditions. However, the basic data was culled to concentrate on Ships, Yachts, Leisure Craft and Fishing Vessels within 12 miles of the Thanet site.

Periods for which traffic data were acquired within the last 12 months, as required by MGN 275(M), are detailed in **Table 14.1**.

Table 14.1 Traffic data periods within last 12 months

Period	AIS Recording Days	Radar Recording Days
October 2004	7	7
January 2005	7	7
March 2005	7	7
June 2005	4	4
August 2005	4	4
TOTALS	**29**	**29**

The combination of data has provided a record of vessel tracks taken by all types of vessel in the area, spread over five periods and totalling 29 days within the last 12 months, as required by the MGN 275(M). The database files generated contain positions with data linked for all tracked targets at one minute intervals. The track data was analysed and assessed, taking into account the requirements of MGN 275(M) and the draft guidance currently being developed under the direction of the Department of Trade and Industry (DTI).

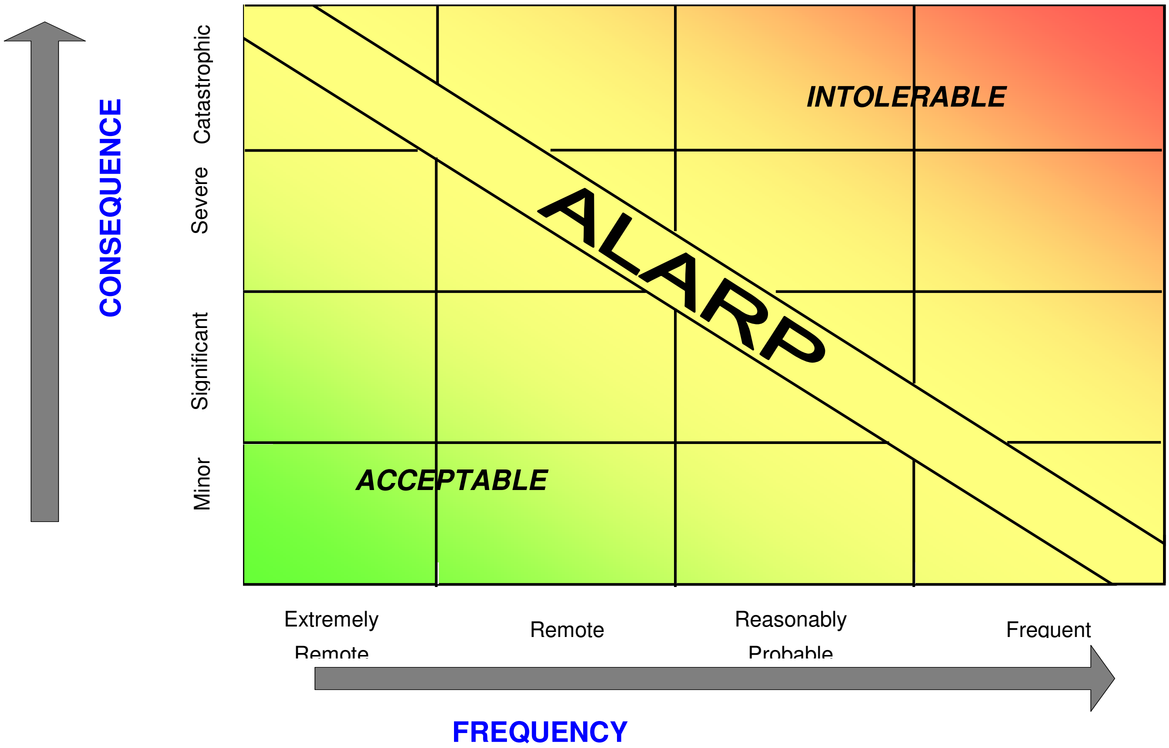
14.2.3 Navigation Risk Assessment

A Navigation Risk Assessment (NRA), as laid out in MGN 275(M), was also carried out with input from a series of consultation meetings held between TOW and navigation stakeholders over a period of more than 18 months. The full report is contained in **Appendix 14.2**.

The NRA for the Thanet project takes into account any additional or increased risks as a result of the construction, operation and eventual decommissioning phases of the wind farm and whether any features of the wind farm could pose any type of difficulty or danger to vessels and their crews operating in the area.

IMO Guidelines define a hazard as *"something with the potential to cause harm, loss or injury"*, the realisation of which results in an accident. The potential for a hazard to be realised can be combined with an estimated or known consequence of outcome. This combination is termed 'risk'. Risk is therefore a measure of the frequency and consequence of a particular hazard. One way to compare risk levels is to use a matrix approach as illustrated in **Figure 14.1**.

Figure 14.1 General risk matrix



At the low end of the scale, frequency is extremely remote, consequence minor and risk can be said to be negligible. At the high end, where hazards are defined as frequent and the consequence catastrophic, then risk is termed intolerable. Between the two is an area defined As Low As Reasonably Practicable (ALARP). The IMO guidelines allow the selection of definitions of frequency and consequence to be made by the organisation carrying out the NRA. This is important, as it allows risk to be applied in a qualitative and comparative way.

ALARP can be defined as 'Tolerable', if the reduction of the risk is impracticable, or if the cost of such reduction would obviously be highly disproportionate to the improvement gained.

Risk matrix criteria

In the study, each hazard was reviewed with respect to cause and effect. Frequencies were derived for notional 'most likely' and 'worst credible' hazard events in each case, using the frequency bands highlighted in **Table 14.2**.

Table 14.2 Risk matrix criteria

1	Frequent	Yearly
2	Reasonably Probable	1 to 9 years
3	Remote	10 to 99 years
4	Extremely Unlikely	100 to 999 years
5	None	More than 1,000 years

Using the assessed notional frequencies for the 'most likely' and 'worst credible' events for each hazard, the probable consequences associated with each event are assessed in terms of damage to:

- People - Personal injury, fatality etc;
- Property - Wind farm and third party;
- Environment - Oil pollution etc; and
- Business - Reputation, financial loss, public relations etc.

The rating applied is such that the consequences are of broadly equivalent or abhorrence value across the categories shown in **Figure 14.2**.

Figure 14.2 Project risk matrix

Category	People	Property	Environment	Business
C0	**None**	**Negligible** < £10,000	**Negligible** < £10,000	**Negligible** < £10,000
C1	**Minor** Two or three slight injuries	**Minor** > £10,000	**Minor** Tier 1 >£10,000	**Minor** >£10,000
C2	**Moderate** Multiple Moderate or single major injury	**Moderate** > £100,000	**Moderate** Tier 2 - limited outside assistance required; oil spill or environmental amenity impaired	**Moderate** Bad local publicity or short-term loss of revenue, etc > £100,000
C3	**Serious** Multiple major injuries or single fatality	**Serious** > £1,000,000	**Serious** Tier 2 - Regional assistance required; oil spill, localised pollution or multiple amenities impaired	**Serious** Bad widespread publicity, temporary closure of wind farm or prolonged restrictions > £1,000,000
C4	**Major** More than one Fatality	**Major** >£10,000,000	**Major** Tier 3 - National assistance required; oil spill, widespread pollution or extensive damage to amenities	**Major** Wind farm closes, navigation seriously disrupted for more than 30 days. Long term loss of income >£10,000,000

Hazard data review process

An expert panel comprising Master Mariners, experienced navigators, construction contractors, wind farm operators, stakeholders and members of the study team scored the hazards identified. Frequency and consequence data was assessed for each hazard in terms of a 'most likely' and 'worst credible' scenario, using the criteria described above. The study team reviewed the frequency and consequence data obtained to ensure internal consistency and also consistency with any existing incident data.

Risk factor matrix used for the assessment

From the frequency and consequence scores, individual risk factors were derived on a scale of 0 (low risk) to 10 (high risk) for each hazard as shown in **Figure 14.3**.

Figure 14.3 Risk factor matrix used for the assessment

Consequence	**Cat 4**	**5**	**6**	**7**	**8**	**10**
	Cat 3	**4**	**5**	**6**	**7**	**9**
	Cat 2	**3**	**3**	**4**	**6**	**8**
	Cat 1	**1**	**2**	**2**	**3**	**6**
	Cat 0	**0**	**0**	**0**	**0**	**0**
	Frequency	**>1,000 years**	**99 – 100 Years**	**9 – 100 years**	**1 – 9 years**	**Yearly**

Hazard ranking

The risk data obtained from the above process was analysed to obtain four indices for each hazard as follows:

- The average risk value of the four categories in the 'most likely' set;
- The average risk value of the four categories in the 'worst credible' set;
- The maximum risk value of the four categories in the 'most likely' set; and
- The maximum risk value of the four categories in the 'worst credible ' set.

These values were combined in MARICO Marine's hazard management software 'Hazman' to produce a numeric value representing each of the four indices. The hazard list was then sorted in order of the aggregate of the four indices to produce a Ranked Hazard List with the highest risk hazards prioritised at the top.

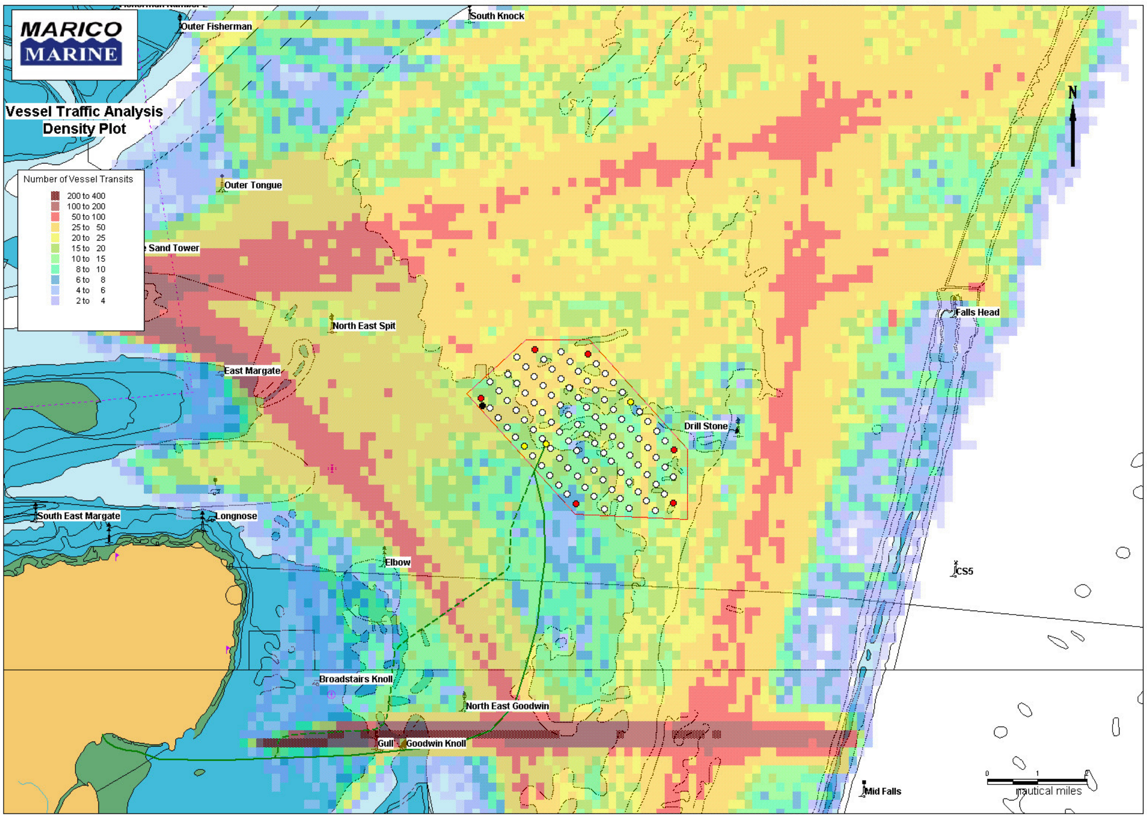
14.3 Existing Environment

14.3.1 Overall traffic analysis

This section of the document presents an analysis of transit data collected from Dover CNIS and 'FPV Morven'. **Figure 14.4** shows a density plot of traffic through the survey area. Each area is an accumulation of the number of vessels that passed through that rectangle during the survey period. The rectangles were set to a size of 300 x 330m approximating to the largest vessel length to be expected. The plot includes all craft using the area.

The density of traffic for the site, which is outlined in red, is low with the densest area in the 25 to 50 ships range or about one to two vessels per day through the most used areas of the site.

Figure 14.4 Thematic plot of all vessel tracks for 29 days

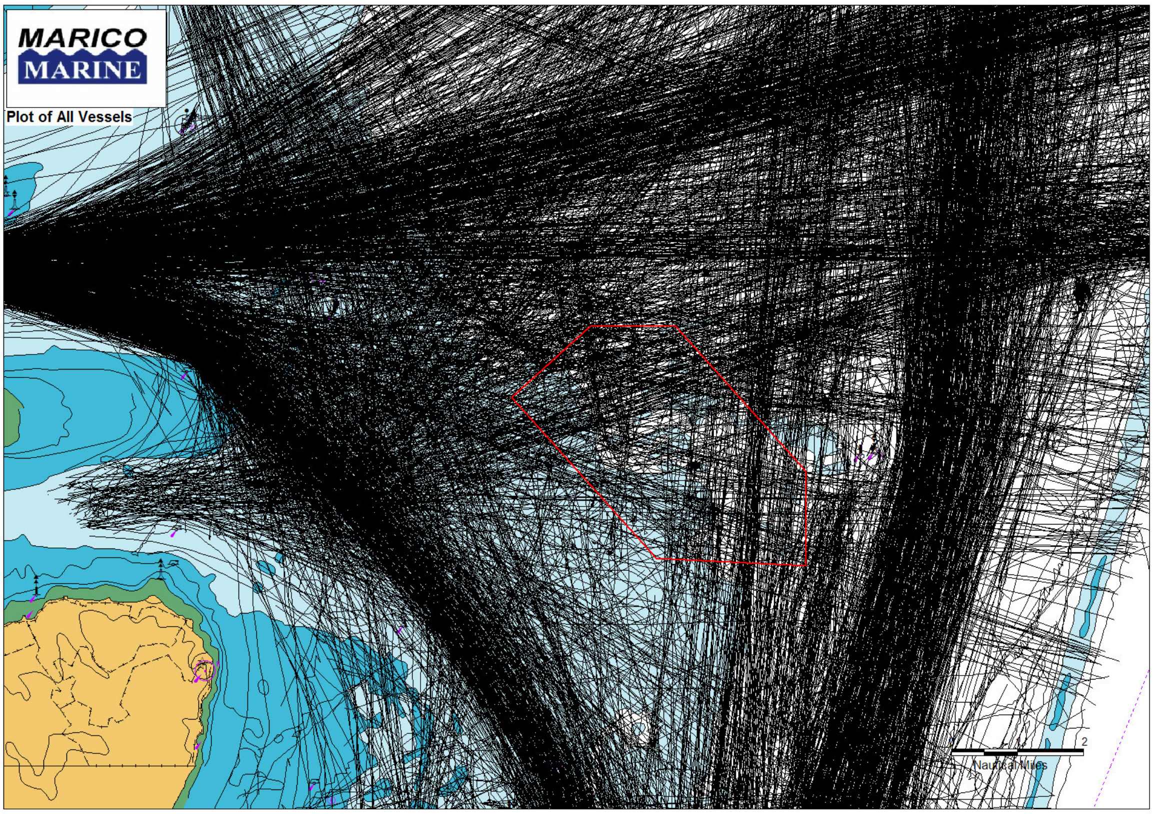


After processing, 289,577 individual records were combined within the GIS database incorporating historic data supplied by Dover CNIS and live data obtained by MARICO operators onboard the patrol vessel 'FPV Morven'.

Statistical analysis has been carried out from the data collected on vessel type, size and transiting draught to produce overall conclusions on navigation and routeing in the area of the Thanet project. Laden conditions and actual draught figures were not present within the CNIS data, explaining the high percentage of 'no details' found in these particular analyses.

Altogether more than 3,600 vessel tracks have been plotted in the 29 days of recoded data and these are show in **Figure 14.5**.

Figure 14.5 Plot of all vessel tracks over 29 days



Vessels in transit through the survey area can be considered in five main groups:

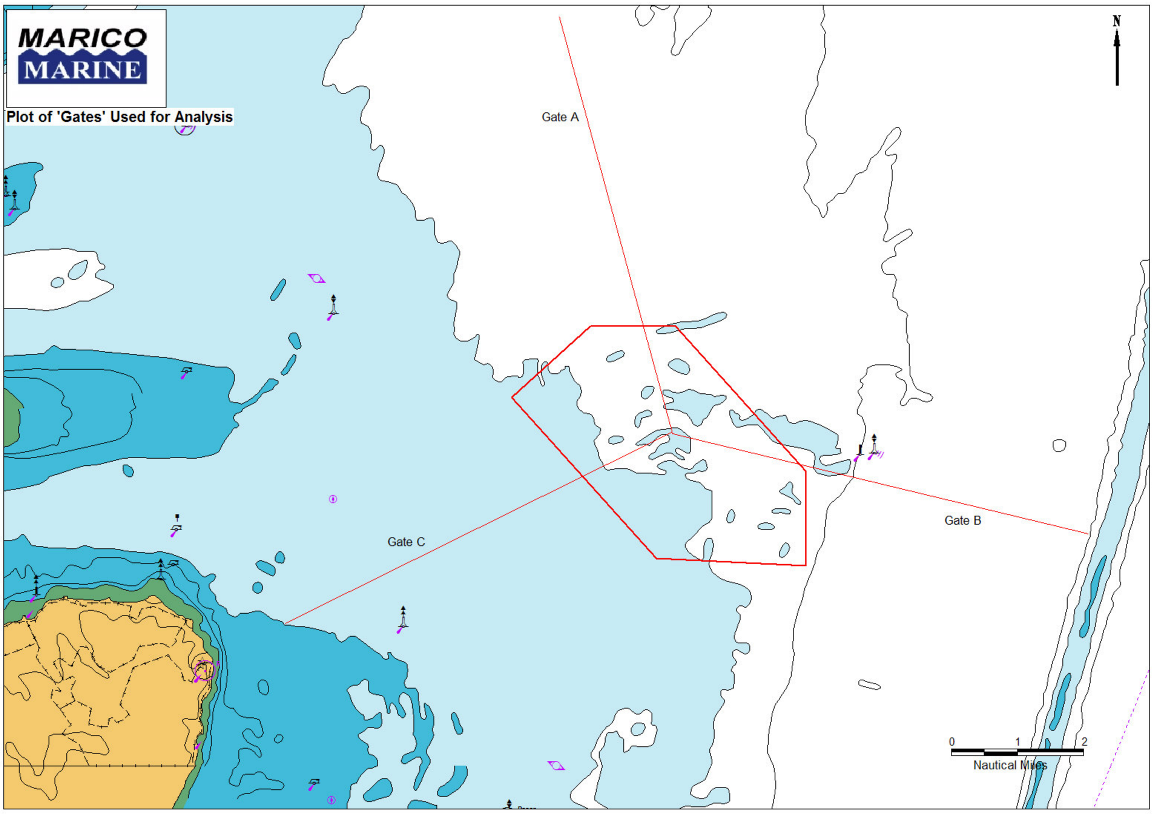
- Traffic bound to/from the North East Spit Pilot Station;
- Traffic bound to/from the east;
- Traffic bound to/from the English Channel;
- Traffic bound to/from the UK east coast; and
- Non-transiting vessels such as leisure and fishing.

14.3.2 Traffic analysis by use of Gates

A series of Gates[1], each with a length of 6.5nm were set from a position within the Thanet site and positioned across the traffic lanes passing through the area (see **Figure 14.6**). This covered the distance to the South Falls Bank to the southeast (Gate 'B') and to just off the Kent coast to the southwest (Gate 'C'). Gate 'A' was set at the same distance for consistency. The Gates were positioned to intersect the main vessel traffic flows within the survey area at right angles. The vessel tracks intersecting the Gates were then analysed by using the database.

[1] A "Gate" is an imaginary line between two points used for analysis of a GIS database.

Figure 14.6 Plot showing the positions of the three Gates used for analysis



The database built for the recording period contained a total of 2,211 vessels passing through the analysis Gates, as shown in **Table 14.3**. The information has been analysed in a number of ways including the use of three 'Gates'.

Table 14.3 Number of vessels in survey – 29 day period (2004-2005)

Vessel Type	Gate A	Gate B	Gate C	Totals
Tanker	113	133	107	353
Dry Cargo	714	374	382	1,470
Passenger	5	8	9	22
Others	55	69	68	192
No details	59	45	70	174
Totals	**946**	**629**	**636**	**2,211**
Average per day	**32.6**	**21.7**	**21.9**	**76.2**

Table 14.3 shows that the average number of vessels transiting the area is approximately 76 per day, despite the fact that there is a large number of vessels proceeding to/from the English Channel passing to the southeast of the Thanet site. By

scaling up to a 12 month period, the indication is that about 28,000 vessels per year transit the area.

Further analysis carried out from the GIS showed that 467 vessels of all types, including Fishing Vessels, entered the Thanet site, an average of just over 16 per day, or some 21% of the total 2,211 vessels tracked in the area.

The level of traffic in the survey area was in line with expectations, based on prior surveys in adjoining areas. In the periods covered by the data, weather conditions were sometimes rough, or visibility poor, but it appears that vessel tracks were not affected by these conditions whilst on passage. A number of vessels also chose to ‘Stooge’ whilst waiting for Pilots or for other operational reasons that did not appear to be associated with the weather.

Figure 14.7 shows an enhanced analysis of traffic flow through Gate ’A’. This indicates that the highest density of traffic in both directions is approximately three miles north of the Thanet site.

Figure 14.7 Vessel density and direction at Gate ‘A’ for 29 day period

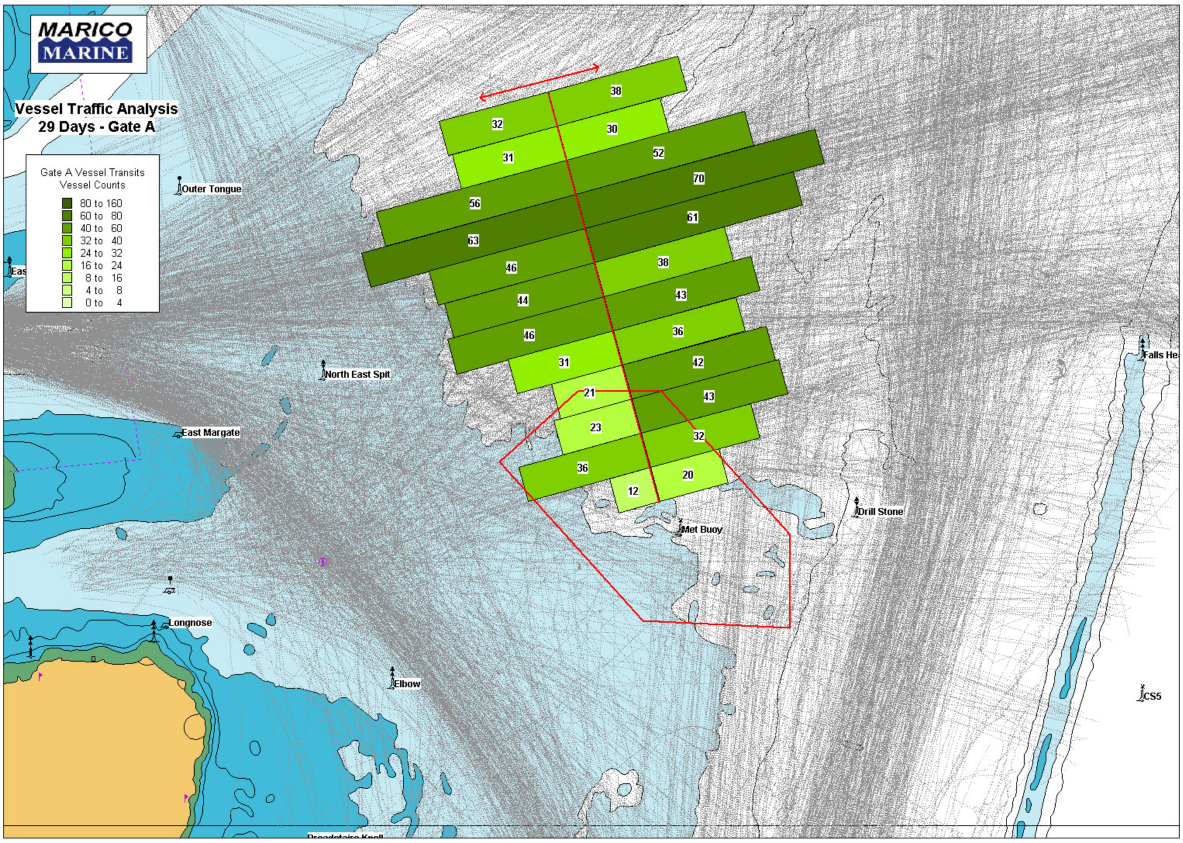


Figure 14.8 shows an enhanced analysis of traffic flow through Gate 'B'. This indicates that the highest density of traffic is approximately 2 miles to the east of the Thanet site. It was observed that the highest numbers of vessels in the plot were using the same track lines in opposing directions.

Figure 14.8 Vessel density and direction at Gate 'B' for 29 day period

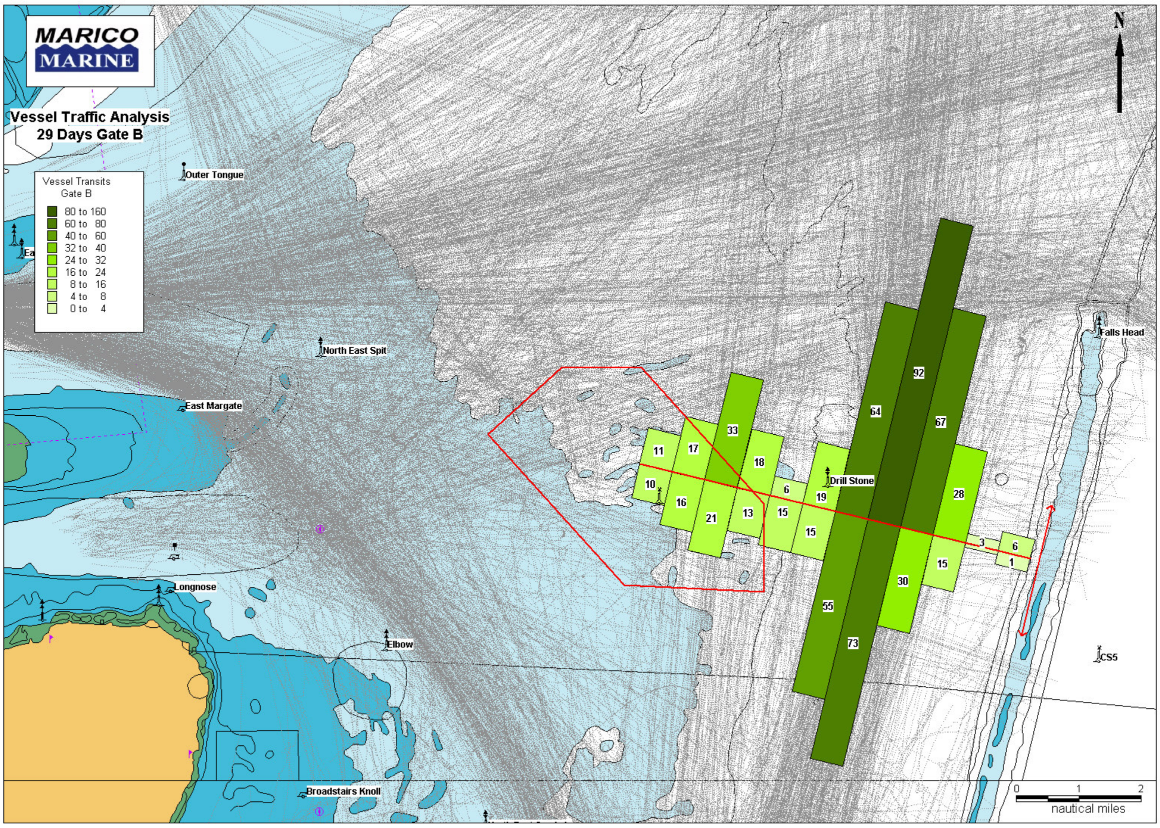
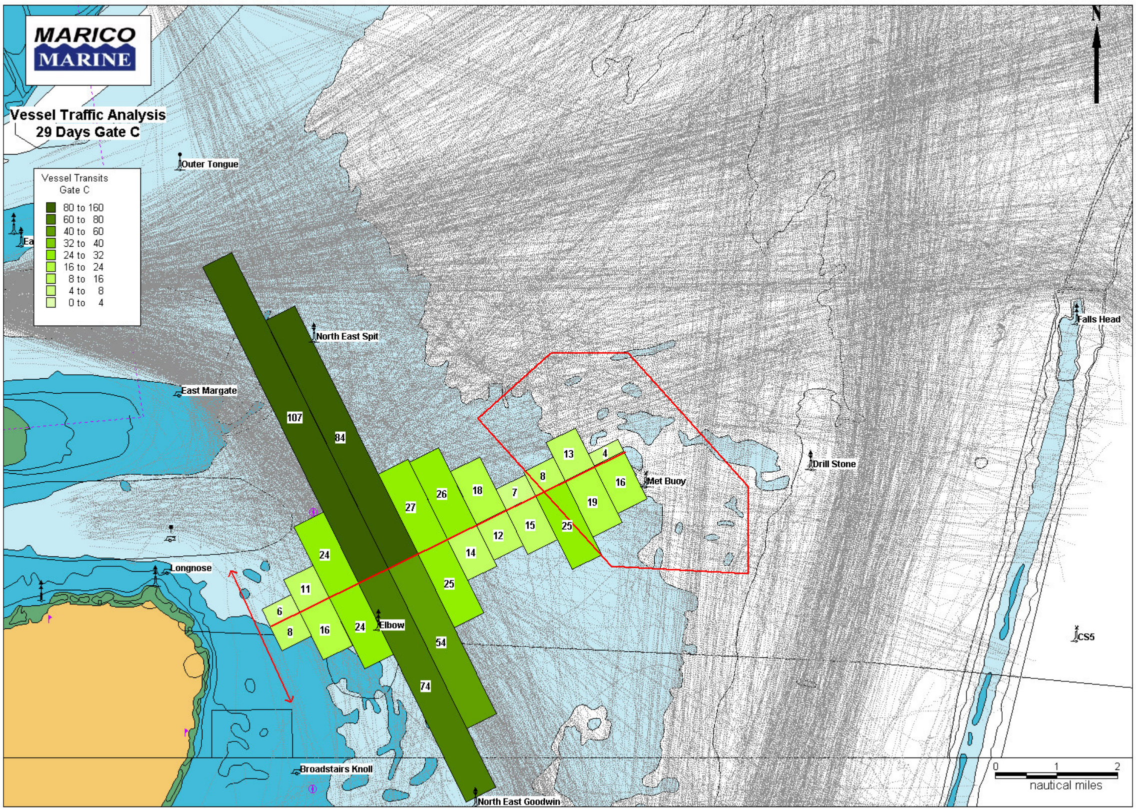


Figure 14.9 shows an enhanced analysis of traffic flow through Gate 'C'. This indicates that the highest density of traffic in both directions is between 2.2 and 3.4 miles from the western boundary of the Thanet site. It was observed that the highest numbers of vessels in the plot were using the same track lines in opposing directions.

Figure 14.9 Vessel density and direction at Gate 'C' for 29 day period



14.3.3 Historic incidents

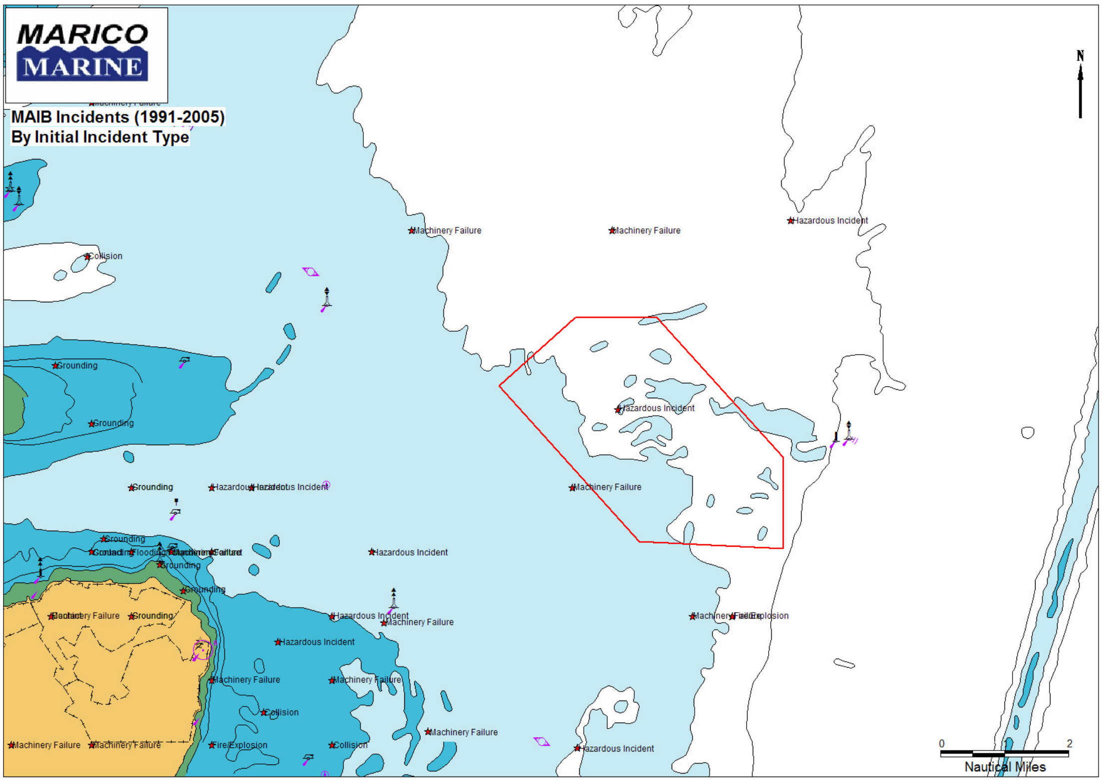
The framework for reporting and investigating accidents is set out in the Merchant Shipping Act 1995. The Merchant Shipping (Accident Reporting and Investigation) Regulations 2005 put the framework into effect. A hazardous incident is defined as an accident that nearly occurs in connection with the operation of a ship, and is often referred to as a 'near miss'.

The Regulations allow for the investigation of 'hazardous incidents', broadly any unspecified events which might have led to an accident, although they do not require such incidents to be reported, but the Marine Accident Investigation Board (MAIB) encourages owners, masters and skippers to report them. The records of incidents are retained in an MAIB database.

The MAIB navigational incident database records 19 hazardous incidents/close quarter situations that have been reported in the study area in the last 14.67 years. Accepting the data limitations of the 29 day sample recording periods, the incident rate on a per movement basis over the 14.67 year period is in the order of 0.4654 x 10^{-4} reported incidents per transiting movement, or an average of 1.30 incidents per annum.

MARICO Marine has previously carried out other navigation surveys where the statistics gave a rate four to five times higher for other similar headland areas, such as Flamborough Head and the Farne Islands. The rate is also much less than that recorded at the entrance to the River Forth of 2.7x10^{-4} reported incidents per transiting movement, where significant densities of fishing vessels exist. This confirms that the Thanet site is a relatively underused area and has a low incident rate when compared to other areas. **Figure 14.10** shows the reported locations of incidents by type.

Figure 14.10 MAIB incidents (1991-2005) by initial incident type



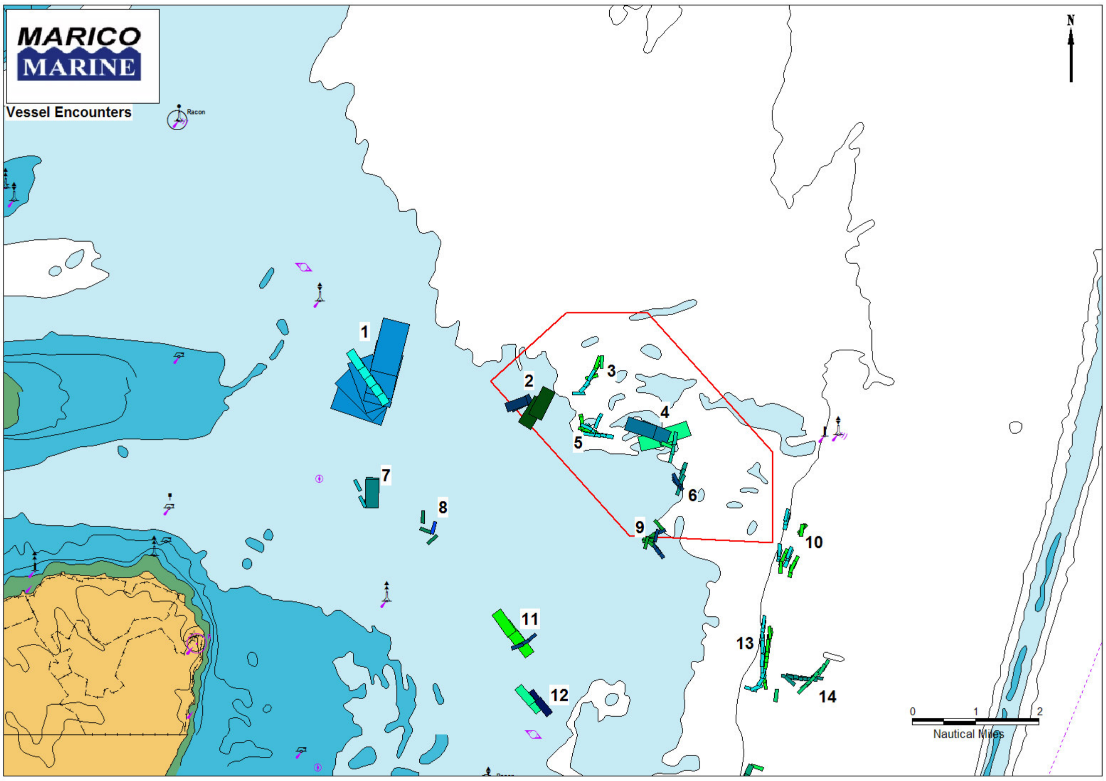
14.3.4 Vessel encounter assessment

An encounter is defined as the intersection of one ship's domain with that of another. Within the confines of the area and with an adjacent Pilotage Station, it was considered that assessing encounters using a high density domain of 0.50nm was unrealistic. More advanced techniques are now available that use specific ship domains, generated individually from the ship's dimensions. This allows encounters between rectangular domains specifically relative to the actual ships involved to be found and closely assessed.

The total database of vessel movements, covering 61 days of observations during 2004 and 2005 was imported into the MARICO Marine Ship Domain Analysis programme and the data interrogated to highlight all close quarter situations. Each ship's domain is generated within the programme with reference to the ship's 'Length Over All' (LOA) using settable parameters. For the North East Spit Pilot Station area, the operations of the Pilot launches were filtered out, as it is the nature of the operation for a Pilot Launch to enter a vessel's domain every time a Pilot is boarded or disembarked, but the movements of the ships at the Pilot Station were included in the assessment.

The 'ship to ship' encounters discovered for this period are shown in **Figure 14.11**, which identifies 15 possible encounters within the 61 day period of observations.

Figure 14.11 Thanet vessel encounter assessment period 61 days 2004 - 2005



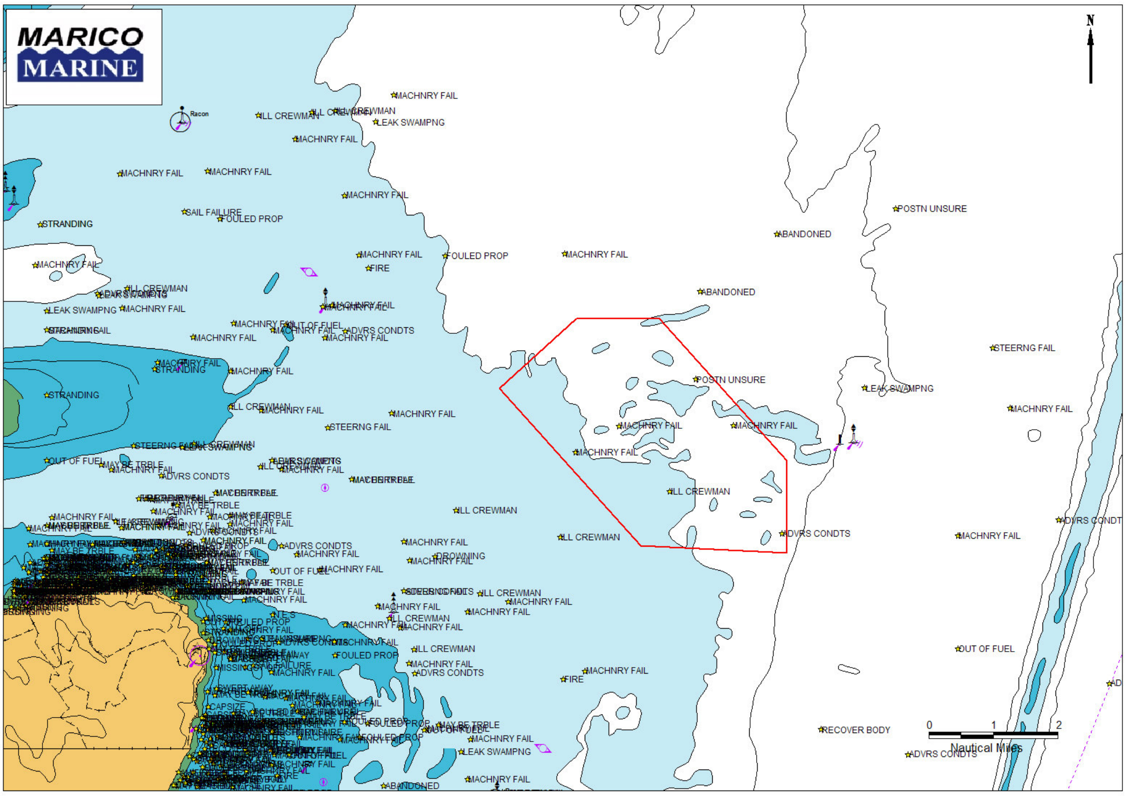
14.3.5 Royal National Lifeboat Institution

In the 10 year period from 1995 to 2004, the boats of the Royal National Lifeboat Institution (RNLI) stations at Ramsgate and Margate were called out on a total of 1,080 occasions, including responses by the inshore lifeboats. These incidents are plotted in **Figure 14.12** by cause. Of this total, 133 were recorded as false alarms. The resulting average number of call outs was 55.2 per year for Ramsgate and 39.5 per year for Margate.

The vast majority of the incidents were within three miles of the coast and only six incidents are recorded within the Thanet site. One of these was due to the Yacht being unsure of its position. It is expected that the presence of the wind farm would enhance navigational aids in the area.

Therefore, the average incident rate within the Thanet site is approximately one every two years. This is a low figure compared to the total number of RNLI call outs, however, the overall situation with Search and Rescue (SAR) is dealt with in **Section 14.3.6**, especially in relation to working with helicopters.

Figure 14.12 RNLI incidents by type



14.3.6 Search and Rescue

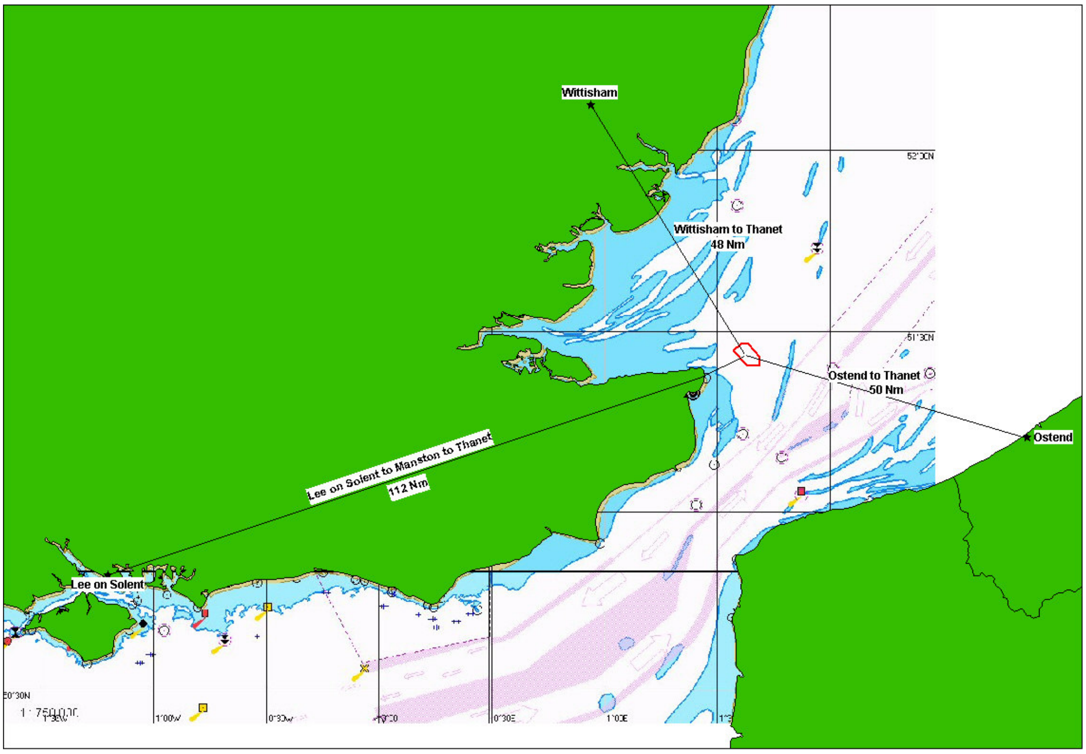
It is clear from the investigations carried out at the North Hoyle offshore wind farm (MCA and QinetiQ, 2004) that with the exception of helicopter operations, the Search and Rescue (SAR) services could continue to operate as at present. However, subsequent investigations carried out highlighted that there could be limitations on the use of helicopters in offshore wind farms and further consultative work continues (MCA, 2005).

The size and capability of the boats used by the RNLI from the stations at Margate and Ramsgate should mean that they would still be able to access the wind farm site without undue problem. This, together with the availability of the wind farm maintenance and support vessels, may provide scope for the development of operational co-operation with the helicopter services.

Helicopter SAR services are available from Wattisham and Lee on Solent. However, the Belgian service at Oostende is also close, as shown in **Figure 14.13**.

The helicopters typically require 15 minutes to get airborne and at their normal flying speed would require about 30 minutes from Wattisham or from Oostende to reach the Thanet site. Therefore, response time would be of the order of 45 minutes. The Lee on Solent helicopter would typically require about 75 minutes to mobilise to site. It is understood that facilities at Manston have been used in the past should re-fuelling be required.

Figure 14.13 Relative positions of helicopter SAR services



14.4 Impacts during Construction

14.4.1 Expected changes in vessel traffic due to the wind farm

Although vessels of many types have been seen to transit the Thanet area, the actual numbers are low. The traffic survey indicates the number, including fishing vessels is in the region of 16 to 17 vessels per day, some of which only cut across the corners of the site. However, the construction of the wind farm would impinge on traffic flows in the area and this is considered below.

The construction of the wind farm is expected to take one to two seasons and during that time the works would generate temporary additional vessel movements in the area. This is expected to vary from small workboats, tugs and barges to large jack-up construction vessels. It is anticipated that much of the construction equipment could come directly to the site from continental ports, however, it is possible that the Port of Ramsgate could be used as a support centre for small vessels. The peak increase in traffic is expected to be up to 20 to 30 vessels and it is considered that this would not cause a significant increase in risk, as they would be under the direction of the Marine Co-ordinator for the project.

14.4.2 Export cables

The export cables would be buried between 1m and 3m under the seabed, depending on localised seabed conditions. Interturbine array cables would also be buried to a target minimum depth of 1m. In areas where the export cables have to cross existing telecommunications cables, structured crossings would be constructed and the cables protected (see **Section 2, Project Details**).

TOW will ensure that all notices required for vessels engaged on subsea projects are given to the CNIS and guard boats employed when working across the main traffic lanes.

The crossing point of the Port of Ramsgate navigation approach channel would be located to the east of 1º 28.3'E to ensure that the export cables do not interfere with the channel (see **Section 2**). Therefore, TOW will ensure that the crossing of the navigation approach channel will not impede arrival/departure of the Ramsgate Ferry or other traffic from this port.

14.4.3 Navigation Risk Assessment

Table 14.4 shows an extract from the top ranked risks during the construction phase, to illustrate the high individual scores that need mitigation, even though the overall risk falls within ALARP.

Table 14.4 Extract from the construction ranked hazard risk

Hazard Detail	Risk By Consequence Category								Risk Overall
	Most Likely				Worst Credible				
	People	Property	Environment	Business	People	Property	Environment	Business	
Dropped major item during installation operations	6	6	0	6	7	7	0	7	5.83
Helicopter crashes onto construction or service vessel	4	7	2	6	6	6	2	6	5.69
Construction vessel encounters existing underwater cables	0	7	0	6	0	7	0	7	5.47
Accident involving leisure craft / sightseers	6	0	0	0	9	0	0	9	5.38
Person in water requires rescue	6	0	0	8	6	0	0	6	5.2
Personnel transfers to/from wind turbine towers from service vessels	8	0	0	0	6	0	0	6	4.83

The highest risk number assessed is 5.83, which is within the ALARP range.

Certain hazard scenarios apply only within the wind farm site i.e. not the export cable route and others apply only within the vicinity of the wind farm site i.e. not on routes to/from ports. These differences are explicit in the Hazard Identification (HAZID) logs included in **Appendix 14.2**.

Although the overall risk numbers fall in the ALARP range, there are a number of individual items that score in the range of 7 to 9, where some consideration for additional mitigation would be beneficial. For example, the highest ranked hazard is "dropped major item during installation operations". Here it is clear that the risk to people in the worst credible case is assessed as being 7 and therefore above the ALARP range. Clearly the close control of the construction phase is essential to mitigate the risk to people.

In each case where the individual assessed risk has scored 7 and above, mitigation would be considered. **Table 14.4** highlights the risk to people if there was an accident involving leisure craft/sightseers at the construction site. The best mitigation for this would be the establishment of Safety Zones to keep non-essential people and vessels away from the construction zone. Additional mitigation would include publicising the dangers, issuing notices to local clubs and sailing organisations.

14.4.4 Safety Zones

As identified above, a 500m Safety Zone around all offshore structures and cable laying vessels would be required during construction for all vessels including fishing boats. This is required on grounds of the safety of life during the construction process, while the structures are being erected and the cables installed. For example, the Thanet site could require the use of a significant number of gravity base structures for the towers and these would vary in size depending on the depth of water and the size of the turbines to be installed. For the largest turbine being considered, these gravity base structures could be up to 41m in diameter requiring extensive construction vessel activity at each site. It is therefore essential that these areas be under the co-ordinated control of the Marine Co-ordinator for the project and that navigation by all vessels not involved in the construction works be excluded from these areas for the safety of life.

14.5 Impacts during Operation

14.5.1 Expected changes in vessel traffic due to the wind farm

It is anticipated that the Port of Ramsgate would be used as the operation and maintenance base for the Thanet project. Even during the peak maintenance period, which would normally be concentrated in the summer months, the increase in traffic is only expected to comprise a few small service vessels and it is considered that this would not cause a significant increase in risk

14.5.2 Export cable routes

The export cables would be buried and their route marked on the appropriate Admiralty Charts. Although the cables would be well protected, it is expected that ships wishing to anchor would chose a site free of cables in the normal way.

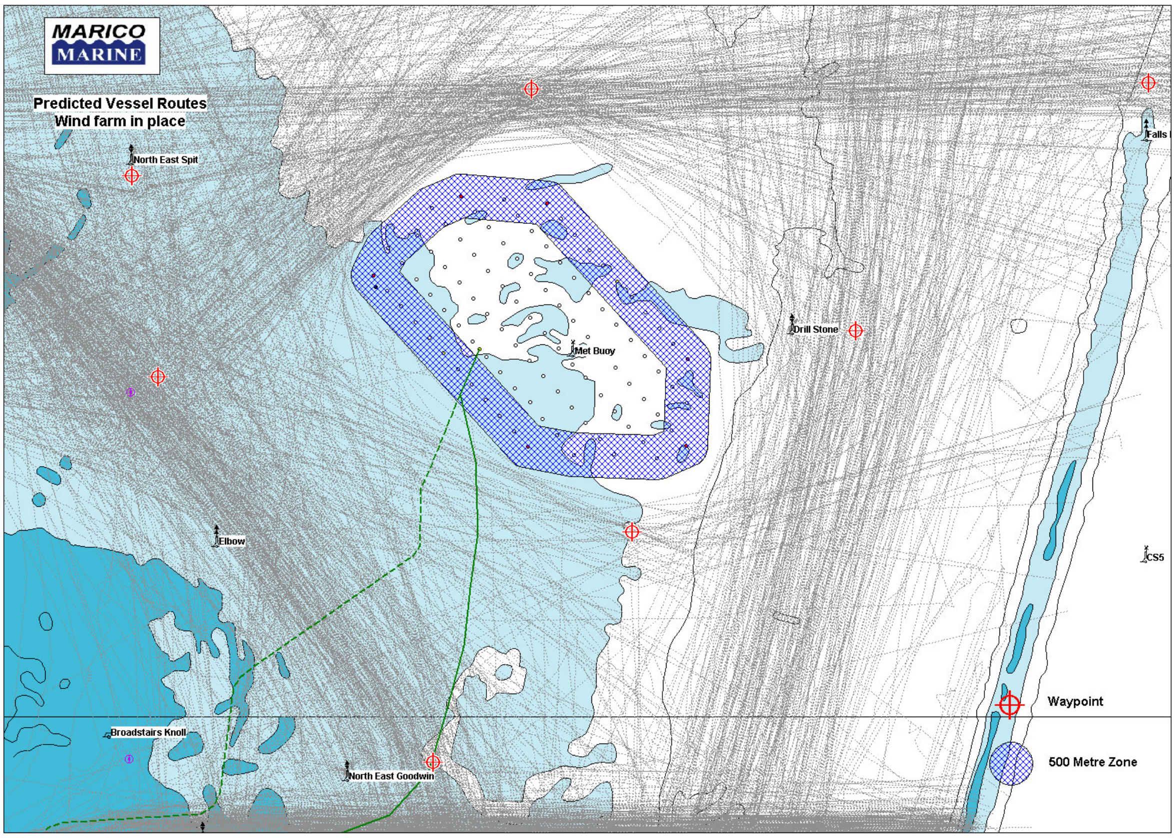
14.5.3 Changes in vessel routing due to the wind farm

To produce an initial estimate of the traffic flows after the construction of the wind farm, the tracks of the vessels that were recorded as passing through the Thanet site were diverted within the GIS to produce **Figure 14.14**. This assumes that the wind farm site is considered to be the area enclosed by the turbines plus a Safety Zone of 500m around the turbines.

As the factors affecting the planning of passages extend well beyond the relatively small sea area of the Thanet site, it is not possible to predict exactly how independent minded Ship's Masters would act. Therefore a consensus of opinion was sought from experienced Master Mariners and senior consultants within the MARICO Marine team to make the assumptions as realistic as possible. The consensus of opinion was that:

- All vessels currently transiting this area, with the exception of Fishing Vessels, would be displaced from their existing Gate sections into the two sections immediately clear of the site in a ratio of 60:40; and
- A small number of vessels could pass to the west of the Drill Stone Buoy, as some currently do, but the majority would be expected to pass to the east as this has the greatest effect on the change in traffic densities

Figure 14.14 Predicted vessel tracks after dispersion from the Thanet site



The above model was created in the GIS from the existing scenario using a Safety Zone of 500m around the outer turbines and the likely traffic flows reassessed. This increased the density of traffic and new bar graphs were generated for each of the three Gates showing the effect of the displaced traffic.

In addition, the analysis has been undertaken assuming the placement of a new navigational buoy approximately 500m to the north of the site, as required by Trinity House Lighthouse Service (THLS) (see below for discussion). This would guide vessels currently passing through or near to the Thanet site to the north to pass round the new buoy, thus increasing the distance from the wind turbines.

To make a comparison of the recorded vessel traffic with that expected during and after the construction of the wind farm, further analysis was carried out using the same three Gates that were used in the original analysis.

As **Figure 14.14** illustrates, there is no single 'route' that can be identified in the area to the north of the Thanet site but rather a convergence of tracks of vessels on passages between waypoints around the area and further afield. The term 'route' is avoided, as it implies imposition of regulating boundaries on traffic flow, such as within a Traffic Separation Scheme. No such system exists in the immediate area.

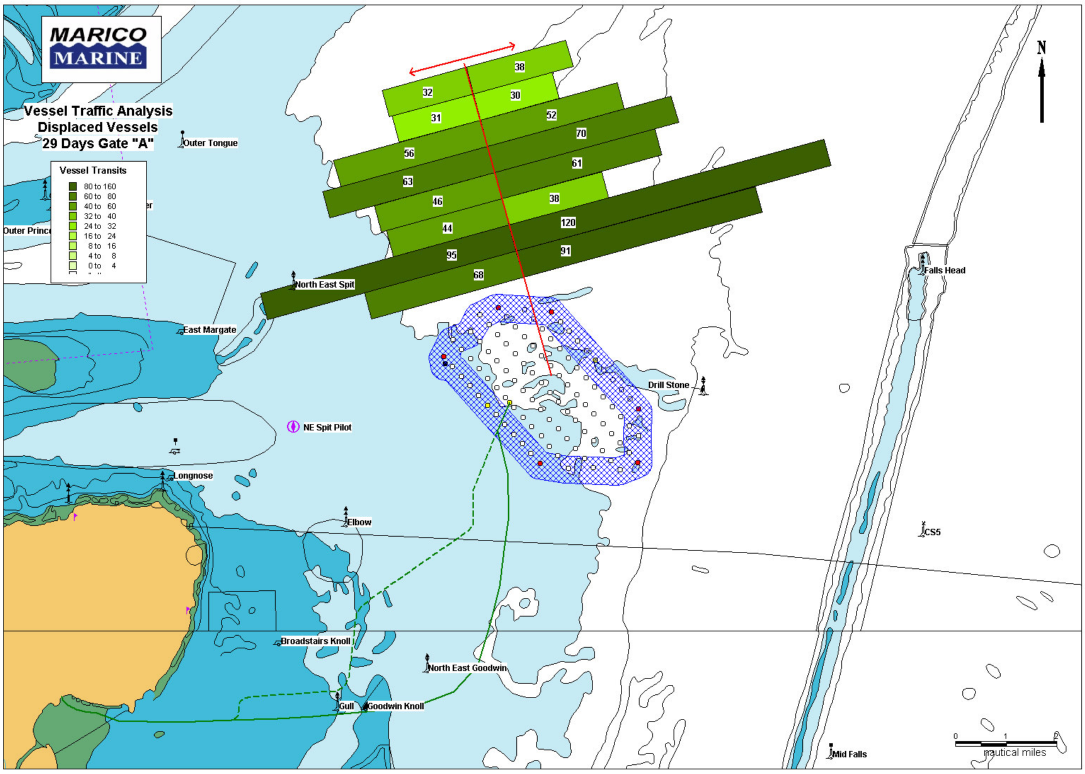
The traffic boundary at its southern edge however can be reasonably defined, as the North Cardinal buoy proposed by THLS would impose this limiting boundary. Mariners should be expected to behave in accordance with normal practices such as plotting their course north of a north cardinal mark.

The model created in **Figure 14.14** is an amalgamation of existing tracks, modified in accordance with mariners' understanding through consultation. The assumptions used in the model are based on real proposed positions for navigation marks. Beyond this, there are very few other assumptions that are not already verified by the existing behaviour of vessels in the area. It is therefore considered that the model is a realistic projection.

Gate 'A' predicted change in traffic density by displaced traffic

Figure 14.15 represents the results of the analysis and reflects the predicted change in traffic densities at Gate 'A'.

Figure 14.15 Predicted traffic densities to the north of the Thanet Site – 29 day period



A comparison of the present number of vessel transits with predicted levels after construction of the wind farm is shown in **Table 14.5**.

Table 14.5 Transits north of the Thanet site

Direction	Recorded vessels per day north of the site	Predicted vessels per day north of the site
East bound	13 to 14	17 to 18
West bound	12 to 13	15 to 16

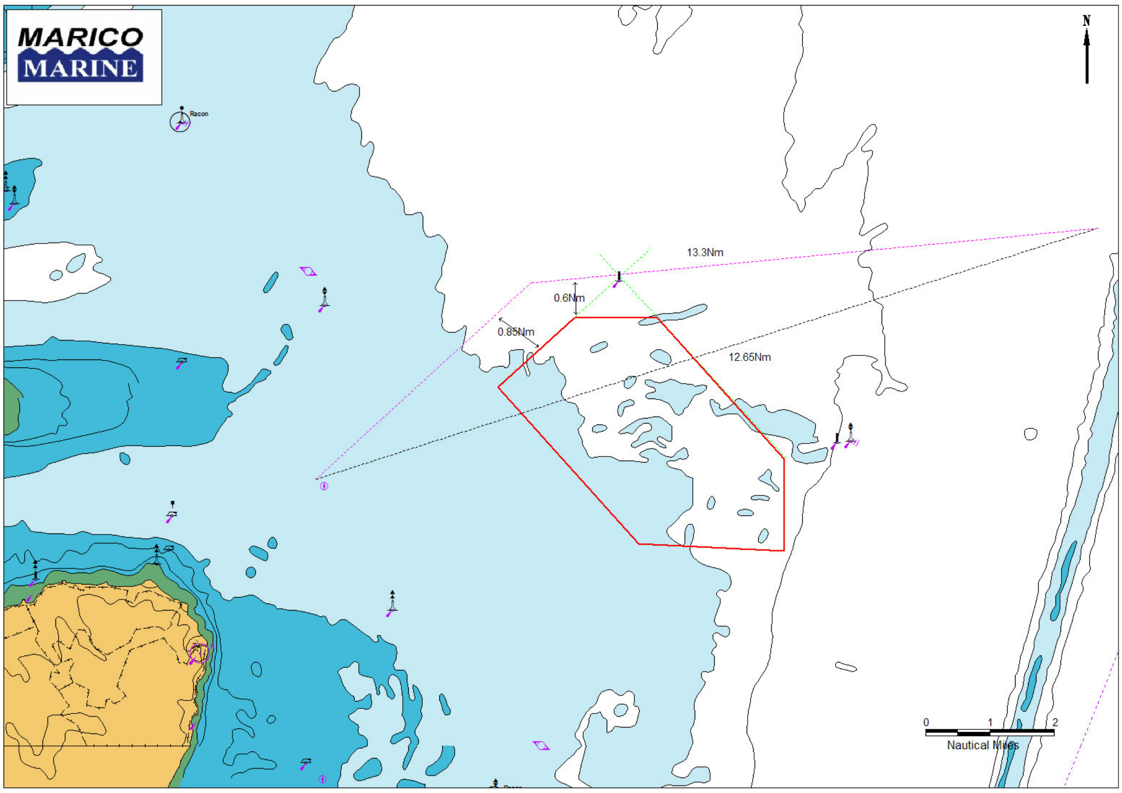
Whilst there would be a significant percentage increase in traffic densities just to the north of the site, in real terms this would only be from the current level of 12 to 14 vessels per day to 15 to 18 vessels per day in each direction. However, it is likely that the traffic would be more concentrated and tracks would pass close to the wind farm, producing an area of vessel traffic that is not normal distribution. On this basis and due to the many individual routes produced by vessels further north (shown in **Figure 14.15**), it has been considered unnecessary to analyse traffic using the 90% distribution, as this would provide unrealistic results.

It was suggested during consultation with THLS that a new navigational buoy should be deployed to the north of the Thanet site. The exact location is yet to be agreed with THLS, but this is expected to be about 500m north of the turbines. This would guide vessels currently passing through the Thanet site, heading to or leaving from the North East Spit Pilot Station from the direction of South Falls Head, to divert to the north to pass round the new buoy.

Figure 14.16 shows the anticipated route passing the new buoy in the original presumed position at the intersection of the lines, which represent extensions of the northeast and northwest boundaries of the wind farm site, thus leaving clearance to the north of the Thanet site boundary, while only increasing the passage distance by about 0.65nm. Should the buoy be positioned closer to the turbines as is likely, the increase in passage distance would be even less. THLS advise that a North Cardinal buoy would be most appropriate for this purpose.

THLS may require an alternate location for the buoy, possibly further to the west or to the east to create protection for either of the two northern corners of the wind farm site. However, the observed tracks indicate that the highest traffic density is most likely to be to the east. By positioning a navigation buoy, ships would be directed further to the north of the Thanet site thus increasing the separation from the wind turbines.

Figure 14.16 Predicted route north of navigation buoy



Gate 'B' predicted change in traffic density by displaced traffic

Figure 14.17 represents the results of the analysis and reflects the predicted change in traffic densities at Gate 'B'.

Figure 14.17 Predicted traffic densities to the east of the Thanet Site – 29 day period

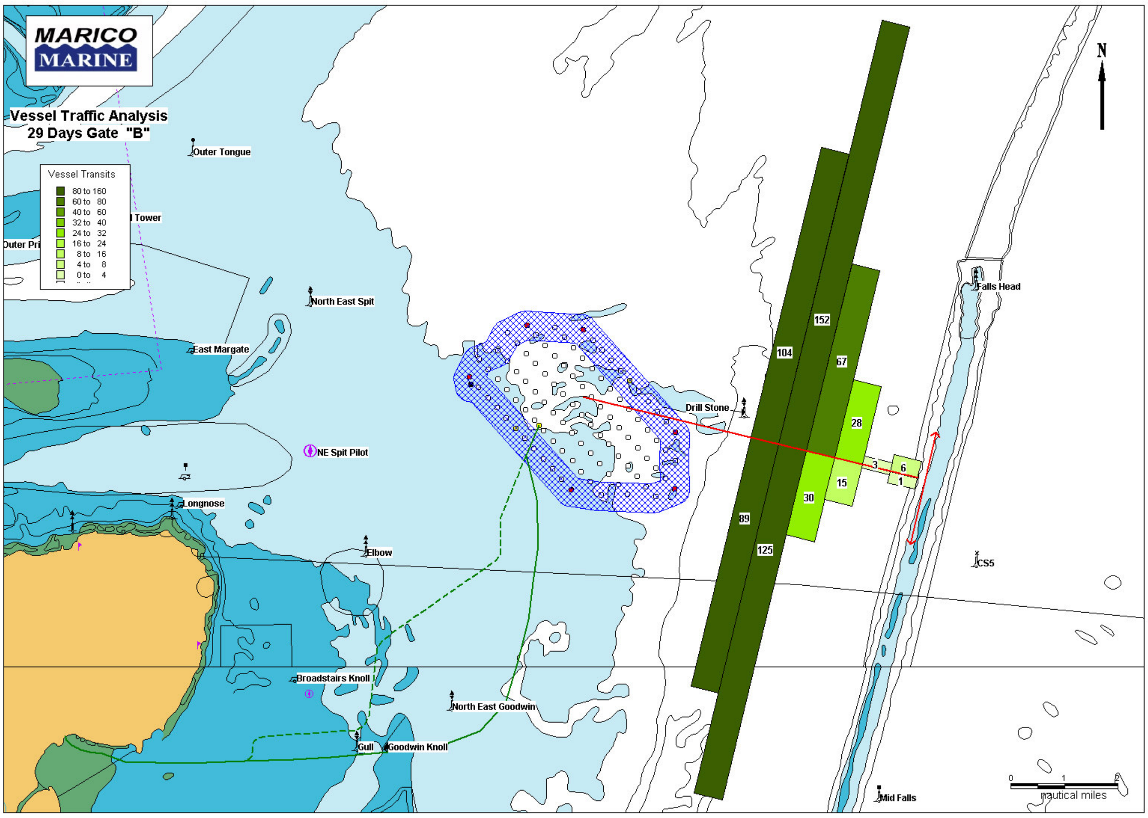


Table 14.6 compares the present number of vessel transits between the South Falls Bank and the Drill Stone Buoy with the predicted levels after construction of the wind farm by consolidating traffic presently transiting the Thanet site:

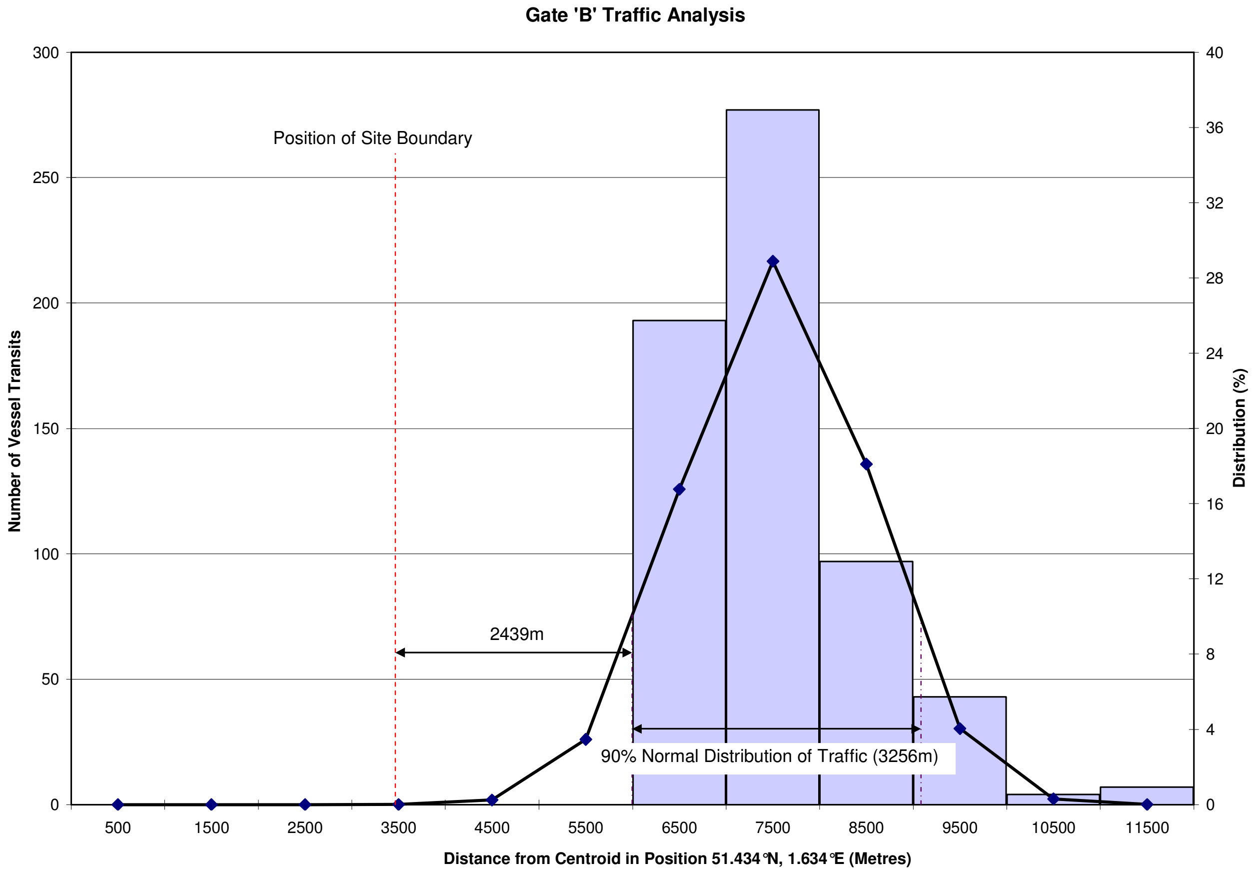
Table 14.6 Transits between South Falls and the Drill Stone Buoy

Direction	Recorded vessels per day between the Falls Bank and the Drill Stone Buoy	Predicted vessels per day between the Falls Bank and the Drill Stone Buoy
North bound	8 to 9	12 to 13
South bound	6 to 7	9 to 10

Whilst there would likely be a significant percentage increase in traffic densities to the east of the Drill Stone Buoy, in real terms this would only be from the current level of 6 to 9 ships per day up to 9 to 13 ships per day in each direction on a remaining Gate length of 6km. This is equivalent to an average of one ship every two hours in each direction and would not present shipping in the area with a significant level of risk. It should also be noted that some vessels could be expected to continue to 'cut inside' and pass to the west of the Drill Stone Buoy, thereby reducing the traffic density further.

Figure 14.18 shows the density of traffic flows and their distance from the turbines.

Figure 14.18 Distance from Thanet site boundary to the nearest shipping

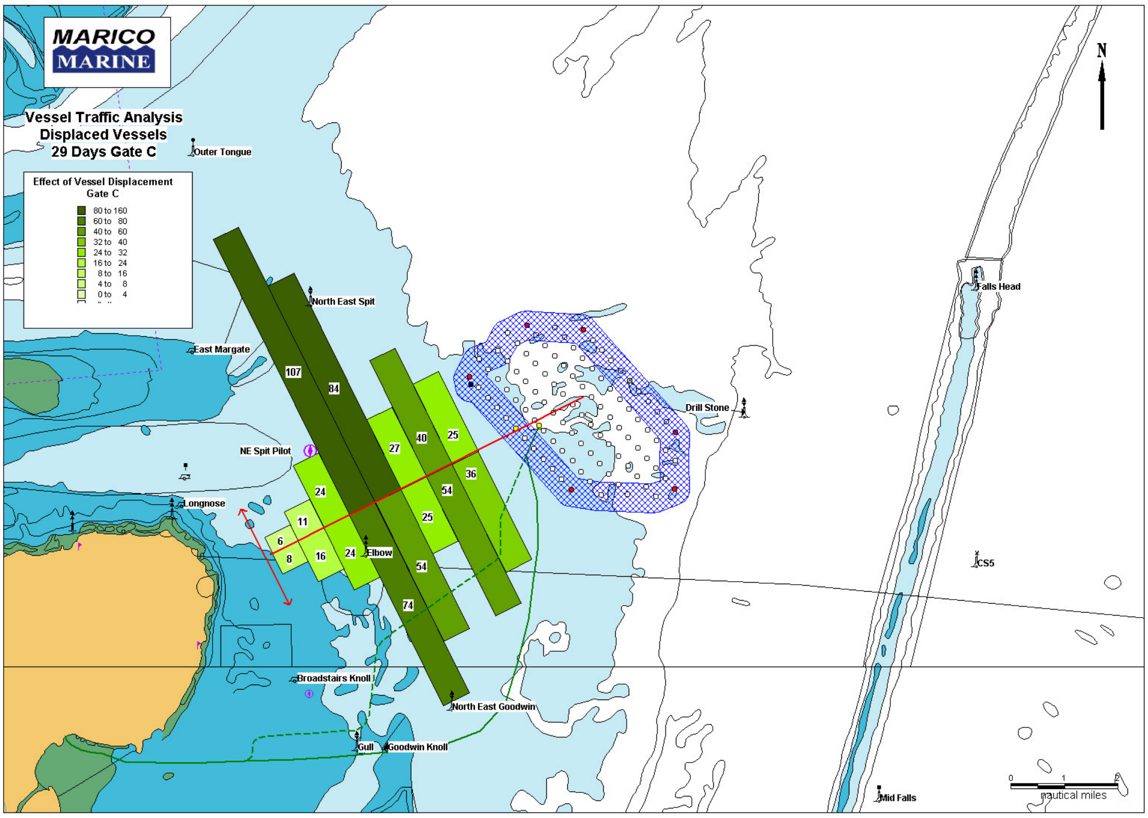


Although the 90% rule is not directly applicable as explained above, **Figure 14.18** clearly shows the distance from the wind farm boundary to the edge of the traffic flow and predicts that this would therefore be about 1.4nm from the nearest turbine. It is therefore considered that no additional mitigation measures would be required in this area.

Gate 'C' predicted change in traffic density by displaced traffic

Figure 14.19 represents the results of the analysis and reflects the predicted change in traffic densities at Gate 'A'.

Figure 14.19 Predicted traffic densities to the southwest of the Thanet Site – 29 day period



Most existing traffic passes well clear to the southwest of the Thanet site. **Table 14.7** compares the current number of vessel transits between the Thanet site and the Goodwin Sands, with the predicted levels after construction of the wind farm by consolidating traffic presently transiting the site.

Table 14.7 Daily transits between the Thanet site and the Goodwin Sands

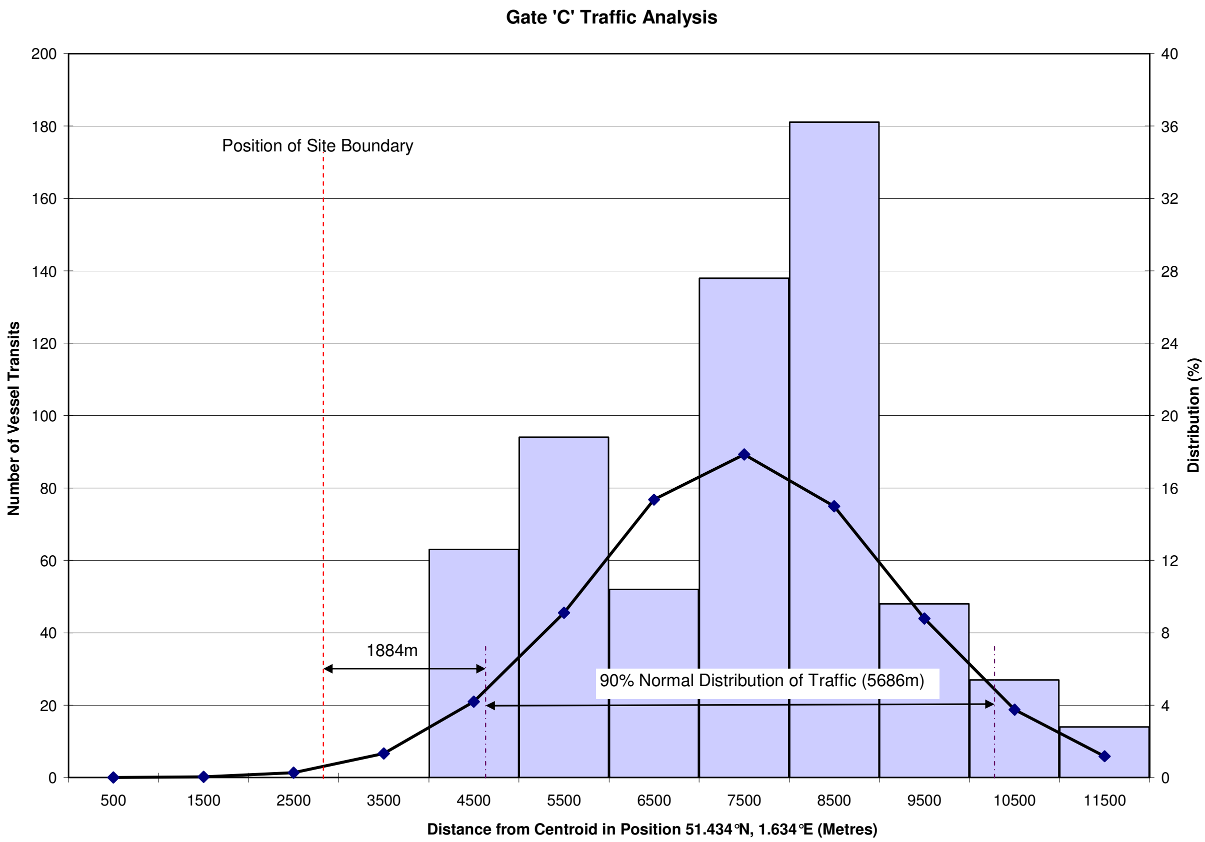
Direction	Recorded vessels per day between the Thanet site and Goodwin Sands	Predicted vessels per day between the Thanet site and Goodwin Sands
North bound	10 to 11	11 to 12
South bound	7 to 8	10 to 11

Whilst there would be a percentage increase in traffic density to the southwest of the Thanet site, in real terms this would only be from the current level of 7 to 11 ships per day up to 10 to 12 ships per day in each direction on a remaining Gate length of 8km. This low average density of about one ship every two hours in each direction would not present shipping in the area with a significant level of risk.

A number of vessels 'Stooge' or drift in the area waiting for Pilots. For example, one Ramsgate ferry spent up to three hours on one day 'Stooging' in and out of the area, between the Ramsgate navigation approach channel entrance and North East Spit, possibly due to heavy weather. This type of action will have tended to increase the numbers of vessels recorded, as some passed the Gates several times in one voyage.

Figure 14.20 shows the density of traffic flows and their distance from the turbines.

Figure 14.20 Distance from Thanet site boundary to nearest shipping



Although the 90% rule is not directly applicable as explained above, **Figure 14.20** clearly shows the distance from the wind farm boundary to the edge of the traffic flow and predicts that this would therefore be about 1.1nm from the nearest turbine. It is therefore considered that no additional mitigation measures would be required in this area.

14.5.4 Possible changes in incident rate due to changes in traffic flow

It is clear from the above that the wind farm would displace existing traffic and concentrate the ships in adjacent areas. The resulting increases in traffic densities in the areas just outside the Thanet site due to the displacement of traffic from the site can be calculated to be between 15.4% and 41.8% above existing vessel densities. However, in real terms, the predictions show that even when making a simple adjustment to the current MAIB overall incident rate, values of below 0.7 x 10^{-4} incidents per transiting movement still represent relatively low levels in comparison with other areas of the UK coast.

In addition, it is believed that many Ship's Masters are likely to leave the wind farm to port, leaving their starboard side open for manoeuvring. This may well have the effect of increasing lamina flow around the wind farm and reducing crossing traffic interaction, thereby providing a possible beneficial impact of forcing vessels into better defined lanes. Therefore, the incidence of high risk close encounters currently observed around the site (see **Appendix 14.1**) would be reduced.

14.5.5 Navigation Risk Assessment

Table 14.8 shows an extract from the top ranked risks during the operation phase to illustrate the high individual scores that need mitigation, even though the overall risk falls within ALARP.

Table 14.8 Extract from the operation ranked hazard risk

Hazard Detail	Risk By Consequence Category								Risk Overall
	Most Likely				Worst Credible				
	People	Property	Environment	Business	People	Property	Environment	Business	
Fishing Vessel's drift nets become entangled in wind farm structures	6	6	8	6	7	7	6	6	7.24
Trawl nets expose and make contact with infield cables or turbine tower structures	3	6	3	3	8	7	6	6	6.32
Helicopter crashes onto maintenance vessel	6	6	2	5	5	5	1	4	4.90
Large drifting vessel makes contact with a wind turbine tower	2	4	2	2	6	6	6	6	4.80
Wind farm maintenance vessel collides with a Ferry	2	4	0	6	5	5	4	5	4.76
Small drifting vessel makes contact with a wind turbine tower	3	6	3	3	4	4	4	4	4.72
Small navigating vessel fouls an interturbine cable	0	6	0	6	6	3	2	5	4.71
Accident involving leisure craft / sightseers	6	0	0	0	7	0	0	7	4.63

The highest risk number 7.24 is above the ALARP range. Additionally there are a number of individual items that score 7 to 8 where some consideration for additional mitigation will be necessary.

The risks posed by drift netting and trawling in the wind farm site are highlighted in **Table 14.8**, where individual assessments are also in the 7 to 8 range and therefore require mitigation. The best mitigation for this would be the establishment of Safety Zones to prohibit drift netting and trawling within 500m of all offshore structures.

Fixed net fishing and potting were scored at a risk number of 3.43 and are therefore not assessed as presenting a significant risk, so these activities could continue, although it would be preferable to maintain a Safety Zone of 50m around each offshore structure to ensure that such activities are kept away from any potential subsea structures or scour holes.

Potential hazards created by leisure craft and/or sightseers have been highlighted with risk numbers of 7. Here again some additional mitigation measures would be necessary and these could include publicising the dangers, issuing notices to local clubs and sailing organisations.

14.5.6 Other navigational considerations

Navigational markings

The wind farm towers will be painted, marked and fitted with navigation lights in accordance with THLS requirements, which will comply with the IALA standards and the additional requirements of MGN 275(M). Significant peripheral structures and intermediate structures of the site will be additionally marked in accordance with the IALA recommendations, as shown in **Figure 14.21**. The site will be fitted with an AIS transceiver and sound signals, as required by THLS and procedures will be put in place to respond to failures of aids to navigation. A maintenance regime for all aids to navigation for the wind farm is necessary and TOW will ensure that this is in place, such that the THLS availability criteria are met at all times (see **Appendix 14.1**).

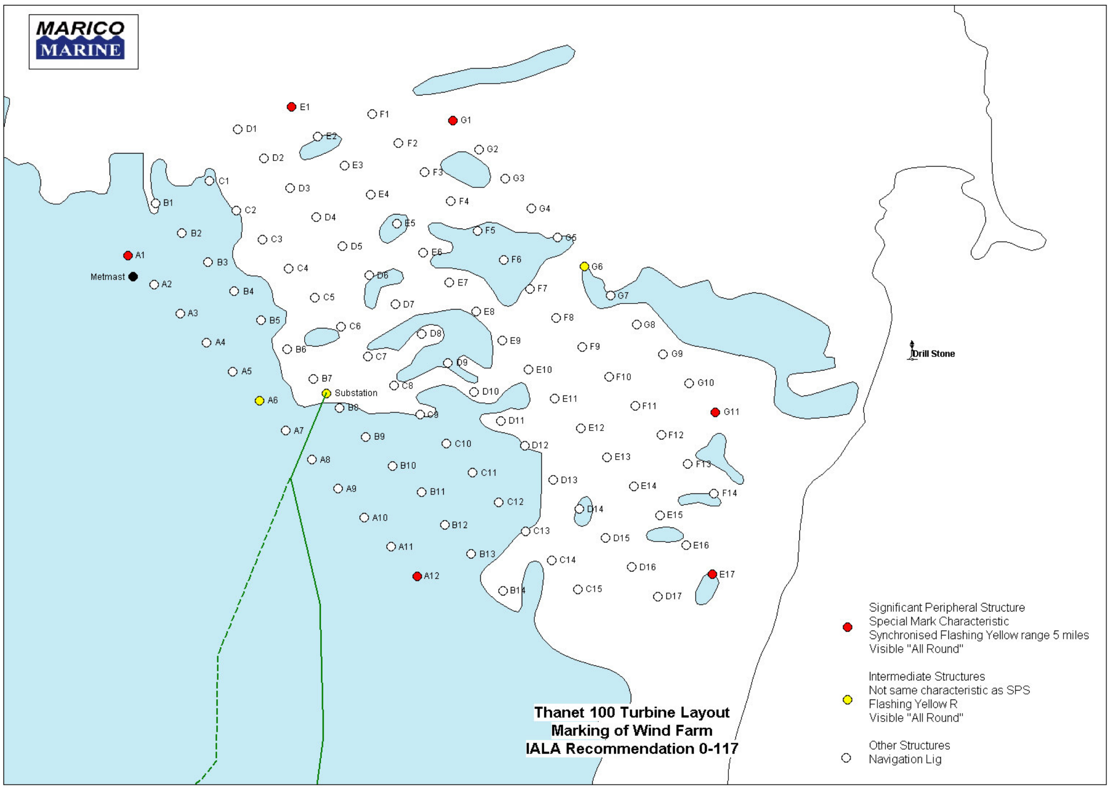
Hindrance of lines of view of other vessels by the wind farm

Vessels passing to the north of the wind farm would be guided by the new navigation buoy, as recommended by THLS, which will be set sufficiently far to the north of the wind farm, that even in the worst circumstances, vessels would have clear sight of any westbound traffic at a minimum range of four miles.

It is recognised that the higher numbers of turbines in some of the layouts being considered would likely increase the visual impairment locally for vessels navigating in the area.

The traffic flow is more lamina to the east in the area of the Drill Stone Buoy and the need for routeing course alterations lower. Crossing traffic would tend to be further to the north or to the south than at present due to the presence of the wind farm. The main crossing areas would therefore be well clear of the wind farm and the turbines would not cause an obstruction to sighting other vessels.

Figure 14.21 Wind farm with significant peripheral structures marked



Vessels on passage to/from the Thames Estuary via the Princes Channel and aiming to cross the Falls Bank would most likely be displaced to the south and need to make a small alteration of course to pass the corner of the Thanet site. This alteration would be of the order of 20 degrees in otherwise open waters. In this context, the wind farm angles away sharply to the northwest, opening the view to any oncoming ships.

With the appropriate navigational aids in place, the wind farm would not significantly restrict a vessel's view of other vessels. There would be no significant restriction in the view of the coastline or existing aids to navigation.

Communication, radar and positioning systems

The effect of wind farms on navigation technology has been examined in projects focusing on maritime (MCA and QinetiQ, 2004) applications. Further trials were carried out to assess the impact on Search and Rescue operations in conjunction with a Royal Air Force helicopter (MCA, 2005). There is general consensus that the impact of wind farms on technology routinely used in maritime navigation is benign, with one exception, that being radar.

Whilst there may be an area of reduced radar coverage to the east of the Thanet site, its affect on the existing or future Margate radar station, would not be significant (see **Section 16, Radar and Transmission Systems**). This radar system provides data to both the Port of London Authority (PLA) and the Channel Navigation Information Service (CNIS). Neither the PLA nor CNIS have expressed concerns in this respect during the consultation process, as the potential area affected is not in a high priority are for them.

There may be an affect on current shipborne radar, especially at distances of less than 1.5nm. TOW is an active member of the cross-industry working group that is considering possible mitigation measures and will abide by any industry guidelines that come out of this group.

Search and Rescue

TOW is mindful of the Search and Rescue (SAR) implications and is fully aware of the importance of maintaining the effectiveness of the SAR services in the area. Therefore, TOW will work with the MCA before the offshore construction activities commence to develop detailed and effective SAR plans and procedures for the Thanet project that cover the construction, operation and decommissioning phases.

The possible perceived increase in the need for SAR due to the wind farm could be mitigated by jointly developing procedures with the SAR services and providing co-ordination training for the wind farm service vessels' crew. Therefore the following action plan is proposed:

- Meet with the SAR services directly to understand the basics of helicopter and lifeboat operation and learn from their offshore experience;
- Jointly develop procedures with the SAR services and provide co-ordination training for the wind farm service vessels' crew;
- Using the principles of BATNEEC (Best Available Technology Not Exceeding Excessive Cost), justify how best to move forward and achieve realistic safety cover for the Thanet site; and
- Jointly create a risk assessment leading to the development of a methodology for SAR operation in the vicinity of the wind farm.

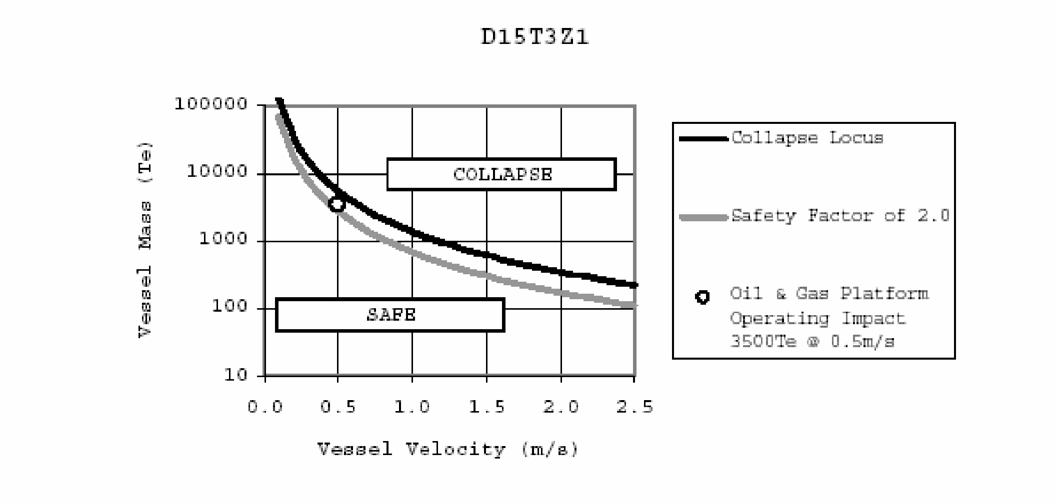
Consequence of vessel allisions with turbines

A study was conducted by Bomel to assess the damage to turbine towers in the event of an allision, where an allision is an impact between a moving vessel and a fixed structure such as one of the turbine towers. The study concluded that tower structures would fail in accordance with the graph depicted in **Figure 14.22**.

The collapse locus extends in the study to a vessel of 100,000 tonnes displacement that would need to be drifting at approximately 0.1m/s (0.2 knots) to cause collapse. At the other end of the scale, the locus tends towards level gradient having followed a curve approximating to parabolic. The curve shows a vessel of approximately 130 tonnes displacement at 2.5m/s (5 knots) being capable of initiating a similar collapse.

The vessel mass is assumed to be rigid, which errs towards safer parameters, even though the rigidity of vessel structures, particularly the larger ones, is such that an allision event could result in a breaching of the vessel's hull integrity.

Figure 14.22 Collapse locus: vessel impact with monopile



In cases of machinery failure causing loss of control, vessels may be set towards the wind farm structures. The Thanet site is in relatively deep water and therefore a drifting vessel would not be stopped by grounding before it reached the offshore structures. Controlling a disabled vessel by use of anchors would be a definite avoidance measure, providing there was sufficient sea room and time to anchor. Most large vessels have accommodation blocks and wheelhouses well over 22m above sea level, which could be at risk of coming into contact with rotating blades.

Considering that it has been estimated that a vessel of approximately 130 tonnes displacement was capable of initiating a tower collapse at 2.5m/s (approx 5 knots), which is greater than the maximum tidal flows at the wind farm site (see **Section 6, Hydrodynamics and Geomorphology**), it is considered necessary that a 500m Safety Zone be established around all offshore structures to reduce the risks of drifting contact from vessels of 300GT and above, which would include most vessels over 130 tonnes displacement.

14.5.7 Safety Zones

As identified above, a 500m Safety Zone around all offshore structures would be required during operation for all vessels above 300GT. This is for the safety of ships to allow sufficient distance for the vessels to anchor or take other evasive action in the event of a sudden breakdown or malfunction of machinery while navigating in the vicinity of the wind farm. It would also allow sufficient time for the wind farm control room to stop the turbines in the immediate vicinity, before the vessel drifted into the wind farm site. The Safety Zones are required on the grounds of the safety of life at sea, as the superstructure of larger vessels could be struck by rotating blades with the potential to cause injury to the ship's crew.

Furthermore, this distance is consistent with the MCA's draft 'Wind Farm Shipping Route Template', which suggests that shipping should be kept a minimum of 500m from wind turbines and that the area should be designated as 'Small Craft Only Recommended'.

For vessels under 300GT, navigation within the site would be permitted but with a Safety Zone of 50m around each offshore structure. This distance is roughly equal to the size of the largest gravity base foundation including scour hole, and would therefore ensure that there was no possible interaction between the vessel and offshore structure.

With regard to fishing in the area, potting and fishing with fixed nets would not pose a safety risk to the fishermen. However, should loose drift nets become snagged across turbine towers or other structures, they would present a danger to all vessels and boats permitted to use the area. Therefore, the potential risk of injury to fishermen and others would be significant.

Trawl nets and their heavy bottom gear could agitate the seabed and expose the interturbine cables and/or the gear could become snagged on the wind farm structures. The unexpected snagging of fishing gear would present a risk to the fishermen and therefore, as with the use of drift nets, preventative action is necessary. It is therefore considered necessary that a 500m Safety Zone be established around all offshore structures to exclude all fishing with drift nets or trawling within these areas.

14.6 Impacts during Decommissioning

14.6.1 Expected changes in vessel traffic due to the wind farm

The eventual decommissioning of the wind farm and the clearance of the site would be substantially a reverse of the construction phase and there would be similar requirements in terms vessel movements to the construction phase.

14.6.2 Navigation Risk Assessment

Table 14.9 shows an extract from the top ranked risks during the decommissioning phase to illustrate the high individual scores that need mitigation, even though the overall risk falls within ALARP.

Table 14.9 Extract from the construction ranked hazard risk

Hazard Detail	Risk By Consequence Category								Risk Overall
	Most Likely				Worst Credible				
	People	Property	Environment	Business	People	Property	Environment	Business	
Dropped major item during decommissioning operations	6	6	0	3	7	7	0	6	5.59
Member(s) public involved in accident	6	0	0	0	9	0	0	6	5.16
Accident involving leisure craft sightseers	6	0	0	0	9	0	0	6	5.16
Decommissioning vessel encounters existing underwater cables	0	7	0	3	0	7	0	3	5.07
Aircraft hits wind turbine blades or tower and crashes	3	6	2	5	5	5	1	5	4.81
Helicopter crashes onto decommissioning vessel	6	6	2	5	5	5	1	4	4.9
Decommissioning vessel collides with a fishing or recreational vessel	6	3	0	3	6	3	2	5	4.78
Decommissioning vessel collides with a fishing or recreational vessel	6	3	0	3	6	3	2	5	4.78
Vessel collides with tower while navigating	3	6	3	0	5	5	3	3	4.54
Person in water requires rescue	6	0	0	6	6	0	0	3	4.29

The highest risk number assessed, 5.59 is within the ALARP range. Although the overall risk numbers fall in the ALARP range, there are a number of individual items that score in the 7 to 9 range where some consideration for additional mitigation would be necessary.

In each case where the individual assessed risk has scored 7 and above, mitigation would be considered. The table highlights the risk to people if there was an accident involving leisure craft / sightseers at the construction site. The best mitigation for this would be the establishment of Safety Zones to keep non-essential people and vessels away from the construction zone. Additional mitigation measures could include publicising the dangers, issuing notices to local clubs and sailing organisations.

14.6.3 Safety Zones

The eventual decommissioning of the wind farm and the clearance of the site would be substantially a reverse of the construction phase and there would be similar requirements in terms of Safety Zones to the construction phase in order to ensure the safety of life at sea.

14.7 Cumulative effects

14.7.1 Effects on navigation of other Thames Estuary wind farms

Other wind farm developments in the wider area include Kentish Flats, London Array and Greater Gabbard wind farms as shown in **Figure 1.1** in **Section 1, Introduction**.

The closest distance between the Thanet site and London Array is 6.55nm and is therefore within the 5 to 10nm range that is labelled as 'Tolerable' in the draft 'Wind Farm Shipping Route Template' (MCA, 2005). All other wind farm developments are outside of this range.

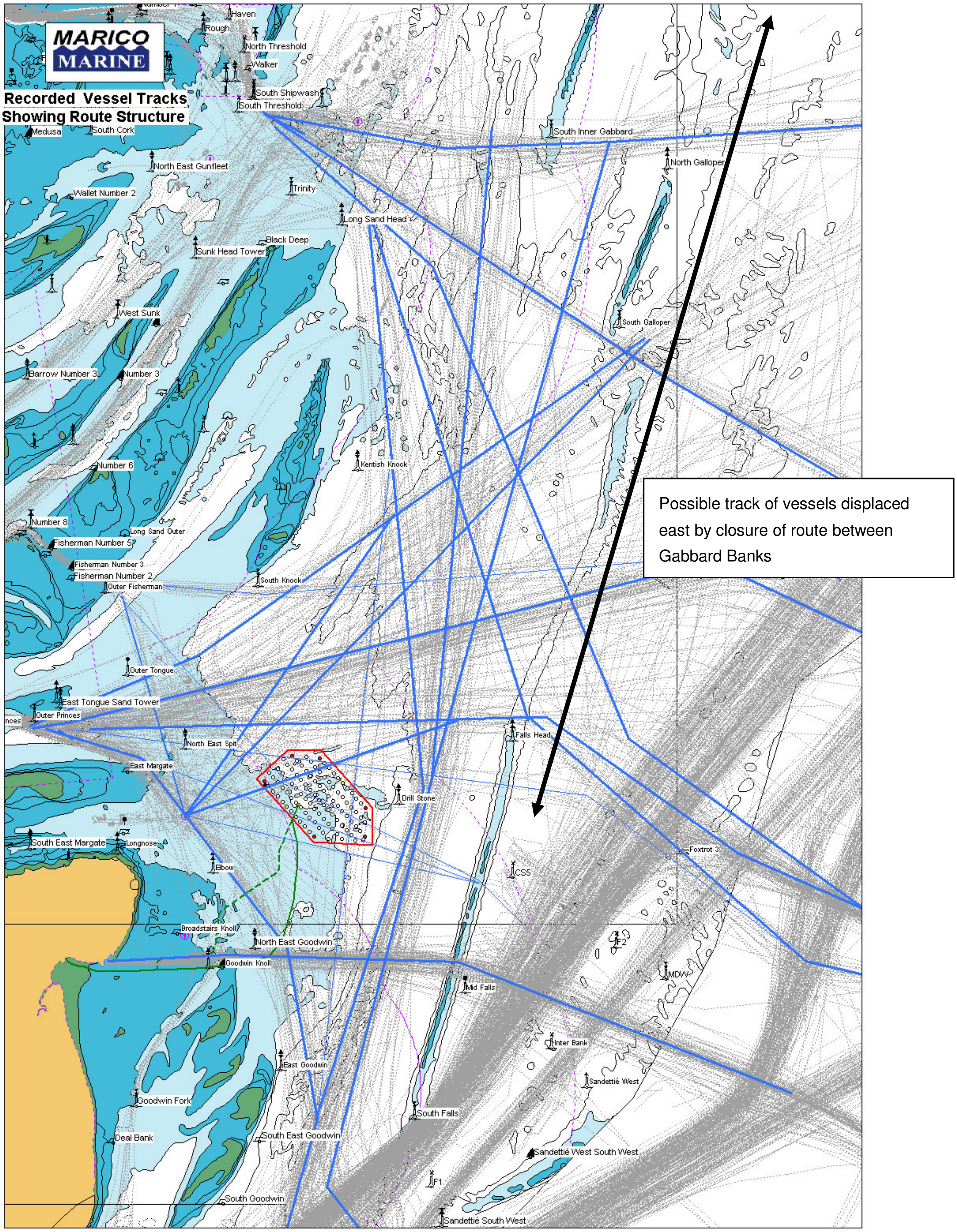
The vessel traffic flows in the vicinity of the London Array are not expected to significantly affect the Thanet project, as the developers are predicting only minor changes in traffic patterns due to the installation of the wind farm (RPS, 2005). It is understood that there is no intention of closing or restricting the Fisherman's Gat navigation channel and therefore, vessel traffic flows directed towards the Thanet site are not expected to change significantly.

The development at Greater Gabbard and the proposed changes to the routeing in the adjacent Sunk area would have an affect on the traffic flows passing the Thanet site. However, it is not possible to make exact predictions, as agreement for the routeing in the Sunk area has still to be agreed locally and then presented to IMO for approval. The proposals for the area currently aim to provide an entry / exit to the system angled towards the South Falls Head and therefore this would collectively move the traffic slightly to the east and generally benefit the traffic flows around Thanet (see track imposed on **Figure 14.23**).

Figure 14.23 shows the main shipping tracks in the wider Thames Estuary area. The north / south tracks passing between the Inner Gabbard and the Galloper banks would effectively be closed off by the Greater Gabbard wind farm, leaving the most likely alternate route to the east of the Galloper Bank and to the east of the South Falls Bank and therefore, reducing the current level of traffic passing close to the Drill Stone buoy by three to four vessels per week.

Therefore, the overall in combination effects of the other wind farms in the area are expected to be **minor beneficial** to **negligible.**

Figure 14.23 Ship tracks in the Thames Estuary



14.7.2 Effects on navigation from future traffic levels

The known development projects at Felixstowe, Harwich, London Gateway and in the Medway and Thames Estuary will have an effect on vessel sizes, types, numbers and traffic flows around the area during the lifetime of the Thanet project. Whilst the effect of some of these developments will mostly mean a migration to the use of larger vessels, others will no doubt affect the actual flow of trade.

The move to larger mainline Container Vessels will see these vessels limited to the deeper waters and therefore generally away from the Thanet site. However, there will undoubtedly be an increase in the feeder Container Vessels that could pass close to the Thanet site. The number of Gas Carriers is expected to increase as the gas terminals in the Medway and Thames Estuary come on line.

A combination of historic traffic statistics for the Dover Strait, CNIS data and local port statistics and future traffic predictions has been used in the analysis (see **Appendix 14.1**). A projection of the vessel traffic changes in the future from known port projects affecting the area, plus an extrapolation of the vessel data show that typically only between one and two vessels per hour can be expected in each direction through each of the three Gates. The predictions for future traffic growth lead to the conclusion that the impact of the Thanet project would be accepted as reasonable to vessels navigating in the area for the life of the project and would not have a significant effect on vessels navigating in the area for the projected life of the project.

14.8 Monitoring Requirements

Ongoing observation of the effects on traffic of the operational wind farm will be made and a check of the vessel traffic flow predictions during the life of the wind farm. This will be achieved by the recording and analysis of AIS data, and a further survey is proposed one year post-construction.

14.9 Summary

MARICO Marine was commissioned by TOW to conduct a maritime traffic survey, navigation assessment and a Navigation Risk Assessment of the Thanet project.

Vessel traffic data was acquired from the Channel Navigation Information Service (CNIS) Dover and further on-site traffic survey work was carried out. The combination of data has provided a record of vessel tracks taken by all types of vessel in the area, spread over five periods and totalling 29 days within the last 12 months, as required by the Marine Guidance Note 275(M) issued by the Maritime and Coastguard Agency [MCA].

The average number of ships transiting the wider area is approximately 76 per day or almost 28,000 vessels per year, the predominant vessel type being commercial Dry Cargo Vessels that account for two thirds of the total number of movements. A total of 467 vessels of all types, including Fishing Vessels, entered the Thanet site, an average of just over 16 per day.

The MAIB incident data confirms that the Thanet study area has a low overall incident rate of 0.4564×10^{-4} per transiting movement. The two most common incident types are machinery failure and hazardous incidents, mostly near miss collisions, with eight incidents of each reported giving an incident rate of 1.96×10^{-5} per transiting movement. Allowing for locally increased traffic density due to the introduction of the wind farm, predicted incident rates of less than 0.70×10^{-4} per transiting movement were obtained. This increased level still compares well with current statistics for other areas of the UK coast

The navigation assessment has shown that with one exception, the introduction of the wind farm should not raise the risks to shipping above levels currently being recorded at other areas around the UK coast. The traffic predictions support the introduction of an additional navigation buoy, as proposed by Trinity House Lighthouse Service (THLS) in the area to the north of the Thanet site, which mitigate this exception.

Predicted traffic clearance to the east of the site would be about 1.4nm, while to the west it would be about 1.1nm. It is therefore considered that additional navigational buoys would not be necessary in these areas.

Ongoing observation of the effects on traffic around the proposed navigation buoy would be made during the early life of the wind farm to check the vessel traffic flow predictions made. This would be achieved by the recording and analysis of AIS data after a set period of nominally one year post-construction.

TOW is applying to the Secretary of State for Trade and Industry to extinguish the public rights to navigation for the individual sites of the turbine towers, the offshore substation and the anemometry mast.

TOW will also apply to the Secretary of State for the implementation of Safety Zones during all phases of the Thanet project, to protect the safety of life at sea, as follows:

- During construction:
    - i. To establish Safety Zones of 500m around each offshore structure and cable laying vessel for the construction phase.
- During operation:
    - i. To establish 500m Safety Zones around each offshore structure to exclude all vessels of 300GT and above from entering the site;
    - ii. To establish 500m Safety Zones around each offshore structure to exclude fishing with drift nets or trawls; and
    - iii. To establish general Safety Zones of 50m around each offshore structure to exclude all vessels other than when authorised by the wind farm control room or in an emergency situation.
- During decommissioning:
    - i. To establish Safety Zones of 500m around each offshore structure for the decommissioning phase.

The wind farm towers will be painted, marked and fitted with navigation lights in accordance with THLS requirements and will be fitted with an Automatic Identification System (AIS) transceiver and sound signals as required by THLS and procedures will be put in place to respond to failures of aids to navigation. In addition, TOW will work with the MCA before offshore construction commences to develop detailed and effective Search and Rescue plans.

Whilst there may be an area of reduced radar coverage to the east of the Thanet site, the impact on the existing or future Margate radar station, would not be significant. There would be an impact on current shipborne radar, especially at distances of less than 1.5nm. TOW is an active member of the cross-industry working group that is considering possible mitigation measures and will abide by any industry guidelines that come out of this group.

The minimum clearance below the turbine blades in their lowermost position at Mean High Water Springs (MHWS) will be 22 metres in accordance with MGN 275(M).

The wind farm will be monitored around the clock with the potential for remote shutdown in the event of an incident or a request from the Maritime and Coastguard Agency.

The increase in traffic volume during the construction and decommissioning phases of the wind farm would be low and is not expected to cause a significant increase in risk, providing suitable Safety Zones are agreed for the construction and decommissioning phases of the project.

The Navigation Risk Assessment (NRA) has shown that although the installation of a wind farm at the Thanet site would have an effect on the overall risk profile of the area, some effects may well be beneficial. For example, many Ship's Masters are likely to keep the wind farm to port leaving their starboard side open for manoeuvring. This can be expected to increase lamina flow around the wind farm and reduce crossing traffic interaction thereby providing a **minor beneficial** impact by forcing vessels into better defined lanes.

Some hazards have been identified that require mitigation measures and recommendations have been made. Providing the mitigation measures are put in place, the risks identified all fall within the ALARP range and are broadly acceptable with normal operating precautionary measures in place.

The NRA process would not cease after the initial exercise represented in the report. It will be an ongoing process throughout the life of the wind farm that takes into account changes in the likes of traffic densities and other factors that may affect the hazard regime. Hazard management software programmes (such as HAZMAN) exist to enable relatively quick and simple updating of Navigation Risk Assessments, while developing an audit trail to verify the process.

The cumulative effects of the other wind farms in the Thames Estuary area are expected to be of **no significance**, due to their remote positions or minimal effects predicted on existing traffic flows.

Assessment of the navigational implications of the Thanet project was also undertaken given predicted increases in future traffic levels associated with local ports. The results of this research lead to the conclusion that the introduction of the Thanet project would have **no significant** impact on vessels navigating in the area for the life of the project.

Overall it is concluded that while the introduction of the wind farm would have some effect on the traffic flows in the area, even assuming that all of the vessels navigate around the site, the increase would still leave the area with modest densities. Given that the mitigation measures highlighted are implemented, risk levels would remain within tolerable levels.