Beatrice and Moray Offshore Wind Farm Developments Helicopter Impact Assessment

Document information

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Executive Summary

This document presents the results of an analysis of the combined impact of the Beatrice and Moray offshore wind farm developments upon commercial air transport helicopter operations to and from the Beatrice and Jacky fields in the Moray Firth.

The document considers the separate and cumulative impacts of the developments and compares then to the current situation. The cumulative impact analysis suggests that under a worst case scenario with no mitigations applied the following number of flights would be impacted each year:

	BOWL& MORL cumulative impact	
Destination	**Total flights prevented currently by existing obstructions**	**Additional flights prevented by BOWL & MORL**
Beatrice A	~5 flights p.a.	~3 flights p.a.
Beatrice B	~1 flight in 2 years	~3 flights p.a.
Beatrice C	~1 flight in 2 years	~1 flight in 3 years
Jacky	None	~1 flight p.a.
Total	**6 flights p.a.**	**7-8 flights p.a.**

A set of proposed mitigations are presented that are believed to be sufficient to mitigate the vast majority of impacted flights to each platform.

The individual impacts of each development are as follows:

	BOWL impact	
Destination	**Total flights prevented by existing obstructions**	**Additional flights prevented by BOWL**
Beatrice A	~5 flights p.a.	~1 flight in 5 years
Beatrice B	~1 flight in 2 years	~1 flight in 2 years
Beatrice C	~1 flight in 2 years	None
Jacky	None	~1 flight p.a.
Total	**6 flights p.a.**	**1-2 flights p.a.**

	MORL EDA impact	
Destination	**Total flights prevented by existing obstructions**	**Additional flights prevented by MORL EDA**
Beatrice A	~5 flights p.a.	~3 flights p.a.
Beatrice B	~1 flight in 2 years	~3 flights p.a.
Beatrice C	~1 flight in 2 years	None
Jacky	None	~1 flight p.a.
Total	**6 flights p.a.**	**7 flights p.a.**

	MORL EDA + WDA impact	
Destination	**Total flights prevented by existing obstructions**	**Additional flights prevented by MORL EDA + WDA**
Beatrice A	~5 flights p.a.	~3 flights p.a.
Beatrice B	~1 flight in 2 years	~3 flights p.a.
Beatrice C	~1 flight in 2 years	~1 flight in 3 years
Jacky	None	~1 flight p.a.
Total	**6 flights p.a.**	**7-8 flights p.a.**

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1 Introduction

1.1 General

1.1.1 This report presents a cumulative assessment of the potential impact of the Beatrice and Moray offshore wind farms on helicopter operations to and from oil platforms in the Beatrice and Jacky fields. The report has been commissioned by Beatrice Offshore Windfarm Ltd (BOWL) and Moray Offshore Renewables Ltd (MORL) and has been prepared by Helios and Spaven Consulting.

1.2 The BOWL and MORL developments

1.2.1 The Beatrice offshore wind farm site (BOWL site) is positioned in the Moray Firth on the north-west corner of the Smith Bank within Scottish territorial waters. The development site covers an approximate area of 131.5km² and is located, at its closest point, approximately 13.5km off the Caithness coast. The proposed wind farm would have an anticipated capacity of up to1,000MW generated from up to 277 turbines with a maximum tip height of 198m (650ft) above LAT. The consent application will be submitted in December 2011 with expected determination in late 2012. Construction is expected to commence late 2014 or early 2015 with final commissioning completed by 2018.

1.2.2 The proposed Moray offshore wind farms will consist of up to 339 wind turbines with an expected maximum tip height of up to 204m (669ft) above Lowest Astronomical Tide (LAT), located some 22km off the southern Caithness coast. The development will have a maximum capacity of 1,500MW.

1.2.3 The Moray offshore wind farms (MORL site) are planned to be built in two phases.

- The first phase will occupy the Eastern Development Area (EDA), covering 295km². This will contain up to a maximum of 339 turbines, with final commissioning anticipated by 2018 and construction commencing in 2015. The Eastern Development Area is further split into three sectors, designated Telford, Stevenson and MacColl. Consent applications will be made in mid-2012 with a consent determination anticipated early 2013

- The second phase will occupy the Western Development Area (WDA), covering 225km². The WDA is expected to contain up to 100 turbines with construction anticipated to commence in 2018 and final commissioning completed by 2020. Consent applications will be made in mid-2015 with a consent determination anticipated early 2016.

1.3 The Beatrice Oil Field

1.3.1 The Beatrice field consists of three platforms, two of which are unmanned. In addition the adjacent Jacky field also has an unmanned installation connected by pipeline to Beatrice with the potential for a jack-up platform to be located temporarily whilst work is undertaken on the well-head:

- Beatrice Alpha is a manned production platform. It typically accommodates 70-80 staff, although in recent years this has peaked at 100+. It has a helideck height of 201ft and is cleared for helicopters of a size up to the EC225. It is currently served by Bond Helicopters typically with two to three flights a week.

- Beatrice Bravo is an unmanned production platform. It has a helideck height of 184ft and can accommodate most aircraft types up to a weight limit of 9.3t.

Operations are limited to wind speeds below 15kts. It is currently served by Bond Helicopters when required with no scheduled flights.

- Beatrice Charlie is an unmanned water pumping platform. It has helideck height of 87ft and a smaller deck and can accommodate aircraft up to an AW139, although there are legacy rights for Bristows to use an AS332. Operations are restricted to daylight hours and when the wind is of less than 15kts. Beatrice C is no longer in active use as a pumping platform. All equipment is retained, but isolated with the exception of a generator to power navigation aids, a fire detection system and a telemetry link to Beatrice A.
- Jacky is an unmanned platform without a certified helideck although there is a deck with a height of approximately 115ft that could be accessed by winching. Jacky is typically visited monthly by boat from Beatrice Alpha and facilities on-board are such to accommodate a six person crew with the possibility of an overnight stay. It is anticipated that there may be a need for at least one well work-over during the life of Jacky. This would necessitate the temporary installation of a jack-up rig.

1.3.2 The Beatrice oil platforms, and Jacky, are located close to the northern boundary of the MORL WDA and to the south-west boundary of the BOWL site as shown in Figure 1-1 below.

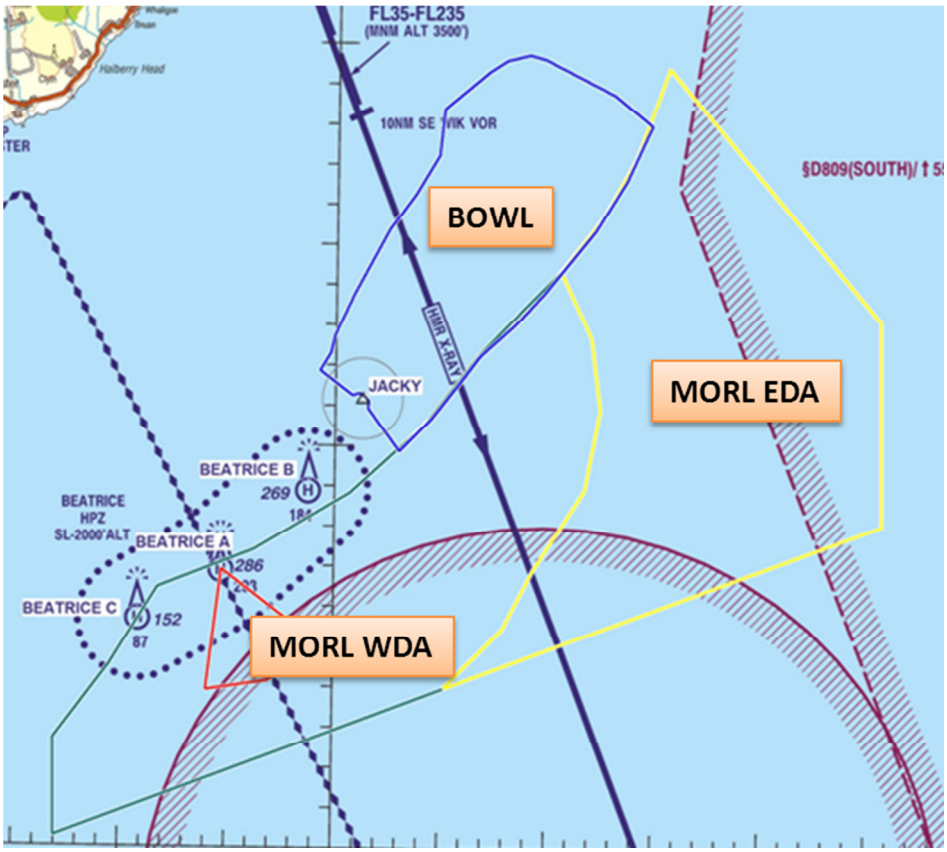

Figure 1-1: Overview of BOWL & MORL developments

1.4 Methodology

1.4.1 This report is concerned with the impact of the BOWL and MORL developments on helicopter access to the Beatrice and Jacky platforms. As such it is primarily concerned with the availability of instrument approach procedures – the GPS

assisted Airborne Radar Approach (ARA). A copy of the Bond Offshore Helicopters ARA procedure chart is attached at Annex C. In Instrument Meteorological Conditions (IMC) conditions, when the wind is blowing from certain directions, a standard ARA procedure will not be able to be flown due to the proximity of wind turbines to the approach track. To analyse the impact the following steps have been undertaken:

- The ARA approach headings restricted by the BOWL and MORL wind farms, the existing demonstrator turbines and the oil platforms themselves have been identified. This has involved the following assumptions:
    - No approaches will be made over the turbines, even during the initial part of the procedure that is flown at MSA.
    - No wind turbines or platforms are allowed within 1nm either side of the approach track.
- Wind, visibility and cloud base data from Wick and Lossiemouth airfields has been analysed so that the number of ARA approaches that would be flown within each restricted sector can be identified. This has included the following assumptions:
    - There is no change to the current visibility or cloud base requirements that define IMC operations in the field (<1,000ft cloud base or < 5km visibility).
    - There is no change to the GPS ARA minima (300ft cloud base and 1.5nm visibility).
- The current flight schedule to each platform has been combined with the results of the Met analysis to arrive at a number of flights per annum impacted by:
    - Existing obstacles (platforms and the Demonstrator Turbines)
    - The BOWL development alone
    - The MORL EDA and WDA
    - The BOWL, MORL EDA and WDA
- Subsequently, the possible mitigations to alleviate the impacts are considered.

1.4.2 This report documents the results of this analysis.

1.4.3 In addition to the impact of the BOWL and MORL developments on ARAs to the Beatrice field platforms, this report considers the potential impacts of the developments on obstacle clearance in the missed approach phase of ARAs, and for helicopter departures from the Beatrice field platforms.

1.5 Meteorological data analysis

1.5.1 In order to understand the impact of specific constraints on helicopter operations it is necessary to examine the likelihood of particular weather conditions in the Beatrice Field. Ideally full wind, cloud base and visibility data from in-field would be available to support such analysis. However, Met data from the Beatrice Alpha is only retained by the operator for one month, data from the operators was limited and only available for the time of scheduled flights and the UK Met Office only had sporadic marine weather observations to offer.

1.5.2 As a result of the lack of in-field data, data from the nearest airfield locations were used instead. Two years' worth of hourly METARS from Wick Airport and three years' worth of hourly METARS from RAF Lossiemouth that were available to the project teams were processed to provide statistics on wind direction, wind speed, cloud base and visibility. The data highlights that winds in the field are predominantly from the south-west with strong winds possible from any direction but significantly less likely from the north-east. Around 1% of the time there are no significant winds (<5 kts), see Figure 1-2 and Figure 1-3 below.

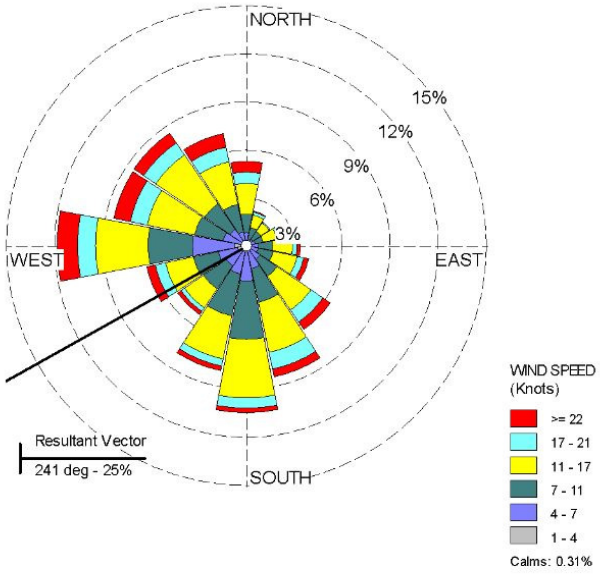

Figure 1-2: Wind rose for Wick Airport (2 years of data)

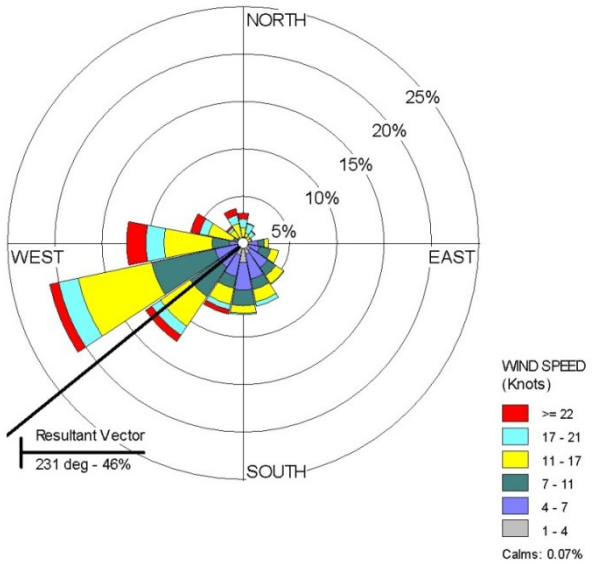

Figure 1-3: Wind rose for RAF Lossiemouth (3 years of data)

1.5.3 Both sets of cloud base and visibility data were also compared to ensure that they provided similar results giving confidence that they could be generalised to represent conditions at the platforms. On the basis of current ARA minima more

than 1% of flights would already be impacted by low cloud, poor visibility or a combination thereof. Figure 1-4 and Figure 1-5 below show the incidence of VMC conditions in the field and the data for Lossiemouth, whilst consistent with Wick does show a markedly higher incidence of good weather. Therefore, the more conservative data set from Wick (providing a higher impact) was used for the full impact analysis of the combined situation. The data is expected to be representative of the conditions in-field.

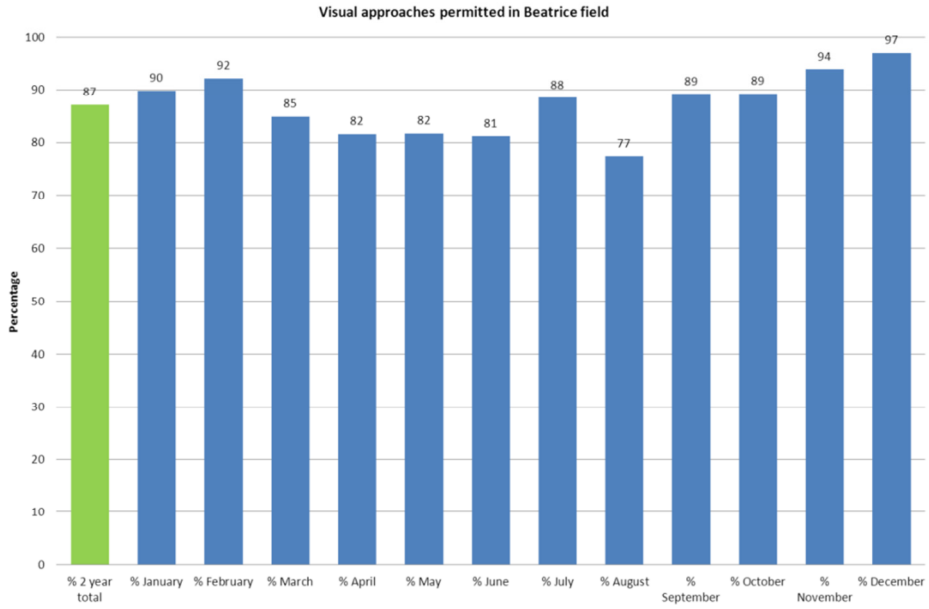

Figure 1-4: Estimated incidence of visual conditions in Beatrice field (Wick data)

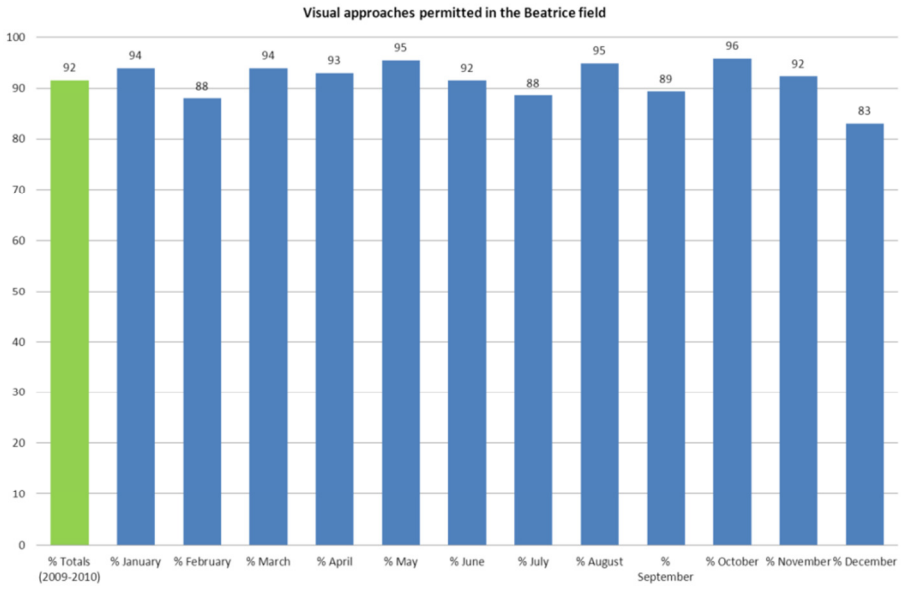

Figure 1-5: Estimated incidence of visual conditions in Beatrice field (Lossiemouth data)

1.5.4 With the current criteria that dictate whether instrument or visual approaches are required (>5km visibility and cloud base (coverage of 3 oktas or more) > 1,000ft) the weather data from Wick suggests that on average 87% of approaches

undertaken will be in visual conditions or conversely slightly more than 10% of approaches will require an ARA. The data from Lossiemouth suggests that on average 92% of approaches undertaken will be in visual conditions. Consequently something less than 10% of flights would require an ARA.

1.6 Structure of this report

1.6.1 This report is structured as follows:

- Section 2 presents an overview of the current situation in the Beatrice and Jacky fields, outlines current operating restrictions and demonstrates the impact of these restrictions on helicopter operations.
- Section 3 presents an overview of the situation when the BOWL development is constructed, outlines the expected operating restrictions and demonstrates the impact of these restrictions on helicopter operations.
- Section 4 presents an overview of the situation when the MORL EDA is constructed, outlines the expected operating restrictions and demonstrates the impact of these restrictions individually and cumulatively on helicopter operations.
- Section 5 presents an overview of the situation when the MORL WDA is constructed, outlines the expected operating restrictions and demonstrates the impact of these restrictions individually and cumulatively on helicopter operations.
- Section 6 presents an overview of the situation when the BOWL and MORL developments are constructed, outlines the expected operating restrictions and demonstrates the impact of these restrictions on helicopter operations.
- Section 7 discusses the proposed mitigations to alleviate the cumulative impact of the BOWL and MORL developments.

1.6.2 The report is also supported by specific annexes:

- Annex A provides a glossary of the terms, abbreviations and acronyms used within this report.
- Annex B provides a calculation of the distances involved in an ARA procedure in the future environment.
- Annex C provides an overview of the existing GPS ARA procedure.

2 Baseline situation

2.1 Overview

2.1.1 Helicopter operations in the Beatrice field are already limited due to the presence of the Demonstrator Turbines near to the Alpha platform and due to the alignment of the platforms themselves. This leads to:

- a range of approach headings where the crew would either undertake an ARA to an adjacent platform and fly a visual transit ("shuttle") to the destination or where they would have to undertake an out-of-wind ARA and circle to land;
- a 60 degree restricted sector out to 3nm from Beatrice Alpha, due to the Demonstrator Turbines, within which night and instrument flight is not permitted; and
- a higher decision height and visibility requirement for both ARA (300ft + 1.5nm) and circling approaches (500ft + 3nm).[1]

2.1.2 There is also a military danger area, D807, to the south of the platforms that when promulgated active (7am through 12 midnight Monday to Friday) and in actual use, prevents flight operations below 1,500ft. The danger area is understood to receive little current use and typically the helicopter operators will call RAF Lossiemouth departures for permission to operate through the danger area.

2.1.3 The result of these restrictions is that a number of approaches to the Beatrice field will already be precluded. This forms the baseline against which additional impacts due to BOWL and MORL will be assessed. In order to understand the impact on flights it is necessary to consider a particular flying schedule for each platform. The following has been assumed:

- Beatrice Alpha – 3 flights per week (all year) – 156 per annum
- Beatrice Bravo – 3 visits per month requiring 2 flights per visit – 72 per annum
- Beatrice Charlie – 3 visits every 3 months requiring 2 flights per visit – 16 per annum
- Jacky – 2 flights per week for an 8 week period – 16 per annum

2.1.4 The calculation of the sectors where ARAs are restricted by existing obstacles is based on the following assumptions:

- No ARAs are flown from any sector where there are turbines within 9nm of the destination platform. This is derived from calculations of the required descent profile (see Annex B), and is in line with new CAA guidance (CAP 764, July 2011).
- All obstacles in the Final Approach phase of the ARA must be avoided laterally by a minimum of 1nm.

2.1.5 In addition, obstacles must be avoided laterally by 1nm in the missed approach phase of an ARA, until the helicopter has climbed to the MSA. The standard missed approach in an ARA procedure involves a climbing turn from the missed

[1] The minima at platforms that are not constrained by other obstacles are 200ft and 0.75nm for a straight-in ARA in daylight and 300ft and 1nm for a circling ARA in daylight.

approach point. In the case of ARAs in the Beatrice field, where the missed approach point is at 1.5nm from the platform, it can be expected that the missed approach turn will be through up to 45° of heading change.

2.1.6 Existing obstructions and the future BOWL and MORL developments will place constraints on ARAs from certain directions because of this additional requirement for an obstacle-free corridor in which to conduct the missed approach. These constraints will typically take the form of the missed approach turn having to be flown in one direction only. Consideration of the impact on missed approaches must also consider the One Engine Inoperative (OEI - engine failure) situation. In such a situation the climb performance of the aircraft can be greatly degraded. The worst case needing protection is when the engine fails at the missed approach point with obstacles in the area ahead. In the case of the Beatrice field, an engine failure at the missed approach point would occur at 300ft or higher and with the aircraft already at or above a safe speed for OEI manoeuvring. The direction of the missed approach turn will have been agreed between the pilots prior to the approach so that it will be flown away from any obstacles. Under some circumstances crews will have to accept that missed approach turns can only be flown to one side of the approach track.

2.1.7 Obstacles will also affect helicopter departures from the Beatrice platforms. Departures may be conducted in weather conditions in which the helicopter enters IMC soon after take-off. In addition, the worst case of an engine failure immediately after take-off has to be considered. This requires that, following the initial descent to attain take-off safety speed, the aircraft climbs straight ahead with a headwind component, and any necessary turn away from obstacles is not initiated until the helicopter attains its best rate of climb speed (Vy) of 80 kts and has reached a height of 500ft. On the basis of calculations undertaken by Bond Helicopters (for a hot day with low pressure) this will require a 9.3km departure corridor from the helideck to be clear of obstacle (including a 1.5km safety buffer between the obstacle and the flight path).

2.1.8 The impacts on operations to each platform are documented below. It should be noted that at this point these impacts take no consideration of potential mitigations.

2.2 Beatrice Alpha

2.2.1 Approaches to the Beatrice Alpha are currently restricted from the south-west due to the Charlie platform, from the north-east due to the Bravo platform and due to the Demonstrator Turbines to the south and south east. When these restricted sectors prevent a direct into-wind approach, flight crew will have to choose to:

- Fly an ARA to Alpha with a cross wind component;
- Make a circling approach to Alpha[2] and accept the higher circling minima,
- Approach to another platform and shuttle to Alpha, accepting shuttling minima.

2.2.2 The current ARA restrictions for the Beatrice A are shown in Table 2-1 and Figure 2-1 below.

[2] A circling approach is defined as one which is carried out with a difference of more than 30° between the final approach track and the wind direction.

Destination platform	Restricted approach sector (°T)	Nature of restriction and possible mitigations	Minima
Beatrice A	035-083	Charlie platform within 1nm of approach path. Approach to Charlie and shuttle to Alpha, fly an out-of-wind ARA or fly a circling approach.	1.5NM. 300ft. (Day shuttling) 2.4NM. 500ft (Night shuttling) 3.0NM. 500ft (Circling) 1.5NM. 300ft (oow ARA)
	206-247	Bravo (and Jacky) platform in approach path. Approach to Jacky/Bravo and shuttle to Alpha, fly an out-of-wind ARA or fly a circling approach.	1.5NM. 300ft. (Day shuttling) 2.7NM. 500ft (Night shuttling) 3.0NM. 500ft (Circling) 1.5NM. 300ft (oow ARA)
	306-006	Existing no go sector due to Demonstrator Turbines.	1.5NM. 300ft. (Day shuttling) 2.4NM. 500ft (Night shuttling) 3.0NM. 500ft (Circling) 1.5NM. 300ft (oow ARA)

Table 2-1: Current restricted approach sectors for Beatrice Alpha

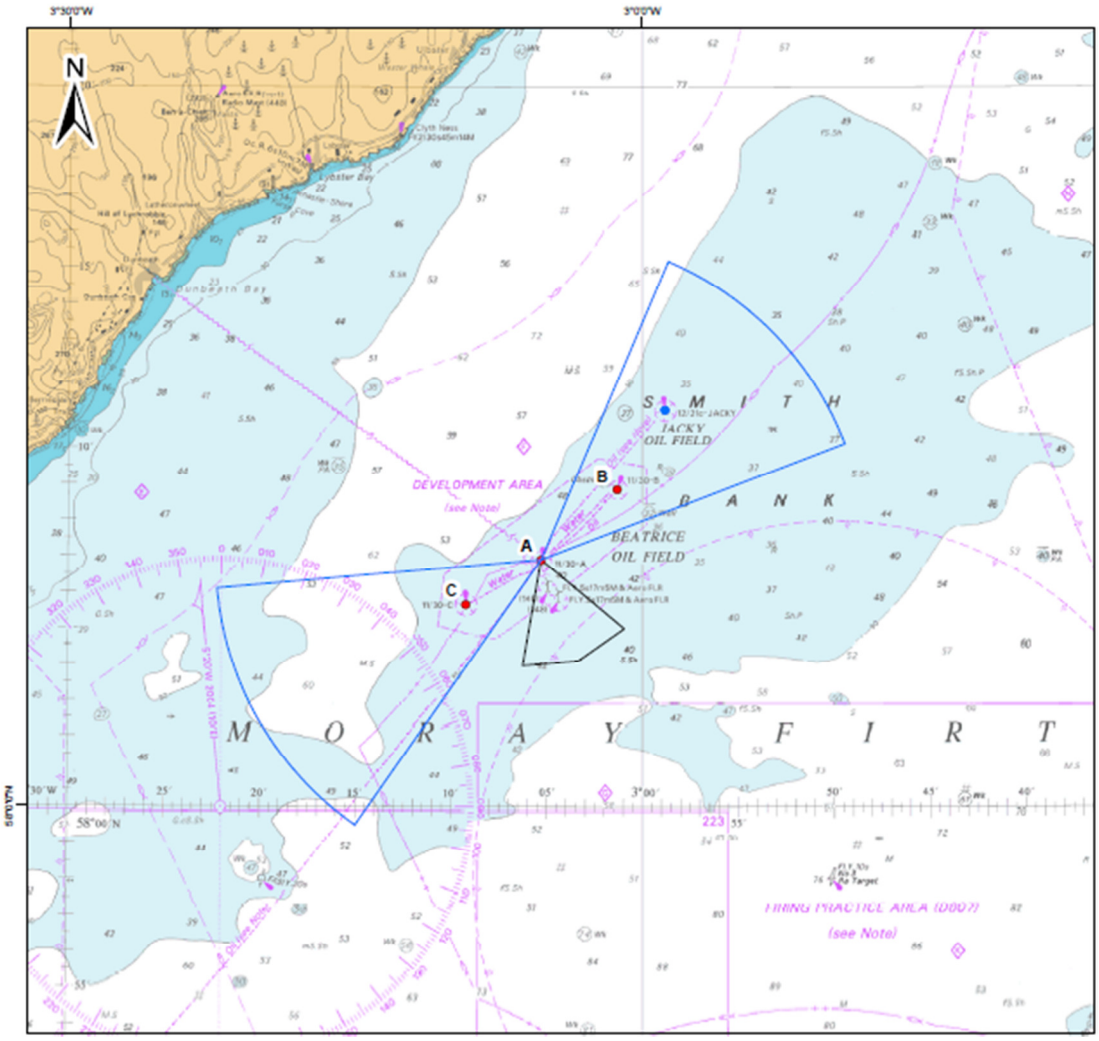

Figure 2-1: Current restricted approach sectors for Beatrice Alpha

2.2.3 Missed approaches from ARAs to the Beatrice Alpha are also currently constrained by existing obstacles, most notably the Demonstrator Turbines restricted zone. Table 2-2 summarises the current constraints on missed approaches at the Beatrice Alpha. It can be seen that these consist primarily of restricting the available missed approach directions to one.

ARA final approach track (°T)	007-034	035-083	084-090	091-121	122-133	134-190	191-205	206-247	248-305	306-006
Missed approach turn direction available	Left only (R prevented by Demo Tbns sector)	ARA not possible due Beatrice C within 1nm of FAT	Left only (R prevented by Demo Tbns sector)	Left only (R prevented by Demo Tbns sector)	Right (with turn required to avoid B) or Left	Left only (R prevented by Beatrice C)	Right only (L prevented by Demo Tbns sector)	ARA not possible due Beatrice B within 1nm of FAT	Right only (L prevented by Demo Tbns sector)	ARA not possible due Demo Turbines restricted zone
Constraints on straight climb-out after 45° initial turn	None		None (Jacky at 5nm+)	Beatrice B	To right: Beatrice B; None to left	None	None		None	

Table 2-2: Beatrice A ARA missed approach constraints (current)

2.2.4 Departures from the Beatrice Alpha, taking account of the OEI climb criteria set out in 2.1.7, are currently restricted to the west due to the Beatrice C, to the south and south east by the Demonstrator Turbines and to the north east by the Beatrice B. In addition, when danger area D807 is active, take-offs on south-easterly and easterly headings will not be possible since the boundary of the danger area is some 4km from the platform.

2.3 Beatrice Bravo

2.3.1 Approaches to the Beatrice Bravo are currently restricted from the south-west due to the Alpha platform, from the north-east due to the Jacky platform and due to the Demonstrator Turbines to the south west. When these restricted sectors prevent a direct into-wind approach, flight crew will have to choose to:

- Fly an ARA to Bravo with a cross wind component;
- Make a circling approach to Bravo and accept the higher circling minima,
- Approach to another platform and shuttle to Bravo, accepting shuttling minima.

2.3.2 The current ARA restrictions for the Beatrice B are shown in Table 2-3 and Figure 2-2 below.

Destination platform	Restricted approaches	Nature of restriction	Minima
Beatrice B	048-067 (023-067)	Alpha (and Charlie) platform within 1nm of the approach path. Approach to Alpha/Charlie and shuttle to Bravo, fly an out-of-wind ARA or fly a circling approach.	1.5NM. 300ft. (Day shuttling) 2.7NM. 500ft (Night shuttling) 3.0NM. 500ft (Circling) 1.5NM. 300ft (oow ARA)
	188-231	Jacky platform within 1nm of the approach path. Approach Jacky and shuttle to Bravo, fly an out-of-wind ARA or fly a circling approach.	1.5NM. 300ft. (Day shuttling) 2.5NM. 500ft (Night shuttling) 3.0NM. 500ft (Circling) 1.5NM. 300ft (oow ARA)
	355-047	Demonstrator Turbines no-go sector in the approach path.	1.5NM. 300ft. (Day shuttling) 2.5NM. 500ft (Night shuttling) 3.0NM. 500ft (Circling) 1.5NM. 300ft (oow ARA)

Table 2-3: Current restricted approach sectors for Beatrice Bravo

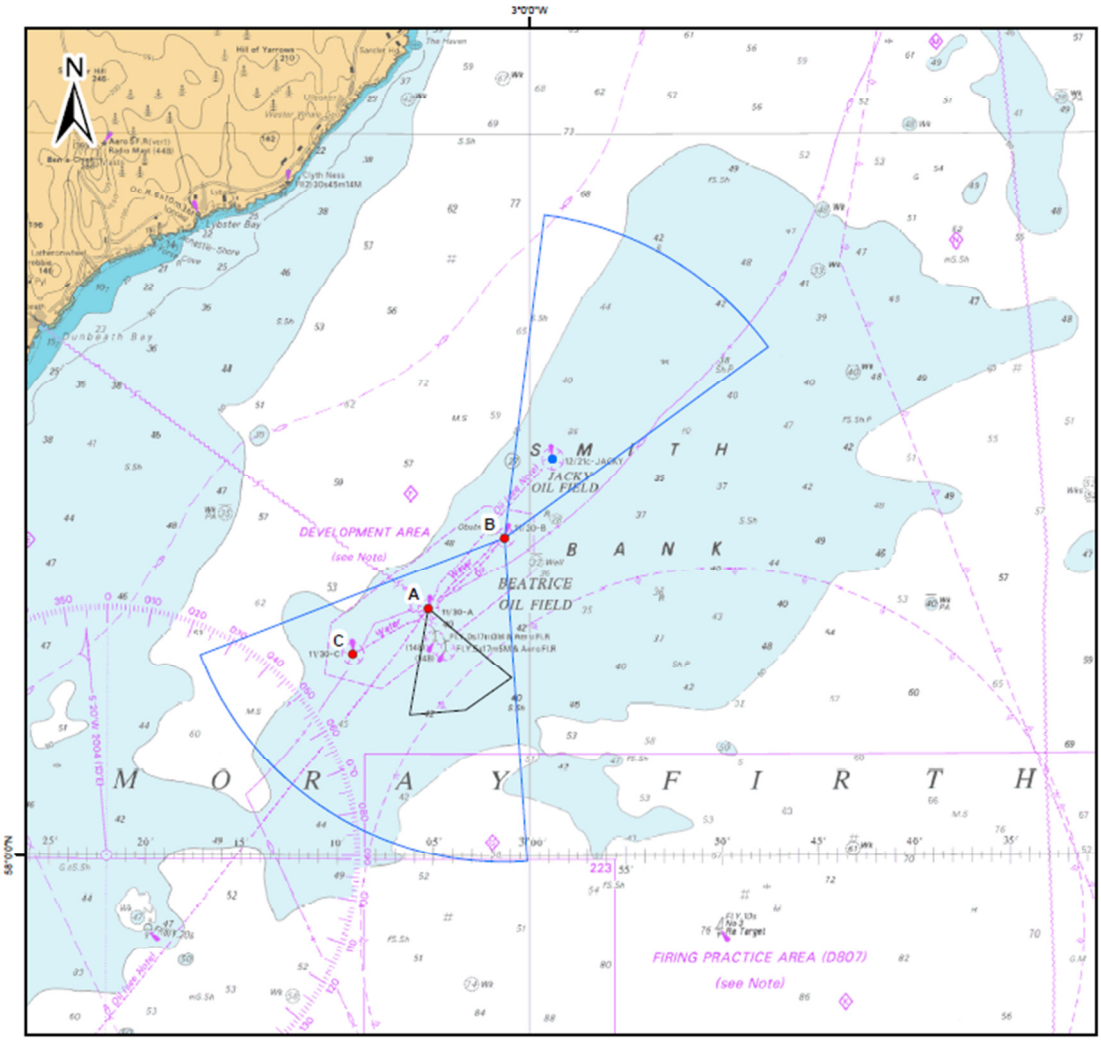

Figure 2-2: Current restricted approach sectors for Beatrice Bravo

2.3.3 Missed approaches from ARAs to the Beatrice Bravo are also currently constrained by existing obstacles, most notably ARAs on north-westerly headings, where a left turn is prevented by the Demonstrator Turbines restricted zone, and on southerly headings, where a right turn is constrained by the Beatrice A and the Demonstrator Turbines restricted zone.

2.3.4 Departures from the Beatrice Bravo, taking account of the OEI climb criteria set out in 2.1.7, are currently restricted in the sector from south-east to south-west due to D807, the Demonstrator Turbines and the Beatrice A, and to the north east by the Jacky.

2.4 Beatrice Charlie

2.4.1 Approaches to the Beatrice Charlie are currently restricted from the north-east due to the Alpha platform and from the east due to the Demonstrator Turbines. When these restricted sectors prevent a direct into-wind approach, flight crew will have to choose to:

- Fly an ARA to Charlie with a cross wind component;
- Make a circling approach to Charlie and accept the higher circling minima,

- Approach to another platform and shuttle to Charlie, accepting shuttling minima.

2.4.2 The current ARA restrictions at the Beatrice C are shown in Table 2-4 and Figure 2-3 below.

Destination platform	Restricted approaches	Nature of restriction	Minima
Beatrice C	239-315	Demonstrator Turbines no-go sector in the approach path.	1.5NM. 300ft. (Day shuttling) 2.7NM. 500ft (Night shuttling) 3.0NM. 500ft (Circling) 1.5NM. 300ft (oow ARA)
	214-238	Alpha (and Bravo/Jacky) platform within 1nm of the approach path. Approach to Alpha/Bravo/Jacky and shuttle to Charlie, fly an out-of-wind ARA or fly a circling approach.	1.5NM. 300ft. (Day shuttling) 2.7NM. 500ft (Night shuttling) 3.0NM. 500ft (Circling) 1.5NM. 300ft (oow ARA)

Table 2-4: Current restricted approach sectors for Beatrice Charlie

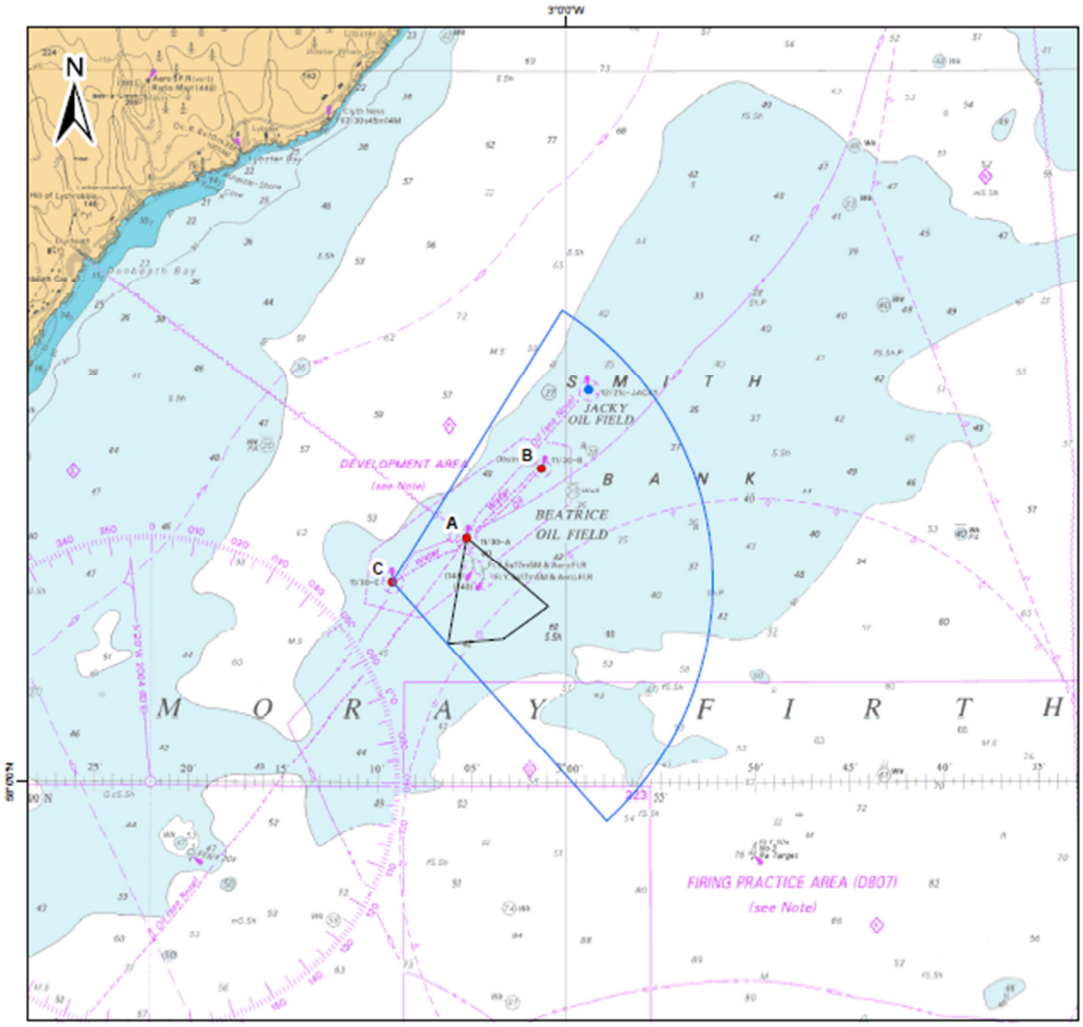

Figure 2-3: Current restricted approach sectors for Beatrice Charlie

2.4.3 Missed approaches from ARAs to the Beatrice Charlie are currently constrained by existing obstacles, most notably ARAs on headings between north and east, where a right turn is prevented by the Demonstrator Turbines restricted zone and the Beatrice A, and on headings between south and east, where a left turn is similarly constrained.

2.4.4 Departures from the Beatrice Charlie, taking account of the OEI climb criteria set out in 2.1.7, are currently restricted on all easterly departure headings by the Demonstrator Turbines and the Beatrice A, and to some extent on south-south easterly departure headings by D807 (when it is active).

2.5 Jacky

2.5.1 Approaches to a jack-up rig positioned at the Jacky platform are currently restricted from the south-west due to the Bravo platform. When this restricted sector prevents a direct into-wind approach, flight crew will have to choose to:

- Fly an ARA to Jacky with a cross wind component;
- Make a circling approach to Jacky and accept the higher circling minima,
- Approach to another platform and shuttle to Jacky, accepting shuttling minima.

2.5.2 The current ARA restrictions at the Jacky are shown in Table 2-5 and Figure 2-4 below.

Destination platform	Restricted approaches	Nature of restriction	Minima
Jacky	009-052	Bravo (and Alpha/Charlie) platform within 1nm of approach path. Approach to Bravo/Alpha/Charlie and shuttle to Jacky, fly an out-of-wind ARA or fly a circling approach.	1.5NM. 300ft. (Day shuttling) 2.7NM. 500ft (Night shuttling) 3.0NM. 500ft (Circling) 1.5NM. 300ft (oow ARA)

Table 2-5: Current restricted approach sectors for Jacky

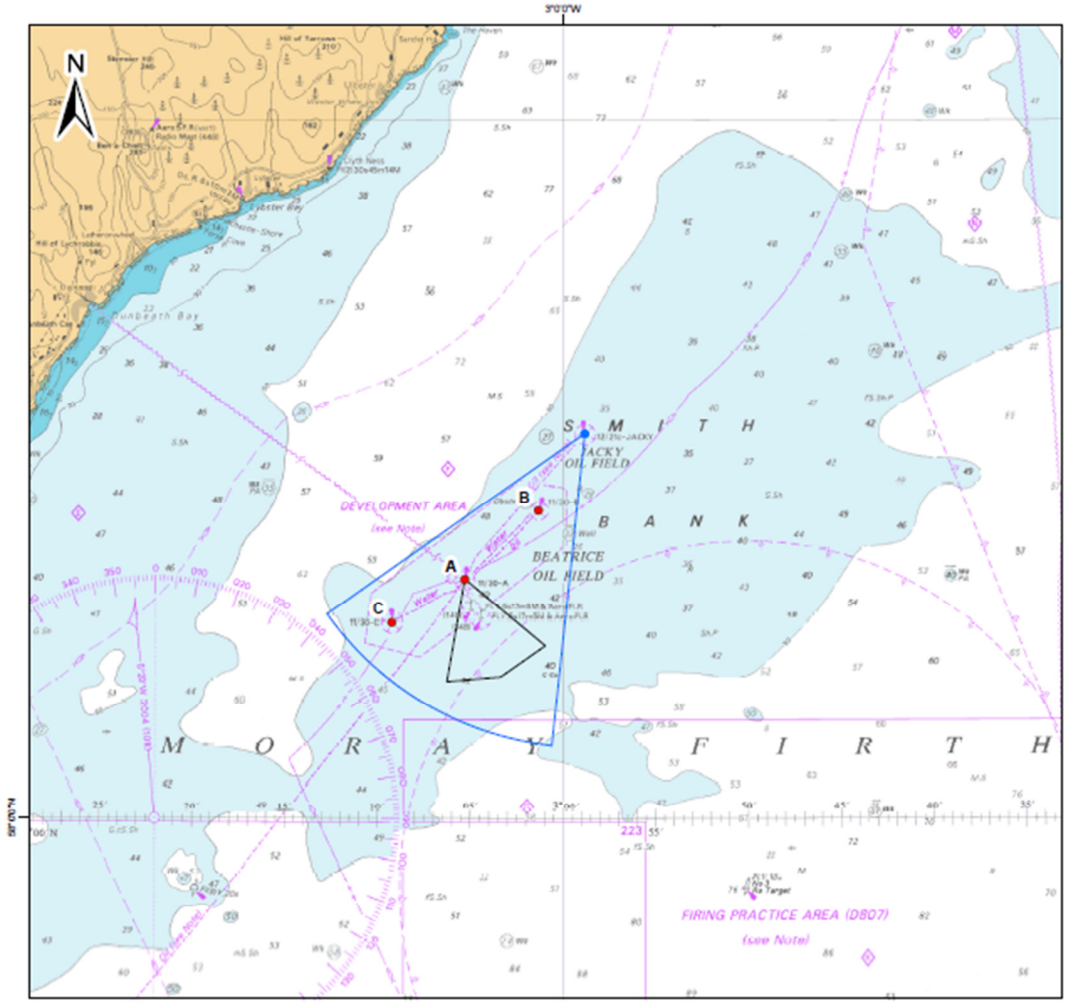

Figure 2-4: Current restricted approach sectors for Jacky

2.5.3 Missed approaches from ARAs to the Jacky are currently constrained by existing obstacles, most notably ARAs on westerly headings, where a left turn is prevented by the Beatrice B, and on southerly headings, where a right turn is similarly constrained.

2.5.4 Departures from the Jacky, taking account of the OEI climb criteria set out in 2.1.6, are currently restricted to the south west by the Beatrice B. There may also be some restrictions on southerly departure headings when D807 is active.

2.6 Impact on operations of the baseline

2.6.1 To assess the impact of current constraints upon the helicopter approaches to the Beatrice field it is necessary to bring together the restrictions outlined above, the weather conditions in-field and a representative flight schedule.

2.6.2 The meteorological data were analysed on the basis that:

- ARAs are required to be flown whenever the cloud ceiling is less than 1,000ft and/or the visibility is less than 5km;
- cloud ceiling is defined as any cloud amount of three oktas or more; cloud amounts of one or two oktas are considered to permit a visual approach; and

- any instance of a wind direction which would require an ARA in a restricted sector, but where the wind speed is less than five knots, is discounted, since in those low wind speeds the crew can fly an out-of-wind approach.

2.6.3 The current operators and owners of the Beatrice (and Jacky) platforms, Ithaca Energy and Wood Group have provided an indicative flight schedules to each of the platforms, see 2.1.3 above:

2.6.4 The impact on the basis of Wick weather data is therefore expected to be as outlined in Table 2-6 below.

	Baseline situation (Wick Data)		
Destination	**Flights prevented by other platforms**	**Flights prevented by Demonstrator Turbines**	**Total flights prevented by existing obstructions**
Beatrice A	0.6% (~1 flights p.a.)	2.6% (~4 flights p.a.)	3.2% (~5 flights p.a.)
Beatrice B	0.6% (~1 flight in 2 years)	0.2% (negligible)	0.7% (~1 flight in 2 years)
Beatrice C	0.2% (negligible)	2.9% (~1 flight in 2 years)	3.1% (~1 flight in 2 years)
Jacky	0.1% (negligible)	N/A	0.1% (negligible)

Table 2-6: Summary of baseline scenario impact (Wick data)

2.6.5 Where it is indicated that approaches would be prevented that does not in itself mean that a flight will not take place. In practice, given forecast weather conditions the helicopter operators may choose to postpone the flight to later in the day, or even reschedule for the following day. However, if these options were not available, the Wick meteorological data analysed for this report indicate that current obstacle constraints around the Beatrice field prevent approximately six flights to the Beatrice field per annum.

2.6.6 It should be emphasised that the figures quoted above assume that no mitigation measures are applied, e.g. no ARA is ever flown other than directly into wind.

2.6.7 It should also be emphasised that the analysis above assumes that all flights to all of the platforms are flown direct from Aberdeen. However in practice a high proportion of the flights to the B, C and Jacky platforms are local flights from the A platform, most if not all of which will be flown in visual conditions.

2.6.8 For comparison, the equivalent figures for flights prevented, using the Lossiemouth meteorological data, are shown in Table 2-7 below.

	Baseline situation (Lossiemouth Data)		
Destination	**Flights prevented by other platforms**	**Flights prevented by Demonstrator Turbines**	**Total flights prevented by existing obstructions**
Beatrice A	1.2% (~2 flights p.a.)	0.6% (~1 flight p.a.)	1.8% (~3 flights p.a.)
Beatrice B	0.4% (~1 flight in 3 years)	0.8% (~1 flight in 2 years)	1.3% (~1 flight p.a.)
Beatrice C	0.1% (negligible)	0.9% (~1 flight in 10 years)	1.0% (~1 flight in 5 years)
Jacky	0.8% (~1 flight in 10 years)	N/A	0.8% (~1 flight in 10 years)

Table 2-7: Summary of baseline scenario impact (Lossiemouth data)

2.6.9 The Lossiemouth meteorological data summarised above indicate that current obstacle constraints prevent approximately four flights to the Beatrice field per annum.

2.6.10 Conclusions drawn from the analysis in this report are based on the Wick meteorological data since these indicate generally worse weather conditions compared to Lossiemouth. The conclusions drawn from the Wick data are therefore expected to be conservative.

3 Impact of BOWL

3.1 MSA

3.1.1 Minimum safe altitude (MSA) is established at the height of the highest obstacle within 5nm plus 1,000ft. The current MSA in the vicinity of the Beatrice field is 1,300ft above sea level, determined by the height of the derrick on the Beatrice A, plus 1,000ft, rounded up to the next highest hundred feet. Proposed turbine heights in the BOWL development are approaching 200 metres (656ft). Therefore, due to the BOWL development the MSA is likely to increase to 1,700ft. The direct in-field consequence is the additional distance required in order for the aircraft to descend to the minimum decision height (MDH) when on an instrument approach.

3.1.2 In order for an ARA to be flown with the approach starting at the revised MSA and for none of the approach to be flown over the wind farm will require approximately 9nm of separation between turbines and helideck.

3.2 Beatrice Alpha

3.2.1 Beatrice Alpha will incur additional restrictions to approaches from the north-east due to the BOWL development.

Destination platform	Restricted approaches	Nature of restriction and potential mitigations
Beatrice A	035-083	Charlie platform within 1nm of the approach path. Approach to Charlie and shuttle to Alpha, fly an out-of-wind ARA or fly a circling approach.
	306-006	Existing no go sector due to Demonstrator Turbines.
	198-249 (195-205)	BOWL development in the approach path. Includes sector where shuttling to Bravo and/or Jacky would be required as these also restricted.

Table 3-1: Restricted approach sectors for Beatrice Alpha including BOWL

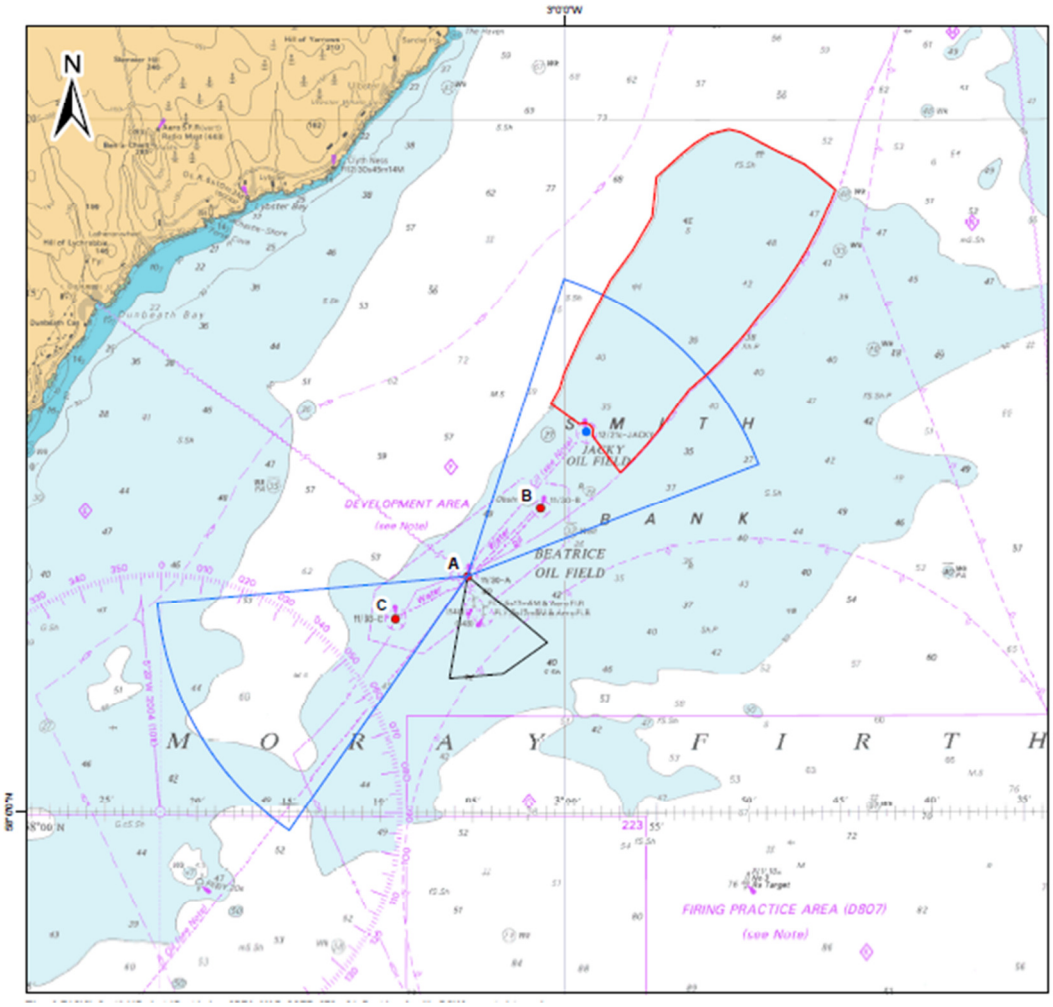

Figure 3-1: Restricted approach sectors for Beatrice Alpha including BOWL

3.3 Beatrice Bravo

3.3.1 Beatrice Bravo will incur additional restrictions to approaches from the north-east due to the BOWL development.

Destination platform	Restricted approaches	Nature of restriction and potential mitigations
Beatrice B	048-067 (023-067)	Alpha (and Charlie) platform within 1nm of the approach path. Approach to Alpha/Charlie and shuttle to Bravo, fly an out-of-wind ARA or fly a circling approach.
	355-047	Demonstrator Turbines no-go sector in the approach path.
	166-269	BOWL development in the approach path. Includes where shuttling from Jacky would be required as this also restricted.

Table 3-2: Restricted approach sectors for Beatrice Bravo including BOWL

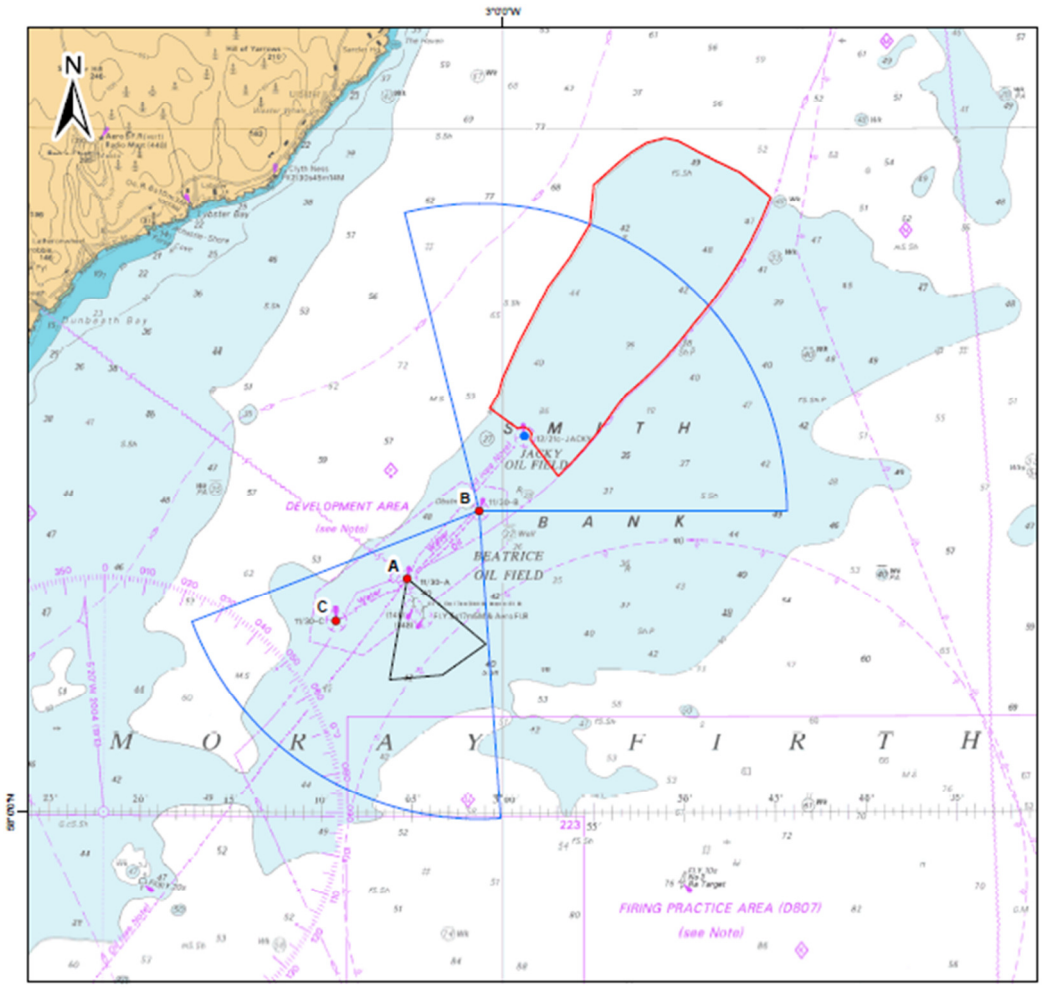

Figure 3-2: Restricted approach sectors to Beatrice Bravo including BOWL

3.4 Beatrice Charlie

3.4.1 Beatrice Charlie will incur some minor additional restrictions to approaches from the north-east due to the BOWL development.

Destination platform	Restricted approaches	Nature of restriction and potential mitigations
Beatrice C	239-315	Demonstrator Turbines no-go sector in the approach path.
	214-238	Alpha platform within 1nm of the approach path. Approach to Alpha and shuttle to Charlie, fly an out-of-wind ARA or fly a circling approach.
	208-213	BOWL development in the approach path

Table 3-3: Restricted approach sectors for Beatrice Charlie including BOWL

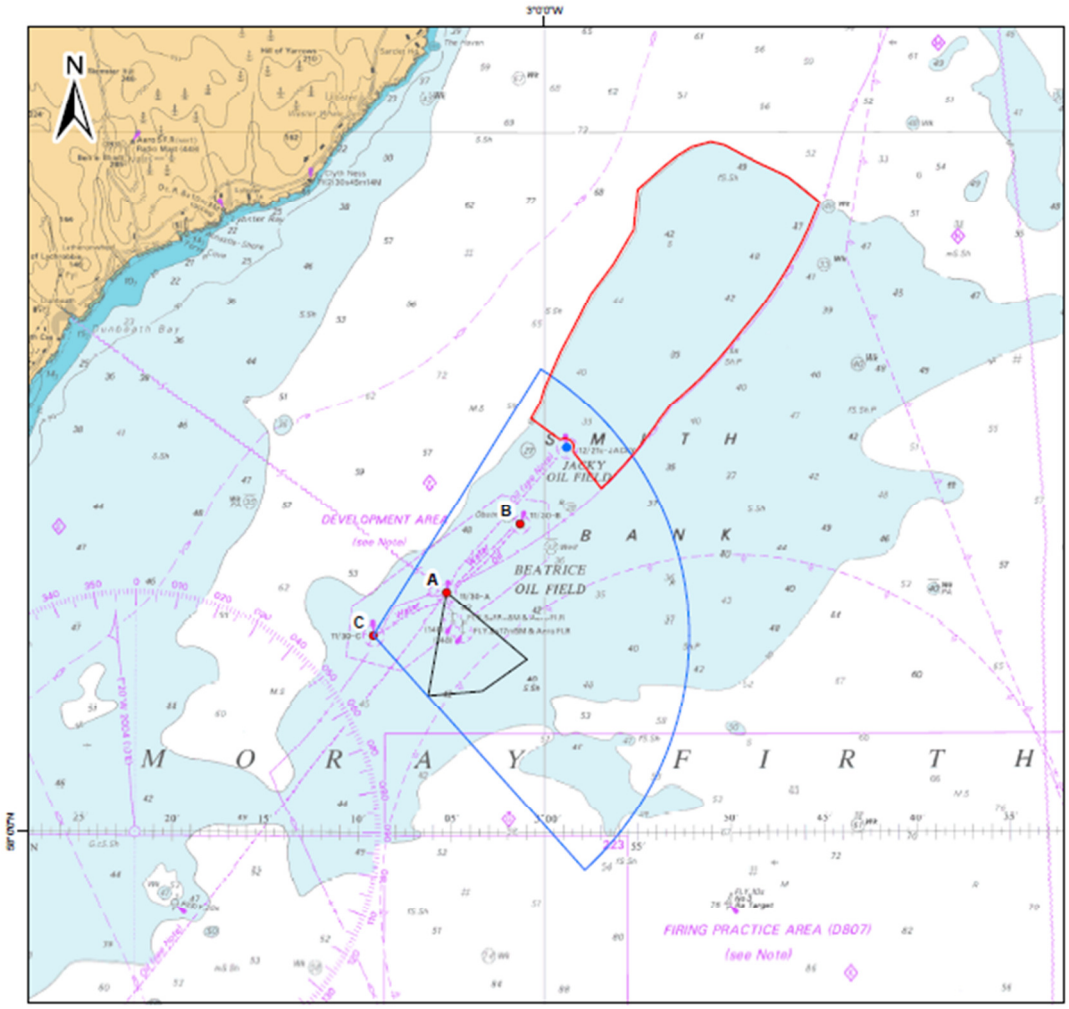

Figure 3-3: Restricted approach sectors to Beatrice Charlie including BOWL

3.5 Jacky

3.5.1 The proximity of the BOWL development to the Jacky effectively prevents all approach headings.

Destination platform	Restricted approaches	Nature of restriction
Jacky	All	BOWL development encompasses the platform

Table 3-4: Restricted approach sectors for Jacky including BOWL

3.6 Impact on operations of BOWL

3.6.1 To assess the impact of current constraints upon the operations in the Beatrice field it is necessary to bring together the existing and BOWL restrictions outlined above, the weather conditions in-field and a representative flight schedule as outlined above.

3.6.2 The impact is therefore expected to be as outlined in Table 3-5 below.

	BOWL situation	
Destination	**Total flights prevented by existing obstructions**	**Additional flights prevented by BOWL**
Beatrice A	3.2% (~5 flights p.a.)	0.1% (~1 flight in 5 years)
Beatrice B	0.7% (~1 flight in 2 years)	0.8% (~1 flight in 2 years)
Beatrice C	3.1% (~1 flight in 2 years)	0.1% (negligible)
Jacky	0.1% (negligible)	7.7% (~1 flight p.a.)

Table 3-5: Summary of BOWL impact (Wick data)

3.6.3 As before, where it is indicated that approaches would be restricted or prevented that does not in itself mean that a flight will be totally prevented. Similarly to the mitigation of delaying a flight the other identified mitigations have not been considered in the analysis above. On this basis, with no mitigations applied the impact would be such that around two additional flights per annum would be prevented. Operations to Bravo and to Jacky receive a greater impact as would be expected due to their proximity to the proposed development.

3.6.4 On the basis of Lossiemouth Met data the impact is therefore expected to be as outlined in Table 3-6 below.

	BOWL situation	
Destination	**Total flights prevented by existing obstructions**	**Additional flights prevented by BOWL**
Beatrice A	1.8% (~3 flights p.a.)	0.0% (negligible)
Beatrice B	1.3% (~1 flight p.a.)	0.4% (~1 flight in 3 years)
Beatrice C	1.0% (~1 flight in 5 years)	0.0% (negligible)
Jacky	0.8% (~1 flight in 10 years)	2.8% (~1 flight in 2 years)

Table 3-6: Summary of BOWL impact (Lossiemouth data)

3.6.5 The figures indicate that, with no mitigations applied, the net effect of the BOWL development would be to prevent approximately less than one flight to the Beatrice field per annum, over and above the existing constraints.

3.6.6 The impact of BOWL on missed approaches, other than those to Jacky, would be relatively small, consisting of some additional constraints on ARAs to the Beatrice B on northerly and easterly headings.

3.6.7 The impact of BOWL on departures would apply to take-offs from Jacky on headings from north west clockwise round to south east, and to north-easterly departures from the Bravo. Departures from the A and C would not be affected.

4 Impact of MORL Eastern Development Area (EDA)

4.1 MSA

4.1.1 The maximum proposed turbine heights in the MORL development are 204 metres above Lowest Astronomical Tide (LAT). This is equivalent to a maximum of 207 metres (679ft) above mean sea level. Therefore, due to the MORL development the MSA is likely to increase to 1,700ft. The direct in-field consequence is the additional distance required in order for the aircraft to descend to the minimum decision height (MDH) when on an instrument approach.

4.1.2 In order for an ARA to be flown with the approach starting at the revised MSA and for none of the approach to be flown over the wind farm will require approximately 9nm of separation between turbines and helideck.

4.1.3 In addition, the presence of turbines approaching 700ft above sea level in the MORL EDA may affect the altitudes at which helicopters are able to fly in VFR conditions while inbound to or outbound from the Beatrice field. Aircraft flying VFR must maintain a minimum of 500ft separation from any structures. For helicopters whose track takes them over the MORL EDA, this would impose a minimum en route VFR altitude of 1,200ft. In view of the geometry of the EDA area this is only likely to affect helicopters in transit direct from Aberdeen to the Jacky platform; direct tracks from Aberdeen to all the other platforms will pass to the west of the EDA.

4.2 Beatrice Alpha

4.2.1 Beatrice Alpha will incur additional restrictions to approaches from the east due to the MORL EDA development.

Destination platform	Restricted approaches	Nature of restriction and potential mitigations
Beatrice A	035-083	Charlie platform within 1nm of the approach path. Approach to Charlie and shuttle to Alpha, fly an out-of-wind ARA or fly a circling approach.
	206-247	Bravo platform within 1nm of the approach path. Approach to Jacky/Bravo/Charlie and shuttle to Alpha, fly an out-of-wind ARA or fly a circling approach.
	306-006	Existing no go sector due to Demonstrator Turbines.
	252-305	MORL EDA development in the approach path.

Table 4-1: Restricted approach sectors for Beatrice Alpha including MORL EDA

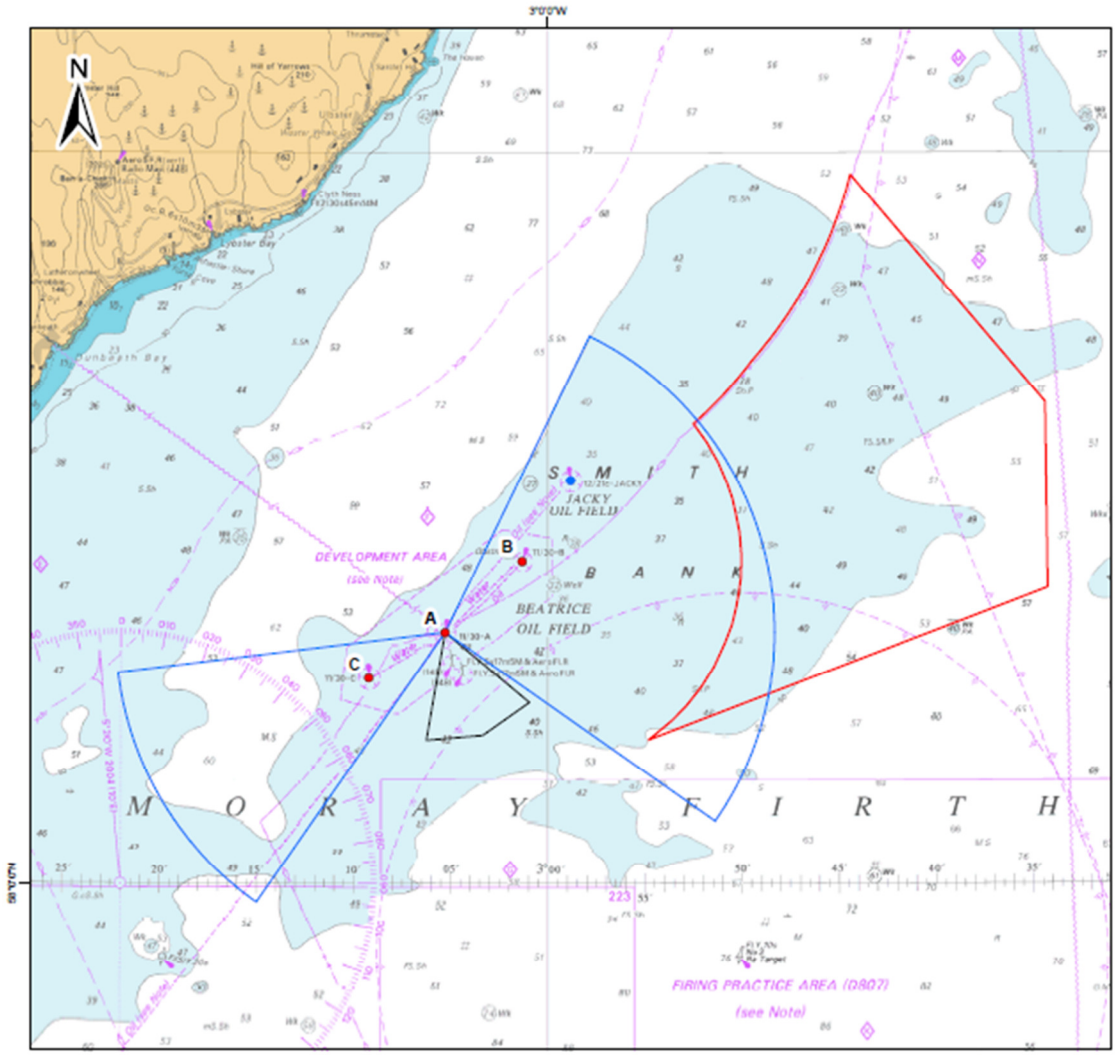

Figure 4-1: Restricted approach sectors for Beatrice Alpha including MORL EDA

4.3 Beatrice Bravo

4.3.1 Beatrice Bravo will incur additional restrictions to approaches from the east and south east due to the MORL EDA development.

Destination platform	Restricted approaches	Nature of restriction and potential mitigations
Beatrice B	048-067	Alpha platform within 1nm of the approach path. Approach to Alpha/Charlie and shuttle to Bravo, fly an out-of-wind ARA or fly a circling approach.
	355-047	Demonstrator Turbines no-go sector in the approach path.
	232-334	MORL EDA development in the approach path.

Table 4-2: Restricted approach sectors for Beatrice Bravo including MORL EDA

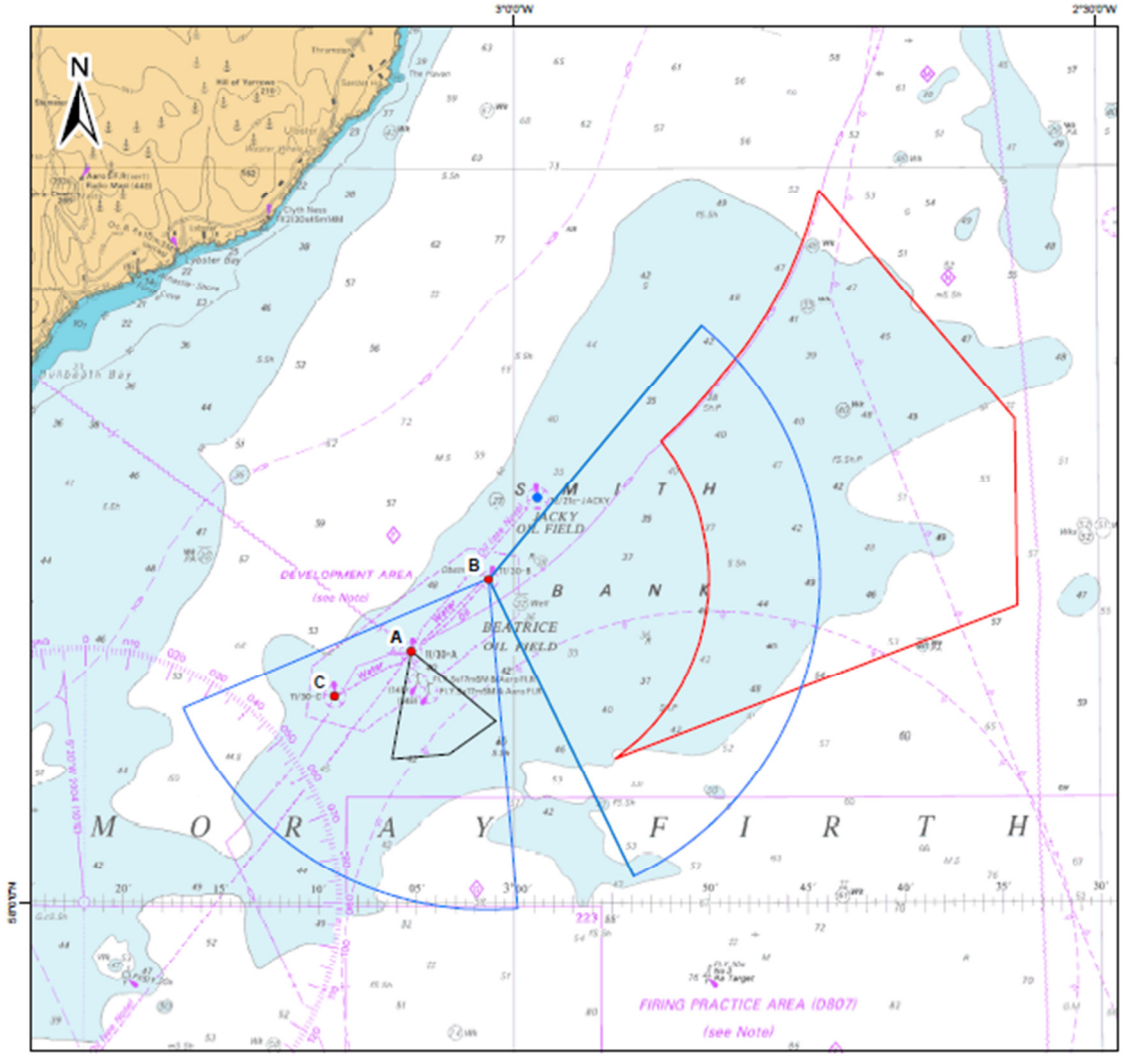

Figure 4-2: Restricted approach sectors to Beatrice Bravo including MORL EDA

4.4 Beatrice Charlie

4.4.1 Beatrice Charlie will not incur any additional restrictions to approaches due to the MORL EDA development. Approaches to the Charlie from that sector are already constrained by the Demonstrator Turbines restricted zone.

4.5 Jacky

4.5.1 Approaches to the Jacky from a sector from north-east round to south would be additionally restricted due to the MORL EDA development.

Destination platform	Restricted approaches	Nature of restriction
Jacky	009-052	Bravo platform within 1nm of the approach path. Approach to Bravo and shuttle to Alpha, fly an out-of-wind ARA or fly a circling approach.
	222-351	MORL EDA development in the approach path.

Table 4-3: Restricted approach sectors for Jacky including MORL EDA

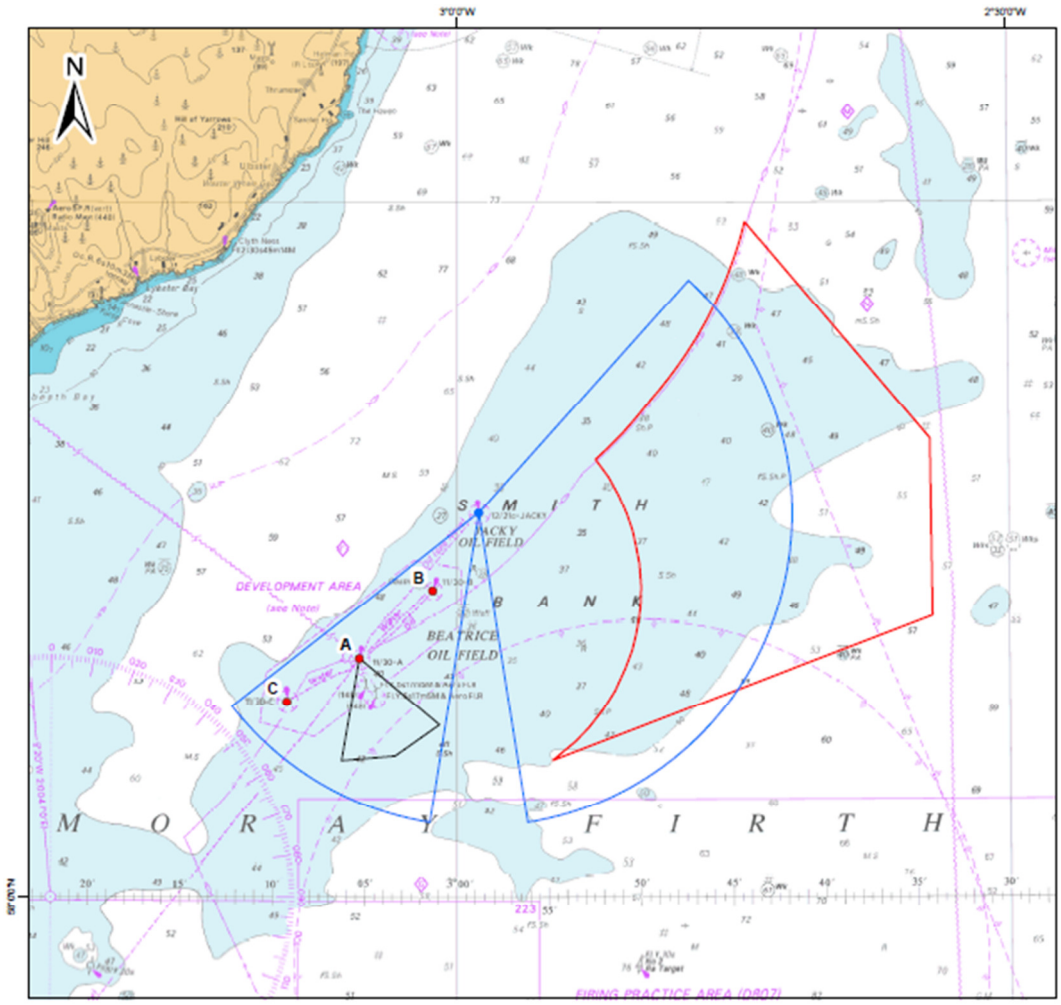

Figure 4-3: Restricted approach sectors for Jacky including MORL EDA

4.6 Impact on operations of MORL EDA

4.6.1 To assess the impact of current constraints upon the operations in the Beatrice field it is necessary to bring together the existing and MORL EDA restrictions outlined above, the weather conditions in-field and a representative flight schedule as outlined above.

4.6.2 The impact is therefore as shown in Table 4-4 below.

	MORL EDA situation (Wick data)	
Destination	**Total flights prevented by existing obstructions**	**Additional flights prevented by MORL EDA**
Beatrice A	3.2% (~5 flights p.a.)	1.9% (~3 flights p.a.)
Beatrice B	0.7% (~1 flight in 2 years)	4.3% (~3 flights p.a.)
Beatrice C	3.1% (~1 flight in 2 years)	0.0% (negligible)
Jacky	0.1% (negligible)	4.9% (~1 flight p.a.)

Table 4-4: Summary of MORL EDA impact (Wick data)

4.6.3 As before, where it is indicated that approaches would be restricted or prevented that does not in itself mean that a flight will be totally prevented. Similarly to the mitigation of delaying a flight, the other identified mitigations have not been considered in the analysis above. On this basis, with no mitigations applied the impact would be such that around seven additional flights per annum would be prevented. Operations to Bravo and to Jacky receive a greater impact as would be expected due to their proximity to the proposed development.

4.6.4 On the basis of Lossiemouth Met data the impact is therefore expected to be as outlined in Table 3-5 below.

	MORL EDA situation (Lossiemouth data)	
Destination	**Total flights prevented by existing obstructions**	**Additional flights prevented by MORL EDA**
Beatrice A	1.8% (~3 flights p.a.)	0.6% (~1 flight p.a.)
Beatrice B	1.3% (~1 flight p.a.)	1.1% (~1 flight p.a.)
Beatrice C	1.0% (~1 flight in 5 years)	N/A
Jacky	0.8% (~1 flight in 10 years)	1.4% (~1 flight in 5 years)

Table 4-5: Summary of MORL EDA impact (Lossiemouth data)

4.6.5 The figures indicate that, with no mitigations applied, the net effect of the MORL EDA would be to prevent approximately two more flights to the Beatrice field per annum, over and above the existing constraints.

4.6.6 MORL EDA would not impose any additional constraints on missed approaches since the EDA boundary is sufficiently far from all possible missed approach points. MORL EDA would have no impact on departures since all platforms are in excess of 9.3 km from the closest boundary of the EDA.

5 Impact of MORL Western Development Area (WDA)

5.1 Scope

5.1.1 The MORL WDA will only be developed in addition to the EDA. There are no circumstances in which the WDA would be developed as a stand-alone wind farm. Consequently this section addresses the impact of the WDA in combination with the EDA.

5.2 Sectors for visual manoeuvring

5.2.1 The northern boundary of the MORL WDA abuts the Beatrice Charlie platform, encompasses the Alpha platform and passes a short distance to the south of the Bravo platform. In order to permit operations to and from the helidecks of these platforms, it has been assumed in this report that no turbines are placed within a radius of 1.5nm (2.8km) of each of those three platforms.

5.3 MSA

5.3.1 The effect of the MORL WDA on the MSA for helicopters flying IFR in the area will be as set out in 4.1.1.

5.3.2 In order for an ARA to be flown with the approach starting at the revised MSA and for none of the approach to be flown over the wind farm will require approximately 9nm of separation between turbines and helideck (see Annex B).

5.3.3 For helicopters flying VFR or in VMC, the effect of the MORL WDA on minimum overflight altitudes will be as set out in 4.1.2. However this will apply to all flights between Aberdeen and any of the Beatrice field platforms since the WDA extends under all of those flight paths. Analysis of the Lossiemouth meteorological data suggests that the effect of this raising of the minimum en route VFR altitude from 1,000ft to 1,200ft would be that three or four additional flights a year from Aberdeen to the Beatrice field, which would otherwise have completed an en route descent into visual conditions and flown a visual approach to the destination platform, will be required to fly an ARA.[3]

5.4 Beatrice Alpha

5.4.1 Beatrice Alpha will incur additional restrictions to approaches from the east and south due to the MORL EDA + WDA developments.

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[3] The Lossiemouth data were used for this calculation since the en route descent to visual conditions would be conducted in an area within 40km of Lossiemouth but more than 50km from Wick. Lossiemouth data are therefore expected to be more representative of actual conditions in the en route descent area.

Destination platform	Restricted approaches	Nature of restriction and potential mitigations
Beatrice A	035-083	Charlie platform within 1nm of the approach path. Approach to Charlie and shuttle to Alpha, fly an out-of-wind ARA or fly a circling approach.
	206-247	Bravo platform within 1nm of the approach path. Approach to Jacky/Bravo/Charlie and shuttle to Alpha, fly an out-of-wind ARA or fly a circling approach.
	306-006	Existing no go sector due to Demonstrator Turbines.
	248-305	MORL WDA development in the approach path.
	007-034	MORL WDA development in the approach path.

Table 5-1: Restricted approach sectors for Beatrice Alpha including MORL EDA/WDA

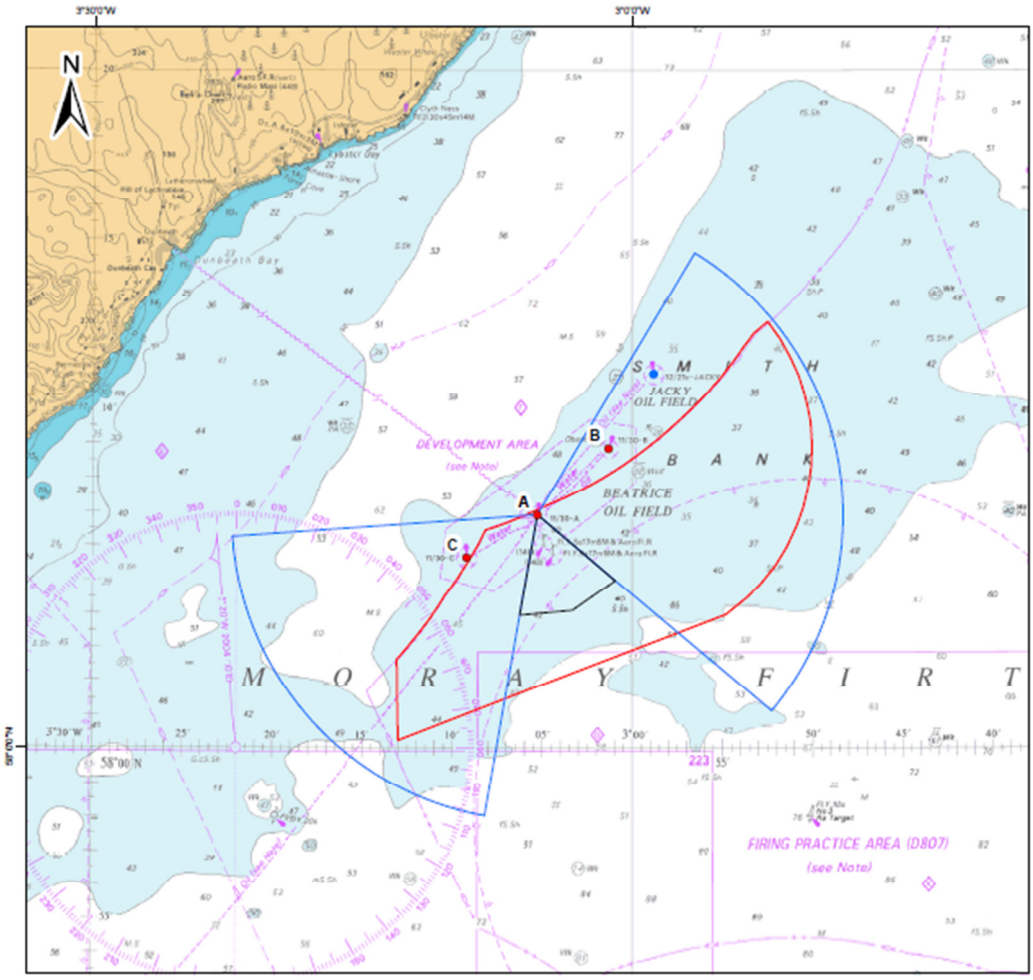

Figure 5-1: Restricted approach sectors for Beatrice Alpha including MORL EDA/WDA

5.5 Beatrice Bravo

5.5.1 Beatrice Bravo will incur additional restrictions to approaches from the east and south due to the MORL EDA + WDA developments.

Destination platform	Restricted approaches	Nature of restriction and potential mitigations
Beatrice B	048-067	Alpha platform within 1nm of the approach path. Approach to Alpha/Charlie and shuttle to Bravo, fly an out-of-wind ARA or fly a circling approach.
	355-047	Demonstrator Turbines no-go sector in the approach path.
	232-354	MORL WDA development in the approach path.

Table 5-2: Restricted approach sectors for Beatrice Bravo including MORL EDA/WDA

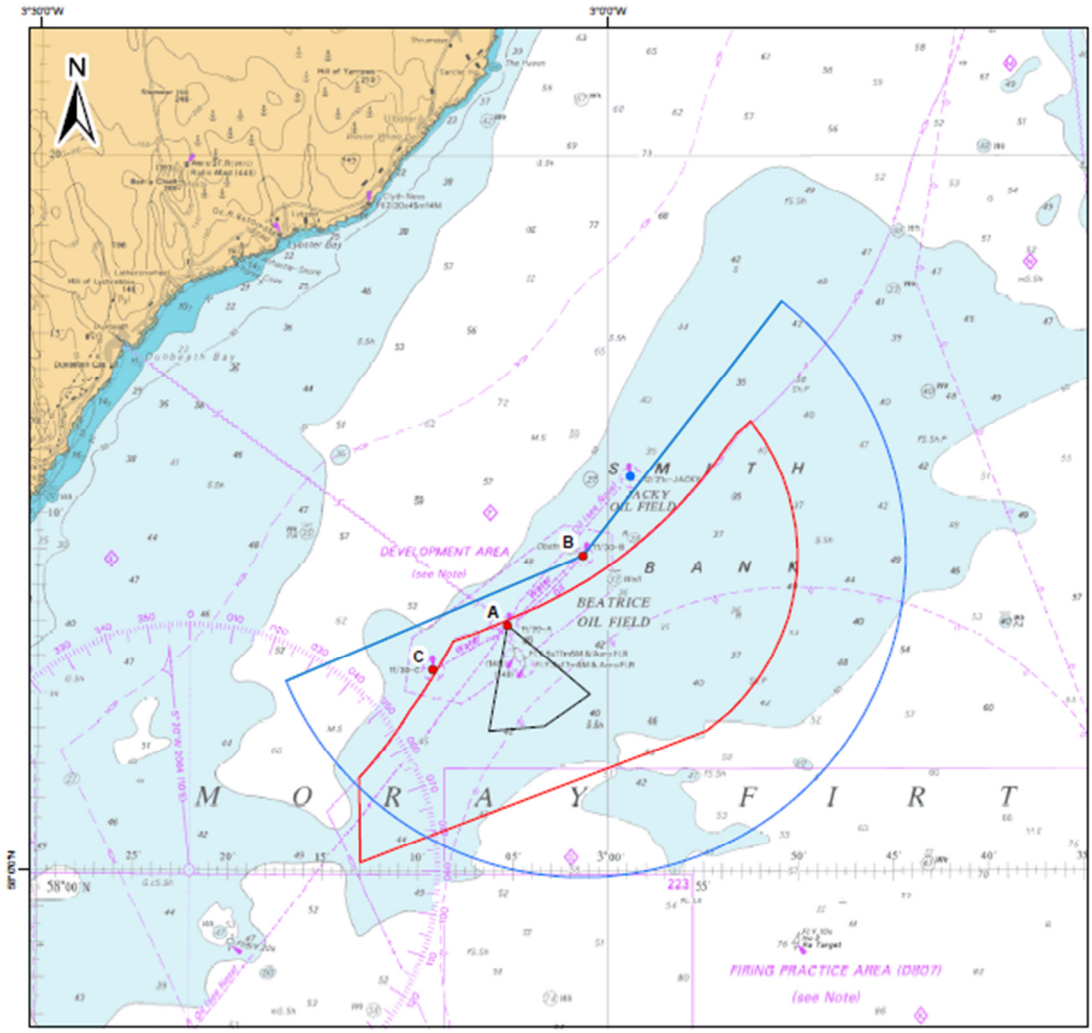

Figure 5-2: Restricted approach sectors to Beatrice Bravo including MORL EDA/ WDA

5.6 Beatrice Charlie

5.6.1 Beatrice Charlie will incur additional restrictions to approaches from the south and south-west due to the MORL EDA + WDA developments.

Destination platform	Restricted approaches	Nature of restriction and potential mitigations
Beatrice C	214-238	Alpha platform within 1nm of the approach path. Approach to Alpha and shuttle to Charlie, fly an out-of-wind ARA or fly a circling approach.
	239-315	Demonstrator Turbines no-go sector in the approach path.
	316-073	MORL WDA development in the approach path.

Table 5-3: Restricted sectors for Beatrice Charlie including MORL EDA/ WDA

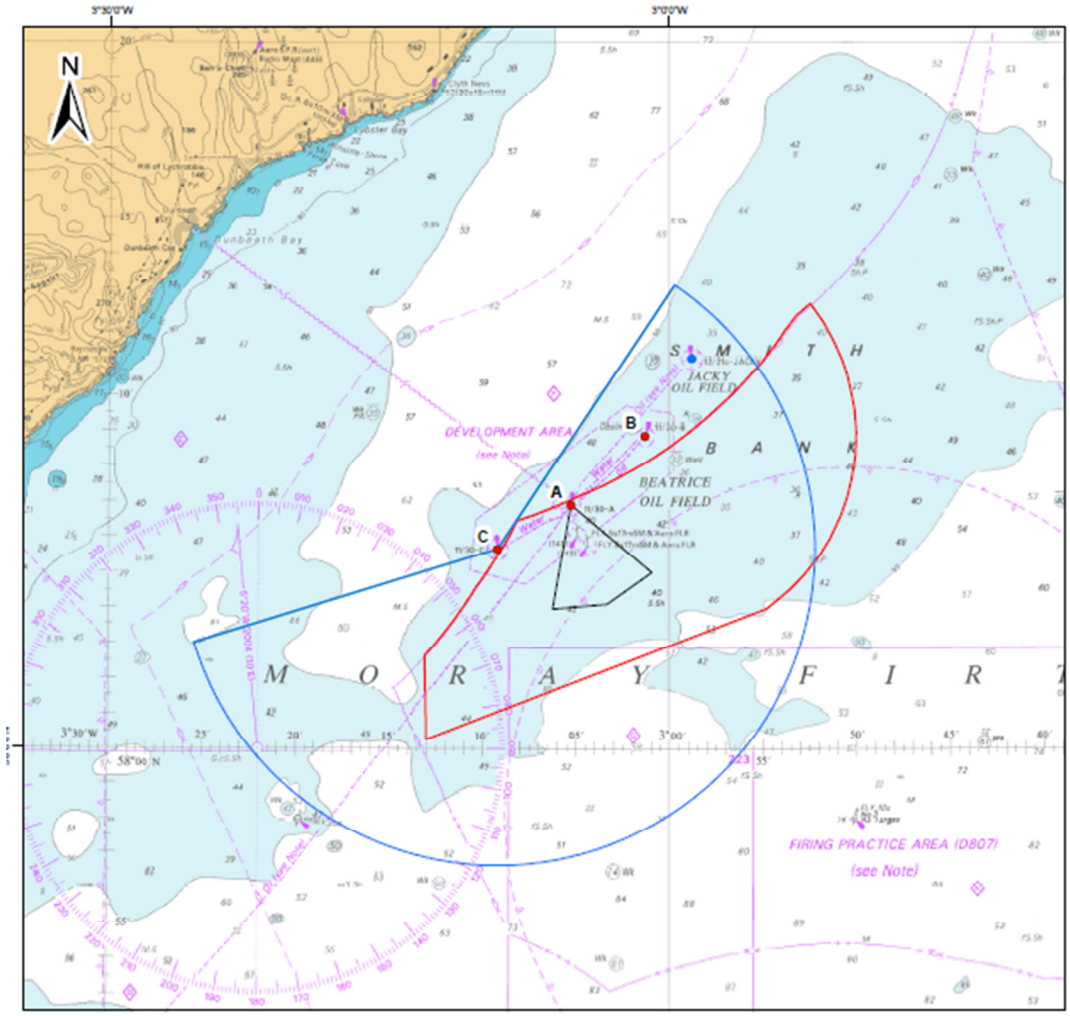

Figure 5-3: Restricted approach sectors to Beatrice Charlie including MORL EDA/ WDA

5.7 Jacky

5.7.1 Approaches to the Jacky from a sector from north-east round to south would be additionally restricted due to the MORL EDA + WDA developments.

Destination platform	Restricted approaches	Nature of restriction
Jacky	009-052	Bravo platform within 1nm of the approach path. Approach to Bravo and shuttle to Alpha, fly an out-of-wind ARA or fly a circling approach.
	222-226	MORL EDA development in the approach path
	227-008	MORL WDA development in the approach path.

Table 5-4: Restricted approach sectors for Jacky including MORL EDA/WDA

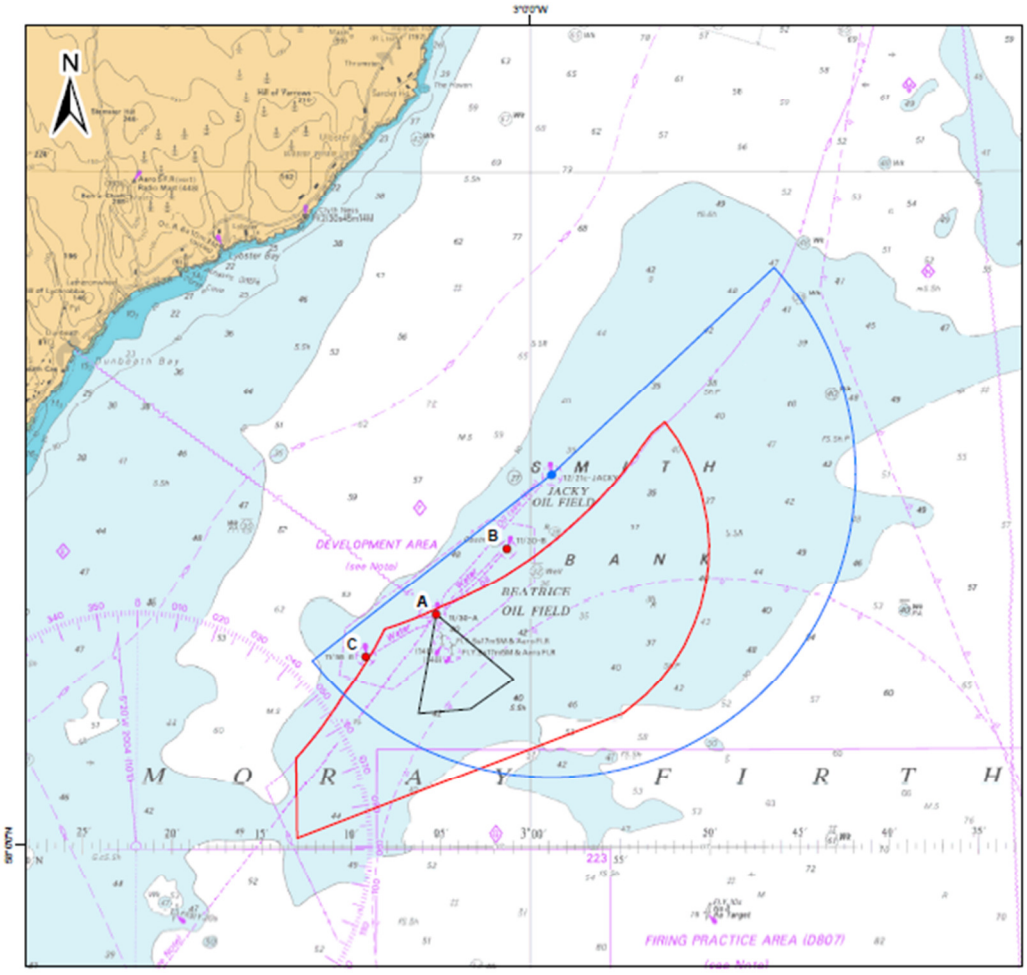

Figure 5-4: Restricted approach sectors for Jacky including MORL EDA/WDA

5.8 Impact on operations of MORL EDA + WDA

5.8.1 To assess the impact of current constraints upon the operations in the Beatrice field it is necessary to bring together the existing and MORL EDA + WDA restrictions outlined above, the weather conditions in-field and a representative flight schedule as outlined above.

5.8.2 The impact is therefore expected to be as outlined in Table 5-5 below.

	MORL EDA + WDA situation (Wick data)	
Destination	**Total flights prevented by existing obstructions**	**Additional flights prevented by MORL EDA + WDA**
Beatrice A	3.2% (~5 flights p.a.)	2.1% (~3 flights p.a.)
Beatrice B	0.7% (~1 flight in 2 years)	4.8% (~3 flights p.a.)
Beatrice C	3.1% (~1 flight in 2 years)	2.1% (~1 flight in 3 years)
Jacky	0.1% (negligible)	4.9% (~1 flight p.a.)

Table 5-5: Summary of MORL EDA + WDA impact (Wick data)

5.8.3 As before, where it is indicated that approaches would be restricted or prevented that does not in itself mean that a flight will be totally prevented. Similarly to the mitigation of delaying a flight, the other identified mitigations have not been considered in the analysis above. On this basis, with no mitigations applied the impact would be such that around seven-eight additional flights per annum would be prevented. Operations to Bravo and to Jacky receive a greater impact as would be expected due to their proximity to the proposed development.

5.8.4 On the basis of the Lossiemouth data the impact is therefore expected to be as outlined in Table 5-6 below.

	MORL EDA + WDA situation (Lossiemouth data)	
Destination	**Total flights prevented by existing obstructions**	**Additional flights prevented by MORL EDA + WDA**
Beatrice A	1.8% (~3 flights p.a.)	1.2% (~2 flight p.a.)
Beatrice B	1.3% (~1 flight p.a.)	1.3% (~1 flight p.a.)
Beatrice C	1.0% (~1 flight in 5 years)	1.8% (~1 flight in 3 years)
Jacky	0.8% (~1 flight in 10 years)	1.5% (~1 flight in 5 years)

Table 5-6: Summary of MORL EDA + WDA impact (Lossiemouth data)

5.8.5 The figures indicate that, with no mitigations applied, the net effect of the MORL EDA + WDA would be to prevent approximately three more flights to the Beatrice field per annum, over and above the existing constraints.

5.8.6 MORL WDA would impose some significant additional constraints on missed approaches since any missed approach requiring the helicopter to fly to the south of the platforms would be prevented. ARAs on southerly headings would be particularly affected. These may require the missed approach turn to be flown

through more than 45° in order to establish on an obstacle-free track, away from the wind farms. The impact of the WDA on missed approaches can be seen in Table 6-5, which summarises the cumulative impact of BOWL and MORL on missed approaches from ARAs to the Beatrice Alpha. Missed approaches to the Bravo are likely to be similarly affected. Impacts of MORL (without BOWL) on missed approaches to the Charlie and Jacky will be of a lesser scale.

5.8.7 MORL WDA will have a potentially significant impact on departures on southerly headings from all platforms. If, as assumed for this report, WDA turbines are placed up to 1.5nm (2.8km) from the A, B and C platforms, modification to departure procedures and/or aircraft weights may be required in certain wind conditions. These are discussed further in Section 7.

6 Cumulative impact of BOWL and MORL

6.1 Impact of BOWL + MORL EDA

6.1.1 MSA

6.1.1.1 Both the BOWL and the MORL EDA developments would cause the MSA to be increased to 1,700ft. The cumulative impact of BOWL and MORL EDA together would also be to increase the MSA to 1,700ft.

6.1.1.2 In order for an ARA to be flown with the approach starting at the revised MSA and for none of the approach to be flown over the wind farm will require approximately 9nm of separation between turbines and helideck.

6.1.1.3 The cumulative impact of BOWL and MORL EDA together on the minimum en route altitude for helicopters flying VFR will be the same as that for MORL EDA – an increase in overflight altitude to 1,200ft.

6.1.2 Beatrice Alpha

6.1.2.1 Beatrice Alpha will incur additional restrictions to approaches from the east due to the BOWL and MORL EDA developments.

Destination platform	Restricted approaches	Nature of restriction
Beatrice A	035-083	Charlie platform within 1nm of approach path. Approach to Charlie and shuttle to Alpha, fly an out-of-wind ARA or fly a circling approach.
	206-247	Bravo platform within 1nm of approach path
	306-006	Existing no go sector due to Demonstrator Turbines.
	195-205	BOWL development in the approach path.
	252-305	MORL EDA in the approach path.

Table 6-1: Restricted sectors for Beatrice A including BOWL and MORL EDA

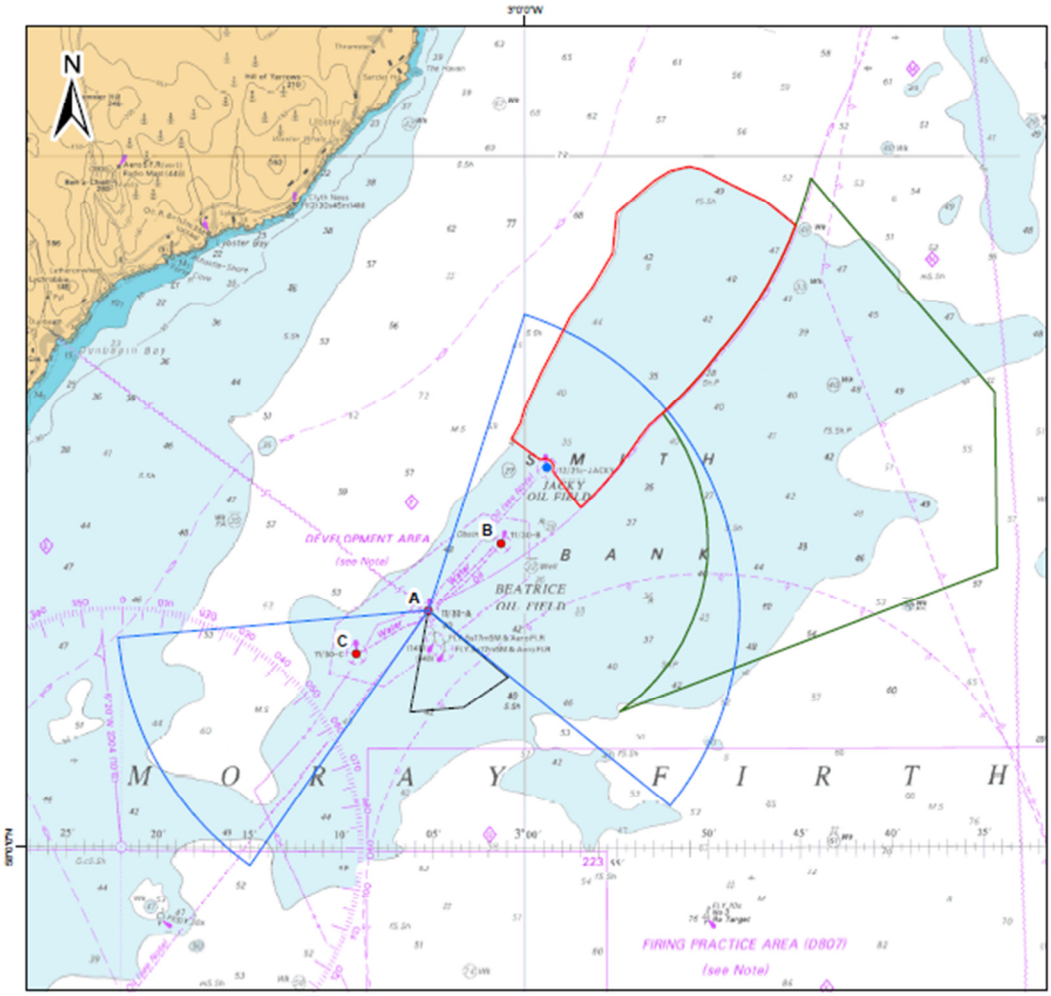

Figure 6-1: Restricted approach sectors for Beatrice A including BOWL & MORL EDA

6.1.3 Beatrice Bravo

6.1.3.1 Beatrice Bravo will incur additional restrictions to approaches from the east and south due to the BOWL and MORL EDA developments.

Destination platform	Restricted approaches	Nature of restriction
Beatrice B	048-067	Alpha platform within 1nm of the approach path. Approach to Alpha/Charlie and shuttle to Bravo, fly an out-of-wind ARA or fly a circling approach.
	355-047	Demonstrator Turbines no-go sector in the approach path.
	188-231	Jacky platform within 1nm of the approach path.
	166-187 232-269	BOWL development in the approach path.
	270-334	MORL EDA development in the approach path.

Table 6-2: Restricted approach sectors for Beatrice B including BOWL & MORL EDA

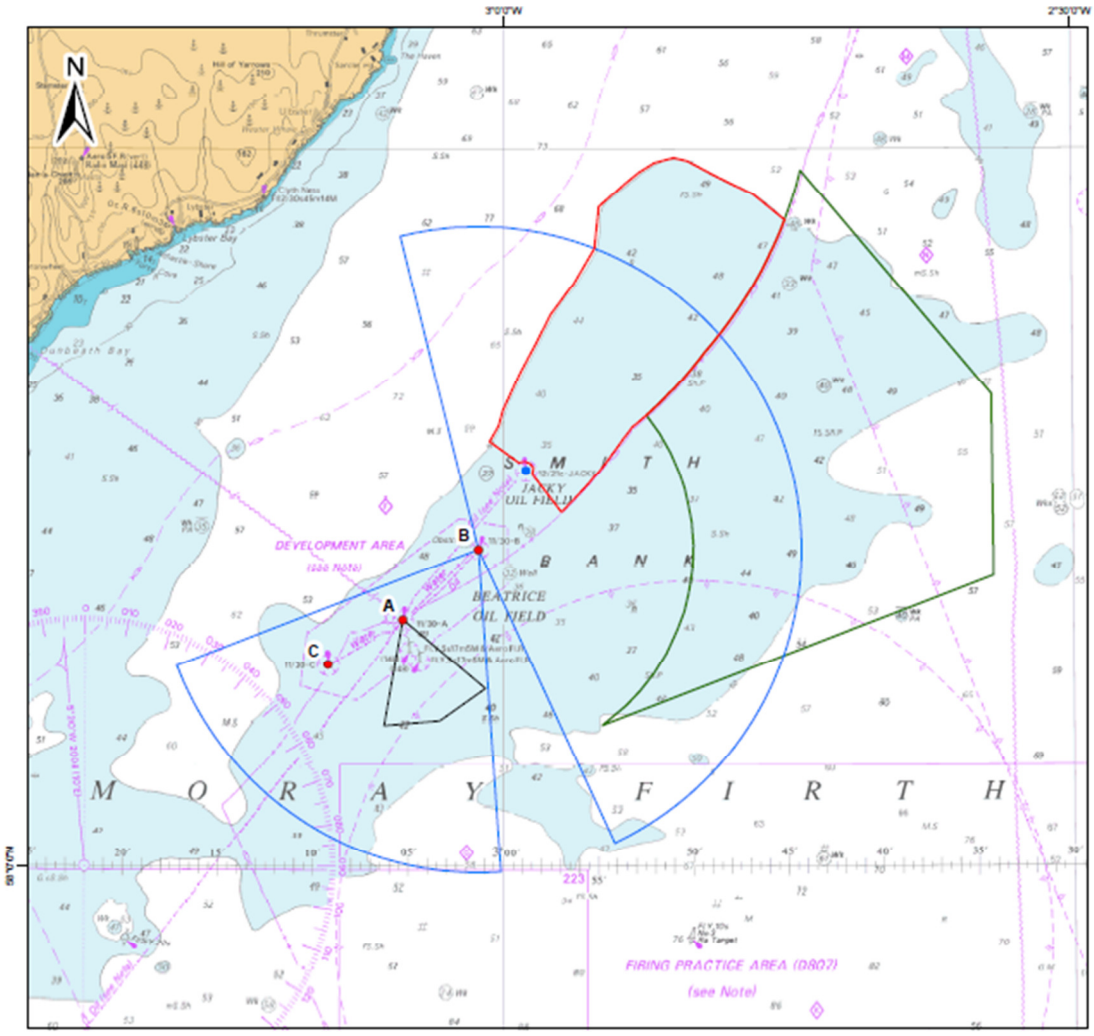

Figure 6-2: Restricted approach sectors for Beatrice B including BOWL & MORL EDA

6.1.4 Beatrice Charlie

6.1.4.1 There is no additional impact of the MORL EDA upon Charlie as the development is masked by the current no-fly zone for the Demonstrator Turbines. The cumulative impact of BOWL and MORL EDA on ARAs to the Beatrice Charlie is therefore the same as the impact on BOWL alone.

6.1.5 Jacky

6.1.5.1 There is no additional impact of the MORL EDA upon Jacky as the development is masked by the BOWL development boundaries. The cumulative impact of BOWL and MORL EDA on helicopter access to the Jacky is therefore the same as the impact of BOWL.

6.1.6 Impact on operations of BOWL& MORL EDA

6.1.6.1 To assess the cumulative impact of constraints upon the operations in the Beatrice field it is necessary to bring together the existing and BOWL & MORL EDA restrictions outlined above, the weather conditions in-field and a representative flight schedule as outlined above.

6.1.6.2 The impact is therefore expected to be as outlined in Table 6-3 below.

	BOWL& MORL EDA situation (Wick data)	
Destination	**Total flights prevented by existing obstructions**	**Additional flights prevented by BOWL & MORL EDA**
Beatrice A	3.2% (~5 flights p.a.)	2.0% (~3 flights p.a.)
Beatrice B	0.7% (~1 flight in 2 years)	4.6% (~3flights p.a.)
Beatrice C	3.1% (~1 flight in 2 years)	0.0% (negligible)
Jacky	0.1% (negligible)	7.7% (~1 flight p.a.)

Table 6-3: Summary of BOWL & MORL EDA impact (Wick data)

6.1.6.3 As before, where it is indicated that approaches would be restricted or prevented that does not in itself mean that a flight will be totally prevented. Similarly to the mitigation of delaying a flight, the other identified mitigations have not been considered in the analysis above. On this basis, with no mitigations applied the impact would be such that around seven to eight additional flights per annum would be prevented. Operations to Bravo and Jacky are impacted to a greater extent as would be expected due to their proximity to the proposed developments.

6.1.6.4 For comparison, using the Lossiemouth meteorological data, the cumulative impact of BOWL and MORL EDA is estimated to be as follows:

	BOWL& MORL EDA situation (Lossiemouth data)	
Destination	**Total flights prevented by existing obstructions**	**Additional flights prevented by BOWL & MORL EDA**
Beatrice A	1.8% (~3 flights p.a.)	0.6% (~1 flight p.a.)
Beatrice B	1.3% (~1 flight p.a.)	1.1% (~1 flight p.a.)
Beatrice C	1.0% (~1 flight in 5 years)	0.0% (negligible)
Jacky	0.8% (~1 flight in 10 years)	2.8% (~1 flight in 2 years)

Table 6-4: Summary of BOWL & MORL EDA impact (Lossiemouth data)

6.1.6.5 Leaving aside the impact on ARAs to the Jacky platform, the Lossiemouth data indicate that, with no mitigations applied, the cumulative impact of BOWL and MORL EDA would be such that approximately two to three additional flights per annum would be prevented, over and above the restrictions caused by existing obstructions.

6.1.6.6 The impact of BOWL with MORL EDA on missed approaches would be the same as the impact of BOWL as a stand-alone development. The constraints on missed approaches from ARAs to the Alpha are summarised in Table 6-5 below.

ARA final approach track (°T)	007-034	035-083	084-090	091-121	122-133	134-190	191-194	195-205	206-247	248-305	306-006
Missed approach turn direction available	Left only (R prevented by Demo Tbns sector)	ARA not possible due Beatrice C within 1nm of FAT	Left only (R prevented by Demo Tbns sector)	Left only (R prevented by Demo Tbns sector)	Left (with turn required to avoid B) or Right	Left only (R prevented by Beatrice C)	Right only (L prevented by Demo Tbns sector)	ARA not possible due BOWL within 1nm of FAT	ARA not possible due Beatrice B within 1nm of FAT	Right only (L prevented by Demo Tbns sector)	ARA not possible due Demo Turbines restricted zone
Constraints on straight climb-out after 45° initial turn	None		None (Jacky and BOWL at 5nm+)	Beatrice B	To left: Beatrice B; None to right	None	None			None	

Note: constraints additional to those currently in place are highlighted in yellow

Table 6-5: Beatrice A ARA missed approach constraints (future BOWL + MORL EDA)

6.1.6.7 The impact of BOWL with MORL EDA on departures would be the same as the impact of BOWL as a stand-alone development.

6.2 Impact of BOWL + MORL EDA + WDA

6.2.1 MSA

6.2.1.1 The BOWL, MORL EDA and MORL WDA developments would each cause the MSA to be increased to 1,700ft. Therefore, the cumulative impact of BOWL, MORL EDA and WDA together would also be to increase the MSA to 1,700ft.

6.2.1.2 The cumulative impact of BOWL, MORL EDA and WDA together on the minimum en route altitude for helicopters flying VFR will be the same as that for MORL WDA – an increase in overflight altitude to 1,200ft.

6.2.2 Beatrice Alpha

6.2.2.1 Beatrice Alpha will incur additional restrictions to approaches due to the BOWL and MORL developments.

Destination platform	Restricted approaches	Nature of restriction
Beatrice A	035-083	Charlie platform within 1nm of approach path. Approach to Charlie and shuttle to Alpha, fly an out-of-wind ARA or fly a circling approach.
	206-247	Bravo platform within 1nm of approach path
	306-006	Existing no go sector due to Demonstrator Turbines.
	195-205	BOWL development in the approach path.
	248-305	MORL EDA + WDA in the approach path.
	007-034	MORL WDA in the approach path.

Table 6-6: Restricted sectors for Beatrice A including BOWL and MORL EDA/WDA

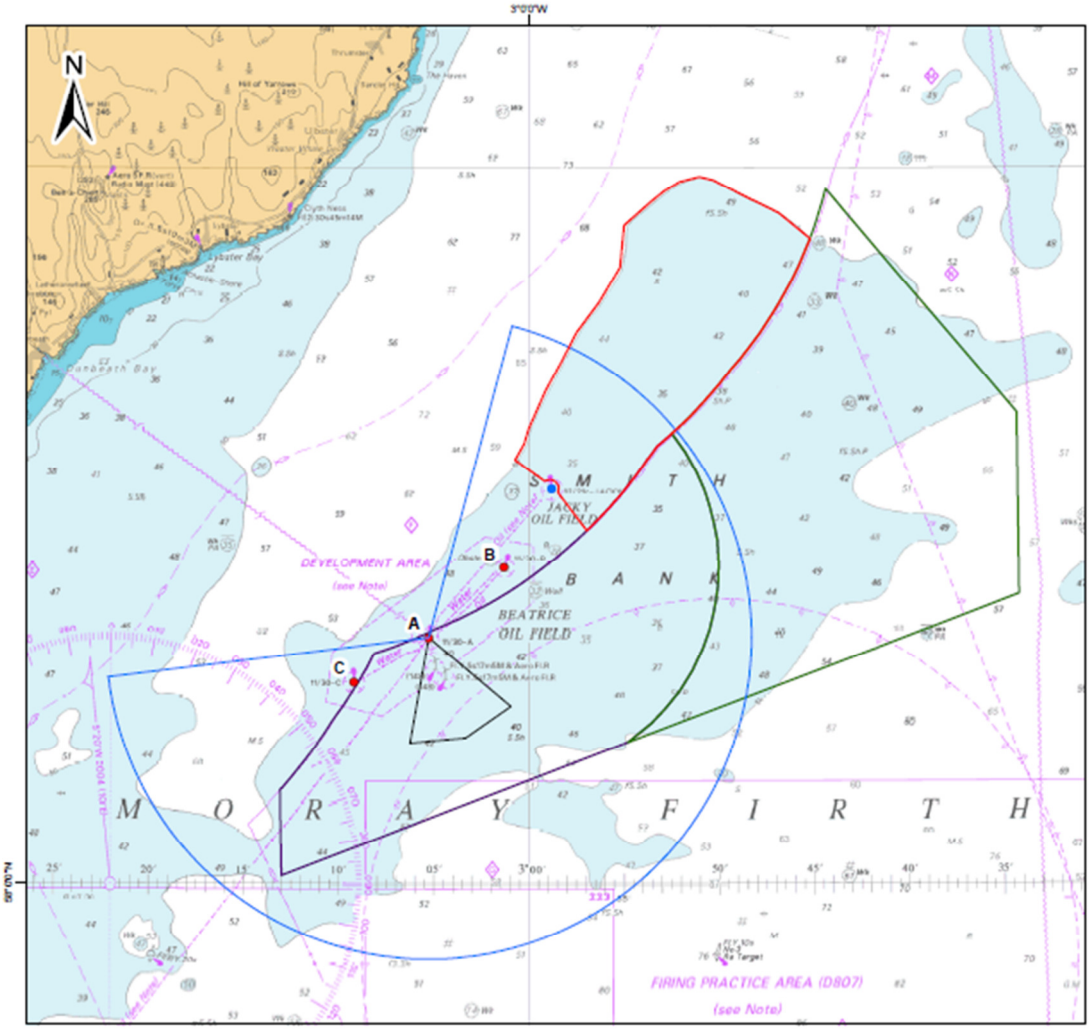

Figure 6-3: Restricted sectors for Beatrice A due to BOWL & MORL EDA/WDA

6.2.3 Beatrice Bravo

6.2.3.1 Beatrice Bravo will incur additional restrictions to approaches due to the BOWL and MORL EDA + WDA developments.

Destination platform	Restricted approaches	Nature of restriction
Beatrice B	048-067 (023-067)	Alpha platform within 1nm of the approach path. Approach to Alpha/Charlie and shuttle to Bravo, fly an out-of-wind ARA or fly a circling approach.
	355-047	Demonstrator Turbines no-go sector in the approach path.
	188-231	Jacky platform within 1nm of the approach path.
	166-187 232-269	BOWL development in the approach path.
	270-354	MORL EDA + WDA development in the approach path.

Table 6-7: Restricted sectors for Beatrice B including BOWL & MORL EDA+WDA

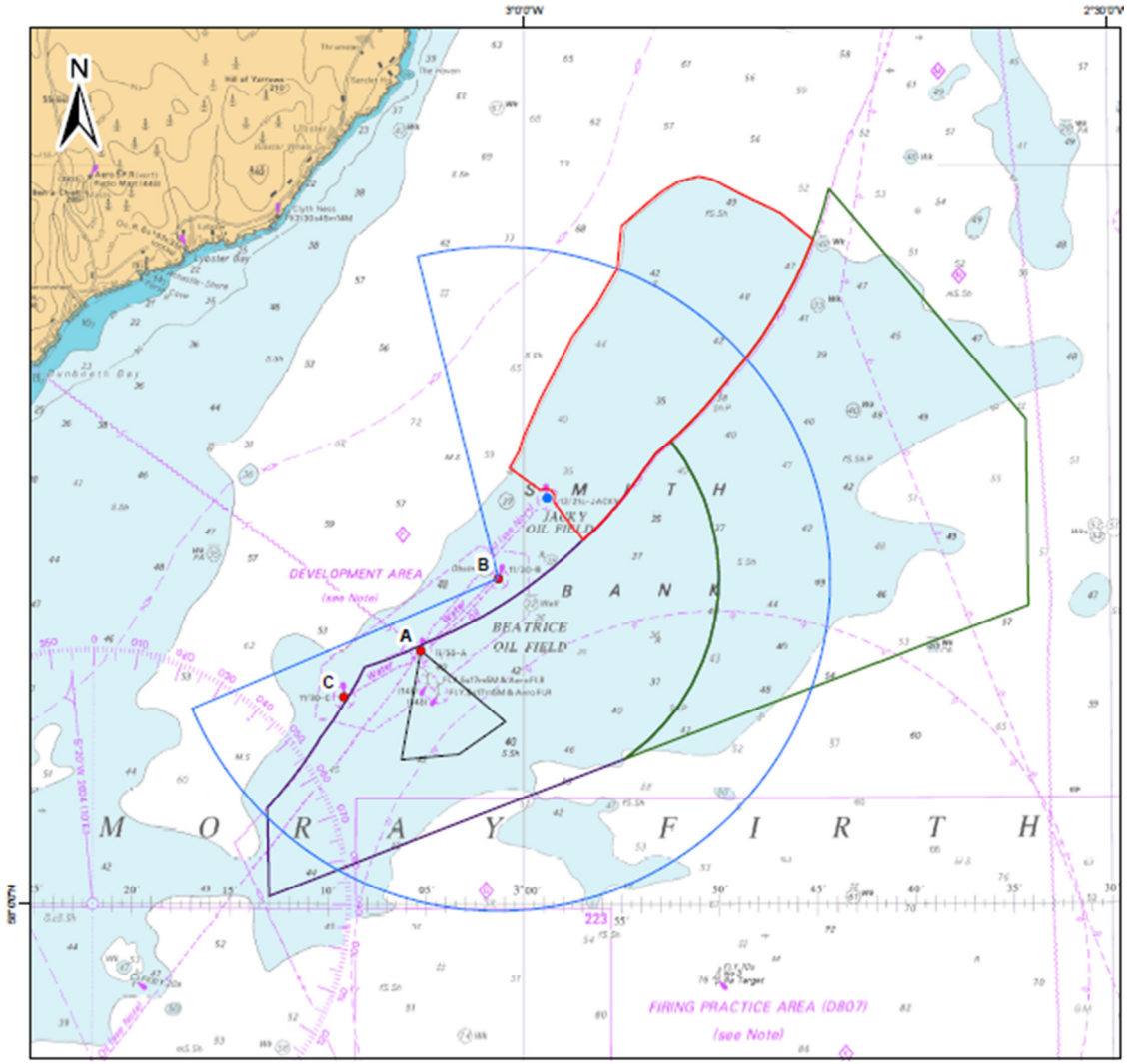

Figure 6-4: Restricted sectors for Beatrice B including BOWL & MORL EDA+WDA

6.2.4 Beatrice Charlie

6.2.4.1 Beatrice Charlie will incur additional restrictions to approaches due to the BOWL and MORL EDA/WDA developments.

Destination platform	Restricted approaches	Nature of restriction
Beatrice C	214-238	Alpha platform within 1nm of the approach path. Approach to Alpha and shuttle to Charlie, fly an out-of-wind ARA or fly a circling approach.
	239-315	Demonstrator Turbines no-go sector in the approach path.
	208-213	BOWL development in the approach path.
	316-073	MORL WDA in the approach path.

Table 6-8: Restricted sectors for Beatrice C including BOWL, MORL EDA/WDA

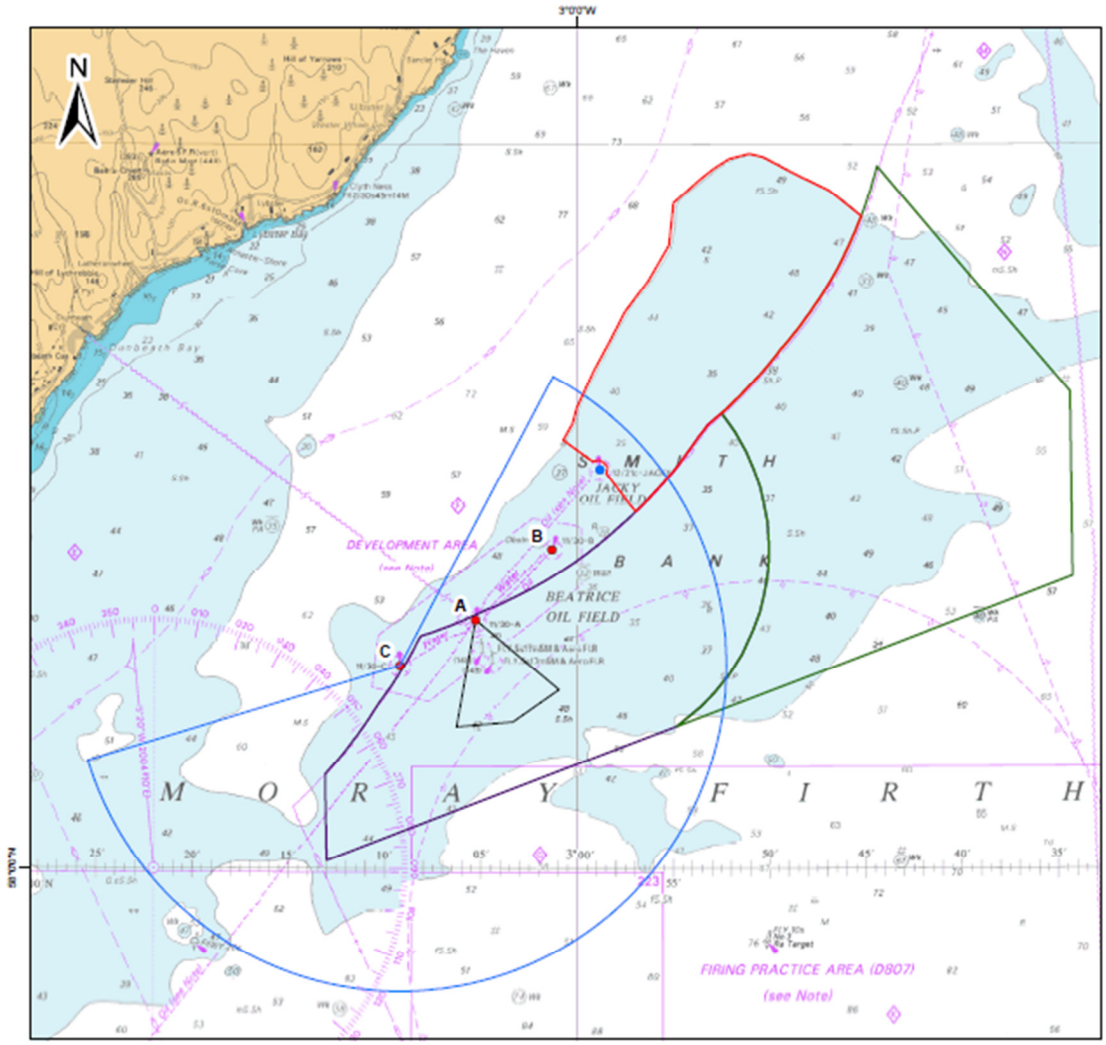

Figure 6-5: Restricted sectors for Beatrice C including BOWL & MORL EDA/WDA

6.2.5 Jacky

6.2.5.1 The cumulative impact of the BOWL, MORL EDA and WDA developments upon Jacky is no greater than the impact of BOWL alone.

6.2.6 Impact on operations of BOWL& MORL EDA/WDA

6.2.6.1 To assess the cumulative impact of constraints upon the operations in the Beatrice field it is necessary to bring together the existing and BOWL & MORL EDA/WDA restrictions outlined above, the weather conditions in-field and a representative flight schedule as outlined above.

6.2.6.2 The impact is therefore expected to be as outlined in Table 6-9 below.

	BOWL& MORL EDA/WDA situation (Wick data)	
Destination	**Total flights prevented by existing obstructions**	**Additional flights prevented by BOWL & MORL EDA/WDA**
Beatrice A	3.2% (~5 flights p.a.)	2.2% (~3-4 flights p.a.)
Beatrice B	0.7% (~1 flight in 2 years)	5.1% (~3-4 flights p.a.)
Beatrice C	3.1% (~1 flight in 2 years)	2.2% (~1 flight in 2 years)
Jacky	0.1% (negligible)	7.7% (~1 flight p.a.)

Table 6-9: Summary of BOWL & MORL EDA/WDA impact (Wick data)

6.2.6.3 As before, where it is indicated that approaches would be restricted or prevented that does not in itself mean that a flight will be totally prevented. Similarly to the mitigation of delaying a flight, the other identified mitigations have not been considered in the analysis above. On this basis, with no mitigations applied the impact would be such that around nine to ten additional flights per annum would be prevented.

6.2.6.4 For comparison, using the Lossiemouth meteorological data, the cumulative impact of BOWL and MORL EDA + WDA is estimated to be as follows:

	BOWL& MORL EDA + WDA situation (Lossiemouth data)	
Destination	**Total flights prevented by existing obstructions**	**Additional flights prevented by BOWL & MORL EDA + WDA**
Beatrice A	1.8% (~3 flights p.a.)	1.2% (~2 flights p.a.)
Beatrice B	1.3% (~1 flight p.a.)	1.3% (~1 flight p.a.)
Beatrice C	1.0% (~1 flight in 5 years)	1.8% (~1 flight in 3 years)
Jacky	0.8% (~1 flight in 10 years)	2.8% (~1 flight in 2 years)

Table 6-10: Summary of BOWL & MORL EDA + WDA impact (Lossiemouth data)

6.2.6.5 Leaving aside the impact on ARAs to the Jacky platform, the Lossiemouth data indicate that, with no mitigations applied, the cumulative impact of BOWL and MORL EDA and WDA would be such that approximately three to four additional flights per annum would be prevented, over and above the restrictions caused by existing obstructions.

6.2.6.6 The impact of BOWL plus MORL on missed approaches will be significant, driven primarily by the presence of the WDA to the south of the platforms. The constraints on missed approaches from ARAs to the Alpha are summarised in Table 6-11below.

ARA final approach track (°T)	007-034	035-083	084-090	091-121	122-144	145-150 (approx)	151-190	191-194	195-205	206-247	248-305	306-006
Missed approach turn direction available	ARA not possible due MORL WDA occupying FAT sector	ARA not possible due Beatrice C within 1nm of FAT	Left only (R prevented by Demo Tbns sector)	Left only (R prevented by Demo Tbns sector)	Left only (with turn required to avoid B)	Left or right (with turns required to avoid B or C)	Right only (L prevented by MORL WDA)	Right only (L prevented by MORL WDA + Demo Tbns sector)	ARA not possible due BOWL within 1nm of FAT	ARA not possible due Beatrice B within 1nm of FAT	ARA not possible due MORL WDA occupying FAT sector	ARA not possible due Demo Turbines restricted zone
Constraints on straight climb-out after 45° initial turn			None (Jacky and BOWL at 5nm+)	Beatrice B	Beatrice B	Beatrice B to left Beatrice C to right	Beatrice C	None				

Table 6-11: Beatrice A ARA missed approach constraints (future BOWL, MORL EDA/WDA)

6.2.6.7 The impact of BOWL plus MORL on departures would be significant, again driven primarily by the presence of the WDA to the south of the platforms.

7 Mitigations

7.1 Overview

7.1.1 There are a range of operational measures available to helicopter flight crews in order to overcome the restrictions imposed by the wind farms. Specific examples for each platform are outlined below.

7.2 Beatrice Alpha

7.2.1 Instrument approaches

7.2.1.1 The impact of the BOWL and MORL developments is to restrict approaches to Alpha from a 105 degree wide range located to the east of the platform. The MORL WDA adds a further 27 degree wide restriction to the south-east of the platform. On top of this a further 60 degree restriction from the existing demonstrator turbines and other restrictions from the other platforms. This leaves approaches from a 112 degree sector from the west of Alpha through to the north.

7.2.1.2 The mitigations to Alpha would consist of a range of measures already practised in the offshore environment:

- ARA slightly out of wind – the ARA procedure offers the flexibility to accept a slightly out of wind approach track of up to 30 degrees, cross wind permitting. At 30 degrees out of wind the aircraft will experience 50% of the wind as a cross wind component. With the aircraft being able to accept 20-25 kts of cross wind such approaches would be possible in wind speeds of 40-50 kts. The Wick meteorological data show a maximum recorded wind speed of 60kts knots. The Lossiemouth meteorological data show a maximum recorded wind speed of 37 knots. This suggests that ARAs flown up to 30° out of wind would mostly be within the aircraft's crosswind limits. It should be noted that previous safety assessments had suggested that for GPS ARA procedures the maximum out of wind heading should be limited to 20 degrees due to the errors inherent in GPS and weather radar. This recommendation, along with other factors will also come into consideration, but this would in theory allow ARA approaches to Alpha from the north-east down one side of the BOWL/MORL development in a wide range of south-westerly wind conditions.

- Circling approach – an ARA undertaken more than 30° out of wind is known as a circling approach. Such an approach provides complete flexibility in approach track. However, in order to position the aircraft into wind to land safely at the end of the approach, to reduce speed and achieve the correct configuration, additional time is required. This additional time results in the need for a higher cloud base and increased visibility conditions than for a standard ARA.

- Shuttling – typically, prior to the BOWL & MORL development, it would be practical to shuttle to Alpha from Bravo when the wind is from the south-west, and from Charlie when it is from the north-east. Shuttling from Charlie will still be a practical proposition. However, shuttling from Bravo is unlikely to be practical.

7.2.1.3 The additional complication for the instrument approach is the need to be able to undertake a missed approach with an engine inoperative. In such a situation the climb performance of the aircraft can be greatly degraded. The worst case needing protection is when the engine fails at the missed approach point when the aircraft is heading towards the BOWL/MORL development. In the case of the Alpha

platform an engine failure at the missed approach point would occur at 300ft and with the aircraft already at or above a safe speed for engine inoperative manoeuvring. It is expected that the direction of the missed approach will be agreed prior to the approach so that it will be flown away from the wind farms. Under some circumstances crews will have to accept that missed approaches can only be flown to one side of the approach track.

7.2.2 Visual approaches

7.2.2.1 Visual approaches will have greater flexibility in the selection of approach tracks to avoid the turbines, as is currently the situation. Furthermore, obstacle clearance requirements are reduced due to the ability of the crew to visually avoid obstacles. The mitigations foreseen above for instrument approaches are expected to provide adequate mitigation for visual approaches made in-field.

7.2.3 Departures

7.2.3.1 Engine inoperative departures from Alpha in IMC need to be safely protected. However, they ideally require that aircraft initially climb with a headwind component and subsequently initiate any necessary turn away from the wind farm when at 500ft and 80kts. On the basis of calculations undertaken by Bond Helicopters (for a hot day with low pressure) this will require 9.3km from the helideck to be clear of turbines (including a 1.5km safety buffer). The separation between the Alpha helideck and the BOWL development is 9.8km and between the Alpha and the MORL EDA is 11km. However, the separation to the MORL WDA is likely to be a minimum of 1.5nm (2.8km) therefore there may need to be additional restrictions imposed upon the wind conditions within which IMC departures can take place.

7.2.3.2 It has been indicated that when the weather conditions are such that a departure towards the wind farms would be preferable there is insufficient separation between the Alpha platform and the MORL WDA turbines for the aircraft to reach safe, engine inoperative manoeuvring speed. The options to address this issue are:

- Accept a smaller head-wind component by adopting a heading with some head-wind, but largely clear of the wind farm;
- Accept that in certain strong winds from the north-east through to south, departures from the platform will be limited. For example, a 25kt restriction on departures could apply, as was the recent situation when the Bravo helideck had a broken perimeter net;
- Restrict the weight of the aircraft to allow a climb performance that will enable manoeuvring much closer to the helideck – however it has been suggested that the weight restrictions needed to achieve the performance needed on a single engine would impose significant restrictions on operations; or
- Accept that manoeuvring may be necessary below 500ft once the aircraft has established a positive rate of climb.

7.3 Beatrice Bravo

7.3.1 Instrument approaches

7.3.1.1 The impact of the BOWL development is to restrict approaches to Bravo from a 99 degree wide range located to the north-east of the platform.

7.3.1.2 The mitigations to access Bravo would consist of a range of measures already practiced in the offshore environment, and as outlined above:

- ARA slightly out of wind – Clearly, other factors will also come into consideration, but this technique would in theory narrow the range of 'lost sectors' for ARA approaches to Bravo from 99 degrees to perhaps 40 – 50 degrees.
- Circling approach – Circling approaches are likely to feature heavily at the Bravo platform if direct approaches are required.
- Shuttling – typically, prior to the BOWL & MORL developments, it would be practical to shuttle to Bravo from Alpha when the wind is from the south-west, and from Jacky when it is from the north-east. Shuttling from Alpha will still be a practical proposition, but the operators have expressed a desire not to shuttle between multiple platforms (e.g. Charlie – Alpha – Bravo) in order to reach their destination. Shuttling from Jacky will no longer be an option.

7.3.1.3 Combined together these procedures should allow crew to partially mitigate the impact of the BOWL/MORL developments for access to the Bravo platform.

7.3.1.4 The additional complication for the instrument approach is the need to be able to undertake a missed approach with an engine inoperative. In such a situation the climb performance of the aircraft can be greatly degraded. The worst case needing protection is when the engine fails at the missed approach point when the aircraft is heading towards the BOWL/MORL development. In the case of the Bravo platform an engine failure at the missed approach point would occur at 300ft and with the aircraft above a safe speed for engine inoperative manoeuvring. It is expected that the direction of the missed approach will be agreed prior to the approach so that it will be flown away from the wind farms. Under some circumstances crews will have to accept that missed approaches can only be flown to one side of the approach track. This is already the case at the Bravo platform due to the restrictions imposed by the Jacky and Alpha platforms and the Demonstrator Turbines restricted zone. The construction of the BOWL, MORL EDA and particularly MORL WDA wind farms is likely to require some missed approaches from ARAs to the Bravo to continue the missed approach turn until the helicopter can be established on a track clear of obstacles.

7.3.2 Visual approaches

7.3.2.1 Visual approaches will have greater flexibility in the selection of approach tracks to avoid the turbines as is currently the situation. Furthermore, obstacle clearance requirements are reduced due to the ability of the crew to visually avoid obstacles. The mitigations foreseen above for instrument approaches are expected to provide adequate mitigation for visual approaches made in-field.

7.3.3 Departures

7.3.3.1 Engine inoperative departures from the Bravo helideck in IMC conditions need to be safely protected. However, they ideally require that aircraft initially climb with a headwind component and subsequently initiate any necessary turn away from the wind farm when at 500ft and 80kts. On the basis of calculations undertaken by Bond Helicopters (for a hot day with low pressure) this will require 9.3km from the helideck to be clear of turbines (including a 1.5km safety buffer). The separation between the Bravo helideck and the BOWL development is 4.6km. The separation to the MORL WDA is likely to be a minimum of 1.5nm (2.8km).

7.3.3.2 With stronger winds from the north-east it has been suggested that in the event of an engine failure after moving off the helideck the crew may fly the aircraft to the left or right of the platform before turning into wind. If this is reasonable in IMC then it is possible that the aircraft could be on a heading more or less directly into the wind farm. Fortunately, strong winds from the north-east do not appear to be frequent so that the BOWL development is not likely to be too problematic for departures.

7.3.3.3 It has been indicated that when the weather conditions are such that a departure towards the wind farms would be preferable there is insufficient separation between the Bravo platform and the BOWL/MORL WDA turbines for the aircraft to reach safe, engine inoperative manoeuvring speed. The options to address this issue are:

- Accept a smaller head-wind component by adopting a heading with some head-wind, but largely clear of the wind farm;
- Accept that in certain strong winds from the north-east through to south, departures from the platform will be limited. For example, a 25kt restriction on departures could apply, as was the recent situation when the Bravo helideck had a broken perimeter net. Fortunately analysis of Met data shows that strong winds from the north-east are rare;
- Restrict the weight of the aircraft to allow a climb performance that will enable manoeuvring much closer to the helideck – however it has been suggested that the weight restrictions needed to achieve the performance needed on a single engine would impose significant restrictions on operations; or
- Accept that manoeuvring may be necessary below 500ft once the aircraft has established a positive rate of climb. If it is realistic to manoeuvre the engine inoperative aircraft to avoid the immediate risk posed by the Bravo platform just to orient into wind then a manoeuvre to avoid the wind turbine may be equally justifiable.

7.4 Beatrice Charlie

7.4.1 Instrument approaches

7.4.1.1 Beatrice Charlie is minimally impacted by the BOWL development due predominantly to the current restricted sector imposed by the demonstrator turbines. However, the MORL WDA is close to the south of the platform leaving access limited to a 137 degree sector from the west to north-east.

7.4.1.2 The mitigations to access Charlie would consist of a range of measures already practiced in the offshore environment, and as outlined above:

- ARA slightly out of wind – Clearly, other factors will also come into consideration, but this technique would in theory narrow the range of 'lost sectors' for ARA approaches to Charlie. For example, accepting up to 20 degrees out of wind on an ARA would provide an additional 40 degrees of approach headings.
- Circling approach – Circling approaches are likely to feature at the Charlie platform if direct approaches are required.
- Shuttling – typically, prior to the BOWL & MORL developments, it would be practical to shuttle to Bravo from Alpha when the wind is from the south-west, and from Jacky when it is from the north-east. Shuttling from Alpha via Charlie

will still be a practical proposition, but the operators have expressed a desire not to shuttle between multiple platforms (e.g. Charlie – Alpha – Bravo) in order to reach their destination. Shuttling from Jacky will no longer be an option.

7.4.1.3 Combined together these procedures should allow crew to partially mitigate the impact of the BOWL/MORL development for access to the Charlie platform.

7.4.1.4 The additional complication for the instrument approach is the need to be able to undertake a missed approach with an engine inoperative. In such a situation the climb performance of the aircraft can be greatly degraded. The worst case needing protection is when the engine fails at the missed approach point when the aircraft is heading towards the BOWL/MORL development. In the case of the Charlie platform an engine failure at the missed approach point would occur at 300ft and with the aircraft above a safe speed for engine inoperative manoeuvring. It is expected that the direction of the missed approach will be agreed prior to the approach so that it will be flown away from the wind farms. Under some circumstances crews will have to accept that missed approaches can only be flown to one side of the approach track, as is already the case due to existing obstacles.

7.4.2 Visual approaches

7.4.2.1 Visual approaches will have greater flexibility in the selection of approach tracks to avoid the turbines as is currently the situation. Furthermore, obstacle clearance requirements are reduced due to the ability of the crew to visually avoid obstacles. The mitigations foreseen above for instrument approaches are expected to provide adequate mitigation for visual approaches made in-field.

7.4.3 Departures

7.4.3.1 Engine inoperative departures from Charlie in IMC need to be safely protected. However, they ideally require that aircraft initially climb with a headwind component and subsequently initiate any necessary turn away from the wind farm when at 500ft and 80kts. On the basis of calculations undertaken by Bond Helicopters (for a hot day with low pressure) this will require 9.3km from the helideck to be clear of turbines (including a 1.5km safety buffer). The separation to the BOWL development is 7.7nm (14.2km) and to the MORL EDA is 6nm (11.1km). The separation to the MORL WDA is likely to be a minimum of 1.5nm (2.8km) therefore there may need to be additional restrictions imposed upon the wind conditions within which IMC departures can take place.

7.4.3.2 It has been indicated that when the weather conditions are such that a departure towards the wind farms would be preferable there is insufficient separation between the Charlie platform and the MORL WDA turbines for the aircraft to reach safe, engine inoperative manoeuvring speed. The options to address this issue are:

- Accept a smaller head-wind component by adopting a heading with some head-wind, but largely clear of the wind farm;
- Accept that in certain strong winds from the north-east through to south, departures from the platform will be limited. For example, a 25kt restriction on departures could apply, as was the recent situation when the Bravo helideck had a broken perimeter net;
- Restrict the weight of the aircraft to allow a climb performance that will enable manoeuvring much closer to the helideck – however it has been suggested

that the weight restrictions needed to achieve the performance needed on a single engine would impose significant restrictions on operations; or

- Accept that manoeuvring may be necessary below 500ft once the aircraft has established a positive rate of climb.

7.5 Jacky

7.5.1 Instrument approaches

7.5.1.1 The impact of the BOWL/MORL development is to restrict instrument approaches to Jacky from all approach headings due to the proximity of turbines. The mitigation is to operate to the platform in visual conditions where the aircraft will be able to undertake all manoeuvres, including the early stages of a missed approach, with good sight of the wind farm. The minima may not need to be as stringent as full VMC such that shuttling from Bravo could still be undertaken under certain weather conditions.

7.5.2 Visual approaches

7.5.2.1 To allow safe visual manoeuvring a combination of mitigations is suggested. Firstly, the OFZ for the helideck of any jack-up rig positioned at Jacky should be oriented to the south-west. This is in any event aligned with regulatory best practice for prevailing winds, but also ensures the best accessibility to the helideck.

7.5.2.2 Secondly it is likely to be necessary to keep a radius clear of turbines around the location of a jack-up at Jacky. This is primarily to permit visual circling to land when the wind is from the south-west, where there is the requirement for the pilot handling the landing to always have the platform in sight on the final stage of the approach. It has been suggested that 1.5km clearance from the turbines is required at all times. A rate one turn at 100kts airspeed has a radius less than 1km, so 2.5km will be adequate clearance, particularly if the turn can be tighter in visual conditions.

7.5.3 Departures

7.5.3.1 Due to the proximity of the turbines it is likely that departures are going to be restricted to those weather conditions in which departures into wind can be made away from the BOWL development. There will be insufficient space to allow engine inoperative departures from the helideck in the situation where the wind is blowing from the north-east. Fortunately, analysis of the Met data shows that strong winds from the north-east are rare and departures predominantly into the prevailing wind (ideally to the due west) will be common.

A Glossary, abbreviations and acronyms

AIP	Aeronautical Information Publication
amsl	Above mean sea level
ARA	Airborne Radar Approach
BOWL	Beatrice Offshore Wind farm Limited
CAA	Civil Aviation Authority
FAF	Final Approach Fix. The point at which descent is commenced at the start of the final approach, defined by a radio navigation facility or a specified distance and bearing from such a facility.
FAP	Final Approach Point. The point at which descent is commenced at the start of the final approach.
FAT	Final Approach Track (a compass bearing in degrees)
GPS	Global Positioning System
Heading	The direction in which the aircraft is pointing (a compass bearing in degrees) [see also 'Track']
ICAO	International Civil Aviation Organization – a UN agency which sets the main international standards and recommended practices for aviation.
IEM	Interpretive and Explanatory Material (guidance material in JAR-OPS documents)
IFR	Instrument Flight Rules. The rules governing flight conducted on instruments. They consist of rules on minimum height above terrain, altimeter setting, cruising levels for traffic flying in different directions, the filing of flight plans and air traffic control clearance.
Initial Approach phase	The part of an instrument approach procedure from the Initial Approach fix (usually a radio beacon) to the point at which the aircraft is lined up with the final approach track.
IMC	Instrument Meteorological Conditions. Weather conditions which would preclude flight by the Visual Flight Rules, i.e. conditions where the aircraft is in or close to cloud or flying in visibility less than a specified minimum.
JAA	Joint Aviation Authorities
JAR-OPS	Joint Aviation Requirements for Operations
MAP	Missed Approach Procedure. The actions for the crew of an aircraft to take when an instrument approach procedure is not successful e.g. the crew are unable to see the runway, approach lights or helideck.
MAPt	Missed Approach Point. The location in an instrument approach procedure where, if the crew have not achieved visual contact with the runway, approach lights or helideck, they must initiate a missed approach.
MDA	Minimum Descent Altitude (as measured by a barometric altimeter, referenced to sea level)
MDH	Minimum Descent Height (as measured by a radio altimeter)
MDR	Minimum Decision Range. The distance from the platform at which the helicopter crew must be able to see the platform in order to complete an approach to land, and at which, if they cannot see the platform, they must execute a Missed Approach.

MOC	Minimum Obstacle Clearance (the minimum vertical separation applied between obstacles and an aircraft flying an approach or departure)
MORL	Moray Offshore Renewables Ltd
MSA	Minimum Safe Altitude (under the IFR, the height above sea level of the highest object within 5nm, plus 1000ft, rounded up to the next hundred feet)
NDB	Non-Directional Beacon
nm	Nautical mile. One nautical mile = 6076 feet or 1852 metres.
NUI	Normally unmanned installation
OEI	One Engine Inoperative. The condition when a multi-engined aircraft has had a failure of one engine.
Offset Initiation Point	The point in the later stages of an airborne radar approach at which the helicopter is turned on to a track offset from the Final Approach Track.
okta	A measure of cloud amount. One okta of cloud is one eighth of the sky covered by cloud.
Rate 1	A turn involving a change of heading of 3º per second - the standard rate of turn used during instrument flying.
Track	The path described by an aircraft across the ground. This will differ from the aircraft's heading (q.v.) when a crosswind is present.
VFR	Visual Flight Rules. The rules governing flight conducted visually i.e. with the crew maintaining separation from obstacles and other aircraft visually. They consist principally of rules on minimum visibility and separation from cloud.
WCA	Wind correction angle. The difference between an aircraft's heading and its track, caused by a wind direction which is not aligned with the aircraft's track.

B Derivation of minimum range of turbines from platforms

B.1 It has been assumed for this report that no Airborne Radar Approaches can be flown to any of the Beatrice/Jacky platforms from any sector where there are turbines within a range of 9nm from the platform. This is based in part on the new guidance contained in the Fourth Edition of the CAA's guidance document CAP 764, published in July 2011, but is also derived from calculation of the distance required for a helicopter to descend from the new higher Minimum Safe Altitude dictated by the BOWL and MORL turbines, using the standard descent rates used in the GPS-assisted ARA procedure. This Annex provides an explanation of those calculations.

B.2 In the standard GPS-assisted ARA procedure (see Annex C for the Bond Offshore Helicopters procedure chart), it is assumed that the Initial Approach phase of the procedure is flown at 1,500ft; that descent is initiated when lined up with the Final Approach Track at 7nm from the platform; and that the Minimum Descent Height of 200ft is reached at a range of 2nm from the platform. The rate of the descent is 50ft in the first and last half miles, otherwise 150ft per half mile. This provides for a smoother descent profile and lower cockpit workload. In light of recent incidents the operators are keen to fly stabilised approaches at descent rates that minimise workload. Hence we have not considered any higher descent rates within this report.

B.3 In the BOWL/MORL case, the Initial Approach phase will be flown at 1,700ft. Additionally, ARAs in the Beatrice field differ from the standard in that the MDH (for day VFR) is 300ft. Thus the helicopter must descend 1400ft compared to 1,300ft in the standard procedure.

B.4 Working backwards from 300ft at 2nm, and using a similar descent profile to the standard procedure,[4] the heights at half mile intervals would be as shown below:

[4] As shown, the start of the descent is rather more gradual than in the standard procedure since the required amount of descent in this case is not divisible into whole 150ft segments.

Range from platform (nm)	Height above sea level (ft)
7.5	1700
7	1650
6.5	1550
6	1400
5.5	1250
5	1100
4.5	950
4	800
3.5	650
3	500
2.5	350
2	300

B.5 The table shows that the helicopter would roll out of the base turn to line up with the FAT at a range of 7.5nm. Working back again from this point, the helicopter will have flown a Rate 1 turn commencing at 7.5nm from the platform. Using a conservative estimate of an 120 knot airspeed for the base turn phase of the approach, the turn will have a radius of 0.64nm.[5] Thus it can be assumed that the helicopter's flight track will take it to a maximum range of 8.14nm from the platform. A turbine free range of 9nm radius from the platform will therefore ensure that helicopters will not overfly turbines at any stage in the ARA given that there will be some margin between the closest turbine and the commencement of the descent.

B.6 It may be possible to reduce the size of the ARA restricted sectors, and therefore reduce the number of flights that would be impacted by BOWL/MORL, by designing the ARA procedure according to standard ICAO procedure criteria in which the Intermediate phase of the approach (lined up with the FAT, flying level, before commencing descent at the Final Approach Point) is flown with a minimum 500ft vertical separation from the turbines, rather than the 1,000ft assumed in this report. This would mean that, at the point where the helicopter descends below 1,200ft (maximum turbine tip height plus 500ft), 1nm horizontal separation must exist from all turbines. From the table above, this would permit ARAs to be flown from sectors where there were turbines located as close as 6.5nm from the platform. On those assumptions, the helicopter would overfly the last turbine at a height of 1,550ft, i.e. with a vertical clearance of some 850ft over the turbine blade tips.

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5 The actual ground track of the helicopter in the base turn will be determined by the wind vector in combination with the airspeed.

C Bond Offshore Helicopters GPS-Assisted ARA procedure

GPS - Assisted AIRBORNE RADAR APPROACH

L1

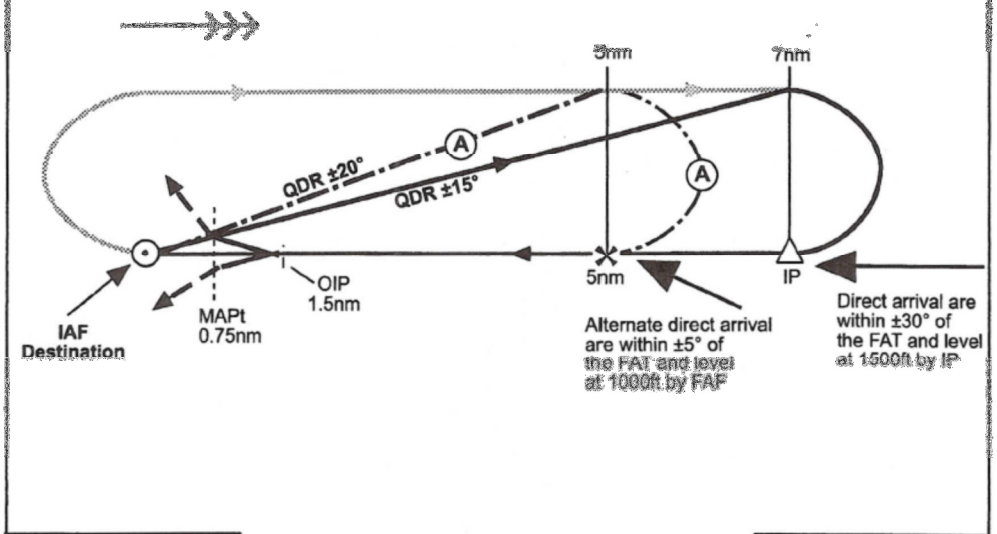
(Bond Offshore Helicopter Ltd.)

05 MAR 10

NORMAL MINIMA			MAPt 0.75nm	CIRCLING MINIMA (if FAT not into wind ±30°)				
MDH (Radalt)		MDA (Baralt)		MDH (Radalt)		MDA (Bar)	MAPt	
Day	Night	Day or Night		Day	Night	Day or Night	Day	Night
200ft (1)	300ft (1)	500ft	Max GS on FAT 90kt	300ft (2)	500ft (3)	500ft (3)	1nm	1.5nm
(1) Or deck height plus 50ft if higher				(2) Or deck height plus 100ft if higher (3) Or deck height plus 200ft if higher				

MEA: **Rig elev +1000ft**

MEA: **Rig elev +1000ft**



MEA: **Rig elev +1000ft**

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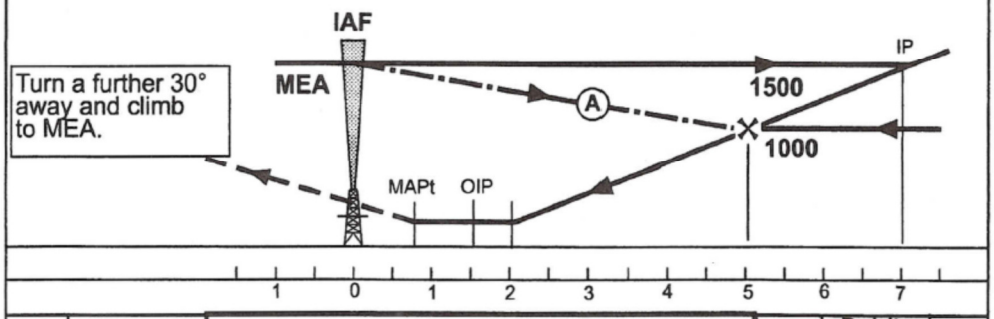

G/S	Time to turn	
(kts)	5nm	7nm
150	2:00	2:48
130	2:18	3:14
120	2:30	3:30
110	2:44	3:49
100	3:00	4:12
90	3:20	4:40
80	3:45	5:15
70	4:17	6:00

1. Below 1000ft fly on Radalt.
2. Below MEA all radar contacts are to be avoided by at least 1nm.
3. Minimum range for the MAPt is 0.75nm.
4. At 1.5nm (OIP) turn away 10°. At 1nm confirm track offset is approx 15°, adjust heading if necessary.
5. If not visual at MAPt (0.75nm) turn a further 30° and climb to MEA.
6. No descent below MDH/A until on correct visual approach profile.
7. If available, NDB may be used to confirm ident / QDR.

Range	Radalt		Baralt
	Day	Night	
7	1500	1500	1500
6.5	1450	1450	1450
6	1300	1300	1300
5.5	1150	1150	1150
5	1000	1000	1000
4.5	850	850	850
4	700	700	700
3.5	550	550	550
3	400	400	500
2.5	250	300	500
2	200	300	500

Rev: Procedure

olrb