Berwick Bank Wind Farm

Additional Environmental Information (AEI) Submission

AEI03: Supplementary Information
Section 3 Consideration of Precaution

sse Renewables

Revision Information					
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Acronyms

Acronym	Description
AEI	Additional Environmental Information
CION	Connection and Infrastructure Options Note
NSIP	Nationally Significant Infrastructure Projects
SPA	Special Protection Area
SNCB	Statutory Nature Conservation Bodies

1. Consideration of Precaution

1.1. Overview

In their ornithology consultation response to the Section 36 Application, NatureScot state "*The magnitude of impacts predicted are due to the extremely high densities of birds found within the proposed development area. The impacts predicted for this site are an order of magnitude greater, and across more species than we have seen for any other offshore wind farm application in Scotland*."

The Applicant considers that the magnitude of estimated bird mortality in the Section 36 Application is a direct consequence of the level of precaution applied to the assessment process.

Whilst the application of the precautionary principle is a requirement given the inherent uncertainties associated with impact predictions, it is a tool to enable decision makers to make a reasonable assessment of the associated risk[1,2], using the best available scientific evidence available. If the precautionary principle is applied excessively (and thereby unreasonably), there is a risk that the level of precaution applied will distort robust decision making by presenting assessment outputs which are unrealistic compared to the risk to the environment.

Here, the Applicant first sets out the case that there is no evidence in support of the assertion that predicted impacts are due to extremely high densities of birds present in the Proposed Development, and second, sets out three areas where the advice provided in the Scoping Opinion is considered to lead to an overestimation of predicted impacts by applying an excessive level of precaution, including:

1. It is not consistent with new guidance published since the Section 36 Application was submitted;
2. It does not use the best available scientific methods available for the impact assessment; and
3. It does not provide sufficient evidence to justify a change from precedent advice for previous Scottish offshore wind farm assessments.

Cumulatively, the Applicant estimates that precaution applied in assessments utilising the Scoping Opinion approach to ornithological assessment overestimates bird mortality by up to 548%.

The Applicant therefore continues to advocate that the Developer Approach outlined in the Section 36 Application includes an appropriate level of precaution relative to the associated risk of the Proposed Development for the purposes of assessment and decision making, and that the Scoping Approach is excessively precautionary.

[1] https://www.gov.uk/government/publications/environmental-principles-policy-statement/environmental-principles-policy-statement#:~:text=Its%20definition%20of%20the%20precautionary,measures%20to%20prevent%20environmental%20degradation

[2] UK Withdrawal from the European Union (Continuity) (Scotland) Act 2021 - Explanatory Notes (legislation.gov.uk)

1.2. Introduction

In their ornithology consultation response to the Section 36 Application, NatureScot state "*The magnitude of impacts predicted are due to the extremely high densities of birds found within the proposed development area. The impacts predicted for this site are an order of magnitude greater, and across more species than we have seen for any other offshore wind farm application in Scotland*."

The Applicant considers that the magnitude of estimated bird mortality in the Section 36 Application is a direct consequence of the level of precaution applied to the assessment process.

Whilst the application of the precautionary principle is a requirement given the inherent uncertainties associated with impact predictions, it is a tool to enable decision makers to make a reasonable assessment of the associated risk[3,4], using the best available scientific evidence available. If the precautionary principle is applied excessively (and thereby unreasonably), there is a risk that the level of precaution applied will distort robust decision making by presenting assessment outputs which are unrealistic comparative to the risk to the environment.

Under the Section 36 Application, the Applicant for the most part adopted the advice on ornithological assessment parameters advised in the Scoping Opinion (volume 3, appendix 6.2 of the Offshore EIA Report). Nevertheless, the Applicant considered that certain modelling parameters and methods which were required under the Scoping Opinion led to a disproportionately high estimate of bird mortality based on best available scientific evidence.

As such, the Applicant presented a dual assessment of potential impacts based on:

- The 'Scoping Approach'; and
- The 'Developer Approach'.

In their consultation response to the Section 36 Application, NatureScot state "*We disagree that the Scoping Approach is overly precautionary as it reflects current methods and evidence as agreed at the time of the Scoping/Roadmap process*".

They go on to state in Appendix C of their response "*The Scoping Approach assessments have elements of precaution built-in, this is in line with the consenting process for Scottish offshore wind farm applications and the approach agreed during the Scoping / Roadmap process. This was informed by the most up-to date, published information as agreed by all parties*."

"*In addition, this approach contrasts with Natural England's offshore wind farm guidance, which in our view, adds additional layers of precaution e.g. inclusion of sabbaticals, use of stable age structure for apportioning age classes, assessing displacement during construction and differing displacement mortality rates which are likely to make the predictions higher*".

The Applicant acknowledges the differing advice amongst UK Statutory Nature Conservation Bodies (SNCBs) and agrees that the consenting process for Scottish offshore wind farms requires the application of the precautionary principle given the uncertainties associated with impact predictions. However, it is considered that the level of precaution applied under some elements of the Scoping Opinion does not accurately reflect the best scientific evidence available during the Roadmap process, nor further evidence gathered since, which has resulted in excessive estimates of predicted mortality.

Here, the Applicant first sets out the case that there is no evidence to demonstrate the assertion that predicted impacts are due to extremely high densities of birds present in the Proposed Development, and second, sets out three supporting arguments to demonstrate that the level of precaution applied under the Scoping Opinion

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[3] https://www.gov.uk/government/publications/environmental-principles-policy-statement/environmental-principles-policy-statement#:~:text=Its%20definition%20of%20the%20precautionary,measures%20to%20prevent%20environmental%20degradation

[4] UK Withdrawal from the European Union (Continuity) (Scotland) Act 2021 - Explanatory Notes (legislation.gov.uk)

is excessive, which when considered together, indicate that the advice provided overestimates bird mortality by between 136% and 548%.

1.3. Densities in the Proposed Development

The Applicant acknowledges that the Proposed Development lies in proximity to a number of designated sites for breeding and non-breeding seabirds, with the potential impacts on these and other sites assessed in depth in SSER (2022) and addressed through the Derogations Case. However, the Applicant refutes the assertion that the "*magnitude of impacts predicted are due to the extremely high densities of birds found within the proposed development area*". Assuming that this statement from NatureScot refers to baseline densities derived from site-specific digital aerial surveys, densities are comparable or lower than densities recorded in other offshore wind farm developments within the Firth and Tay region, as shown in Table 1.1.

Table 1.1: Peak monthly densities of three key species recorded in the Proposed Development (Berwick Bank) during baseline surveys compared to peak densities recorded during baseline surveys in neighbouring consented Forth and Tay offshore wind farms.

Species	Development	Peak Monthly Density (birds/km^2)	Month/Year
Guillemot	Berwick Bank[5]	0.75	Apr 21 S02
	Seagreen (Alpha)[6]	0.60	Jul-17
	Seagreen (Brava)[7]	0.10	Jul-17
	Neart na Gaoithe[8]	0.26	Oct-10
	Inch Cape[9]	0.91	Jun-11
Kittiwake	Berwick Bank[5]	20.7	Apr 21 S02
	Seagreen (Alpha)[6]	61.53	Jul-17
	Seagreen (Brava)[7]	18.88	Jul-17
	Neart na Gaoithe[8]	36.03	Aug-12
	Inch Cape[9]	15.63	Jul-11
Gannet	Berwick Bank[5]	3.58	Jul-19
	Seagreen (Alpha)[6]	13.78	Jun-10
	Seagreen (Brava)[7]	10.89	Jun-17
	Neart na Gaoithe[8]	20.12	Apr-10
	Inch Cape[9]	7.73	Aug-11

The peak guillemot density recorded by the Proposed Development was lower than that recorded by Inch Cape, and comparable to that recorded by Seagreen (Alpha). For kittiwake, the peak density in the Proposed Development was substantially lower than that recorded in Seagreen (Alpha) and also lower than that recorded by Neart na Gaoithe, and for gannet, the Proposed Development recorded the lowest peak density across all five Forth and Tay developments (Table 1.1). Indeed, NatureScot themselves state in their Section 36 consultation response that the "*same species and high densities are recorded through several different surveys within this region (e.g. Berwick Bank boat-based surveys, Seagreen boat-based surveys, Seagreen pre-construction surveys, JNCC Seabirds at Sea)*", suggesting that the densities recorded in the Proposed Development are not exceptional for the region. As such, there is no evidence to support the NatureScot assertion that the "*magnitude of impacts predicted are due to the extremely high densities of birds found within the proposed development area".*

[5] Berwick Bank data for all species taken from: Offshore EIA Report, volume 3, appendix 11.1, annex H (note guillemot data are not corrected for availability bias (as required for digital aerial surveys) to allow direct comparison with other developments (where data were collected during boat-based surveys).

[6] Seagreen (Alpha) data for all species taken from: https://www.seagreenwindenergy.com/_files/ugd/fe5128_b5e1e0e27f4440a5915a4b2dc5a959ec.pdf;

[7] Seagreen (Brava) data for all species taken from: https://www.seagreenwindenergy.com/_files/ugd/fe5128_b5e1e0e27f4440a5915a4b2dc5a959ec.pdf

[8] Neart na Gaoithe data for all species provided by email on 24 November 2021

[9] Inch Cape data for all species taken from https://www.inchcapewind.com/wp-content/uploads/2020/10/IC01-EC-OFA-002-110-RRP-APE 001_Appendix_11A_Offshore_Ornithology_Baseline_Survey_Report_RevB.pdf

The Applicant therefore considers that the magnitude of estimated bird mortality for the Proposed Development is a direct consequence of the overprecaution applied under the Scoping Opinion, as set out below.

1.4. Precaution

1.4.1. New Guidance

Following submission of the Section 36 Application, NatureScot published a suite of guidance notes relevant to the assessment of potential impacts from offshore wind on marine ornithology. Whilst much of the guidance contained within these notes aligns with advice provided in the Scoping Opinion, there are some significant updates which are relevant to the Proposed Development.

Avoidance Rates

New guidance from NatureScot (NatureScot 2023a) provides updated parameters for collision risk modelling which incorporate recent evidence provided in Oslanav-Harris *et al*. (2023). Notably, avoidance rates have increased for both gannet and kittiwake from 0.989 to 0.992, resulting in a marked reduction in predicted collision mortality for both species since the application was submitted (Table 1.2).

Indeed, for both gannet and kittiwake this reduces total predicted collisions by 27% (Table 1.2), noting that these totals include non-breeding adults (sabbatical birds) and immatures.

Table 1.2: Collision estimates for kittiwake and gannet for the Developer Approach and Scoping Approach using the deterministic Band CRM, generic flight height data (Option 2) and the worst case scenario of 307 x 14MW turbines.

Species	Avoidance rate	Guidance	Predicted collision mortality	
			Scoping Approach	Developer Approach
Kittiwake	0.989	SNCBs (2014)	986	685
	0.992	NatureScot (2023a)	717	498
Gannet	0.989	SNCBs (2014)	191	153
	0.992	NatureScot (2023a)	139	112
	0.998	NatureScot (2023a) plus macro-avoidance of 0.70	35	28

Further evidence collected at the Aberdeen Offshore Wind Farm has since been published, with no gannet or kittiwake collisions or near-misses recorded in over 10,000 bird videos collected over a two-year study period (April-October; Tjørnløv *et al*. 2023). Whilst the Applicant acknowledges that the flight behaviour of gannets and kittiwakes may differ at the Proposed Development given the proximity of breeding colonies, the results of Tjørnløv *et al*. (2023) add to the scientific evidence base which supports the reduction of predicted collision impacts.

In addition, and of particular relevance to the gannet assessment, the avoidance rate used with the collision risk model relates to behaviour within the wind farm array only and excludes consideration of macro-avoidance, which is considered to be high for gannet (Cook *et al*. 2014, Skov *et al*. 2018, Cook 2021, Peschko *et al*. 2021, Oslanev-Harris *et al*. 2023; Tjørnløv *et al*. 2023). Whilst the Applicant acknowledges that gannet flight behaviour in proximity to breeding colonies may differ to that on passage, the current advised approach effectively means that predicted gannet mortality is double-counted, with the same individuals predicted to die as a result of both wind farm displacement and collision, which is not plausible.

This issue is now recognised in recent advice from Natural England, which recommends the application of a macro-avoidance correction for gannet (ranging from 65 – 85%) to reduce the estimated density of birds in flight within the array area (Natural England 2022a; Equation 1).

Equation 1: Total Avoidance = 1-((1-Macro Avoidance) x (1-Within Wind Farm Avoidance))

The Section 36 Scoping Opinion for the Proposed Development advised a 70% displacement rate for gannet at the Proposed Development. By factoring this rate into Equation 1 (and thus removing the double-counting of impact), the collision avoidance rate increases to 0.998, reducing predicted gannet collisions at the Proposed Development to 28-35 per annum depending upon approach (Table 1.2). This equates to an 82% reduction in predicted collision mortality per year compared to that presented in the Section 36 Application using the Scoping Approach (reduction from 191 predicted collisions to 35; Table 1.2).

Given that new guidance, advice and scientific evidence on avoidance rates show significant reductions in predicted collisions, the Applicant continues to advocate that the Scoping Approach overestimates precaution in relation to gannet and kittiwake collision impacts and indeed, incorrectly double-counts predicted gannet mortality from both displacement and collision, and that the Developer Approach should be preferred.

1.4.2. Best Available Scientific Methods

For some aspects of the Scoping Opinion, unprecedented assessment methods have been advised on the basis that they represent a precautionary approach (Offshore EIA Report, volume 3, appendix 11.8). It is the Applicant's view that whilst precautionary, these methods do not represent the most scientifically robust means of assessment, which the Applicant demonstrates can be employed whilst still accounting for uncertainty.

Mean versus Maximum Monthly Densities for Collision Risk Modelling (birds/km^2)

Current best practice industry guidance on the use of the collision risk modelling suggests that model predictions should be based upon the mean monthly densities of flying birds estimated within an array area (Band 2012) and, to the best of the Applicant's knowledge, this approach has been applied in all recent UK offshore wind farm assessments (i.e. from at least the Round 3 and Scottish territorial waters leasing rounds onwards). Indeed, recent guidance on collision risk modelling from NatureScot does not contradict this approach (NatureScot 2023a).

However, the Scoping Opinion advised that the collision risk models for the Proposed Development should use the maximum monthly densities of flying birds within the array area. Collision estimates using both mean and maximum monthly densities were presented in the Section 36 Application for kittiwake and gannet (Table 1.3).

In part at least, the position in the Scoping Opinion appeared to derive from Marine Scotland Science advice that it was not possible to use the stochastic version of the collision risk model (McGregor *et al*. 2018) due to an absence of recommended avoidance rates, meaning that the resultant collision estimates for the Proposed Development (as generated from the deterministic collision risk model) would not account for variation and uncertainty in input information, including baseline densities (K. Bell, email 02/03/2022; Offshore EIA Report, volume 3, appendix 11.8).

However, the use of the maximum monthly densities does not actually address this issue since uncertainty measured in this manner is limited to the difference between the two density calculations (i.e. mean density and maximum density, rather than accounting for standard deviations around the mean) and does not account for variability around other key input parameters (e.g. flight height, avoidance rate, nocturnal activity factors). Alternative solutions to expressing the associated variability in the collision estimates exist and have been applied in other assessments (e.g. Ørsted 2021; Natural England 2022b).

In contrast to Marine Scotland Science, NatureScot advised that maximum monthly densities should be used because "*there are two surveys allocated per month – where monthly mean has been used previously this has addressed multiple surveys per month*" (K.Bell, email 02/03/2022; Offshore EIA Report, volume 3, appendix 11.8). In their Section 36 Application consultation response, NatureScot go on to state that "*maximum monthly densities were required to address the variation in baseline densities particularly in light of gaps in survey coverage*".

It was agreed during the Roadmap process that the baseline survey results were of sufficient quality to provide robust baseline characterisation despite differences in survey coverage in some months (Offshore EIA Report, volume 3, appendix 11.8). Monthly baseline surveys were undertaken over two years in line with precedent and current best practice guidance (NatureScot 2023c; Natural England 2022c). The Applicant is unaware of any change to the evidence base to support a change from this approach, noting that in their advice for the revised designs of the Forth and Tay projects Marine Scotland Science stated that an approach of using the maximum monthly density values within collision risk modelling "*runs the very high risk of producing an estimated effect that is highly likely to be unreasonable and unrealistically high*." (Marine Scotland, 2017a, Marine Scotland, 2017b). The Applicant therefore considers that the NatureScot justification for the use of maximum monthly densities is unwarranted given that the monthly mean has been used previously where there are two surveys allocated per month and that the baseline survey results were considered to be robust during the Roadmap process.

This single change in advice increases predicted collision mortality by c.30% for kittiwakes and c.20% for gannets (Table 1.3). Multiplied over the course of 35-year operational lifespan, this equates to *c*.10,500 additional kittiwake mortalities and more than *c*.1,000 additional gannet mortalities (Table 1.3).

Table 1.3: Collision estimates for kittiwake and gannet for the Developer Approach (mean density) and Scoping Approach (maximum density) using the deterministic Band CRM, generic flight height data (Option 2) and the worst case scenario of 307 x 14MW turbines.

Species	Avoidance Rate	Predicted Annual Collisions	
		Maximum Density	Mean Density
Kittiwake	0.989	986	685
Gannet	0.989	191	153

Calculation of Mean Seasonal Peak for use in the Displacement Matrix

Following the Scoping Opinion and current advice from NatureScot (2023b), estimates of displacement mortality for both the Scoping and Developer Approaches were based upon the mean seasonal peak population estimate in each season, taken as an average over the two years of surveying (March 2019 – April 2021). For example, the mean seasonal peak population estimate for the breeding season was calculated as the average of the peak monthly count in the breeding season in year one and the peak monthly count in the breeding season in year two (e.g. the average of counts recorded April 2019 and August 2020 if this is where peaks occurred in each consecutive breeding season).

However, this method is likely to inaccurately estimate the true seasonal peak in numbers depending upon the pattern of monthly abundance estimates within a season and the number of monthly samples (i.e. if a count was particularly high in one month this method of calculation may skew the mean seasonal peak such that it is not reflective of the average usage of the Proposed Development across each consecutive season). An alternative approach which has been applied and accepted for Nationally Significant Infrastructure Projects (NSIPs) is to take the mean of each calendar month (e.g. the mean of April 2019 and April 2020, the mean of June 2019 and June 2020, etc.) and then within each season select the peak of the resultant mean values (MacArthur Green 2018; Table 1.4). This has the advantage of using all of the available survey data and also selects the part of the season where we might reasonably expect the peak to occur over the lifetime of a development.

Table 1.4: Mean seasonal peaks (MSPs) used to estimate displacement mortality across the Proposed Development array area and 2 km buffer. Shown are MSPs calculated following the Scoping Approach (Offshore EIA Report, volume 3, appendix 11.4, Table 3.3) and the alternative NSIP approach accepted for a number of consented NSIP projects (e.g. MacArthur Green 2018).

Species	Season	Mean Seasonal Peak	
		Scoping Approach	Alternative NSIP Approach
Kittiwake	Breeding (mid-Apr-Aug)	21,141	16,224
	Non-breeding (Sep-mid-Apr)	18,279	13,506
Gannet	Breeding (mid-Mar-Sep)	4,735	4,549
	Non-breeding (Oct-mid-Mar)	1,500	1,058
Guillemot	Breeding (Apr-mid-Aug)	74,154	63,876
	Non-breeding (mid-Aug-Mar)	44,171	29,322

Table 1.5 demonstrates how this recalculation of mean seasonal peak affects predicted displacement mortality according to the displacement and mortality rates used under the Developer and Scoping Approaches in the Offshore EIA Report, volume 3, appendix 11.4. Under all scenarios, total displacement mortality is reduced by around 20%, noting that these totals include non-breeding adults (sabbatical birds) and immatures.

Table 1.5: Estimated displacement mortality using the mean seasonal peaks (MSPs) calculated following the Scoping Approach (Offshore EIA Report, volume 3, appendix 11.4, Table 3.3) and the alternative NSIP approach (e.g. MacArthur Green 2018). Displacement rates are shown in Table 3.4 of the Offshore EIA Report, volume 3, appendix 11.4.

Species	Assessment Approach	Annual Displacement Mortality	
		Scoping Approach MSP	Alternative Approach MSP
Kittiwake	Developer Approach	127	97
	Scoping Approach A	139	89
	Scoping Approach B	416	268
Gannet	Developer Approach	47	44
	Scoping Approach A	47	44
	Scoping Approach B	138	131
Guillemot	Developer Approach	592	466
	Scoping Approach A	1,601	1,326
	Scoping Approach B	3,021	2,444

1.4.3. Insufficient Evidence to Support a Change from Precedent

Elements of the Scoping Opinion represent a significant change in the advice provided for all previous Scottish offshore wind farm assessments. Whilst changes in advice which reflect the best available scientific evidence base are welcomed by the Applicant, it is considered that the advised changes from precedent advice are based upon assertion, with insufficient evidence presented to justify this change in position (Offshore EIA Report, volume 3, appendix 11.8).

Inclusion of Non-breeding Season Kittiwake for Displacement Assessment

Current best practice industry guidance does not list kittiwake among the priority species for displacement assessment (SNCBs 2022), as it falls below the threshold of disturbance sensitivity used to determine which species should be taken forward for displacement assessment.

Furthermore, there is no precedent for considering kittiwake displacement during the non-breeding season in Scottish waters, with NatureScot having previously stated that kittiwake did not need to be considered for displacement effects, as "*the data available from post-construction monitoring indicated no significant avoidance behaviour by this species*" (Marine Scotland 2017a).

The Applicant is not aware of any more recent post-construction monitoring research that contradicts this evidence or justifies a change in position. Indeed, recent NatureScot guidance (NatureScot 2023b) does not identify kittiwake as a priority species for assessment of potential displacement impacts.

Consequently, this change in precedent was queried by the Applicant in Road Map 6 (volume 3, appendix 11.8). Marine Scotland Science stated "*as the scale of development increases across the North Sea, the cumulative effects may be great*" and there was therefore a requirement to consider potential displacement during the non-breeding season for this species. However, there is no evidence to support this hypothesis, which directly contradicts a comment from Marine Scotland Science in the Scoping Opinion for the original Berwick Bank project, which states "*due to their physiology in terms of flight efficiency and additionally their wide-ranging ecology, displacement impacts to kittiwake should be considered only during the breeding season when they function as central-place foragers*" (Marine Scotland 2021).

Following the Scoping Opinion, up to 225 kittiwakes were predicted to be subject to non-breeding season displacement mortality per year (Table 4.4, volume 3, appendix 11.4), totalling 7,875 individuals over the 35-year lifespan of the wind farm. Including these birds increases total kittiwake mortality by 54% per year under Scoping Approach B (Table 1.6).

Given that current and planned offshore wind farm development in the North Sea represents 2.2% of Scottish waters available to this species (noting that kittiwakes will range further than Scottish waters during the non-breeding season e.g. Bogdanova *et al*. 2011), the Applicant maintains that the facts do not support the assertion that cumulative effects may be great and that assessment of kittiwake displacement should not be a consideration during the non-breeding season given that no new evidence has been presented to justify its inclusion.

Application of Displacement Mortality Rates

The estimation of displacement mortality rates is a critical component of the main tool that is currently used in assessing risk from displacement – the "Displacement Matrix". Estimated mortality is very sensitive to changes in mortality rate. For example, increasing mortality rate from 1% to 5% increases predicted breeding season mortality for guillemot by 83% (Table 1.6).

However, there is a complete absence of empirical evidence upon which these mortality rates should be based. As a consequence of this uncertainty, statutory advice as to which mortality rates are appropriate for assessment of potential displacement impacts varies amongst UK SNCBs. In Scotland, a 1% mortality rate has been applied as precedent across recent offshore wind farm developments (e.g. Marine Scotland 2017a,b,c), whilst in England decisions by the Secretary of State have been based upon a 2% mortality rate for auks throughout the year (e.g. DESNZ 2023).

Despite the complete absence of empirical evidence to justify a change in position, the Scoping Opinion and recent NatureScot (2023b) guidance now advise an upper displacement mortality rate of 5% in the breeding season and 3% in the non-breeding season for auks, and 3% in the both the breeding and non-breeding seasons for gannet and kittiwake.

At Road Map 5 (volume 3, appendix 11.8) NatureScot and Marine Scotland Science stated that higher mortality rates were advised given that an individual-based model, SeabORD (Searle *et al*. 2018), "*indicates mortality rates from displacement are likely to be higher than those used in the Displacement Matrix for Round 3 sites*" following Searle *et al*. (2020).

Whilst it is widely acknowledged that the Displacement Matrix is simplistic, SeabORD is extremely complicated, inaccessible, and there are concerns that the drivers underlying survival and reproductive rates predicted by the model are not fully understood (Vallejo *et al*. 2022). The Applicant maintains that it is not appropriate to use the SeabORD outputs to inform the mortality rates used within the Displacement Matrix given:

- Outputs from the SeabORD model are only applicable to the 'chick-rearing' period and cannot therefore be used to inform mortality rates outside of this period;
- A full sensitivity analysis of the model has not been undertaken by the authors;
- SeabORD incorporates a vast range of parameters and assumptions, many of which are based on little or no empirical evidence but rather on simplifications, calibration or expert judgement;
- The sensitivity of SeabORD to some key parameters, including those based entirely on professional judgement, suggests that the outputs are unlikely to be more reliable than those from the Displacement Matrix with the added disadvantage that the sources and magnitude of uncertainty are not transparent;
- Several assumptions underlying SeabORD are precautionary such that combined with precautionary displacement and barrier rates, predicted impacts may be substantially overestimated;
- Some parameters to which SeabORD is very sensitive are based on proxy data where more relevant empirical data exist, which would reduce overestimation of adult mortality; and
- Although a measure of uncertainty is provided with the model, this only reflects a small portion of the total uncertainty inherent within the modelling process. Additional sources of uncertainty, such as uncertainty associated with parameter estimation, the structural uncertainty associated with the model, and the uncertainty associated with the spatial distributions of birds and prey are not incorporated, thus providing outputs that inaccurately represent the true uncertainty associated with the modelling process. While the model authors are clear that this is the case, Vallejo *et al*. (2022) consider that the outputs suggest a lot more confidence than can truly be attributed.

The Applicant acknowledges that a key drawback of the Displacement Matrix is that it cannot account for indirect effects on individuals that do not use the wind farm but may be impacted by it – e.g. indirect effects on chicks driven by displacement impacts on breeding adults. However, this is accounted for in the assessment process through Population Viability Analysis, which is used to assess the impact of additional mortality on both productivity and survival across age classes.

As such, the Applicant continues to advocate that the displacement mortality rates previously advised for Scottish wind farm assessments are used to inform the Section 36 Application given that no new empirical evidence has emerged to justify a change from rates which were previously considered to be suitably precautionary by NatureScot and Marine Scotland Science.

Table 1.6: Estimated displacement mortality across the Proposed Development array area plus 2 km buffer following the Developer Approach and the Scoping Approach. Taken from Offshore EIA Report, volume 3, appendix 11.4.

Species	Assessment Approach	Displacement Rate	Mortality Rate		Displacement Mortality	
			Br	N-Br	Br	Non-Br
Kittiwake	Developer	30%	2%	-	127	-
	Scoping A	30%	1%	1%	64	75
	Scoping B	30%	3%	3%	191	225
Gannet	Developer	70%	1%	1%	34	13
	Scoping A	70%	1%	1%	34	13
	Scoping B	70%	3%	3%	100	38
Guillemot	Developer	50%	1%	1%	371	221
	Scoping A	60%	3%	1%	1,335	266
	Scoping B	60%	5%	3%	2,225	796

1.5. Cumulative Precaution

For each of the three areas considered above, hundreds to thousands of additional birds are added to predicted mortality over the course of the wind farm lifecycle depending upon the level of precaution applied. This accumulates across each assessment step such that total mortality estimates are several orders of magnitude different depending upon the approach taken.

Considering the evidence set out above, it is the Applicant's view that this level of overestimation is not a reasonable assessment of likely significant effects warranted by the precautionary principle.

Tables 1.7-1.9 set out the level of cumulative precaution applied under the Scoping Opinion for three key species. **Estimated annual bird mortality following the Scoping Opinion is between 2.4 and 6.5 times greater than the advocated approach based on best available evidence**.

Table 1.7: Example of quantifiable cumulative precaution within the kittiwake assessment process within the Section 36 Application.

Predicted Impact	Parameter	Report reference	Predicted Annual Mortality		*Percent increase*
			Scoping Opinion	Advocated Approach	
Collision	Mean vs. max monthly densities	Table 1.2	986	685	
	+ updated avoidance rates	Table 1.2		**498**	***98%***
Displacement	Mortality rate	Table 1.5	416	127	
	+ inclusion of non-breeding season	Table 1.6		127	
	+ calculation of MSP	Table 1.5		**97**	***329%***
Total Annual Mortality			**1,402**	**595**	***136%***

Table 1.8: Example of quantifiable cumulative precaution within the gannet assessment process within the Section 36 Application.

Predicted Impact	Parameter	Report reference	Predicted Annual Mortality Scoping Opinion	Predicted Annual Mortality Advocated Approach	*Percent increase*
Collision	Mean vs. max monthly densities	Table 1.2	191	153	
	+ updated avoidance rates	Table 1.2		112	
	+ correction for macro-avoidance	Table 1.2		**28**	***582%***
Displacement	Mortality rate	Table 1.5	138	47	
	+ calculation of MSP	Table 1.5		**44**	***214%***
Total Annual Mortality			**329**	**72**	***357%***

Table 1.9: Example of quantifiable cumulative precaution within the guillemot assessment process within the Section 36 Application.

Predicted Impact	Parameter	Report reference	Predicted Annual Mortality Scoping Opinion	Predicted Annual Mortality Advocated Approach	*Percent increase*
Displacement	Mortality rate	Table 1.5	3,021	592	
	+ calculation of MSP	Table 1.5		**466**	***548%***
Total Annual Mortality			**3,021**	**466**	***548%***

1.6. Conclusions

The Applicant considers that the magnitude of estimated bird mortality in the Section 36 Application is a direct consequence of the level of precaution applied to the assessment process, with no evidence to support the NatureScot assertion that predicted impacts are "*due to the extremely high densities of birds found in the proposed development area*".

Whilst the application of the precautionary principle is a requirement given the uncertainties associated with impact predictions, there remains a need to make a reasonable assessment of the associated risk, using the best available scientific evidence.

The Applicant has set out three arguments which demonstrate that the assessment methods and parameters advised under the Scoping Opinion are not adequately justified by the best scientific evidence available during the scoping process, nor further evidence gathered since, which has the potential to distort robust decision-making.

Compared to the approach advocated in this report, advice provided in the Scoping Opinion overestimates mortality by:

- 136% for kittiwake;
- 357% for gannets; and
- 548% for guillemots.

The Applicant therefore continues to advocate that the Developer Approach outlined in the Section 36 Application is scientifically robust, suitably precautionary and reflective of current methods of assessment and recommends that it can and should be reasonably relied upon by the decision maker for the purposes of assessment.

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