



Meridian Solar Farm

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Environmental Statement

6.3 ES Appendix 9-15:
Avian Collision Risk
Model - Technical Note

APFP Regulation 5(2)(a)

Infrastructure Planning (Applications:
Prescribed Forms and Procedure)
Regulations 2009

March 2026

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1. Introduction

1.1. Background

- 1.1.1. This technical note is intended to provide detail of the approach, method and outputs of avian collision-risk modelling undertaken to inform impact assessment in relation to the proposed Meridian Solar Farm (the Scheme). This is intended to support ornithological assessment presented within **ES Chapter 9: Ecology and Biodiversity** (Doc Ref. 6.1) and **ES Appendix 9-14: Habitats Regulations Assessment (HRA) Report** (Doc Ref. 6.3) by providing an estimated prediction of potential avian collision rates with the proposed overhead lines.

1.2. Details of the Scheme

- 1.2.1. The Scheme would comprise the construction, operation (including maintenance) and decommissioning of a solar PV electricity generating station with associated infrastructure, including co-located Battery Energy Storage System (BESS), Inter-Array Connections to link the land parcels that form the Solar Development Areas, and an up to 13km overhead line Grid Connection (with one short undergrounded section) which would run north towards a point of connection (PoC) at the proposed Weston Marsh B National Grid Electricity Transmission (NGET) substation, to the north of Weston. Collision risk is associated with the overhead line of the Grid Connection, and as such, this report focuses on the Grid Connection only.
- 1.2.2. Detailed construction and design parameters are set out in **ES Chapter 2: The Scheme** (Doc Ref. 6.1) and the **Design Parameters** (Doc Ref. 7.4). Parameters used for the collision risk analysis are detailed below in paragraph 2.3.1.

2. Methodology

2.1. Approach

- 2.1.1. NatureScot have developed detailed modelling tools to assist with assessment of avian collision risk with onshore wind turbines, but advise that a generic collision risk model is unlikely to accurately predict levels of mortality for power lines and the focus should therefore be on providing mitigation where survey data indicate potential conflicts. In consultation with Natural England, it has been agreed that a collision model will be used to support interpretation of the survey data and inform if and where mitigation may be required, but it is important to note the

limitations of a modelling approach and make use of wider survey data to inform assessment.

2.1.2. In the absence of a standard model for overhead line collision risk calculation this approach follows similar principles to those applied for the NatureScot onshore wind turbine model, which has been extensively tested and is widely accepted. This approach uses a geometric model to represent the probability of any bird flying through the line of the proposed overhead lines colliding with one of the wires, and multiplying this by the number of birds predicted to be flying through, based on extrapolation of vantage point (VP) survey data. In summary, the approach comprises the following steps:

1. Determining Collision Probability:
 - a. Determine the Risk Window;
 - b. For each species, determine the Collision Area (dependent on bird size and Risk Window);
 - c. For each species, calculate the probability of collision per bird transit.
2. Determining number of flights per year for each species:
 - a. Calculate birds per hour during survey;
 - b. Calculate total activity hours per year;
 - c. Estimate bird flights per year.
3. Estimate total bird collisions per year (with no avoidance).
4. Apply avoidance factors.
5. Estimate total bird collisions per year.
6. Identify if more detailed study, such as population viability assessment (PVA), might be needed by predicting changes in mortality rates.

2.2. Operation of the Model

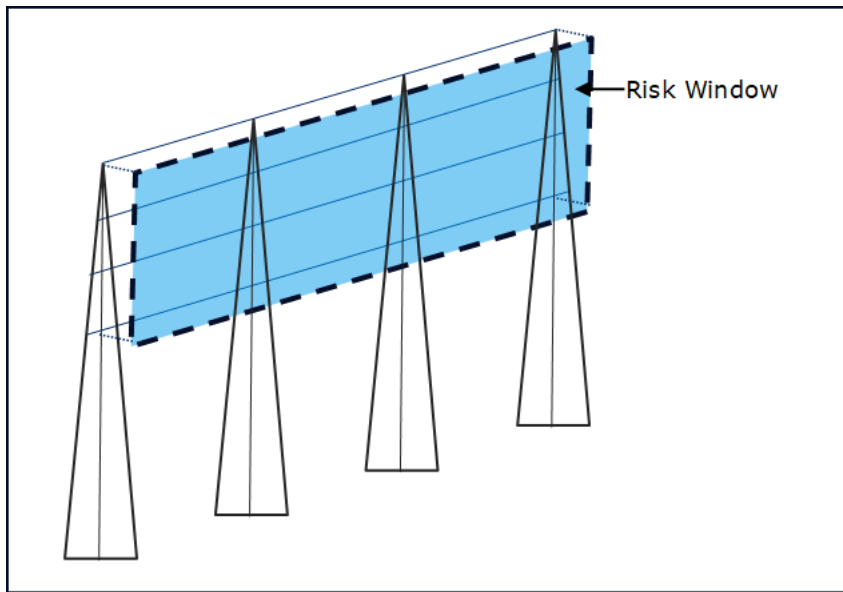
Determining Collision Probability

2.2.1. The collision risk model focuses on the Grid Connection Route overhead lines element of the proposed infrastructure, on the basis that the primary risk of collision arises from the wires that are less easily seen by approaching birds and are therefore less easily avoided.

2.2.2. The area of space occupied by the proposed overhead lines is referred to as the Risk Window, which represents the surface area of a vertical plane in space, through which any birds passing could be at risk of collision and correlates to the ‘at-risk’ height band used for recording bird flights during Vantage Point (VP) surveys. This is represented in the model by the following equation as illustrated in Plate 2-1.

$$\text{Risk Window (m}^2\text{)} = \text{Route Length (m)} \times (\text{Height of highest wire (m)} - \text{Height of lowest wire(m)})$$

Plate 2-1: Collision Risk Window



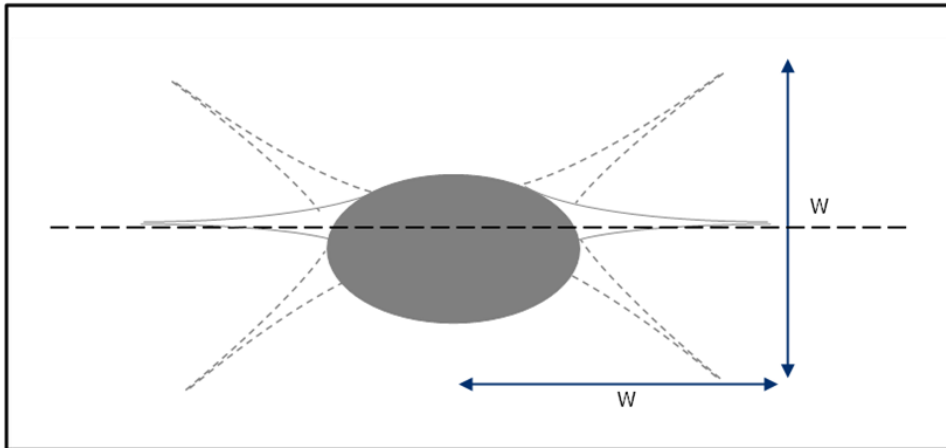
2.2.3. The probability of a bird that passes through the Risk Window of colliding with the wires is determined by the proportion of space within the Risk Window that is occupied by overhead lines, multiplied by the cross-sectional size of the bird (the Collision Area).

$$\text{Collision Area} = \text{Number of wires facing} \times \text{Route Length} \times (\text{Wingspan} \div 2)$$

$$\text{Probability of collision} = \text{Risk Window} \div \text{Collision Area}$$

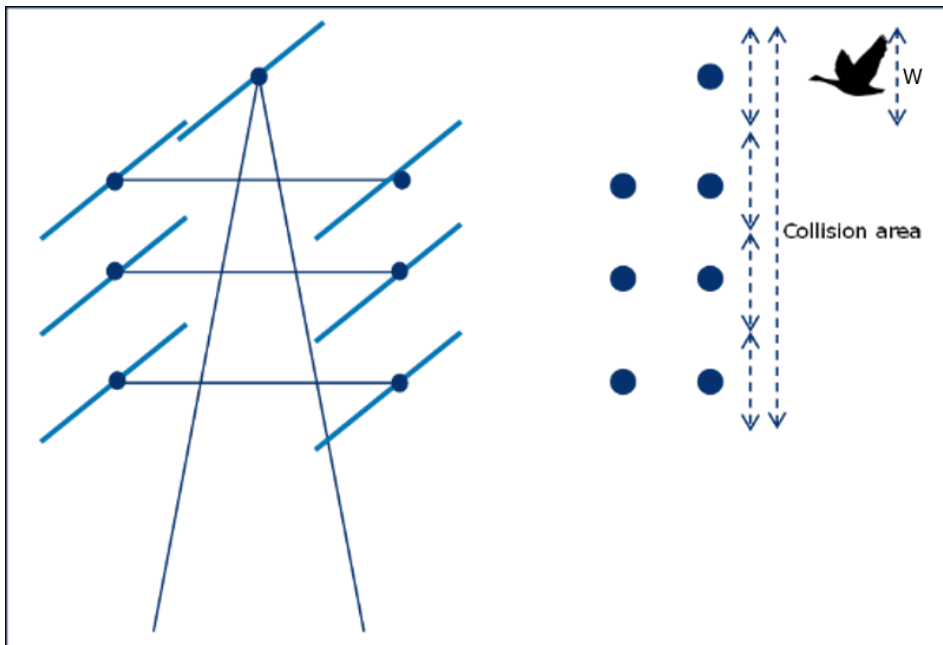
2.2.4. The cross-sectional size of the bird is based on half the wingspan of the relevant species on the assumption that birds will be approaching on a horizontal plane (i.e. not banking). A half wingspan (W) therefore represents the typical flap height (maximum combined upward and downward movement of the wings in flight) (Plate 2-2).

Plate 2-2: Bird in horizontal plane flight (rear view), showing flap height represented by wingspan (W)



2.2.5. The Collision Area also assumes that birds are approaching at a horizontal angle of incidence (*i.e.* flying horizontally toward the wires) and the number of wires therefore excludes those 'behind' another wire (Plate 2-3). This is appropriate for birds en-route between locations in the wider area, but may be less representative where birds are taking off and landing nearby. A more complex analysis taking account of angle of incidence, and modelling probabilities across a range of angles, would be possible, but introduces a level of complexity that is disproportionate to the purpose of this tool.

Plate 2-3: Determination of Collision Area in relation to overhead lines and bird size



Predicting Number of Flight Transits

- 2.2.6. To calculate the annual collision risk rate, the predicted total number of flight transits is based on data from VP surveys. These surveys follow NatureScot guidance¹ for onshore windfarm VP surveys, adapted to take account of the parameters of the proposed overhead lines, comprising a total of at least 36 hours of surveying at each VP location per season². During VP surveys, all flights of focal species (*i.e.* those species of conservation concern that are at significant risk of collision) are recorded. This includes recording the number of birds in any flocks, the direction of flight and height of flight in relation to height bands determined to correlate with the height of the proposed overhead lines (as represented by the Collision Risk Window). This provides the ‘total flight passages’ for each species. To account for survey coverage of the overall Grid Connection Route, the ‘total flight passages’ value is divided by the length of the route covered by VP surveys, and multiplied by the total length of the route.

Predicted flight passages = Total flight passages (for each species) × (Length covered by VP surveys ÷ Total length of Grid Connection Route)

- 2.2.7. The rate of birds per hour for each species is calculated by analysing the flight data to determine the number of passages through the Collision Zone over the course of surveys and dividing by the number of hours of survey (at each VP location).

Bird Transits per Hour = Predicted flight passages (for each species) ÷ Number of hours surveyed

- 2.2.8. To extrapolate the number of bird transits per year, the birds per hour rate for each species is multiplied by the total number of Active Hours in a year.

- 2.2.9. VP Surveys were carried out during the day-time; however, some species are also active during the night. Due to the limitations of recording at night-time, it is not practical to include the results of nocturnal counts in the model, however nocturnal surveys were undertaken alongside the VP surveys to provide a qualitative evaluation of night-time activity.

¹ NatureScot (2025) *Recommended bird survey methods to inform impact assessment of onshore windfarms* <https://www.nature.scot/doc/recommended-bird-survey-methods-inform-impact-assessment-onshore-windfarms>. [Accessed 05/03/2026].

² ES Appendix 9-10, Vantage Point Survey Report 2024-25 (Doc Ref. 6.3)

2.2.10. Where species are sensitive at particular times of year, only those relevant months are included in the modelling. For example, where assessing impacts in relation to wildlife sites designated specifically for their wintering populations, only winter months are considered to be relevant months.

2.2.11. The number of Active Hours is calculated for each month using sunrise and sunset times to calculate the number of daylight hours; an Activity Hours Factor is then applied for each species to increase the active hours to account for predicted nocturnal activity. For example, in a month with an average of 12 daylight hours per day, applying an Activity Hours Factor of 0.25 would increase this to 15 Active Hours per day. The Active Hours for each relevant month are then summed to determine the total annual Active Hours.

$$\text{Annual Active Hours (each species)} = \sum(\text{Daylight hours}_{\text{month}} \times \text{Activity Hours Factor})_{\text{all relevant months}}$$

$$\text{Annual Flight Transits (each species)} = \text{Bird Transits per Hour} \times \text{Annual Active Hours}$$

Estimating Bird Collisions per Year (no avoidance)

2.2.12. The estimated Bird Collisions per year is calculated for each species as the Annual Flight Transits multiplied by the Probability of Collision. However, as the model is not derived from empirical data, it is liable to result in significant bias due to a variety of factors, in particular the lack of data on collision and avoidance rates in relation to the outcomes predicted by the model. To compensate for this, the model was tested against the NatureScot onshore windfarm collision risk model³, which is recognised as an industry standard. To do this, the survey data were entered into the windfarm collision risk model for golden plover (as a representative medium sized bird) and whooper swan (the largest species observed). Parameters were selected to represent an equivalent scale array to the Collision Risk Zone of the Scheme, *i.e.* an array of turbines with a vertical rotor diameter of 25m and a total array length of 13km. These data produced a collision rate of approximately 14% of that calculated by the overhead line (OHL) model for golden plover and 9% for whooper swan.

³ NatureScot (2024) *Guidance on using an updated collision risk model to assess bird collision risk at onshore wind farms* <https://www.nature.scot/doc/guidance-using-updated-collision-risk-model-assess-bird-collision-risk-onshore-wind-farms>. [Accessed 05/03/2026].

- 2.2.13. On a precautionary basis, a Model Alignment Factor of 0.2 has been applied to the Model to bring it into alignment, while allowing a significant degree of leeway to account for uncertainties, including differences in avoidance rates between wind farms and overhead lines.

Predicted Bird Collisions per Year (no avoidance) (each species) = Annual Flight Transits × Probability of Collision × Model Alignment Factor

Avoidance and Additional Factors

- 2.2.14. The model to this point assumes that all birds approaching the overhead line will collide without taking any avoidance, so an Avoidance factor is applied to take account of the probability of approaching birds successfully taking avoidance action. As there are no reliable figures published for avoidance of collisions with overhead lines, the model relies on those published for onshore wind farms⁴. These avoidance factors vary between different species, so where no published value is available for any particular species, an appropriate proxy value of 0.98 is applied, which corresponds to the lowest avoidance rate of those published for wind turbines. It should be noted that more recent studies have resulted in avoidance rates for some species being increased; this means that these species may have higher avoidance rates than those that have not been updated, or for which there is no published figure, even where these refer to species, such as swans, that are likely to be at greater risk of collision.
- 2.2.15. The uncertainty in the accuracy of these figures for overhead lines is recognised to be a limitation to this model, so this has been tested through a sensitivity test to review the effect of reducing all avoidance rates used by one percentage point (see Section 3.2).
- 2.2.16. In addition to the natural avoidance rate, the model allows for a further Adjustment Factor to be applied. This is only used to account for additional considerations that are likely to affect the collision risk, such as the installation of line markers to reduce collision risk.

Predicted Bird Collisions per Year (each species) = Predicted Bird Collisions per Year (no avoidance) × Avoidance Factor × Adjustment Factor (where applicable)

⁴ NatureScot (2024) *Wind farm impacts on birds - Use of Avoidance Rates in the NatureScot Wind Farm Collision Risk Model v4*. <https://www.nature.scot/doc/wind-farm-impacts-birds-use-avoidance-rates-naturescot-wind-farm-collision-risk-model>. [Accessed 05/03/2026].

Predicting Changes in Mortality Rate

- 2.2.17. To provide an indication as to whether the predicted number of collisions could result in a significant effect, the resulting change to mortality rate was calculated.
- 2.2.18. Background mortality rates were taken from published annual adult survival rates⁵ (% Mortality rate = 100% - % Survival Rate). These figures were used to determine the number of birds expected to die annually in the absence of the Scheme in relation to populations at each of the relevant Internationally Important Wildlife Sites (IIWS)⁶ within 20km. The additional predicted mortality from the calculated bird collisions per year was then used to determine the percentage change in mortality rate.

Relative Change in Mortality Rate = Predicted Annual Collisions ÷ (Background Mortality Rate × Population of relevant IIWS)

- 2.2.19. In consultation, Natural England advised that while “there is no defined threshold that triggers the need for further assessment [...] an increase of more than 1% in Baseline Mortality found through CRM or other impact assessment has been used historically as the trigger for further investigation, consideration or assessment, which may include Population Viability Assessment (PVA) modelling”. Changes of less than 1% in mortality rate are unlikely to be statistically detectable in relation to natural background fluctuation, so this provides an indicative level of de minimis change; however, values below this may still be relevant and higher values do not necessarily imply a significant effect.

2.3. Source data

Scheme Parameters

- 2.3.1. The following parameters have been used for the purposes of this assessment:
- Total length of overhead line: 13.2km;
 - Height of highest wire: 50m;
 - Height of lowest wire: 25m; and

⁵ BTO (2026) Bird Facts. <https://www.bto.org/learn/about-birds/birdfacts#species>. [Accessed 05/03/2026].

⁶ IIWS specifically relevant to birds include Special Protection Areas (SPA) and Ramsar sites.

- Number of rows of cables: 4 (top earth wire and three rows of two conductors)

Vantage Point Survey Metadata

- 2.3.2. Details of VP survey data are provided in the **ES Appendix 9-10: Vantage Point Survey Report 2024-25** (Doc Ref. 6.3).
- 2.3.3. Surveys were undertaken from October 2024 to March 2025 (inclusive), with a total of six hours per month. These were carried out from three VP locations, with an approximate combined viewshed coverage of 12km.

Species-Specific Data

- 2.3.4. Data relating to specific species, used to inform the collision risk analysis include:
- Flight numbers (derived from VP surveys);
 - Wing length (to determine wingspan), taken from data published by the BTO⁷;
 - Adult survival rates (to determine mortality rates), also taken from BTO Bird Facts data; and
 - Avoidance rates, taken from NatureScot published values⁸.
- 2.3.5. Data regarding flight numbers, wing lengths, survival rates and avoidance rates are summarised in Table 1.

⁷ BTO (2026) Bird Facts. <https://www.bto.org/learn/about-birds/birdfacts#species>. [Accessed 05/03/2026].

⁸ NatureScot (2024) *Wind farm impacts on birds - Use of Avoidance Rates in the NatureScot Wind Farm Collision Risk Model v4*. <https://www.nature.scot/doc/wind-farm-impacts-birds-use-avoidance-rates-naturescot-wind-farm-collision-risk-model>. [Accessed 05/03/2026].

Table 1: Summary of Species-Specific Bird Data

Species	Total Bird Transits at Collision Height ^a	Wing length (mm) ^{b,c}	Adult Survival Rate	Avoidance Rate
Black-headed Gull	110	305.3	90%	99.2%
Common Gull	23	359	86%	99.2%
Dunlin	9	119.2	74%	98.0%
Golden Plover	1485	193.5	73%	98.0%
Lapwing	1150	231.3	71%	98.0% ^d
Mallard	50	274.5	63%	98.0% ^d
Pink-footed Goose	259	434.7	83%	99.8%
Red Kite	1	720	61%	99.0%
Ruff	0	244	52%	98.0% ^d
Shelduck	0	328.5	89%	98.0% ^d
Snipe	0	136.1	48%	98.0% ^d
Swan sp.	4	598.5	80%	99.5%
Teal	0	187.2	53%	98.0% ^d
Whooper Swan	18	598.5	80%	99.5%
Black-headed Gull	110	305.3	90%	99.2%
Waterfowl Assemblage	3108	Derived from weighted mean of combined species		98.0% ^d
a This includes species recorded, but not crossing the overhead line route and therefore having zero transits b Average (mean) wing length, using the 'All adults' average in species subject to sexual dimorphism. c Wingspan is derived as wing-length ×2 plus 10% (to account for body width), and converted to metres. d Precautionary assumption where species-specific data are not available				

2.3.6. Data regarding IIWS populations are provided in Table 2; this includes populations of qualifying features cited on the SPA citations or Ramsar

Information Sheets⁹ (in bold type), other populations noted on the citations, but not qualifying features, and the latest 5-year mean BTO Wetland Bird Survey (WeBS) count data for the relevant IIWS¹⁰ (2019-2020 to 2023-24).

⁹ JNCC (2005) *The Wash: Information Sheet Ramsar Wetlands*.

<https://rsis.ramsar.org/RISapp/files/RISrep/GB395RIS.pdf>. [Accessed 05/03/2026].

JNCC (1993) *Nene Washes: Information Sheet Ramsar Wetlands*. <https://jncc.gov.uk/jncc-assets/RIS/UK11046.pdf>. [Accessed 05/03/2026].

Natural England (2014) *The Wash SPA Citation*

<https://publications.naturalengland.org.uk/file/5834437967216640>. [Accessed 05/03/2026].

Natural England (2014) *Nene Washes SPA Citation*

<https://publications.naturalengland.org.uk/file/6652903360036864>. [Accessed 05/03/2026].

¹⁰ Calbrade, N.A., Birtles, G.A., Woodward, I.D., Feather, A., Hiza, B., Caulfield, E., Balmer, D.E., Peck, K., Wotton, S.R., Shaw, J.M., and Frost, T.M. (2025). *Waterbirds in the UK 2023/24: The Wetland Bird Survey and Goose & Swan Monitoring Programme*. BTO, RSPB, JNCC, NatureScot. Thetford.

<https://app.bto.org/webs-reporting/numbers.jsp>. [Accessed 05/03/2026].

Table 2: IIWS reference populations

Species or Feature	Season	The Wash Ramsar	The Wash SPA	The Wash WeBS	Nene Washes Ramsar	Nene Washes SPA	Nene Washes WeBS
Waterfowl Assemblage	Winter or migration	292,541	214,000	423,684			40,809
Avocet	Winter			550			
Bar-tailed godwit	Winter	16,546	8,200	16,607			
Bean goose	Winter	7					
Bewick's swan	Winter				694	1,300	151
Black-headed gull	Winter	31,403					
Black-tailed godwit	Winter or migration	6,849	260	10,271	482		1,734
Common eider	Winter	1,109					
Common greenshank	Spring or Autumn	376					
Common pochard	Winter				1,795		
Common redshank	Spring or Autumn	6,373					
Common scoter	Winter	1,190	830				
Common shelduck	Winter	9,746					

Species or Feature	Season	The Wash Ramsar	The Wash SPA	The Wash WeBS	Nene Washes Ramsar	Nene Washes SPA	Nene Washes WeBS
Cormorant	Spring or Autumn	367					
Curlew	Winter	9,438	3,700	8,047			
Dark-bellied brent goose	Winter	20,861	17,000	11,546			
Dunlin	Winter	36,600	29,000	28,364			
Eider	Winter			2,593			
Gadwall	Winter		130			95	325
Golden plover	Winter	22,033		23,898	2,949		6,013
Goldeneye	Winter		220				
Greenshank	Winter			179			
Grey plover	Spring or Autumn	13,129	5,500	12,116			
Knot	Winter		7,500	222,796			
Lapwing	Winter	46,422		29,548			10,707
Lesser black-backed gull	Spring or Autumn	1,993					
Little Egret	Winter			442			
Oystercatcher	Winter	15,616	24,000	22,836			

Species or Feature	Season	The Wash Ramsar	The Wash SPA	The Wash WeBS	Nene Washes Ramsar	Nene Washes SPA	Nene Washes WeBS
Pied avocet	Spring or Autumn	422					
Pink-footed goose	Winter	29,099	7,300	18,138			
Pintail	Winter	431	1,700	543	1,848	440	673
Pochard	Winter						427
Red knot	Spring or Autumn	68,987					
Redshank	Winter		4,331	5,727			
Red-throated diver	Winter	55					
Ringed plover	Spring or Autumn	1,500		1,348			
Ruff	Winter	25		74	98		164
Sanderling	Winter	3,505	500	9,072			
Shelduck	Winter		16,000	3,065			
Shoveler	Winter			460	343	110	879
Spoonbill	Winter			62			
Spotted redshank	Winter	54					
Teal	Winter				2,015	980	

Species or Feature	Season	The Wash Ramsar	The Wash SPA	The Wash WeBS	Nene Washes Ramsar	Nene Washes SPA	Nene Washes WeBS
Turnstone	Winter	888	980	918			
Whimbrel	Spring or Autumn	191		242			
White-fronted goose	Winter	100					
Whooper swan	Winter			457	80		2,040
Wigeon	Winter		3,900	11,107	9,651	3,640	10,391

Line Markers and Effectiveness

- 2.3.7. Where potential requirements for mitigation are identified (through collision risk analysis or wider qualitative or quantitative assessment), published data on the effectiveness of line markers¹¹ as mitigation for collision risk have been used to determine an appropriate additional collision reduction factor. Based on this evidence, a precautionary value of 58% has been used, which represents the bottom of the range of reported values for larger ‘flapper’ or equivalent types of devices.
- 2.3.8. Based on qualitative evaluation of the ornithological data as well as the collision risk analysis without mitigation, the design of the Scheme includes installation of line markers in two sections of the Grid Connection Route. As shown on Figure 5 of **ES Appendix 9-14: Habitats Regulations Assessment (HRA) Report** (Doc Ref. 6.3), these include areas in the central section of the Grid Connection Route, where notable flocks of golden plover were recorded, and at the southern end of the route where notable assemblages of wildfowl were recorded moving to and from areas adjacent to the River Welland, including pink-footed goose and whooper swan.

Limitations

- 2.3.9. No industry standard collision risk model has been developed and accepted for overhead line collision risk analysis, and as such this model is intended only to provide indicative data to inform a wider review of potential collision risk. Outcomes of the analysis should not be taken alone to provide a definitive measure of likely collision rates.
- 2.3.10. The model includes a number of assumptions including:
- Overhead line assessment assumptions are approximate, given that detailed design of structures will be determined post-consent.
 - The model is focused on collision risk with the overhead line element of the Grid Connection Route as any additional contribution from pylons is considered to be negligible in relation to this.

¹¹ Renewables Grid Initiative (2024). Avian-Power Line Collision: Overview of risk factors and effectiveness of mitigation measures. Available at <https://renewables-grid.eu/?id=534>. [Accessed 05/03/2026].

- The model assumes that birds flying through the collision risk zone will be flying at a horizontal approach angle and flying flat (*i.e.* not banking).
- Activity levels are based on survey data, which is limited to proportional survey effort and will therefore lead to a source of potential inaccuracy in the data. Although analysis was based on one season's survey data, an additional season of surveys were carried out in 2023-2024 to inform the Grid Connection Route selection and these data have been used to support the wider assessment of collision risk; refer to **ES Appendix 9-5: Wintering Bird Survey Report 2023-2024** (Doc Ref 6.3).
- VP surveys covered the majority of the Grid Connection Route, but the model includes extrapolation of the data to cover the full length of the route so that flight numbers not underestimated, but this assumes even coverage of movement along the whole length of the route. The VP data also provide valuable information on the distribution of hotspots of activity, which have been taken into account in the wider assessment of collision risk.
- As discussed with Natural England, the qualifying features of the relevant IIWS do not include breeding species that would reasonably be expected to be affected by the proposed Grid Connection Route, so assessment has been limited to the non-breeding season. Surveys completed in summer 2025 (see **ES Appendix 9-13** (Doc Ref. 6.3)) have been taken into account in consideration of the wider assessment of collision risk, these data indicate that there were not significant movements of target species over this period, with the exception of some flocks of golden plover recorded in September.
- Avoidance rates are based on wind-farm collision modelling data, which provide a good relative measure of the ability of different species to respond to potential hazards, but the direct applicability of these figures have not been well tested for overhead lines, which is a primary source of uncertainty in the model.
- Avoidance rates cited by NatureScot are of varying levels of confidence, and would vary significantly in practice with different weather conditions and between day and night. Therefore, species have been assigned a relatively low level of avoidance on a precautionary basis where there are insufficient available data.
- The model has been compared to the NatureScot onshore wind-farm collision model, using an equivalent scale array, which has been used to

provide a comparative measure with which it has been aligned. The use of an alignment factor, including a significant degree of precautionary allowance, will account for many of the other assumptions made within the model, but may mask more subtle variables that could affect the outcomes.

3. Results of Analysis

3.1. Collision Risk Analysis

- 3.1.1. The results of the collision risk analysis are presented in Table 3. This provides a summary of the calculated collision risk, without mitigation (Adjustment Factors) and the predicted change in mortality rate relative to each of the IIWS population measures (figures over 1% highlighted in bold type). A full summary of the collision risk model data is show in Table 4.

Table 3: Collision Risk Analysis Results

Species	Predicted Annual Collisions without Avoidance	Overall Collision Risk per Annum	The Wash Ramsar % change of mortality	The Wash SPA % change mortality	The Wash WeBS % change mortality	Nene Washes Ramsar % change mortality	Nene Washes SPA % change mortality	Nene Washes WeBS % change mortality
Red Kite	3.5	0.035	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Lapwing	600.2	12.004	0.09%	0.00%	0.14%	0.00%	0.00%	0.39%
Common Gull	15.5	0.124	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Pink-footed Goose	264.6	0.529	0.01%	0.04%	0.02%	0.00%	0.00%	0.00%
Black-headed Gull	63.1	0.505	0.02%	0.00%	0.00%	0.00%	0.00%	0.00%
Whooper Swan	25.3	0.127	0.00%	0.00%	0.14%	0.79%	0.00%	0.03%
Golden Plover	675.4	13.508	0.23%	0.00%	0.21%	1.70%	0.00%	0.83%
Mallard	25.8	0.516	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Shelduck	0.0	0.000	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Snipe	0.0	0.000	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Dunlin	2.0	0.040	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Teal	0.0	0.000	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Swan sp.	5.6	0.028	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Ruff	0.0	0.000	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Waterfowl Assemblage	1731.0	34.620	0.05%	0.06%	0.03%	0.00%	0.00%	0.32%

- 3.1.2. The outcomes of the model indicate that no species are predicted to suffer significant change to mortality rates, except for golden plover, which would be subject to a predicted 1.70% increase in mortality in relation to the Nene Washes Ramsar site population.

3.2. Additional Factors

- 3.2.1. To test the effect of uncertainty of avoidance rates, a sensitivity test has been applied by reducing all avoidance factors by one percentage point. The resulting increase in predicted change in mortality rates would lead to whooper swan exceeding 1% change at 2.37%; no other additional species exceed 1% change.
- 3.2.2. The Scheme includes installation of line markers (secured through the **Design Parameters** (Doc Ref. 7.4), as shown on Figure 5 of **ES Appendix 9-14: Habitats Regulations Assessment Report** (Doc Ref 6.3)) in the section of the Grid Connection Route where flocks of golden plover were recorded. Applying an Adjustment Factor of 0.58 to represent the effect of line markers would reduce the predicted change in mortality rate to 0.71%.
- 3.2.3. The Scheme also includes installation of line markers in the southern section of the Grid Connection Route where notable assemblages of wildfowl were recorded (including pink-footed goose and whooper swan). Applying the Adjustment Factor would lead to reductions in the change in mortality rates, such that the highest change for these species would be 0.33% for whooper swan in relation to the (non-qualifying) population cited for the Nene Washes Ramsar.

Table 4: Collision Risk Model Data

Species	Wingspan (m)	Collision Area (m ²)	Probability of Collision	Total Bird Transits for All Flights	Hours Watched	Birds per hour	Daylight Hours	Activity Hours factor	Activity Hours	Estimate of Birds flights per year	Birds Hitting Wires (No Avoidance)	Avoidance Factor	Overall Collision Risk per Annum	Predicted Annual Collision Rate
Red Kite	1.58	42235.78	0.1280	1	36	0.028	4484.550	0.000	4484.6	137.0	3.5	99.0%	0.035	0.035
Lapwing	0.51	13568.24	0.0411	1150	36	31.944	1730.958	0.200	2077.1	72988.7	600.2	98.0%	12.004	12.004
Common Gull	0.79	21059.23	0.0638	23	36	0.639	1730.958	0.000	1731.0	1216.5	15.5	99.2%	0.124	0.124
Pink-footed Goose	0.96	25499.85	0.0773	259	36	7.194	1730.958	0.250	2163.7	17123.3	264.6	99.8%	0.529	0.529
Black-headed Gull	0.67	17909.14	0.0543	110	36	3.056	1730.958	0.000	1731.0	5817.9	63.1	99.2%	0.505	0.505
Whooper Swan	1.32	35108.49	0.1064	18	36	0.500	1730.958	0.250	2163.7	1190.0	25.3	99.5%	0.127	0.127
Golden Plover	0.43	11350.86	0.0344	1485	36	41.250	1730.958	0.250	2163.7	98177.8	675.4	98.0%	13.508	13.508
Mallard	0.60	16102.39	0.0488	50	36	1.389	1730.958	0.000	1731.0	2644.5	25.8	98.0%	0.516	0.516
Shelduck	0.72	19270.07	0.0584	0	36	0.000	1730.958	0.000	1731.0	0.0	0.0	98.0%	0.000	0.000
Snipe	0.30	7983.73	0.0242	0	36	0.000	1730.958	0.000	1731.0	0.0	0.0	98.0%	0.000	0.000
Dunlin	0.26	6992.37	0.0212	9	36	0.250	1730.958	0.000	1731.0	476.0	2.0	98.0%	0.040	0.040
Teal	0.41	10981.30	0.0333	0	36	0.000	1730.958	0.000	1731.0	0.0	0.0	98.0%	0.000	0.000
Swan sp.	1.32	35108.49	0.1064	4	36	0.111	1730.958	0.250	2163.7	264.5	5.6	99.5%	0.028	0.028
Ruff	0.54	14313.24	0.0434	0	36	0.000	1730.958	0.000	1731.0	0.0	0.0	98.0%	0.000	0.000
Waterfowl Assemblage	0.52	13899.94	0.0421	3108	36	86.333	1730.958	0.250	2163.7	205479.2	1731.0	98.0%	34.620	34.620

