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Appendix 8.1

Ornithology Appendix

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List of Abbreviations

Abbreviation	Description
BBS	Breeding Bird Survey
BoCC	Birds of Conservation Concern
BTO	British Trust for Ornithology
CRM	Collision Risk Modelling
EIAR	Environmental Impact Assessment Report
(Q)GIS	(Quantum) Geographic Information System
GPS	Global Positioning System
LBRSG	Lothian and Borders Raptor Study Group
RSPB	Royal Society for the Protection of Birds
SBL	Scottish Biodiversity List
SUP	Southern Uplands Partnership
TWIC	The Wildlife Information Centre
VP	Vantage Point

A8.1 INTRODUCTION

A8.1.1. This Technical Appendix presents the following information in support of Chapter 8: Ornithology of the Environmental Impact Assessment Report (EIAR) for Scawd Law Wind Farm (the Proposed Development):

- Existing non-confidential ornithological records within 10 km radius of the Survey Area (breeding raptors within 5 km radius), held by the Lothian and Borders Raptor Study Group (LBRSG), Southern Uplands Partnership (SUP), Royal Society for the Protection of Birds (RSPB), and The Wildlife Information Centre (TWIC);
- The methods employed by Natural Power to provide baseline information on target bird species present within the Survey Area. Timings, surveyors, and duration of survey work are provided for relevant surveys. Details of weather conditions during survey can be provided on request;
- Details of target and non-target species flights recorded during Vantage Point (VP) surveys undertaken between September 2017 and August 2018; March 2019 and February 2020; and May and August 2022;
- Details of target raptor flights recorded during breeding raptor surveys in 2018 and 2019; and
- Calculations of the theoretical collision risk to target species (where a sufficient number of flights was recorded) using the Band Model[1] as advocated by NatureScot[2].

A8.2 LATIN NAMES

A8.2.1 Latin names of all bird species referred to in Chapter 8: Ornithology are given in Table A8.1 below.

Table A8.1: Latin names of bird species referred to in Chapter 8

Scientific Name	Common Name
Branta canadensis	Canada goose
Anser anser	Greylag goose
Anser brachyrhynchus	Pink-footed goose
Anas platyrhynchos	Mallard
Lyrurus tetrix	Black grouse
Lagopus lagopus	Red grouse
Alectoris rufa	Red-legged partridge
Phasianus colchicus	Pheasant
Ardea cinerea	Grey heron
Pandion haliaetus	Osprey
Aquila chrysaetos	Golden eagle
Accipiter gentilis	Goshawk
Circus aeruginosus	Marsh harrier
Circus cyaneus	Hen harrier
Milvus milvus	Red kite
Haliaeetus albicilla	White-tailed eagle
Buteo buteo	Buzzard
Haematopus ostralegus	Oystercatcher

[1] SNH. (2007) Band, W., Madders, M. & Whitfield, D.P. Developing field and analytical methods to assess avian collision risk at wind farms. In de Lucas, M., Janss, G. & Ferrer, M. (eds.) Birds and Wind Power. Quercus, Madrid.

[2] SNH. (2010) Use of Avoidance Rates in the SNH Wind Farm Collision Risk Model. SNH Avoidance Rate Information and Guidance Note. Scottish Natural Heritage. http://www.snh.gov.uk/docs/B721137.pdf

Scientific Name	Common Name
Vanellus vanellus	Lapwing
Pluvialis apricaria	Golden plover
Charadrius morinellus	Dotterel
Numenius phaeopus	Whimbrel
Numenius arquata	Curlew
Calidris alpina	Dunlin
Scolopax rusticola	Woodcock
Gallinago gallinago	Snipe
Lymnocryptes minimus	Jack snipe
Actitis hypoleucos	Common sandpiper
Tringa ochropus	Green sandpiper
Tringa totanus	Redshank
Tringa nebularia	Greenshank
Tyto alba	Barn owl
Asio flammeus	Short-eared owl
Falco tinnunculus	Kestrel
Falco columbarius	Merlin
Falco subbuteo	Hobby
Falco peregrinus	Peregrine
Corvus corax	Raven
Alauda arvensis	Skylark
Sturnus vulgaris	Starling
Saxicola rubicola	Stonechat
Oenanthe oenanthe	Wheatear
Anthus pratensis	Meadow pipit
Loxia sp.	Crossbill species

A8.3 SURVEY METHODS

A8.3.1 Baseline surveys were carried out over two 12-month periods: between September 2017 and August 2018, and March 2019 and February 2020. It was agreed with NatureScot that 12 months of baseline surveys were sufficient to describe the baseline conditions of the Proposed Development, however, a change to the proposed turbine layout made in early 2019, resulted in additional turbines being proposed at Seathope Rig (an area previously not covered by baseline surveys). Therefore, an additional year of baseline surveys was necessary (from March 2019 to February 2020) to provide survey coverage of the previously unsurveyed area around Seathope Rig. As data was collected for the two adjacent survey areas over two different 12-month periods, the baseline information for the Proposed Development still comprises one year of data overall. Supplementary VP data was also collected in 2022 (May to August) specifically to target flight activity of golden eagles.

- Baseline ornithological surveys comprised:
- Vantage Point (VP) flight activity surveys;
- Breeding raptor surveys;
- Breeding bird surveys (BBS); and
- Black grouse surveys.
- All ornithology surveys were undertaken by experienced ornithological surveyors:
- Adam Anderson (AA);
- Alein Shreeve (AS);
- Chris Rodger (CCR);
- Dan Carrington (DC);
- Fiona Morton (FM);
- Graeme Cook (GC);
- Graeme Garner (GG);
- Gus Keys (GK);
- Helen Allinson (HA);
- Kirsten Hazelwood (KH); and
- Pawel Plonczkier (PP).

A8.3.2 The survey methods are described in detail below.

Vantage Point ("VP") Surveys

A8.3.3 VP surveys were undertaken using the standard method published in NatureScot guidelines[3]. This method focuses on identifying flight-paths and flight heights of target species, such as waterfowl and raptors, and allows any regular patterns of flight lines to be identified, allowing turbine locations to be designed to minimise collision risk to birds. The data generated can also be used to estimate the theoretical collision risk of a particular species.

A8.3.4 NatureScot guidance states that VP locations are chosen in order to achieve maximum visibility with the minimum number of points; all of the survey area should be covered such that no point is greater than 2 km from a VP. Two VP locations were used throughout the surveys for the Original Survey Area, with a third location being used to cover Seathope Rig and the Additional Survey Area – see Figure 8.2.

A8.3.5 The weather conditions during each survey were recorded every hour, full details of survey dates, times and weather conditions during VP surveys can be provided upon request. As recommended in NatureScot guidance[3], a minimum of 36 hours per VP were carried out in conditions of good visibility.

A8.3.6 Surveys were carried out at various times of day, ensuring that a representative sample of times between dawn and dusk were surveyed. VP surveys were three hours in duration (unless aborted due to unsuitable weather conditions), with a minimum resting period of 30 minutes between surveys, in line with the most recent NatureScot guidance[3].

A8.3.7 A summary of VP survey effort for each VP is shown in Table A8.2 Observers included AA, AS, CCR, FM, GC, GG, GK, HA, KH, and PP. The VP survey hours completed in 2022 are shown in Table A8.3.

A8.3.8 Focal sampling was carried out for target species. The area in view was scanned until a target species was observed, at which point it was followed until it had ceased flying or had flown out of sight. The flight lines of target bird species observed were recorded onto 1:10,000 scale maps. Following NatureScot guidance[3] the

[3] SNH. (2017) Recommended bird survey methods to inform impact assessment of onshore wind farms. SNH, Battleby.

time and duration of the flight were recorded, and the altitude of the target bird(s) was recorded at the start of the observation and at 15 second intervals thereafter into one of four height bands: (1) <25 m, (2) 25-50 m, (3) 50-200 m, (4) >200 m.

A8.3.9 A map showing the flight lines for each target species was compiled in a Geographic Information System (QGIS), with each flight line linked to its associated flight duration and height information held in an Excel spreadsheet.

A8.3.10 The information collected on key target species flying over the Survey Area and the adjacent airspace was used to estimate the number of individuals per species predicted to collide with the turbine rotors. The collision risk modelling (CRM) methods are described in the main ornithology chapter in Section 8.4 and parameters used in the calculations are presented in Section A8.5 of this appendix.

A8.3.11 All secondary species were recorded using five-minute summaries. Each VP survey was sub-divided into five-minute periods. At the end of each five-minute period, the number and activity of all secondary species observed was recorded. The number of birds recorded in a five-minute period was the minimum number of individuals that could account for the activity observed. Observation of target species took priority over the recording of secondary species.

Table A8.2: VP Survey hours 2017-2018 and 2019-2020 breeding and non-breeding seasons

					Total Survey Hours		
Year	**VPs**	**Season**	**Month**	**Observers**	**VP1**	**VP2**	**VP3**
2017	1-2	Non-breeding	September	AS	6	6	
2017	1-2	Non-breeding	October	AS, CCR, GG, PP	15	15	
2017	1-2	Non-breeding	November	AS, CCR, PP	15	15	
2017	1-2	Non-breeding	December	GG, PP	6	6	
2018	1-2	Non-breeding	January	AS, CCR	6	6	
2018	1-2	Non-breeding	February	AS, CCR	6	6	
Sum of 2017-2018 Non-breeding Season					**54**	**54**	
2018	1-2	Breeding	March	AS, CCR, PP	6	6	
2018	1-2	Breeding	April	AS	6	6	
2018	1-2	Breeding	May	AS, GC	6	6	
2018	1-2	Breeding	June	GG	6	6	
2018	1-2	Breeding	July	AS, GC	6	6	
2018	1-2	Breeding	August	AS, GG	6	6	
Sum of 2018 Breeding Season					**36**	**36**	
2019	3	Breeding	March	AA			6
2019	3	Breeding	April	PP			5
2019	3	Breeding	May	AA, AS			9
2019	3	Breeding	June	FM			6
2019	3	Breeding	July	AA			6
2019	3	Breeding	August	HA			6
Sum of 2019 Breeding Season							**38**
2019	3	Non-breeding	September				*
2019	3	Non-breeding	October	AS, HA			12
2019	3	Non-breeding	November	HA			6
2019	3	Non-breeding	December	HA			6

2020	3	Non-breeding	January	HA	6
2020	3	Non-breeding	February	HA	6
Sum of 2019-2020 Non-breeding Season					**36**

**September surveys completed in early October due to bad weather*
Source: Natural Power

Table A8.3: VP survey hours 2022 breeding season

Year	VPs	Season	Month	Observers	VP1	VP2	VP3
2022	2-3	Breeding	May	GK		12	12
2022	2-3	Breeding	June	GK		12	12
2022	2-3	Breeding	July	GK		6	6
2022	2-3	Breeding	August	GK		6	6
Sum of 2022 Breeding Season						**36**	**36**

Source: Natural Power

Breeding Raptor Surveys

A8.3.12 Breeding raptor surveys were undertaken within the Original Survey Area between March and August 2018 and 2019. A combination of ad-hoc VP surveys, and walkover surveys over suitable breeding habitat was undertaken. Ad-hoc VP surveys were carried out with the aim of identifying courtship displays and territorial behaviour and walkover surveys were to check for signs of breeding raptors and, where relevant, to locate nest sites. The breeding raptor surveys focussed on areas identified during the VP surveys (flight activity surveys) as potentially being occupied by breeding raptors, but all areas identified as providing suitable nesting habitat were surveyed, regardless of whether VP surveys indicated raptor occupancy. The raptor survey area also extended beyond the viewsheds of the VPs. The timing and location focus of surveys was tailored to incorporate methods appropriate to those species present, or considered likely to be present, in the vicinity of the Proposed Development, as described in Hardey *et al*., 2013[4].

A8.3.13 All raptor and owl species encountered were recorded. This included all observations of secondary raptor species such as buzzard, kestrel and sparrowhawk.

A8.3.14 A summary of survey effort for each raptor survey is shown in Table A0.1, full details of weather conditions during raptor surveys can be provided upon request.

Table A0.1: Breeding raptor survey effort 2018 and 2019

Year	Observer	Date
2018	CCR	27/03/2018
2018	GG/CCR	25/04/2018
2018	AS	25/05/2018
2018	GG	21/06/2018
2019	AA	27/05/2019
2019	FM	21/06/2019
2019	AA	20/08/2019

Source: Natural Power

Breeding Bird Surveys

A8.3.15 Breeding bird surveys were undertaken in the breeding seasons of 2018 (Original Survey Area) and 2019 (Additional Survey Area), covering all areas of open habitat (Figure 8.5a). The site was surveyed using the standard methodology for assessing upland wader populations, as described by Brown and Shepherd (1993)[5]. This standard methodology, as advocated by NatureScot, is used to survey breeding upland wading birds to assess the presence and map the distribution of breeding birds in a proposed development area. Four survey visits were carried out between April and July in both 2018 and 2019. Table A0.2 lists the survey details. Full details of weather conditions during BBS surveys can be provided upon request.

A8.3.16 A single surveyor walked a pre-determined route ensuring that all parts of the survey area were approached to within 100 m. A handheld GPS unit was used to ensure that the survey route was maintained. The location and behaviour of all birds encountered during the survey visits were recorded in the field on 1:15,000 scale maps. Standard British Trust for Ornithology (BTO) behaviour and species codes were used on field forms.

A8.3.17 Following completion of the survey season, territory analysis was carried out for waders species and red grouse (species targeted during the BBS). Territories were identified using a cluster analysis method, as outlined in Bibby *et al*.[6]. This method used the following principles:

- For resident bird species and summer migrants alike, a minimum of two registrations from two separate visits were required to generate a 'cluster'. This cluster was considered to represent a territory;
- Where a nest with eggs or young chicks was recorded, this record on its own constituted a breeding territory;
- Species were considered to be breeding if any of the following behaviour was observed during a single visit:
  - Song, courtship or territorial display;

[4] Hardey, J., Crick, H., Wernham, C., Riley, H., Etheridge, B. & Thompson, D. (2013) Raptors: a field guide to survey and monitoring. 3rd Edition. The Stationery Office, Edinburgh.

[5] Brown, A.F. & Shepherd, K.B. (1993) A Method for Censusing Upland Breeding Waders. *Bird Study* **40**, 189-195.

[6] Bibby, C.J., Burgess, N.D., Hill, D.A. and Mustoe, S., (2000) *Bird census techniques*. Elsevier.

- Territorial dispute;
- Nest building and nest-hole excavation;
- Agitated behaviour by adult bird(s) indicating the presence of a nearby nest or young (e.g. repetitive alarm calling, distraction display);
- Adult(s) carrying food; and
- Juveniles with parents in attendance;

- Where there were too few records to generate a cluster, with no evidence of any breeding behaviour, the individuals were not included in estimates for number of territories.

A8.3.18 The field data for each visit was combined to produce overarching species maps, showing locations of registrations and behaviour indicative of breeding for each individual species. These locations and behaviour were then assessed to produce an estimate of the overall breeding population for each species recorded in the survey area.

A8.3.19 All surveys were carried out by experienced surveyors in suitable weather conditions.

Table A0.2: Breeding Bird survey effort 2018 and 2019

Year	Visit No.	Observer	Date	No. Survey Hours
2018	1	PP	19/04/2018	8.5
2018	2	GG	24/05/2018	8
2018	3	AS	22/06/2018	9
2018	4	GC	05/07/2018	7
2019	1	PP	14/05/2019	9.5
2019	2	GG	05/06/2019 - 06/06/2019	7
2019	3	HA, DC	25/06/2019 - 26/06/2019	14
2019	4	KH	15/07/2019 - 16/07/2019	11

Source: Natural Power

Black Grouse Surveys

A8.3.20 Black grouse surveys were undertaken within all suitable habitat within the Original Survey Area (1.5 km of proposed turbine locations) between April and May 2018. In the areas beyond that accessible to surveyors, time was spent at the edge of the ownership boundary looking and listening for birds lekking on the surrounding ground.

A8.3.21 Surveys were carried out following the method specified in the National Black Grouse Survey Instructions7. Two survey visits were undertaken in the period between the last week of March and mid-May, to determine the presence of black grouse. Areas of suitable habitat for lekking were determined prior to the two surveys, on a previous visit undertaken on 27 March 2018.

A8.3.22 Details of each survey visit are presented in Table A0.3. Weather conditions on each survey visit can be provided upon request.

Table A0.3: Black Grouse survey effort 2018

Date	Observer	Start Time	End Time
25/04/2018	GG	05:20	07:20
11/05/2018	AS	04:20	07:30

Source: Natural Power

[7] Etheridge, B. & Baines, D. (1995) Instructions for the Black Grouse Survey 1995/6. Unpublished document, RSPB/GCT/JNCC/SNH, Edinburgh.

A8.4 RESULTS

Desk Study Results

A8.4.1 Table A8.6 lists all protected bird species for which there were records from RSPB and TWIC recorded within a 10 km radius of the Survey Area between 2010 and 2020, along with their conservation designations. Confidential ornithological records provided by LBRSG and SUP were used to inform the assessment but are not listed here.

Table A8.6: Desk Study Results from RSPB and TWIC

Common Name (Latin name)	Number of records - RSPB	Number of Records - TWIC	Last recorded	Conservation status	BoCC List	Biodiversity Lists
Brent goose (*Branta bernicla*)		1	2015			
Barnacle goose *(Branta leucopsis)*		3	2012	BirdsDir-A1	Amber	SBL
Greylag goose		246	2019		Amber	
Pink-footed goose		31	2018		Amber	
Mute swan *(Cygnus olor)*		240	2018		Amber	
Whooper swan (*Cygnus cygnus*)		11	2018	BirdsDir-A1, WCA-Sch1	Amber	SBL
Shelduck *(Tadorna tadorna)*		2	2017		Amber	
Shoveler *(Spatula clypeata)*		1	2012		Amber	
Wigeon *(Mareca penelope)*		95	2018		Amber	
Mallard		812	2018		Amber	
Teal *(Anas crecca)*		158	2018		Amber	
Pochard *(Aythya ferina)*		2	2017		Red	SBL
Tufted duck *(Aythya fuligula)*		133	2018			
Scaup *(Aythya marila)*		2	2012	WCA-Sch1	Red	SBL
Velvet scoter *(Melanitta fusca)*		6	2013	WCA-Sch1	Red	
Goldeneye *(Bucephala clangula)*		44	2018		Amber	
Goosander *(Mergus merganser)*		499	2018			
Red-breasted merganser *(Mergus serrator)*		1	2012			
Black grouse		336	2018		Red	SBL
Red grouse		403	2018		Amber	
Grey partridge *(Perdix perdix)*		20	2019		Red	SBL
Quail *(Coturnix coturnix)*		1	2011	WCA-Sch1	Amber	
Manx shearwater *(Puffinus puffinus)*		1	2017		Amber	SBL
Fulmar (*Fulmarus glacialis)*		2	2014		Amber	
Little grebe *(Tachybaptus ruficollis)*		63	2018			
Great crested grebe *(Podiceps cristatus)*		12	2018			
Black-necked grebe *(Podiceps nigricollis)*		1	2012	WCA-Sch1	Amber	SBL
Grey heron		453	2018			
Cormorant (*Phalacrocorax carbo)*		82	2018			
Osprey		77	2018	BirdsDir-A1, WCA-Sch1	Amber	SBL
Golden eagle		2	2015	BirdsDir-A1, WCA-Sch1		SBL
Sparrowhawk *(Accipiter nisus)*		4	2018			
Goshawk		52	2018	WCA-Sch1		

Marsh harrier		1	2014	BirdsDir-A1, WCA-Sch1	Amber	SBL
Hen harrier		11	2018	BirdsDir-A1, WCA-Sch1	Red	SBL
Red kite		15	2018	BirdsDir-A1, WCA-Sch1		SBL
White-tailed eagle		1	2014	BirdsDir-A1, WCA-Sch1	Red	SBL
Buzzard		1374	2019			
Barn owl		90	2019	WCA-Sch1		SBL
Tawny owl *(Strix aluco)*		252	2019		Amber	
Long-eared owl *(Asio otus)*		9	2018			
Short-eared owl		29	2019	BirdsDir-A1	Amber	SBL
Kestrel		434	2019		Amber	SBL
Merlin		16	2018	BirdsDir-A1, WCA-Sch1	Red	SBL
Hobby		1	2015	BirdsDir-A1, WCA-Sch1		SBL
Peregrine		30	2018	BirdsDir-A1, WCA-Sch1		SBL
Water rail *(Rallus aquaticus)*		8	2016			
Moorhen *(Gallinula chloropus)*		160	2018			
Coot (*Fulica atra)*		17	2018			
Oystercatcher		1091	2019		Amber	
Lapwing		575	2019		Red	SBL
Golden plover		51	2018	BirdsDir-A1		SBL
Dotterel		1	2011	BirdsDir-A1, WCA-Sch1	Red	SBL
Whimbrel		2	2010	WCA-Sch1	Red	
Curlew		599	2019		Red	SBL
Dunlin		1	2018		Amber	SBL
Woodcock		52	2018		Red	SBL
Jack snipe		5	2016			
Snipe		165	2019		Amber	
Common sandpiper		270	2019		Amber	
Green sandpiper		3	2018	WCA-Sch1	Amber	
Redshank		79	2019		Amber	
Greenshank		1	2013	WCA-Sch1	Amber	
Black-headed gull *(Chroicocephalus ridibundus)*		202	2018		Amber	SBL
Common gull *(Larus canus)*		193	2019		Amber	
Great black-backed gull *(Larus marinus)*		19	2018		Amber	
Glaucous gull *(Larus hyperboreus)*		1	2014		Amber	
Herring gull *(Larus argentatus)*		88	2018		Red	SBL
Lesser black-backed gull *(Larus fuscus)*		184	2018		Amber	
Stock dove *(Columba oenas)*		103	2019		Amber	
Cuckoo (*Cuculus canorus*)		128	2019		Red	SBL
Swift *(Apus apus)*	13	156	2019		Amber	SBL
Kingfisher *(Alcedo atthis)*		66	2018	BirdsDir-A1, WCA-Sch1	Amber	SBL

Hoopoe *(Upupa epops)*	2	2014	WCA-Sch1		
Great spotted woodpecker *(Dendrocopos major)*	640	2019			
Green woodpecker *(Picus viridis)*	129	2018			
Ring ouzel *(Turdus torquatus)*	7	2012		Red	SBL

BirdsDir: Birds Directive Annex 1. WCA: Wildlife and Countryside Act – Schedule 1.. SBL: Scottish Biodiversity List.
Source: RSPB and TWIC

Survey Results

A8.4.2 A summary of the ornithology results is presented in Chapter 8: Ornithology of the EIAR. Further details of these results are provided below. Full non-confidential survey results data can be provided on request.

Vantage Point Surveys

A8.4.3 A summary of all baseline flights of target species recorded during the non-breeding season surveys during 2017-2018 are presented in Table A8.7. Flights recorded during the breeding season in 2018 are presented in Table A8.8 and those recorded during the breeding season in 2019 are presented in Table A0.5. Flights of target species recorded during the non-breeding season surveys during 2019-2020 are presented in Table A0.6. Incidental observations of target species recorded during VP surveys 2017 to 2020 breeding and non-breeding seasons are summarised in Table A0.7. These include birds that were not in flight, birds that were heard but not seen and birds that were observed well beyond the survey area. Secondary species observed are summarised in Table A0.8. Table A8.13 summarises the incidental observations of (all) target species recorded during the golden eagle VP surveys undertaken in 2022.

Table A8.7: VP flight activity survey results non-breeding season September 2017 to February 2018 – Original Survey Area (VPs 1& 2)

Species	No. Flights	No. Individuals	Conservation Status	BoCC List	Biodiversity Lists
Pink-footed goose	1	52		Amber	
Goshawk	26	28	WCA-Sch1		
Golden plover	2	46	BirdsDir-A1		SBL
Merlin	3	3	BirdsDir-A1, WCA-Sch1	Red	SBL
Peregrine	1	1	BirdsDir-A1, WCA-Sch1		SBL

BirdsDir: Birds Directive Annex 1. WCA: Wildlife and Countryside Act – Schedule 1. SBL: Scottish Biodiversity List.
Source: Natural Power

Table A0.4: VP flight activity survey results breeding season March to August 2018 – Original Survey Area (VPs 1 & 2)

Species	No. Flights	No. Individuals	Conservation Status	BoCC List	Biodiversity Lists
Greylag goose	1	2		Amber	
Goshawk	9	9	WCA-Sch1		
Hen harrier	4	4	WCA-Sch1	Red	
Short-eared owl	1	1		Amber	
Merlin	2	2	BirdsDir-A1, WCA-Sch1	Red	SBL
Peregrine	1	1	BirdsDir-A1, WCA-Sch1		SBL
Curlew	6	10		Red	SBL

BirdsDir: Birds Directive Annex 1. WCA: Wildlife and Countryside Act – Schedule 1. SBL: Scottish Biodiversity List.
Source: Natural Power

Table A0.5: VP flight activity survey results breeding season March to August 2019 – Additional Survey Area (VP 3)

Species	No. Flights	No. Individuals	Conservation Status	BoCC List	Biodiversity Lists
Greylag goose	1	2		Amber	
Osprey	1	1	BirdsDir-A1, WCA-Sch1	Amber	SBL
Goshawk	1	1	WCA-Sch1		
Red kite	1	1	BirdsDir-A1, WCA-Sch1		SBL
White-tailed eagle	2	2	BirdsDir-A1, WCA-Sch1	Red	
Merlin	2	2	BirdsDir-A1, WCA-Sch1	Red	SBL
Curlew	15	36		Red	SBL

BirdsDir: Birds Directive Annex 1. WCA: Wildlife and Countryside Act – Schedule 1. SBL: Scottish Biodiversity List.
Source: Natural Power

Table A0.6: VP flight activity survey results non-breeding season September 2019 to February 2020 – Additional Survey Area (VP 3)

Species	No. Flights	No. Individuals	Conservation Status	BoCC List	Biodiversity Lists
Unidentified goose	1	50			
Merlin	1	1	BirdsDir-A1, WCA-Sch1	Red	SBL
Golden plover	5	241	BirdsDir-A1		SBL

BirdsDir: Birds Directive Annex 1. WCA: Wildlife and Countryside Act – Schedule 1. SBL: Scottish Biodiversity List.
Source: Natural Power

Table A0.7: Incidental records of target species recorded during VP surveys 2017 to 2020

Year	Season	Species	No. Flights	No. Individuals	Conservation Status	BoCC List	Biodiversity Lists
2017/2018	Non-breeding	Greylag goose	1	9		Amber	
2017/2018	Non-breeding	Pink-footed goose	4	345		Amber	
2017/2018	Non-breeding	Goshawk	1	1	WCA-Sch1		
2018	Breeding	Goshawk	2	2	WCA-Sch1		
2019/2019	Non-breeding	Goshawk	4	5	WCA-Sch1		
2019	Breeding	Curlew	2	3		Red	SBL
2019	Breeding	Snipe	1	1		Amber	

WCA: Wildlife and Countryside Act – Schedule 1.
Source: Natural Power

Table A0.8: Records of secondary species recorded during VP surveys 2017 to 2020

Species	Number of records		
	< 10 times	10-100 times	> 100 times
Red grouse		26	
Grey heron	2		
Sparrowhawk	7		
Buzzard			360
Black-headed gull	5		
Common gull	5		

Herring gull	1		
Lesser black-backed gull		15	
Unidentified gull	2		
Kestrel		68	
Raven			170

Source: Natural Power

Table A8.13: Incidental records of target species recorded during VP surveys 2022

Year	Season	Species	No. Flight	No. Individuals	Conservation Status	BoCC List	Biodiversity Lists
2022	Breeding	Red kite	1	1	BirdsDir-A1, WCA-Sch1		SBL
2022	Breeding	Golden eagle	3	3	BirdsDir-A1, WCA-Sch1	Red	SBL
2022	Breeding	Golden plover	2	2	BirdsDir-A1		SBL
2022	Breeding	Curlew	1	1		Red	SBL
2022	Breeding	Snipe	1	1		Amber	

Secondary species recorded during the 2022 VP surveys can be provided upon request

Source: Natural Power

Breeding Raptor Surveys

A8.4.4 Several unoccupied nests and seven target flights were recorded during raptor surveys. Records from raptor surveys in 2018 and 2019 are shown in Confidential Figure 8.5. Target species recorded in 2018 and 2019 are shown in Table A8.14, with secondary species recorded are in Table A8.15.

Table A0.14:Target species recorded during raptor surveys 2018 - 2019

Date	Flight or point?	Species	Sex/ age	No. Individuals	Sign	Notes
27/03/2018	Point	Goshawk			Nest	Old; possible goshawk nest.
27/03/2018	Point	Goshawk			Nest	Old and untidy; possible goshawk nest.
27/03/2018	Point	Goshawk			Nest	Reasonable condition and deep. Probable goshawk nest.
27/03/2018	Point	Goshawk			Nest	Reasonable condition and deep. Green vegetation visible on crown probably moss rather than deposited fresh material. Probable goshawk nest.
27/03/2018	Point	Goshawk			Nest	Old and untidy, small and partially collapsed. Possible goshawk nest.
27/03/2018	Point	Goshawk/Buzzard			Nest	Large but not deep. Old prey remains on crown.
27/03/2018	Point	Goshawk/Buzzard			Feathers	Buzzard inner primary feather & splash, close to raptor nest.
27/03/2018	Point	Goshawk/Buzzard			Nest	
27/03/2018	Point	Goshawk/Buzzard			Nest	Cluster of 4 nests. Buzzard calling overhead.
25/04/2018	Point	Goshawk			Nest	Probable goshawk nests. 2 nests in fair condition. 1 nest flattened, possibly by brood, although more likely old age. Male seen displaying over this area. Bird heard alarming.
21/06/2018	Flight	Goshawk		1		
21/06/2018	Flight	Goshawk		1		Flew out, gained height and headed NE.
21/06/2019	Point	Goshawk		1		Distant raptor seen, carrying prey. Heading south towards forestry. Very distant but considered to be goshawk.
20/08/2019	Flight	Goshawk		2		Soaring over plantation.
20/08/2019	Flight	Goshawk		2		Pair. Flushed from perch.

20/08/2019	Point	Goshawk	1	Perched.
20/08/2019	Flight	Merlin	1	Female foraging.

Source: Natural Power

Table A0.15:Secondary species recorded during raptor surveys 2018 - 2019

Date	Species	Sex/age	No. Individuals	Notes
25/04/2018	Buzzard		1	Flying.
25/04/2018	Buzzard		1	Flying.
21/06/2018	Buzzard		1	Calling overhead.
21/06/2018	Buzzard		1	Flying above forestry block.
21/06/2018	Buzzard		1	Flew out of forestry block on the north side of track, alarming.
21/06/2018	Buzzard		5	Forest on west side of Glede Knowe.
21/06/2018	Buzzard		6	
21/06/2018	Lesser Black-backed gull		1	Quartering site.
21/06/2018	Corvid		1	Quartering site.
27/03/2018	Buzzard		1	Calling over cluster of four potential buzzard nests.
21/06/2019	Buzzard	Adult	1	Circling over suitable habitat.
21/06/2019	Buzzard		1	Hunting/hovering over hillside.
21/06/2019	Buzzard		1	Took flight from suitable habitat.
21/06/2019	Buzzard	Adult	1	In flight south to north.
21/06/2019	Buzzard		2	Active nest on edge of forestry.
21/06/2019	Buzzard		2	In aggressive encounter.
21/06/2019	Buzzard		2	In aggressive encounter.
21/06/2019	Buzzard		1	Vocal display, then plunged into forestry.
20/08/2019	Sparrowhawk	Female	1	Foraging.
20/08/2019	Buzzard	Juvenile	1	Calling (begging call).
20/08/2019	Buzzard	Juvenile	1	Calling.
20/08/2019	Buzzard	Juvenile	1	Dead on ground.

Source: Natural Power

Breeding Bird Surveys

A8.4.5 Birds detected during breeding bird surveys that did not undergo territory analysis (moorland passerines or other species where a lack of evidence of breeding was observed within the survey area) are listed in Table A8.16.

Table A0.16: Species recorded during breeding bird surveys in 2018 and 2019 that did not undergo territory analysis

Species	Recorded 2018	Recorded 2019
Red-legged partridge	Yes	Yes
Pheasant	Yes	Yes
Goshawk	Yes	Yes
Red kite		Yes
Buzzard	Yes	Yes
Black-headed gull		Yes
Herring gull		Yes
Lesser black-backed gull		Yes
Woodpigeon	Yes	Yes
Cuckoo	Yes	Yes
Kestrel	Yes	Yes
Peregrine		Yes
Carrion crow *(Corvus corone)*		Yes
Raven	Yes	Yes
Coal tit *(Periparus ater)*		Yes
Skylark	Yes	Yes
Swallow *(Hirundo rustica)*		Yes
Willow warbler *(Phylloscopus trochilus)*	Yes	Yes
Blackcap *(Sylvia atricapilla)*		Yes
Wren *(Troglodytes troglodytes)*	Yes	Yes
Mistle thrush *(Turdus viscivorus)*	Yes	Yes
Ring ouzel	Yes	Yes
Robin *(Erithacus rubecula)*		Yes
Whinchat *(Saxicola rubetra)*	Yes	Yes
Stonechat	Yes	Yes
Wheatear *(Oenanthe oenanthe)*	Yes	Yes
Dunnock *(Prunella modularis)*		Yes
Pied wagtail *(Motacilla alba)*		Yes
Meadow pipit	Yes	Yes
Chaffinch *(Fringilla coelebs)*	Yes	Yes
Yellowhammer *(Emberiza citrinella)*	Yes	Yes

Source: Natural Power

Black Grouse Surveys

A8.4.6 No black grouse were recorded within the Survey Area. Lekking birds were recorded outwith the Survey Area to the west and northwest of the Proposed Development (see Table A8.17) and Confidential Figure 8.7.

Table A0.17: Black grouse survey results 2018

Date	Sex/age	No.	Sign	Notes
25/04/2018	Male	2	Lek	Lekking beyond buffer
11/05/2018	Male	2	Lek	Located Lek. Lek 'A'.
11/05/2018	Male	2	Foraging	Foraging. Lek 'B'.
11/05/2018	Male	4	Lek	Lekking. Lek 'C'.
11/05/2018	Male	1	Lek	5th black grouse joins other four at Lek 'C'.
11/05/2018	Male	3	Lek	From 7:00 onwards, 3 black grouse males at Lek 'B', 2 lekking. Possible bird movements between Lek 'B' and Lek 'C'.

Source: Natural PowerCollision Risk Modelling Parameters

A8.5 COLLISION RISK MODELLING PARAMETERS

A8.5.1 Collision Risk Modelling was carried out for vantage point data collected at the Proposed Development between September 2017 and August 2018 inclusive from VPs 1 and 2 and between March 2019 and February 2020 inclusive from VP 3. Collision risk modelling was also carried out for golden eagle between May 2022 and August 2022 inclusive from VPs 2 and 3. Data collected during flight activity VP surveys were used to predict the number of individuals per species expected to collide with the turbine rotors per season. For each species, the risk of collision for an individual given that it passes through the rotor swept volume is calculated by estimating the likelihood of collision based on the characteristics of the birds and of the turbines. Where turbine specifications were not available, representative values were used. Wind farm specifications used in the model are provided in Table A8.18.

Table A0.18: Wind turbine specifications used in CRM

Attribute	Value
Number of turbines	8
Number of blades	3
Maximum chord length (metres)	4.2
Pitch (degrees)	6*
Rotor diameter (metres)	155
Rotation period (seconds)	4.2*

Source: Natural Power

A8.5.2 The height within which the proposed turbine blades will rotate (potential collision height – PCH) falls within height bands 2 and 3 (i.e. 25–200 m) and only flights within these height bands were considered at potential collision risk.

Species Collision Risk

A8.5.3 Species with sufficient data to run CRM during the breeding season are shown in Table A8.19. Table A8.20 shows species with sufficient data to run CRM during the non-breeding seasons. Bird parameters used in the model are provided in Table A8.21.

Table A0.19: Number of flights and individuals observed passing through the turbine area at collision risk height during the breeding season in 2018, 2019 and 2022

Species	No. flights	Flights at risk height	Individuals at risk height	CRM carried out
Greylag goose	1	1	2	No
Osprey	1	0	0	No
Hen harrier	4	1	1	No
Red kite	1	0	0	No
White-tailed eagle	2	0	0	No
Golden eagle[8]	7	4	4	Yes
Goshawk	11	3	3	Yes
Golden plover	3	3	22	Yes
Curlew	21	3	11	Yes
Short-eared owl	1	0	0	No
Merlin	4	0	0	No
Peregrine	2	0	0	No

Source: Natural Power

Table A0.20: Number of flights and individuals observed passing through the turbine area at collision risk height during the non-breeding season in 2017/18 and 2019/20

Species	No. flights	Flights at risk height	Individuals at risk height	CRM carried out
Pink-footed goose	1	0	0	No
Unidentified goose	1	0	0	No
Goshawk	26	8	9	Yes
Golden plover	7	4	166	Yes
Merlin	4	0	0	No
Peregrine	1	1	1	No

Source: Natural Power

Table A0.21: Bird specifications used in CRM

Attribute	Golden eagle	Curlew	Goshawk	Golden plover
Bird length (metres)	0.88	0.55	0.55	0.29
Wingspan (metres)	2.2	0.90	1.50	0.76
Bird speed (metres/second)	11.9	16.30	11.30	17.90
Estimated nocturnal activity (as proportion of diurnal activity)	0	0	0	0.25
Calculated individual collision risk	0.10	0.062	0.083	0.049

Source: Natural Power

A8.5.4 Details of calculations used to produce estimates for collision risk models for each raptor and wader species eligible for CRM during the breeding season are shown in Table A8.22. Details of calculations used to produce estimates for collision risk models for each raptor and wader species eligible for CRM during the non-breeding season are shown in Table A8.23.

Table A0.22: Collision Risk Model for raptor and wader species in the 2018, 2019 and 2022 breeding seasons

Parameter	Formula	Golden eagle	Goshawk	Golden plover	Curlew
Occupancy of risk volume (sec)	a	59	117	989	223
Survey effort (ha-min)	b	358436	538622	538622	538622
Observed occupancy rate for site (sec/ha-min)	c = a / b	0.00016	0.00022	0.00184	0.00041
Daylight minutes	d	120974	168336	168336	168336
Potentially active period (min)	e = d*1	120974	168336	210420	168336
Area of the wind farm polygon (ha)	f	182.71	182.71	182.71	182.71
Total occupancy of risk volume during period of interest (sec)	g = c * e * f	3633	6659	70611	12751
Rotor diameter (m)	h	155	155	155	155
Risk volume (m^3)	i = f * h * 10,000	283199170	283199170	283199170	283199170
Number of turbines	j	8	8	8	8
Rotor blade width (m)	k	4.2	4.2	4.2	4.2
Length of bird of interest (m)	l	0.88	0.55	0.29	0.55
Rotor-swept volume (m^3)	m = j * pi * (h/2)^2 * (k + l)	766844	717029	677781	717029
Bird occupancy of rotor-swept volume (sec)	n = g * m / i	9.8	16.9	169	32.3
Bird flight speed (m/sec)	o	11.9	11.3	17.9	16.3
Time taken for bird to transit rotor (sec)	p = (k + l) / o	0.43	0.42	0.25	0.29
Number of rotor transits	q = n / p	23	40	674	111
Probability of collision for a bird flying through rotors (estimated using SNH spreadsheet)	r	0.1	0.083	0.049	0.062

[8] May to August only

Parameter	Formula	Golden eagle	Goshawk	Golden plover	Curlew
Predicted mortality with no avoidance - turbines operational 85% of the time (collisions/season)	y = q * r * 0.85	1.97	2.84	27.91	5.86

Values have been rounded up for presentation purposes. Following the calculations using the rounded values may yield slightly different results

Table A0.23: Collision Risk Model for raptor and wader species in the 2017/18 and 2019/20 non-breeding seasons

Parameter	Formula	Goshawk	Golden plover	Curlew
Occupancy of risk volume (sec)	a	498	6745	0
Survey effort (ha-min)	b	709448	709448	709448
Observed occupancy rate for site (sec/ha-min)	c = a / b	0.00070	0300951	0.00000
Daylight minutes	d	101442	101442	101442
Potentially active period (min)	e = d*1	101442	126803	101442
Area of the wind farm polygon (ha)	f	182.71	182.71	182.71
Total occupancy of risk volume during period of interest (sec)	g = c * e * f	13002	220261	0
Rotor diameter (m)	h	155	155	155
Risk volume (m^3)	i = f * h * 10,000	283199170	283133170	283199170
Number of turbines	j	8	8	8
Rotor blade width (m)	k	402	4.2	4.2
Length of bird of interest (m)	l	0.55	0.29	0.55
Rotor-swept volume (m^3)	m = j * pi * (h/2)^2 * (k + l)	717029	677781	717029
Bird occupancy of rotor-swept volume (sec)	n = g * m / i	32.9	527.2	0
Bird flight speed (m/sec)	o	11.3	17.9	16.3
Time taken for bird to transit rotor (sec)	p = (k + l) / o	0.42	0.25	0.29
Number of rotor transits	q = n / p	78	2102	0
Probability of collision for a bird flying through rotors (estimated using SNH spreadsheet)	r	0.083	0.049	0.062
Predicted mortality with no avoidance - turbines operational 85% of the time (collisions/season)	y = q * r * 0.85	5.55	87.05	0

Values have been rounded up for presentation purposes. Following the calculations using the rounded values may yield slightly different