TA 7.4: Fisheries

Technical Appendix 7.4: Fisheries

Introduction

1.1.1 This Technical Appendix has been prepared to accompany Chapter 7 of the EIAR.

1.1.2 It presents detailed methodologies and results of desk studies and field survey completed to establish baseline conditions with regards to fisheries, in order to identify any potentially important/ critical fish habitat which may be impacted by the Proposed Development and to inform any required changes to scheme design and the requirement for mitigation.

1.1.3 It should be read with reference to the following specific figures presented in Volume 3a of the EIAR:

- Figure 7.1 – Designated Sites of Nature Conservation; and
- Figure 7.7 a and b – Fish Habitat Survey Plan.

1.1.4 The following species of conservation significance are considered:

- European eel (*Anguilla Anguilla*) - Council Regulation (EC) No 1100/ 2007 establishing measures for the recovery of the stock of European eel; listed by IUCN as Critically Endangered, Scottish Biodiversity List (SBL) (Watching Brief Only) and UK Biodiversity Action Plan (BAP) Priority Species;
- Atlantic salmon (*Salmo salar*) - Annex II of Habitats Directive (92/43/EEC), Salmon and Freshwater Fisheries (Consolidation) (Scotland) Act 2003, SBL (Conservation Action Needed & Avoid Negative Impacts) and UK BAP Priority Species;
- brown trout/ sea trout (*Salmo trutta*) - SBL (Conservation Action Needed) and UK BAP Priority Species;
- freshwater pearl mussel (*Margaritifera margaritifera*) - Schedule 5 of the Wildlife and Countryside Act (1981) and Annex II of Habitats Directive SBL (Conservation Action Needed) and UK BAP Priority Species;
- river lamprey (*Lampetra fluviatilis*) - Annex II of Habitats Directive, SBL (Avoid Negative Impacts) and UK BAP Priority Species;
- brook lamprey (*Lampetra planeri*) - Annex II of Habitats Directive, SBL (Avoid Negative Impacts); and
- sea lamprey (*Petromyzon marinus*) - Annex II of Habitats Directive, SBL (Avoid Negative Impacts) and UK BAP Priority Species.

Site Overview

1.1.5 The Site boundary is shown in Figure 1.1. The Site is located approximately 8 km south east of Dufftown, Moray.

1.1.6 The habitats within the Site comprise a mosaic of commercial conifer plantation, coniferous semi-natural woodland, blanket bog, marshy grassland, dry modified bog and acid dry dwarf scrub.

1.1.7 The north western section of the Site consists of south east facing slope comprising blanket bog leading to Craig Watch and Garbet Hill, the latter falling outside of the Site.

1.1.8 Full habitat descriptions are provided in Technical Appendix 7.1 Habitats and Vegetation.

Methodology

Desk Study

1.1.9 A desk study was undertaken to identify the proximity of the Proposed Development to any statutory or non-statutory designated sites for nature conservation and any classified waterbodies and existing fisheries records within the Site and surrounding area.

1.1.10 Desk study sources, information obtained and search area is summarised in Table 7.4.1.

Table 7.4.1: Desk Study Sources - Chapter 7

Source	Information Sought	Search Area
Sitelink	Statutory designated sites for nature conservation with qualifying fish interests.	Within 10 km of the Site boundary.
North East Scotland Biological Records Centre (NESBReC)	Existing records of fish, and non-statutory designated sites with fish interest.	2 km for fish records and 5 km for non-statutory designated sites from Site central grid reference (NJ 38300 34705).
SEPA's River Basin Management Plan	Relevant information concerning notable fish habitats.	Within the Site boundary.
The Deveron, Bogie and Isla Rivers Trust and River Deveron Salmon Fishery Board	Relevant information concerning notable fish habitats.	Watercourses downstream of the Proposed Development; predominantly the River Deveron.

Field Surveys

1.1.11 A Fish Habitat Survey was completed of all watercourses within the original Site boundary (the 'Study Area') between 24 and 26 August 2020 in normal flow conditions.

1.1.12 Note that following surveys, the Site boundary was extended, and so some areas of watercourse at the west of the Site were not included in the Study Area; see Figures 6.7a and 6.7b.

1.1.13 The survey aimed to identify any areas of critical fish habitat (i.e., spawning, nursery areas, juvenile and adult holding areas and freshwater pearl mussel habitat).

1.1.14 All stretches of watercourses with a gradient of ≥6% are considered to be unsuitable or non-productive fish habitat for Atlantic salmon and brown/ sea trout. Mills (1973)[1] found that gradients of <3% were favourable for Atlantic salmon; whilst sea trout were found to spawn in streams with gradients up to 4%. Most populations of lamprey occur where the average stream gradient is 1.9 to 5.7 m/km, being rarely found where gradients exceed 7.8 m/km or 0.78% (Maitland and Campbell, 1992)[2]. Whilst gradients of ≥6% are considered to be typically unsuitable for fish fauna, it is recognised that small, isolated, populations of brown trout may occur in locally suitable habitat in stretches with steeper gradients.

1.1.15 The watercourses within the Site boundary were systematically walked (including in-stream inspections where required) and the habitats mapped according to the classification presented in Table 7.4.2. The habitat survey focused on the identification of the following:

- spawning habitat for salmonid and lamprey species;
- nursery habitat for lamprey species;

[1] Mills, D.H. (1973*). Preliminary assessment of the characteristics of spawning tributaries of the River Tweed with a view to management*. In: M.W. Smith & W.M. Carter (eds.). International Atlantic Salmon Symposium, St Andrew's, International Atlantic Salmon Special Publication Series 4 (1), 145-55.

[2] Maitland, P.S. & Campbell, R.N. (1992). *Freshwater Fishes of the British Isles*. New Naturalist. HarperCollins, London.

- areas of habitat important for juvenile salmonids (fry and parr);
- areas of habitat important for adult holding areas; and
- areas of suitable substrate and flow conditions for supporting freshwater pearl mussel.

Table 7.4.2: Fish River Habitat Classification - Chapter 7

Category	Habitat Type	Description	Species Suitability
1 1a 1b 1c	Unsuitable Steep >10% gradient 6-10% gradient Other – ephemeral, shallow drains, dry beds	Usually 1st – 2nd order watercourses with steep gradient, ³6% slopes (often substantially greater), abundant bedrock, lack of fixed substrates, high velocity (e.g. headwaters/ rivulets). Also includes less steep ephemeral stretches (e.g. headwater sources), shallow drains and modified watercourses with dry beds.	No productive fish habitat, although some species may migrate through these areas (also refer to 7. Rapids) depending on whether they represent a migration barrier.
2 2a 2b	Spawning Habitat Salmonids Lamprey	Stable "gravels" of minimum 15-30 cm depth, optimal 20-30 mm, not compacted or with excessive silt/ sands (<20% by weight) for salmonids. Lamprey spawning habitat where "gravels" include sands. Often at tail end of pools or upstream ends of riffle-runs ensuring oxygenated substrate. Can also be found at end of weir pools.	Spawning habitat - Atlantic salmon (approx. 9 m² per pair) and sea/ brown trout; lamprey.
3	Riffle	Shallow (<20 cm) and fast flowing, with upstream-facing wavelets which are unbroken (although often some broken water), with substrate dominated by gravel and cobbles.	Fry (0+) habitat – Atlantic salmon/ brown trout/ sea trout.
4 4a 4b	Run Shallow (<0.5 m deep) Deep (>0.5 m deep)	Generally deeper (20-40 cm) and less steep bed compared to riffle, with substrate of boulders, cobbles and gravels. Usually disturbed, rippled surface. Often located immediately downstream of riffle.	Mixed salmonid juvenile habitat. Fry (0+) & Par (1+) habitat - Atlantic salmon/ brown trout/ sea trout.
5 5a 5b	Glide Shallow (<0.5 m deep) Deep (>0.5 m deep)	Shallow gradient stretches with smooth laminar flow with little surface turbulence and generally >30 cm deep; water flow is silent. Often located below pool.	European eel; non-productive salmonid habitat, although may provide some shelter for adults.
6 6a 6b 6c	Pool Plunge/ Scour pool Meander pool Weir/ bridge pool	No perceptible flow, eddying and usually >100 cm deep. Substrate with high proportion of sand and silts. Often located on the outside of meanders, but includes natural scour or plunge pools and artificial weir pools.	Adult refugia Atlantic salmon, sea/ brown trout, European eel.
7 7a 7b 7c	Rapids Steep >10% gradient Moderate – 6-10% gradient Low - <6% gradient	Sections of relatively steep gradient with fast currents and turbulence, with mixed flow types, including free-fall, chutes and broken, with obstructions such as large boulders, rock outcrops and falls.	Negative feature for migratory species and may pose a migratory barrier; elvers and eels limited to velocity of <0.5 m/sec and 2.0 m/sec respectively; lamprey to 2 m/sec.
8 8a 8b	Banks of fine sediment of silts and sands Optimal Sub-optimal	Limited flow (sometimes back-flow) allowing deposition of silts/ sands, not anoxic, with/ without riparian trees. Optimal habitat is stable fine sediment and sand 15 cm deep with some organic detritus. Sub-optimal habitat includes small areas of deposited silts/ sands behind boulders.	Lamprey ammocoete nursery and adult refuge.
9 9a	Vegetation features Riparian trees (tunnel)	Closed woodland canopy forming tunnel vegetation, in-stream emergent boulders, stands	Tunnel riparian trees may be negative feature for salmonids,

Table 7.4.2: Fish River Habitat Classification - Chapter 7

Category	Habitat Type	Description	Species Suitability
9b 9c 9d 9e	Flow constriction Aquatic macrophytes Emergent macrophytes Large woody debris	of aquatic and floating vegetation, stands of emergent (usually marginal) vegetation, LWD forming dams, etc.	although tree roots and fallen trees may provide refugia for Atlantic salmon/ brown trout/ sea trout and European eel. Aquatics/ emergents provide cover for fish, particularly juveniles.
10	Obstructions to migration	Impassable waterfalls, rapids, flow constrictions, weirs, bridge sills, culverts, shallow braided river sections, pollution preventing upstream migration.	All migratory species; impassability varies between species. Leaping ability: <3.7 m Atlantic salmon; <1.81 trout; European eel and lamprey none.
11 11a 11b 11c	Other features Side channel Backwater Artificial channel	Includes other channel features, with side channel (connected to main channel) and backwaters. Artificial channels may comprise either man-made banks and/ or beds.	Side channel/ backwater often important refugia for juveniles. Artificial channels have limited diversity and are often non-productive fish habitat.

1.1.16 The habitat classification used in this study is based on the Scottish Fisheries Co-ordination Centre's Habitat Surveys Training Course Manual (SFCC, 2007), the Environment Agency's Restoration of Riverine Salmon Habitats Guidance Manual (Hendry & Cragg-Hine, 1997)[3], a review of key habitat requirements for other species of conservation significance including lamprey, salmonids and freshwater pearl mussel (e.g. Maitland, 2003[4]; Hendry & Cragg-Hine, 2003[5]; Skinner *et al.* 2003[6]).

1.1.17 Each watercourse was walked in full across its extent within the Site. Every 100 m a description of the channel and substrate of a 10 m sample area was completed. The following information was collected at each sample location: channel gradient; substrate composition (% bedrock, boulders >256 mm, cobbles 65 to 256 mm, pebbles 4 to 64 mm, gravel 2 to 4 mm, coarse sand 0.5 to 2 mm and fine sand/ silt/ peat <0.5 mm); average wetted channel width (m); average depth (m) and turbidity (1 [clear] – 3 [turbid]). Any potential barriers to fish movement within watercourses were also recorded. A photograph was taken at each sample point.

Personnel

1.1.18 The survey was undertaken by Simon Green and Dave Dowse who are both full members of the Chartered Institute of Ecology and Environmental Management (MCIEEM), with 19 and 15 years' experience respectively as professional ecologists.

Limitations

1.1.19 The fish habitat survey was completed within the normal range of flows for watercourses in the geographical area, as defined by Scottish Environmental Protection Agency (SEPA)[7].

1.1.20 Given the western Site boundary was extended after fish habitat surveys were undertaken, some areas of watercourse in the west of the Site were not surveyed. As no Proposed Development works are to be carried out in the west of the Site, the omission of these watercourses is not considered a substantive limitation.

1.1.21 The survey was therefore considered not to be subject to any significant limitations.

[3] Hendry, K. & Cragg-Hine, D. (1997). *Restoration of riverine salmon habitats: A guidance manual.* R&D Technical Report W44. Environment Agency, Bristol.

[4] Maitland, P.S. (2003). *Ecology of the River, Brook and Sea Lamprey.* Conserving Natura 2000 Rivers Ecology Series No. 5. English Nature, Peterborough.

[5] Hendry, K. & Cragg-Hine, D. (2003). Ecology of the Atlantic Salmon. Conserving Natura 2000 Rivers Ecology Series No. 7. English Nature, Peterborough.

[6] Skinner, A, Young, M. & Hastie, L. (2003). *Ecology of the Freshwater Pearl Mussel.* Conserving Natura 2000 Rivers Ecology Series No. 2 English Nature, Peterborough.

[7] https://www2.sepa.org.uk/waterlevels/default.aspx?sd=t&lc=234176 [Accessed January 2022].

Results

Desk Study

1.1.22 This section provides details of existing fish information and existing records of fish identified within and in proximity to the Proposed Development from desk study sources listed in Table 7.4.1.

Statutory Designated Sites

1.1.23 This section should be read with reference to Figure 7.1.

1.1.24 A review of Sitelink[8] identifies that the Proposed Development does not form part of any statutory designated site for nature conservation with qualifying fish interests.

1.1.25 A single statutory designated site, River Spey Special Area of Conservation (SAC)[9], with qualifying fish interests is located within 10 km of the Site boundary as summarised in Table 7.4.3.

Table 7.4.3: Desk Study Sources-Chapter 7

Designated Site	Distance	Qualifying Fish Interest
River Spey SAC	Approximately 0.05 km north west of most north western Site boundary.	▪ Atlantic salmon ▪ Sea lamprey ▪ Freshwater pearl mussel

Non-statutory Designated Sites

1.1.26 NESBReC identified no non-statutory designated sites with qualifying fish interests within 5 km of the Proposed Development.

Existing Records

1.1.27 NESBReC returned no records of protected or notable fish within 2 km of the Proposed Development.

1.1.28 The Deveron, Bogie and Isla Rivers Trust and River Deveron Salmon Fishery Board returned two records of Atlantic salmon (fry and parr) and two records of brown trout (fry and parr) from Charach Water, a tributary of the River Deveron, located at the southernmost Site boundary.

1.1.29 All watercourses within the Study Area comprise tributaries of the River Deveron. The European Water Framework Directive (WFD)[10] requires that surface waterbodies in member states are classified according to ecological status. SEPA's River Basin Management Plan[11] website confirms that the River Deveron has an overall condition score of 'Good', including water quality and access for fish migration. Tributaries of the River Deveron surveyed within the Proposed Development and the SEPA's River Basin Management Plan condition score are presented below:

- Un-named ditches discharging to Burn Treble: un-named ditch unclassified. Burn Treble as an overall 'Good' condition score with 'Good' water quality and 'High' access for fish migration;
- Green Burn and headwaters: unclassified;
- Burn of Succouth headwaters: unclassified;
- Linn Burn and headwaters: unclassified
- Tammie's Burn headwaters: unclassified; and
- Chapel Burn headwaters: unclassified.

Field Surveys

1.1.30 This section presents the results of a Fish Habitat Survey on watercourses within the Study Area.

1.1.31 This section should be read with reference to Figure 7.7.

1.1.32 The full survey results are presented in Annex 1. Photographs of the survey sections, including sample points with no water flow, are presented in Annex 2.

Un-named Ditches Discharging to Burn Treble

1.1.33 Sample Points 01 to 14.

1.1.34 Agricultural field ditches classified as *Category 1 Unsuitable* being either *Sub-category 1b;* with moderate (6 to 10%) gradient channels or *Sub-category 1c*; with channels that were ephemeral, shallow or dry. The channels were noted to be dry or carrying very little water, although would carry water during high flow conditions.

1.1.35 No functional fish or freshwater pearl mussel habitat is present and no substrate or flow condition records were made at the sample points.

Green Burn and Headwaters

1.1.36 Sample Points 15 to 23 and 37 to 57.

1.1.37 The majority of the watercourse (Sample Point 37 to 57) was wet with a channel width of 0.25 to 0.6 m and depth of <0.05 to 0.4 m. For the most part the watercourse consists of *Category 4a Shallow Run* with some *Category 6a Scour Pools* below localised steeper sections. Category *9c Aquatic Macrophytes* are a significant feature, comprising emergent rushes and sedges within the localised flush habitats (Sample Points 3 to 49). Upstream of Sample Point 49 the headwaters are classified as *Category 1 Unsuitable*, *Sub-category 1c Other*; channels are occasionally subterranean within this headwater section and become somewhat diffuse through heavily vegetated flush sections dominated by rushes. No defined channel was located at the extreme northern extent; hence no environmental data is presented for Sample Points 56 and 57.

1.1.38 The watercourse at the most southern extent (Sample Points 15 to 23) comprised agricultural field ditches classified as *Category 1 Unsuitable* being either *Sub-category 1b;* with moderate (6 to 10%) gradient channels or *Sub-category 1c*; where the gradient lessens and comprises heavy livestock poaching within the channel. No wetted channel is present upstream of Sample Point 18; hence no environmental data is presented for Sample Points 19 to 23.

1.1.39 Substrates within the majority of the watercourse generally trend from being typically dominated by boulders and cobbles on the downstream sample points to fine silt (peat) within the upper stretches.

1.1.40 Within the wetted sections; no areas of high calibre *Category 2a Salmonid spawning habitat* were noted for Atlantic salmon or sea trout. No sections of deep stabilised "gravels" or pebbles were identified. The run habitats provide mixed salmonid juvenile habitat (including fry [0+] and parr [1+]). Similarly, no significant areas that could provide *Category 8 lamprey nursery habitat* were noted; no areas of stabilised sands were recorded and silts identified are primarily composed of peat.

1.1.41 Due to a lack of suitable substrates, that likely wash-out during high flow conditions, and generally narrow, shallow channels that diffuse through flush vegetation, the watercourse is considered unsuitable to support freshwater pearl mussel.

8 https://sitelink.nature.scot/map [Accessed January 2022].
9 https://sitelink.nature.scot/site/8365 [Accessed January 2022].
10 https://ec.europa.eu/environment/water/water-framework/index_en.html [Accessed January 2022].
11 https://www.sepa.org.uk/data-visualisation/water-environment-hub [Accessed January 2022]

Burn of Succoth

1.1.42 Sample Points 24 to 36.

1.1.43 The watercourse was classified as *Category 1 Unsuitable, Sub-category 1c Other;* with channels comprised of dry ditches and flush habitat.

1.1.44 No functional fish or freshwater pearl mussel habitat is present and no substrate or flow condition records were made at the sample points as the channel was dry.

Linn Burn and Headwaters

1.1.45 Sample Points 58 to 95.

1.1.46 The three upstream tributaries were classified as *Category 1 Unsuitable, Sub-category 1c Other;* with the watercourse being dry, flushes or hagged. This consisted of Sample Points 75 to 78, 80 to 85 and 86 to 95; as a result no environmental data was collected.

1.1.47 Similarly, the two channels unattached from Linn Burn (Sample Points 63 to 66 and 58 to 62) were also classified as *Category 1 Unsuitable, Sub-category 1c Other;* with channels being dry and comprised of heavily vegetated flush habitat.

1.1.48 The watercourse downstream of where the three tributaries meet (Sample Point 67 to 74) comprised a wet channel with a width of 0.2 to 1 m and a depth of <0.15 to 0.6 m. For the most part the watercourse consists of *Category 1 Unsuitable*, *Sub-category 1c Other* with small (downstream) sections of *Category 4a Shallow Run* with some *Category 6a Scour Pools* below localised steeper sections (short sections of which are recorded as *Category 1 Unsuitable Sub-category 1b* being a moderate (6 to 10%) gradient channel and *Category 7a Steep Rapids*). Category *9c Aquatic Macrophytes* are a significant feature, comprising emergent rushes and sedges within the localised flush habitats which become dominant further upstream.

1.1.49 Substrates generally trend from being typically dominated by boulders and cobbles on the downstream sample points to fine silt (peat) within the upper stretches, prior to the watercourse becoming a flush with no defined channel beyond Sample Points 74.

1.1.50 Within the wetted sections; no areas of high calibre *Category 2a Salmonid spawning habitat* were noted for Atlantic salmon or sea trout. No sections of deep stabilised "gravels" or pebbles were identified. The run habitats provide mixed salmonid juvenile habitat (including fry [0+] and parr [1+]). Similarly, no significant areas that could provide *Category 8 lamprey nursery habitat* were noted; no areas of stabilised sands were recorded and silts identified are primarily composed of peat.

1.1.51 Due to a lack of suitable substrates, that likely wash-out during high flow conditions and generally narrow, shallow channels that diffuse through flush vegetation, the watercourse is considered unsuitable to support freshwater pearl mussel.

Tammie's Burn Headwaters

1.1.52 Sample Points 96 to 105.

1.1.53 Small section of headwater classified as *Category 1 Unsuitable, Sub-category 1c Other;* with a shallow dry bed encroached with vegetation. The channel is considered likely to carry water during high flow conditions.

1.1.54 No functional fish or freshwater pearl mussel habitat is present and no substrate or flow condition records were made at the sample points as the channel was dry.

Chapel Burn Headwaters

1.1.55 Sample Points 106 to 112.

1.1.56 The section of Chapel Burn within the Site was classified as *Category 1 Unsuitable, Sub-category 1c Other;* with a dry channel within the forested section and flush habitat within un-forested areas downstream.

1.1.57 No functional fish or freshwater pearl mussel habitat is present and no substrate or flow condition records were made at the sample points as the channel was dry.

Summary

1.1.58 Functional fish habitat within the Study Area is restricted to downstream sections of Green Burn and Linn Burn and is considered to be of low sensitivity due to the short extent of low quality habitat recorded.

1.1.59 No significant areas of high calibre Category *2a Salmonid spawning habitat* were identified within these watercourses with habitat suitability limited to juvenile fish. Similarly, no significant areas of spawning or nursery habitat for lamprey species were noted and suitable habitat for European eel is patchy and probably restricted to deeper, slower sections (e.g. *Category 6 Pool*).

1.1.60 No suitable habitat within the wetted channels was considered likely to support freshwater pearl mussel due to a lack of suitable substrates, that likely wash-out during high flow conditions, and generally narrow, shallow channels that diffuse through flush vegetation.

1.1.61 Watercourses downstream of the Proposed Development may support higher quality fish and freshwater pearl mussel habitat and are hydrologically connected to the river Deveron.

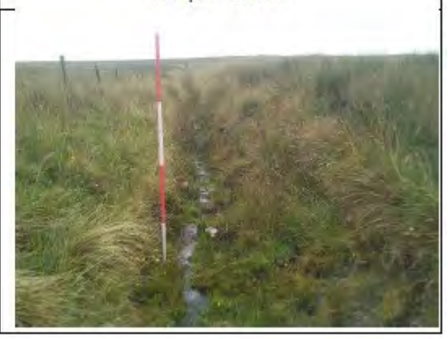
Annex 1: Environmental Data

Sample/ Photo No	OS Grid ref.	Bedrock	Boulders >256mm	Cobbles 65–256mm	Pebbles 4 – 64mm	Gravel 2 – 4mm	Coarse sand 0.5 – 2mm	Fine sand/silt/ peat	Av. Wetted Width (m)	Av. Depth (m)	Turbidity (1 [clear]-3[turbid])	Gradient (%)
15			5	5	60	30			0.2	0.3	1	5
16			5	80				15	0.3	0.2	1	5
17						20		80	0.3	0.3	1	>5
18			15	20	20	25	10		0.75	0.05	1	>5
37			30	50	15	5			0.5	0.25	1	<5
38			50	20	20	10			0.5	0.2	1	<5
39			30	30	20				0.5	0.15	1	<5
40			25	25	15	15	10	10	0.5	0.2	1	<5
41			10	30	25	15	10	10	0.4	0.1	1	<5
42			30	30	30	10			0.5	0.15	1	<5
43			75	20	5				0.56	0.25	1	5-8
44			30	30	30	10			0.6	0.2	1	<5
45			15	10	25	20	5	20	0.5	0.2	1	<5
46			5	5	15	40	25	10	0.5	0.2	1	<5
47			20	20	20	20	10	10	0.25	0.4	1	<5
48				20	20	20	20	20	0.4	0.1	1	<5
49			5	10	35	30	15	5	0.5	0.2	1	<5
50					40	20		40	0.4	0.25	1	<5

Sample/ Photo No	OS Grid ref.	Bedrock	Boulders >256mm	Cobbles 65–256mm	Pebbles 4 – 64mm	Gravel 2 – 4mm	Coarse sand 0.5 – 2mm	Fine sand/silt/ peat	Av. Wetted Width (m)	Av. Depth (m)	Turbidity (1 [clear]-3[turbid])	Gradient (%)
51						5		95	0.5	0.5	1	<5
52								100	0.3	0.1	1	<5
53					75	20		5	0.4	0.05	1	<5
54						10		90	0.4	0.2	1	<5
55								100	0.5	0.15	1	<5
67					25	25		50	0.9	0.25	2	<5
68			15	10	25	25		25	0.75	0.2	2	<5
69			30	10	20	20		20	1	0.3	2	5-10
70			20	20				60	0.5	0.2	2	<5
71			25	25	25			25	0.75	0.6	2	<5
72								100	0.4	0.15	1	<5
73				5	5			90	0.2	0.5	1	<5
74								100	No defined channel	No defined channel	2	5
79								100	0.1	0.2	1	5

Annex 2: Photographic Plates

Sample Point 9	Sample Point 10
	

Sample Point 12	Sample Point 13
	

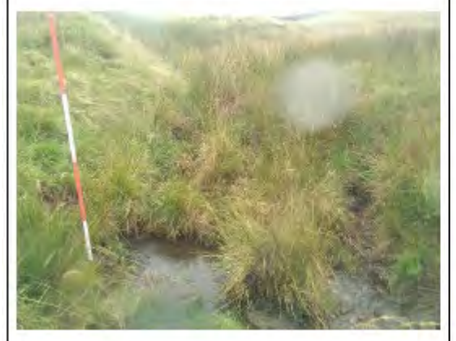
Un-named ditches discharging to Burn Treble

Sample Point 3	Sample Point 6
	

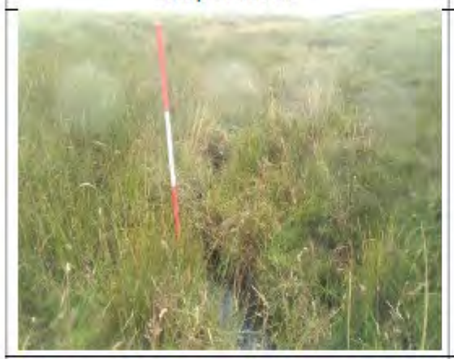
Green Burn headwaters

Sample Point 23	Sample Point 21
	

Sample Point 19	Sample Point 18
	

Sample Point 17	Sample Point 16
	

Sample Point 15



Sample Point 41

Sample Point 42

Sample Point 37

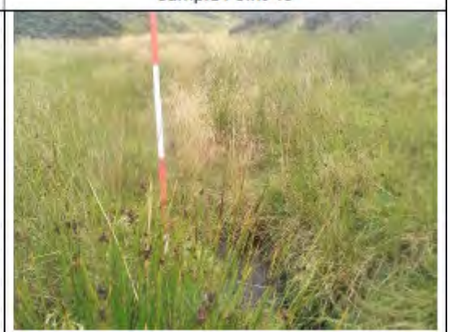
Sample Point 38

Sample Point 43

Sample Point 44

Sample Point 39

Sample Point 40



Sample Point 45

Sample Point 46

Sample Point 47

Sample Point 48

Sample Point 49

Sample Point 50

Sample Point 51

Sample Point 52

Sample Point 53

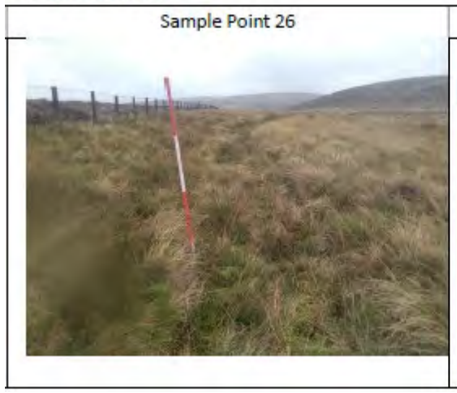
Sample Point 54

Sample Point 55

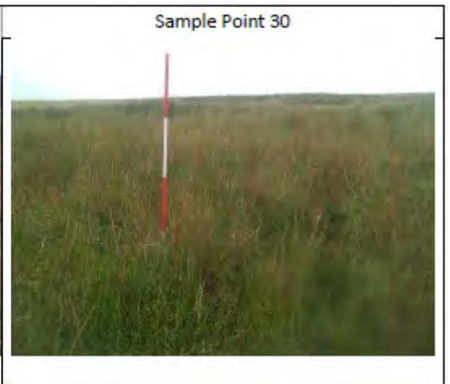
Sample Point 56

Burn of Succouth

Sample Point 26



Sample Point 30



Sample Point 36

Linn Burn

Sample Point 67

Sample Point 68

Sample Point 69

Sample Point 70

Sample Point 71

Sample Point 72

Sample Point 73

Sample Point 74

Sample Point 75

Sample Point 79

Sample Point 80

Sample Point 83

Sample Point 93

Sample Point 94

Sample Point 86

Sample Point 62

Sample Point 66

Sample Point 89

Sample Point 90

Tammie's Burn

Sample Point 99

Sample Point 103

Chapel Burn

Sample Point 112	Sample Point 111
	

Sample Point 110	
	

TA 7.5: Outline Habitat Management Plan

Craig Watch Wind Farm

Technical Appendix 7.5: Outline Habitat Management Plan

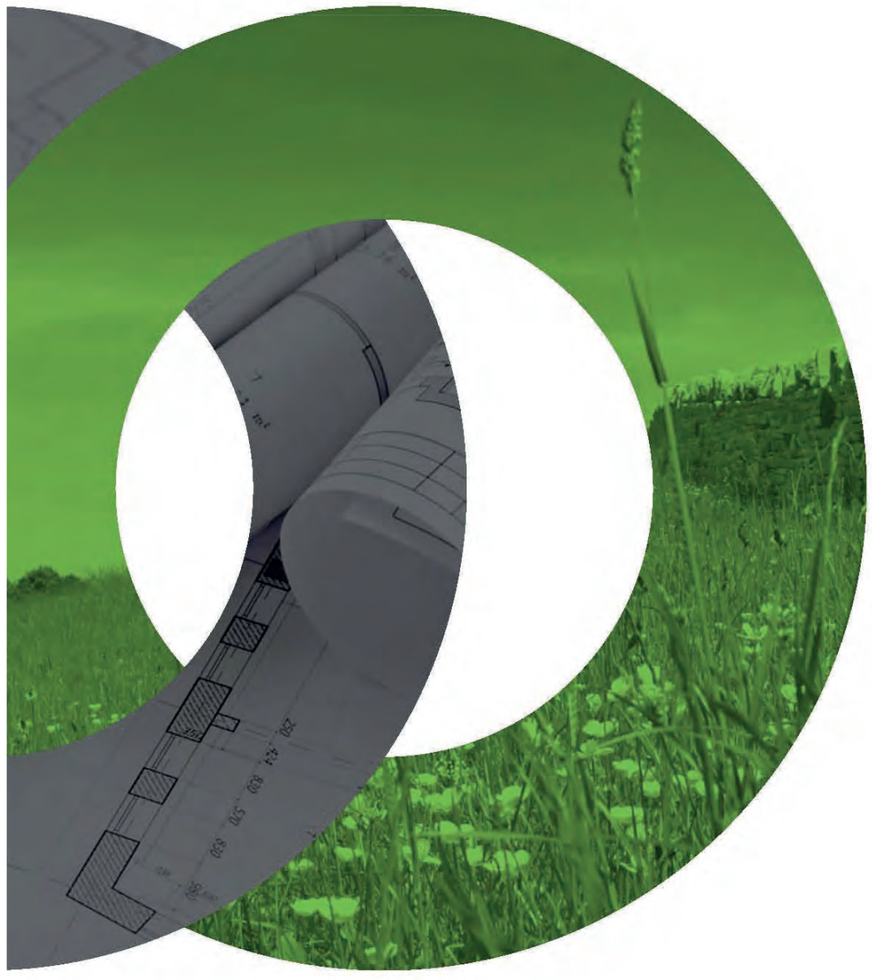


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Figure 7.5.1: Site and Proposed Habitat Management Areas

1 INTRODUCTION

1.1.1 This Technical Appendix has been prepared as part of the Proposed Development Environmental Impact Assessment Report (EIAR).

1.1.2 It presents outline habitat management plan principles to be finalised in consultation with NatureScot, Moray Council (MC), Aberdeenshire Council (AC) and additional relevant stakeholders following receipt of planning consent. This would be implemented as a Habitat Management Plan (HMP) in accordance with a suitably worded planning condition.

1.1.3 The HMP will be agreed pre-construction subject to an appropriate planning condition, with detailed methods and locations for peatland restoration and tree planting to be agreed during the construction phase, and to be implemented during construction and in the first year of operation of the Proposed Development. The HMP would remain in place as agreed over the operational lifetime of the Proposed Development, subject to adaptive management where required.

1.1.4 The HMP presents outline measures to enhance habitats within the Site which would benefit the following: habitats, fisheries, terrestrial mammals, birds, invertebrates, reptiles and amphibians.

1.1.5 The Site covers an area of approximately 1,074 hectares (ha), and is located on land on the border of Morayshire and Aberdeenshire.

1.2 Aims and Objectives

1.2.1 There are five proposed aims and related objectives of the Craig Watch Wind Farm HMP, to be achieved through the implementation of habitat management measures and habitat creation practices outlined herein. These are as follows:

- Aim 1: Enhancement of moorland habitats;
- Aim 2: Enhancement of fisheries habitats;
- Aim 3: Enhancement of opportunities for black grouse;
- Aim 4: Enhancement opportunities for common gull; and
- Aim 5: Enhancement of opportunities for wildcat and otter.

1.2.2 The success of habitat management measures and habitat creation in achieving the aims and objectives of the HMP would be monitored, with the results reported, in accordance with timings and protocols to be agreed with NatureScot, MC, AC and other relevant stakeholders.

1.2.3 The HMP should be read in conjunction with **Technical Appendix 2.4** (Outline Peat Management Plan) and **Technical Appendix 2.6** (Forestry). The combined aims of the three documents are to preserve and enhance notable habitats and forestry and provide compensatory woodland planting within the Site in a way which is sensitive to other Site-specific ecological and ornithological interests.

1.2.4 It is proposed that the aims, objectives and habitat management measures outlined herein would be further refined and prescribed in consultation with MC and AC (and other relevant stakeholders) following pre-construction baseline surveys (if required), and/ or Site investigation works as necessary.

1.3 Site Location

1.3.1 The Site is located approximately 8 km south east of Dufftown and 11.9 km south west of Huntly, on the border of Morayshire and Aberdeenshire.

1.4 Current Site Conditions

1.4.1 The dominant habitat type on-site is commercial coniferous forestry, mainly comprising Sitka spruce *Picea sitchensis*, with some clear-fell in the north east. Open habitats are typically concentrated in the south of the Site and comprise improved grassland, acid dry dwarf shrub heath and semi-improved acid grassland. The improved grassland is currently sheep-grazed which has a low herb diversity and is dominated by perennial rye-grass *Lolium perenne*.

1.4.2 Bog habitats are found predominantly in the centre of the Site (south of the commercial forestry) and along the western edge of the commercial forestry areas. Marshy grassland occurs mainly alongside watercourses on-site and wet heath is found within damp forest rides and clearings within the Site. Blanket bog dominates Craig Watch Hill, while dry modified bog is associated with the slopes of Garbet Hill. The modified bog has been subjected to drainage, grazing and heather mowing/ burning, on peat of variable depths.

1.5 Implementation

1.5.1 The HMP would be implemented prior to the end of the first year of operation of the Proposed Development.

1.5.2 Responsibility for the finalisation and implementation of the HMP would be borne by the Developer and/ or Operator of the Craig Watch Wind Farm, as consented, and/ or any subsequent Developer and/ or Operator with works associated with the implementation of the HMP also undertaken by the Developer and/ or Operator, or by their appointed agents.

1.5.3 The Developer and/ or Operator of the Craig Watch Wind Farm would be responsible for the cost of implementing the HMP; including the cost of carrying out any monitoring, except where otherwise specified or agreed with the Steering Group and Review Committee (SGRC).

1.6 Steering Group and Review Committee

1.6.1 An SGRC would be established prior to the finalisation of the HMP to agree to the effectiveness of prescribed management measures and monitoring techniques, oversee the implementation of the HMP, monitoring results and recommendations for any amendments to the HMP.

1.6.2 For the first five years of implementation, the steering group would meet or correspond at least annually.

1.6.3 The following bodies would be invited to form part of the steering group and review committee:

- The Owners of the Proposed Development;
- The Landowners (or their representatives);
- Independent ecologist appointed by the Owner(s);
- NatureScot;
- SEPA;

- Scottish Forestry;
- Moray Council and Aberdeenshire Council;
- River Deveron District Salmon Fishery Board;
- Deveron, Bogie, and Isla Rivers Charitable Trust.

2 AIMS AND OBJECTIVES

2.1 Approach to HMP

2.1.1 The Proposed Development infrastructure layout has been designed to minimise potentially significant effects on sensitive ecological and ornithological features and peat reserves. A description of the Proposed Development is given in Chapter 2: Development Description.

2.1.2 Opportunities for restoration and enhancement of peatland has been identified which in turn enhances the biodiversity, flood storage and carbon sequestration/ storage of the Site.

2.1.3 No ditch blocking would be undertaken where there is a risk of obstruction of fish movements.

2.1.4 Where habitat management measures (dam creation) or other operations may result in impacts on protected species or habitats, protective measures will be implemented as follows:

- Habitat Specific Protection Plans (HSPPs) detailing good practice measures for construction works within heath and blanket bog habitats. HSPPs would detail measures required to manage construction works within these sensitive habitats and include habitat restoration measures; and
- Species Protection Plans (SPPs) for protected species so as to ensure all works are completed in accordance with relevant legislative requirements. Where necessary, derogation licences would be obtained from NatureScot.

2.1.5 The aims, objectives and habitat management measures outlined herein would be further refined and prescribed through detailed site investigation work and further consultation with the SGRC.

Hen Harrier

2.1.6 **Technical Appendix 2.6**: Forestry presents the proposed felling activities required to facilitate the construction of the Proposed Development. Forestry removal measures would comprise key-holing in the north and east of the Site.

2.1.7 Where felling is proposed, replacement tree planting would be undertaken but would maintain a 96 m unplanted buffer around each turbine. This is required to prevent potentially significant effects on bats as outlined in Chapter 7: Ecology.

2.1.8 Felled areas, however, have the potential to be used by hen harrier *Circus cyaneus* primarily for nesting. These habitats therefore need to be managed in order to discourage use by this species. If encouraged into the key-holed area, there is the risk that hen harriers would collide with turbine blades (most notably in the breeding season during display flights).

2.1.9 A breeding pair of hen harriers was recorded in open habitats close to the Site. Following NatureScot guidance (SNH, 2016[1]), retaining a short sward (≤30 cm) of vegetation is the main measure to discourage hen harriers from nesting and foraging within key-holed areas. This would include the cutting back of vegetation including grasses, heather *Calluna vulgaris*, bracken *Pteridium aquilinum* and rushes which may otherwise encourage nesting hen harriers.

2.1.10 Some of the enhancement measures proposed in this OHMP in other parts of the Site are expected to attract hen harrier, thus providing alternative habitats for the species. This would further reduce the likely incidence of hen harriers using these key-holed areas. Forestry management measures would also be considered to deter hen harriers from key-holed areas with all restocked areas within 500 m of key-holed areas for turbines, re-planted to increase forest cover. This is prudent, as forestry as it ages become unsuitable for hen harriers.

2.2 Aim 1: Enhancement of Moorland Habitats

Objective 1: Promote Improved Structural Diversity of Wet Heath and Blanket Bog

2.2.1 Objective 1 would complement the Outline Peat Management Plan (**Technical Appendix 2.4**) and mitigation commitments made in Chapter 9: Hydrology, Hydrogeology and Geology in relation to using excavated soil and peat in Site restoration and rehabilitation at the end of the construction period. Vegetation cover would be re-established as quickly as possible on track and infrastructure verges and cut slopes by re-laying excavated peat acrotelm. This is intended to improve slope stability and provide erosion protection. Additional methods, including hydroseeding and/ or use of a biodegradable geotextile, would be considered if necessary in specific areas. For further details on habitat restoration after construction, see the Outline Construction Environmental Management Plan (OCEMP), in **Technical Appendix 2.1**.

2.2.2 As detailed in the Outline Peat Management Plan (**Technical Appendix 2.4**), it is assumed that ditch backfilling and reinstatement of historic peat cutting, ploughed furrow and de-stumped areas could be subject to backfilling with peat, along with improvements to other areas of degraded or existing peatland as part of habitat management and restoration.

2.2.3 Opportunities for habitat improvement in proposed habitat enhancement areas to be considered include the following:

- reinstatement of peat turves and vegetated peat divots;
- use of mulches or heather brash or occasionally a biodegradable geotextile, like jute and re-seeding to protect areas of bare peat from further erosion;
- management of grazing by livestock in sensitive areas;
- re-profiling of peat hags, and hydroseeding if necessary and appropriate; and
- ditch-blocking to promote re-wetting where this is appropriate and does not interfere with operational activities of the Proposed Development or forestry operations.

2.2.4 It is anticipated that habitat restoration plans would result in the improvement of peat bog habitats covering an area likely to be in excess of those peat habitats to be directly lost as a result of the Proposed Development.

[1] SNH (2016) Wind farm proposals on afforested sites – advice on reducing suitability for hen harrier, merlin and short-eared owl. January, 2016.

2.2.5 The success of the habitat improvement and peat restoration activities would be monitored on a regular basis for an ongoing period during the operational phase of the Proposed Development. The details would be included in the HMP to be agreed with the SGRC.

2.2.6 Areas identified for enhancement, particularly where drain blocking is proposed, would be subject to investigation survey and assessment by suitably qualified hydrologists and ecologists and agreed with the landowner(s) and MC and AC (if required) to ensure water levels are not unexpectedly raised, or lowered, elsewhere within and outside the Site.

2.2.7 Areas suitable for peatland habitat improvement and restoration works have been identified as four distinct areas as shown (Areas 1, 3, 4, & 5) in **Figure 7.5.1**.

2.2.8 The Site is currently primarily grazed by sheep (and also cattle) and wild deer. It is proposed that livestock grazing within the Site and access for deer would continue throughout the operational lifetime of the Proposed Development and as such, habitat management principles to be further detailed and implemented would comprise a sensitive grazing regime (which would include maintaining the number of livestock at an optimal level for the habitat type, to avoid overgrazing and excessive poaching). Grazing densities would be managed within all management areas (see **Figure 7.5.1**), to prevent overgrazing and encourage and maintain a good overall Site condition.

2.2.9 Targeted deer management is not proposed as part of the HMP, and it is assumed that wild deer would be managed on-site as per the existing situation whilst the Proposed Development is operational. As part of the monitoring (see section 3) grazing levels would be checked over the course of the operation of the Proposed Development to ensure that grazing pressure is appropriate for the habitat enhancement goals. In the event that grazing pressure is considered to be too high, livestock levels (and deer management protocols) would be reviewed and discussed with the landowner(s) so that appropriate action is taken as necessary (this could include reducing stocking levels through limiting the number of livestock in sensitive areas and/ or increasing deer management measures).

Objective 2: Enhance Breeding and Foraging Habitat for Wetland Birds

2.2.10 The enhancement of moorland habitats and measures detailed above in Objective 1 would benefit ground-nesting species such as curlew and lapwing, and provide foraging opportunities for these species as well as waterfowl, such as teal.

2.3 Aim 2: Enhancement of Fisheries Habitats

Objective 1: Management of Fish Cover

2.3.1 Baseline surveys undertaken as part of the ecology assessment (Chapter 7) did not identify any high calibre salmonid spawning habitat within the Site. Functional fish habitat was restricted to downstream sections of Green Burn and Linn Burn, which are considered to be of low sensitivity due to the short extent of low quality habitat recorded.

2.3.2 The un-named burn which flows through Area 1 (see **Figure 7.5.1**) to Ballochford has been identified as a potentially suitable watercourse for undertaking riparian native-tree planting.

2.3.3 Tree planting would improve areas of shelter for wildlife using the watercourses, including invertebrates and any fish, and would improve connectivity in the south of the Site for other species such as foraging/ commuting bats and otter.

2.3.4 Tree species to be planted along the riparian zone would be those that are of local provenance and these include ash *Fraxinus excelsior*, aspen *Populus tremula*, alder *Alnus glutinosa*, rowan *Sorbus aucuparia*, birch *Betula* sp., sycamore *Acer pseudoplatanus* and beech *Fagus sylvatica*, and some coniferous species (see Aim 3).

2.3.5 Given the livestock grazing in the south of the Site, it is proposed that these trees would be planted with biodegradable tree guards for protection.

2.3.6 Areas for planting would be subject to surveys and assessments by suitably qualified ecologists and a forestry specialist to ensure the most appropriate stretches of watercourses are chosen. For example, those areas with little or no tree cover would be selected whilst avoiding any areas of deeper peat.

2.3.7 Measures for improving and/ or creating further fish cover would be explored and would comprise techniques such as placing boulders and wood debris in watercourse channels, which whilst providing refugia for both juvenile and adult fish, can also provide opportunities for macroinvertebrates.

2.3.8 The potential for restoration and/ or creation of spawning habitats would also be explored.

2.3.9 A Fisheries Management Plan (FMP) would be produced to accompany the HMP to detail proposed monitoring of watercourses and fish populations within the Site, to ensure fish on, and adjacent to, the Site are protected during all phases of the Proposed Development.

2.3.10 Opportunities to enhance and/ or create fish habitats by way of the creation of fish cover and riparian planting would be identified in consultation with the River Deveron District Salmon Fishery Board (RDDSFB) and the Deveron, Bogie and Isla Rivers Charitable Trust (DBIRCT).

2.3.11 Habitat management measures for inclusion within the HMP would then be agreed with NatureScot, MC, AC and other relevant stakeholders.

2.4 Aim 3: Enhancement of Opportunities for Black Grouse

2.4.1 An objective of the riparian planting (Area 1 on **Figure 7.5.1**) would be to enhance terrestrial biodiversity with woodland and edge habitat suitable for species, including for black grouse *Tetrao tetrix*.

Objective 1: Enhancing Shelter and Foraging

2.4.2 Riparian planting to be prescribed would include both continuous and discontinuous shrub and tree dominated planting. Discontinuous areas of planting would ensure that extensive shading of existing food plants (e.g. grasses and bilberry *Vaccininum myrtillus*, where present) for black grouse does not occur. Tree and shrub species planted would be selected for their preference by black grouse and would include birch, willow *Salix* species, Scots pine *Pinus sylvestris*, rowan and juniper *Juniperus communis*.

2.4.3 Such species would provide additional food sources for black grouse in the spring and winter, together with suitable cover from predation for both adults and broods.

2.5 Aim 4: Enhancement of Opportunities for Common Gull

2.5.1 Kelman Hill has been identified, during baseline surveys, as a heavily used area for foraging common gull *Larus canus* from the Tips of Corsemaul and Tom Mor Special Protection Area (SPA) and Site of Special Scientific Interest (SSSI).

2.5.2 All tree planting proposed (see Aim 2, and also compensatory planting proposed, see Technical Appendix 2.6) has been sensitively located, so that tree cover is not likely to adversely affect foraging gulls using Kelman Hill.

Objective 1: Enhance Foraging Habitat

2.5.3 An objective to manage grassland/ heathland on Kelman Hill for foraging common gulls is proposed (Area 2 on **Figure 7.5.1**). This would include the adoption of a sensitive grazing regime to minimise

overgrazing on the hill, while maximising the benefits that grazing brings[2]. Other management measures would also be considered including heather and scrub removal on Kelman Hill if establishment of these plants are deemed a threat to the integrity of the optimal foraging grassland habitat.

Objective 2: Predator Control

2.5.4 It has been identified that along with the implementation of sensitive grazing regimes, predator control would benefit common gulls using the SPA/SSSI (see SNH, 2011[3]). This is likely to include corvids and possibly mammals, such as fox *Vulpes vulpes*, although it is understood that evidence of mammal predation at the gull colony is relatively limited.

2.5.5 It is proposed that consultation with NatureScot, MC, AC and other relevant stakeholders is carried out regarding proposals for predator control measures. This is to minimise adverse effects on common gulls from the SPA/ SSSI on and close to, the Site, during the lifespan of the Proposed Development as well as to protect gulls nesting on the colony but also foraging gulls within the Site.

Objective 3: Common Gull Monitoring

2.5.6 During operation of the Proposed Development, monitoring of common gulls on and adjacent to the Site is proposed (see section 4). Given the Site is used by foraging gulls (and not for nesting), it is proposed that gull foraging surveys are carried out during the breeding season (between April and August). This would principally be to survey gull use of Kelman Hill and any other areas on-site, which would help determine the effectiveness of habitat enhancement measures (summarised in section 2.5.3). The methodology and frequency of these surveys would be agreed through consultation with NatureScot and other relevant stakeholders such as the RSPB.

2.5.7 The results of monitoring would be shared with NatureScot to assist in their principal objective for management of the SPA/ SSSI (SNH, 2011) which reads:

"We wish to work with the owners and occupiers to protect the site and to maintain and where necessary enhance its features of special interest. SNH (now NatureScot) aims to carry out site survey, monitoring and research as appropriate, to increase our knowledge and understanding of the site and its natural features".

2.6 Aim 5: Enhancement of Opportunities for Wildcat and Otter

2.6.1 The Site falls at the outer limit of the Strathbogie Scottish Wildcat Priority Area. Furthermore, a wildcat *Felis silvestris* (or hybrid cat) was recorded to the east of the commercial forestry on-site during baseline surveys.

Objective 1: Enhancing Shelter and Foraging

2.6.2 Wildcat prefer mosaic habitat comprising woodland and more open habitats such as grassland and heathland. The riparian tree planting proposed in Area 1 (see **Figure7.5. 1**) would provide shelter and cover for wildcat. The enhancement of moorland habitats would improve habitat for prey species of wildcat such as ground-nesting passerines and thus improve foraging opportunities for the species. Scrub habitat within the commercial forestry on-site would be retained, where possible, to provide shelter for wildcat and other wildlife. Providing structural diversity within the conifer plantation

[2] Common gulls typically prefer foraging on low sward height vegetation, and droppings from livestock will encourage invertebrates which gulls may feed on.
[3] SNH (2011) Tips of Corsemaul and Tom Mor Site of Special Scientific Interest. Site Management Statement. Site Code 1706.

(including within the management of those areas identified for compensatory planting) via mixed planting and different aged coupes would also be beneficial for wildcat.

Objective 2: Creating Potential Den Sites

2.6.3 Den opportunities on-site for wildcat are limited, based on information gathered during baseline surveys. Therefore, the opportunity to create potentially suitable den sites for wildcat would be explored further and would include creating a small number of hibernacula style piles of waste material from the construction of the Proposed Development, including tree debris and rubble/ large rocks. The placement of these habitat piles would be targeted at the forest edge and would be located in the north and west of the Site. This is so as not to be in close proximity to Kelman Hill which may otherwise compromise the enhancement measures for foraging common gull on Kelman Hill given common gulls could be a prey species for wildcat.

2.6.4 It is proposed that wildcat enhancement measures would be developed in consultation with NatureScot and 'Saving Wildcats' (who have superseded 'Scottish Wildcat Action' (SWA)).

2.6.5 Enhancement opportunities for wildcat would also benefit otter, which is likely to benefit from riparian planting providing shelter and cover, and through the creation of den opportunities where these are in close proximity to watercourses.

2.7 Restricted Operations within HMP Areas

2.7.1 The following operations would be prohibited within the HMP areas:

- clearing of existing ditches and watercourses;
- application of any insecticides, fungicides or molluscicides;
- application of lime or any other substance to alter the soil acidity;
- cutting or topping vegetation except to control injurious weed species;
- burning of vegetation or other materials;
- use of roll or chain-harrow;
- carrying out any earth moving activities;
- use for off-road vehicles;
- construction of tracks, roads, yards, hard standing or other structures; and
- storage of materials of machinery.

3 MONITORING

3.1.1 A monitoring programme would be established and agreed in consultation with NatureScot, MC, AC and other relevant stakeholders. This would check compliance of habitat management measures implemented along with monitoring the effectiveness of such measures.

3.1.2 Monitoring is proposed as part of the HMP in operational years 3, 5, 10 and 15 of the Proposed Development and would consist of checks of the habitat enhancement measures detailed in this Technical Appendix (as well as monitoring of common gulls as summarised in section 2.5). This monitoring schedule may be refined as appropriate as the final HMP is agreed. The Developer would

provide a summary of the HMP activities and monitoring results to NatureScot, MC and AC each year of monitoring. The frequency of monitoring and reporting thereafter would be agreed with key stakeholders.

3.1.3 The HMP is intended to remain a live document which would be updated and amended as necessary, based on results of Site investigation works and monitoring. NatureScot, MC and AC would be kept informed of any proposed changes to the HMP and their agreement sought as necessary as part of the SGRC.

3.1.4 The requirement for any updated baseline surveys to act as Year 0 for monitoring purposes would also be identified and undertaken at the appropriate time (such as, within the first year of operation of the Proposed Development and during the growing/ breeding season March to August, inclusive).

4 PROPOSED HABITAT MANAGEMENT PLAN AREAS

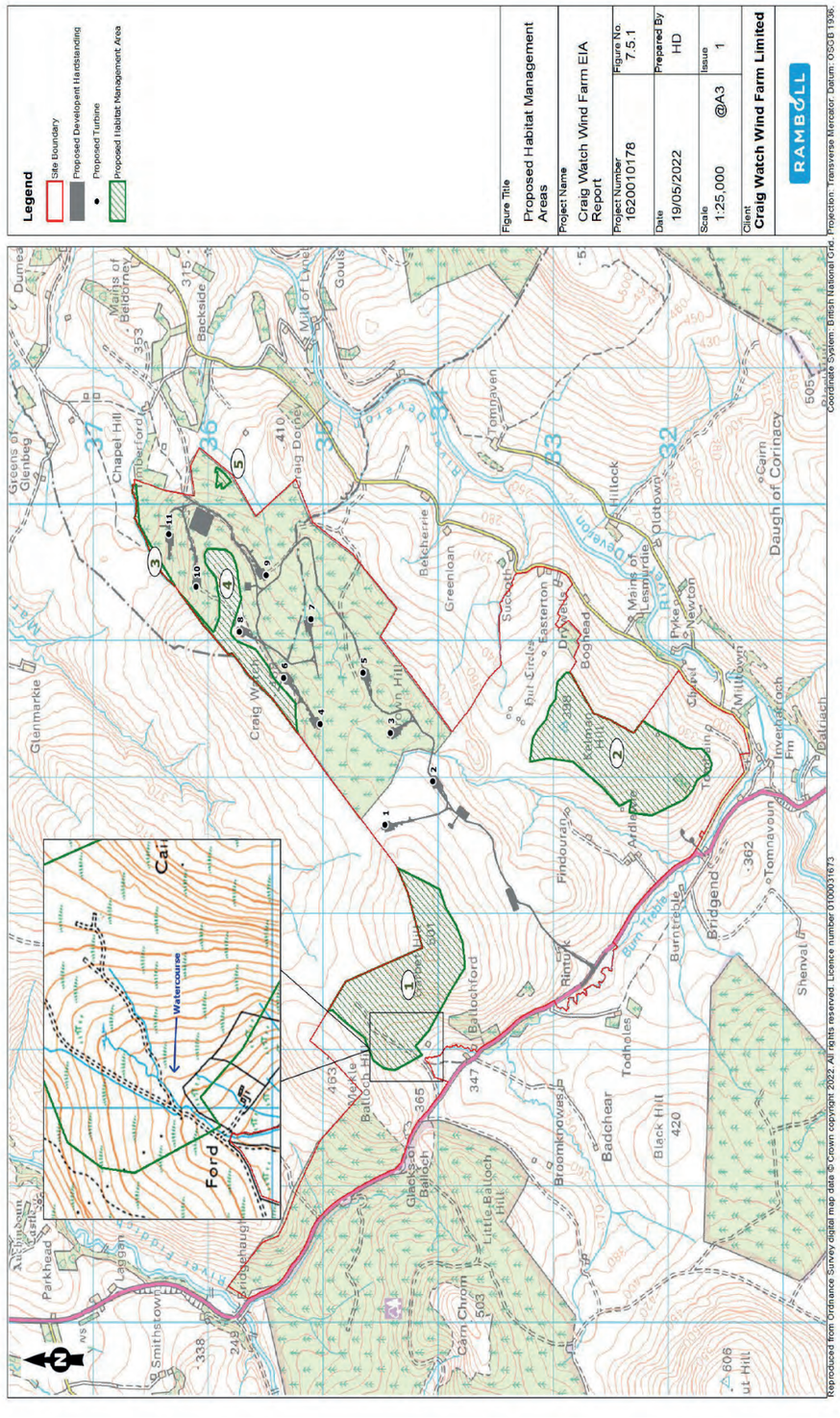
4.1.1 The proposed habitat management plan areas which address the aims listed in Section 2 are as follows:

- Area 1 – peat restoration and riparian planting. This could involve re-wetting/ possibly ditch blocking if appropriate. Sensitive grazing regime in place, reseeding bare areas to promote vegetation growth to protect and protect against erosion, reinstate/ re-profile peat. Riparian planting along watercourse flowing through Area 1 would consist of planting principally broad-leaved trees. Planting would be a mixture of continuous and discontinuous, to maximise benefits to wildlife.

- Area 2 – grassland/ heathland management. Important area for foraging common gull from SPA so manage to encourage continued use. Sensitive grazing regime, heather/ scrub removal (when required) to maintain a short grassy sward which is optimal for foraging gulls.

- Area 3, 4 & 5 – peat restoration. This could involve re-wetting/ possibly ditch blocking. Sensitive grazing regime in place, reseeding bare areas to promote vegetation growth to protect versus erosion, reinstate/ re-profile peat.

FIGURE 7.5.1: SITE AND PROPOSED HABITAT ENHANCEMENT AREAS



Technical Appendix 8: Ornithology

TA 8.1: Ornithology

TA 8.2: Collision Risk Model Analysis

TA 8.1: Ornithology

Craig Watch Wind Farm

Technical Appendix 8.1: Ornithology

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ANNEXES

1 INTRODUCTION

1.1.1 This Technical Appendix has been prepared to accompany **Chapter 8: Ornithology** of the Craig Watch Wind Farm ('the Proposed Development') Environmental Impact Assessment (EIA) Report.

1.1.2 It presents detailed methodologies and results of ornithology desk studies and field surveys to inform the design and assessment of the Proposed Development.

1.1.3 It should be read with reference to the following Figures, which are included within **Volume 3a** of the EIA Report:

- **Figure 8.1**: Ornithological Statutory Designated Sites;
- **Figure 8.2a:** Desk Study Records;
- **Figures 8.3a-c**: Vantage Point and Viewshed Location Plans;
- **Figures 8.4a-b**: Breeding Bird Survey Plans;
- **Figures 8.5a-f**: Target Species Flights;
- **Figures 8.6-b**: Moorland Breeding Bird Survey Results; and
- **Figure 8.7a**: Breeding Raptor and Owl Survey Results (Year 1).

1.1.4 Only common bird species names are referred to within the main text of this Technical Appendix. **Annex 1** provides a summary of all bird species referred to herein, within **Chapter 8: Ornithology** and all other associated Technical Appendices in **Volume 4** and the Figures in **Volume 3a**. Both common and species names together with a summary of their conservation status as relevant is provided.

1.1.5 Collision mortality risk analysis is provided separately in **Technical Appendix 8.2** in **Volume 4**.

1.1.6 Information pertaining to the locations of sensitive breeding bird species and which are considered confidential is provided in **Confidential Ornithology Technical Appendix 8.3** in **Volume 5**.

1.1.7 The following confidential Figures are provided in **Volume 5** of the EIA Report:

- **Figure 8.2b**: Confidential Desk Study Records;
- **Figures 8.7b-c**: Confidential Breeding Raptor and Owl Survey Results; and
- **Figures 8.8a-b**: Confidential Woodland Grouse Lek Results.

1.1.8 Such information will not be made publically available, but will be provided to the Scottish Government and NatureScot.

1.2 Site Overview

1.2.1 The proposed site ('the Site') covers an area of approximately 1,121 hectares (ha), and is located on land approximately 8 km south east of Dufftown, Moray in Scotland. The Site straddles two local authority boundaries: Aberdeenshire Council and Moray Council. Much of the Site is dominated by semi-mature coniferous plantation woodland, with some underlying marshy grassland and wet heath. Open areas of blanket bog and dry modified bog are located in the south western portion and around the slopes of Craig Watch. A mosaic of wet and dry heath, acid, improved and marshy grassland is located along the south-western and south-eastern corners.

1.2.2 There are a number of named hills within the Site, including Craig Watch and Kelman Hill. A small number of watercourses also intersects the Site, and the watercourses predominantly comprise the headwaters of the River Deveron, which passes to the east of the Site.

1.3 Key Guidance

1.3.1 Ornithology survey methodologies and subsequent interpretation of results has made reference to the following key industry standard guidance:

- Brown, A.F. & Shepherd, K.B. (1993). A method for censusing upland breeding waders. *Bird Study* 40, 189-195.
- NatureScot (SNH, 2017). *Recommended bird survey methods to inform impact assessment of onshore wind farms.* Version 2. March 2017.
- Hardey, J., Crick, H., Wernham, C., Riley, H., Etheridge, B. & Thompson, D. (2013). *Raptors: a field guide to survey and monitoring.* Third Edition. The Stationary Office, Edinburgh.
- Gilbert, G., Gibbons, D.W. & Evans, J. (1998). *Bird monitoring methods.* A manual of techniques for key UK species. RSPB, Sandy, Bedfordshire.
- Stanbury, A., Eaton, M., Aebischer, N., Balmber, D., Brown, A., Douse, A., Lindley, P., McCulloch, N., Noble, D. and Win, I. (2021) The status of our bird populations: the fifth Birds of Conservation Concern in the United Kingdom, Channel Islands and the Isle of Man and second IUCN Red List assessment of extinction risk for Great Britain. *British Birds* 114: 723-747.
- NatureScot (SNH, 2000). *Windfarms and Birds – Calculating a theoretical collision risk assuming no avoiding action*. SNH Guidance Note.
- NatureScot (SNH, 2018). *Assessing significance of impacts from onshore wind farm outwith designated* areas. Guidance. Version 2 – February 2018.
- NatureScot (SNH, 2016). *Assessing connectivity with Special Protection Areas (SPAs).* Guidance. Verison 3 – June 2016.

1.4 Target Species

1.4.1 Target species for survey and recording were identified through desk study and consultation with NatureScot (see **Chapter 8: Ornithology**), on the basis of their known or likely presence, their likely sensitivity to the Proposed Development and those which are afforded a higher level of legislative protection, which is in accordance with current NatureScot guidance (SNH, 2017[1] and 2018[2]).

1.4.2 Primarily, target species included:

- Those listed on Annex 1 of the EC Birds Directive (2009/147/EC);

[1] NatureScot (SNH, 2017). *Recommended bird survey methods to inform impact assessment of onshore wind farms.* Version 2. March 2017.

[2] NatureScot (SNH, 2018). *Assessing significance of impacts from onshore wind farm outwith designated* areas. Guidance. Version 2 – February 2018.

- Those listed on Schedule 1 of the Wildlife and Countryside Act 1981 (Amendment) (Scotland) Regulations 2001;
- Black grouse;
- Wetland birds, including geese, duck, waders and waterfowl (but excluding feral, and non-native species and mallard); and
- Common gull.

1.4.3 This has ensured inclusion of qualifying interests of designated sites for nature conservation (**Table 3.1**) and target species that should be considered in the development of onshore wind farms in Scotland, as per NatureScot guidance (SNH, 2017[3]).

2 METHODOLOGY

2.1 Desk Study

2.1.1 In accordance with NatureScot guidance (SNH, 2017[3]), a desk study was undertaken to ascertain an overview of likely bird populations and designated sites in proximity to the Proposed Development, in order to identify possible target species to inform the requirements for survey.

2.1.2 The desk study comprised a review of sources summarised in **Table 2.1.**

2.1.3 Existing EIA documentation related to ornithology for the refused Garbet Wind Farm (21/00020/EIA)[4] located adjacent to the north-western Site boundary were reviewed, as well as peer reviewed literature and industry guidance, which is referred to where relevant.

Table 2.1: Desk study key sources and information sought.

Key Source	Information Sought	Search Area
Sitelink	Statutory designated sites for nature conservation with qualifying ornithological interests.	Within 10 km of the Site boundary, extended to 20 km for internationally designated sites with migratory geese qualifying interests (see **Figure 8.1**).
Royal Society for Protection of Birds (RSPB)	Existing ornithological records.	Within 6 km of the approximate Site centre (NJ 38300 34705), extended to 10 km for eagles (see **Figure 8.2a**).
North East Scotland Raptor Study Group (NESRSG)	Existing records of scarce breeding and roosting raptors and owls.	Within 2 km of the approximate Site centre (NJ 38300 34705), extended to 6 km for eagles (see **Figure 8.2a**).
North East Scotland Biological Records Centre (NESBReC)	Non-statutory designated sites for nature conservation with qualifying ornithological interests, and existing ornithological records.	Within 5 km and 10 km respectively for non-statutory sites and ornithological records of the approximate Site centre (NJ 38300 34705) (see **Figure 8.2a**).

[3] NatureScot (SNH, 2017). *Recommended bird survey methods to inform impact assessment of onshore wind farms.* Version 2. March 2017.
[4] As of 07/02/2022 'at appeal'.

2.2 Field Surveys

2.2.1 Field survey effort and methodologies were agreed with NatureScot prior to commencement (see **Chapter 8: Ornithology)**, in order to assess the potential effects of the Proposed Development upon ornithological features. Furthermore consultation with NatureScot on completion of Year 1 ornithology surveys confirmed that a second full year of ornithology surveys would not be required, and instead these could be restricted to surveys during the breeding bird season (March to August) in Year 2 (see **Chapter 8: Ornithology**).

2.2.2 Detailed knowledge of bird populations, distributions and flight activity has been derived from field surveys undertaken between 2019 and 2020.

2.2.3 Field surveyor knowledge and experience of bird habitat associations at comparable sites has also informed and guided survey effort over the course of surveys.

2.3 Field Survey Personnel

2.3.1 All field surveys have been completed by experienced and professional ornithologists named in **Annex 3**; all of whom are all fully conversant in recognised bird survey methodologies for wind turbine developments.

2.4 Methodologies

2.4.1 The following ornithology field surveys were completed:

- Vantage Point (VP) flight activity surveys (March 2019 to August 2020);
- Moorland breeding bird survey (MBBS) (2019 and 2020);
- Breeding Annex 1/Schedule 1 raptor and owl searches (2019 and 2020); and
- Breeding woodland grouse searches (2019 and 2020).

VP Flight Activity Surveys

2.4.2 VP flight activity surveys were undertaken between March 2019 and August 2020, providing coverage of two consecutive breeding seasons (March to August) and one non-breeding season (September to February).

<u>VP Locations and Viewsheds</u>

2.4.3 In Year 1 (March 2019 to February 2020) the extent of the Site boundary was greater than the final Site, and during these surveys four vantage points (VPs) were required to provide maximum coverage of the VP Study Area (defined as a 500 m buffer around the outermost Proposed Development turbines; in accordance with NatureScot guidance (SNH,2017[5])).

2.4.4 Furthermore, access issues meant that VP2 was moved to a new location on completion of the Year 1 breeding bird season surveys (in August 2019), with the new location (termed VP2a) used for Year 1 non-breeding season surveys (September 2019 to February 2020). NatureScot were consulted on the

[5] NatureScot (SNH, 2017). *Recommended bird survey methods to inform impact assessment of onshore wind farms.* Version 2. March 2017.

subject of the relocation of VP2 (see **Chapter 8: Ornithology**), and were satisfied with the approach and VP viewshed coverage from VP2a.

2.4.5 The Site boundary was reduced on completion of Year 1 ornithology surveys and accordingly only two VP locations (VP1 and VP2b) were utilised to provide maximum coverage of the VP Study Area in Year 2.

2.4.6 VP locations used during the survey period, along with ground-truthed modelled areas of visible coverage within the 2 km viewsheds of VPs are shown in **Figure 8.3a-c,** and are presented within **Table 2.2**. Note, VP2a and VP2b were the same location but were orientated in a different direction so are accordingly categorised as two different VPs.

Table 2.2: VP locations.

VP	Grid reference	Orientation	Survey period used
1	NJ 38321 32944	North north west	March 2019 to August 2020
2	NJ 40410 35332	North west	March 2019 to August 2019
2a	NJ 38653 35407	East north east	September 2019 to February 2020
2b		South east	March 2020 to August 2020
3	NJ 36952 34438	North north east	March 2019 to February 2020
4	NJ 38923 36054	North	March 2019 to February 2020

VP Survey Effort

2.4.7 The total survey effort (hours) completed at each VP is summarised in **Table 2.3** and **Table 2.4**. Full details of all survey times, field surveyors used and weather conditions are presented in **Annex 3**.

2.4.8 The total VP survey effort completed in Year 1 at each VP was 84 hours. This comprised, at each VP, 48 hours during the breeding bird season period (March to August 2019), and 36 hours during the non-breeding season (September 2019 to February 2020).

2.4.9 During Year 2, 48 hours of VP surveys were undertaken during the breeding bird season period (March to August 2020), with no surveys carried out during the Year 2 non-breeding bird season (as agreed with NatureScot; see **Chapter 8: Ornithology**).

2.4.10 Survey effort during the breeding and non-breeding bird seasons met, or exceeded, the 36 hours recommended per VP (in accordance with current NatureScot guidance (SNH, 2017[6])).

2.4.11 Survey times were dispersed throughout the day and were also completed in a range of weather conditions, but always conducive to survey and safe access.

2.4.12 VP flight activity surveys commenced after a short period of "settling in", to ensure any potential disturbance to target species present within each viewshed had reasonably passed and surveyors were alert to survey following a traverse to each VP location.

[6] NatureScot (SNH, 2017). *Recommended bird survey methods to inform impact assessment of onshore wind farms.* Version 2. March 2017.

2.4.13 In accordance with current NatureScot guidance (SNH, 2017[7]), flight lines were mapped for all target species passing through the VP survey area. Details of species, number of birds, flight height in bands (at, below or above collision risk height), duration and direction were noted on standardised recording forms and field plans.

2.4.14 Surveyors were stationary until the completion of watches at the VP locations and (when the VP surveys were carried out simultaneously) were in contact to ensure flight lines of target species where they were recorded, were not duplicated.

2.4.15 Height bands (HT) were used in the field to record target species activity at, below or above collision risk height for subsequent use in the calculation of collision mortality risks. Height bands used in the field were based on a preliminary proposed turbine height, with proposed turbine heights for the Proposed Develoment considered up to 200 m tip.

2.4.16 Based on the proposed turbine height, height band HT2, HT3 and HT4 incorporate the rotor sweep:

- HT1 <20 m;
- HT2 20-50 m;
- HT3 50-180 m; and
- HT4 >180 m.

Table 2.3: VP flight activity survey effort summary (hours) – Year 1.

VP	2019										2020		Total
	Breeding Season						Non-breeding season						
	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	
1	6	9	9	9	9	6	6	6	3	9	6	6	84
2	6	9	9	6	9	9	-	-	-	-			48
2a	-	-	-	-	-	-	6	6	6	6	6	6	36
3	6	9	9	6	9	9	6	6	6	6	6	6	84
4	6	9	9	9	9	6	6	6	6	6	6	6	84

Table 2.4: VP flight activity survey effort summary (hours) – Year 2.

VP	Breeding Season						Total
	Mar	Apr	May	Jun	Jul	Aug	
1	6	9	9	9	9	6	48
2b	6	9	9	6	9	6	48

[7] NatureScot (SNH, 2017). *Recommended bird survey methods to inform impact assessment of onshore wind farms.* Version 2. March 2017.

Secondary Species

2.4.17 Secondary species were also noted in approximately 15-minute summary intervals, with the number of birds present and general behaviour recorded in order to build an overall picture of their activity. The 15-minute periods were considered appropriate to ensure surveyors were fully alert to target species activity.

2.4.18 Secondary species are defined here as commoner raptors (e.g. buzzard, kestrel and sparrowhawk), all gulls, raven, feral species and mallard, along with any large concentrations of Schedule 1 or Red-listed[8] passerines as recorded during survey.

Moorland Breeding Bird Surveys

2.4.19 Moorland breeding bird surveys (MBBSs) were undertaken in 2019 and 2020.

2.4.20 The MBBS Study Area comprised coverage of open habitats within the Site, extended to include accessible areas of open habitats within 500 m of proposed turbine locations, as shown in **Figures 8.4a** and **8.4b** and in accordance with current guidance (SNH, 2017[9]). Given the evolution of the Proposed Development design and alterations to the Site boundary, the MBBS Study Area was modestly amended in Year 2, and this is discussed in **Section 3.2 - Field Survey Limitations**. The term MBBS Study Areas is accordingly used to define these areas surveyed during the survey period.

2.4.21 The methodology employed followed the Brown and Shepherd (1993[10]) method for censusing upland breeding waders, based upon the recommendations set out in Calladine *et al*. (2009[11]) as per current guidance (SNH, 2017[12]). The methodology is suitable for moorland and open country species including, waders, skuas, gulls and some wildfowl species however, incidental observations of any raptors, owls or notable passerines (i.e. Schedule 1 and Birds of Conservation Concern (BoCC) red-listed) are also recorded.

2.4.22 A series of four staggered visits were completed between April and July 2019 (Year 1), and between April and July 2020 (Year 2).

2.4.23 During each survey visit a pre-determined route was walked through the survey area, with all birds seen or heard, and their behaviours (e.g. displaying, carrying food etc.) mapped in the field.

2.4.24 All surveys were undertaken during daylight hours and in fine conditions conducive to survey. Survey effort for Year 1 and Year 2 is summarised in **Table 2.5**. Full details of all survey times, field surveyors used and weather conditions are presented in **Annex 3.** Given the size of the MBBS Study Area, survey visits were typically undertaken by a small team of surveyors and/or over consecutive days.

[8] Stanbury, A., Eaton, M., Aebischer, N., Balmber, D., Brown, A., Douse, A., Lindley, P., McCulloch, N., Noble, D. and Win, I. (2021) The status of our bird populations: the fifth Birds of Conservation Concern in the United Kingdom, Channel Islands and the Isle of Man and second IUCN Red List assessment of extinction risk for Great Britain. *British Birds* 114: 723-747.

[9] NatureScot (SNH, 2017). *Recommended bird survey methods to inform impact assessment of onshore wind farms.* Version 2. March 2017.

[10] Brown, A.F. & Shepherd, K.B. (1993). A method for censusing upland breeding waders. *Bird Study*, 40, 189-195.

[11] Calladine, J., Garner, G., Wernham, C. & Thiel, A. (2009). The influence of survey frequency on population estimates of moorland breeding birds. *Bird Study*, 56 (3), 381-388.

[12] NatureScot (SNH, 2017). *Recommended bird survey methods to inform impact assessment of onshore wind farms.* Version 2. March 2017.

Table 2.5: MBBS effort.

2019 (Year 1)			
Visit	**Date**	**Start Time (24hrs)**	**Finish Time (24hrs)**
1	09/04/2019 11/04/2019	08:40 08:45	14:55 12:25
2	16/05/2019 17/05/2019	08:20 08:30	14:30 15:10
3	18/06/2019 19/06/2019	09:00 08:45	15:15 12:15
4	23/07/2019	08:30	14:45
2020 (Year 2)			
Visit	**Date**	**Start Time (24hrs)**	**Finish Time (24hrs)**
1	21/04/2020 22/04/2020	08:30 08:30	13:40 14:40
2	13/05/2020	09:50	15:30
3	17/06/2020 18/06/2020	07:30 06:45	13:05 12:15
4	14/07/2020 15/07/2020	07:30 08:00	12:40 13:00

Breeding Annex 1/Schedule 1 Raptor and Owl Searches

2.4.25 Searches for Annex 1/Schedule 1 breeding raptor and owls were undertaken during the core breeding season between April and July 2019 (Year 1) and between March and July 2020 (Year 2) with reference to species-specific methodologies outlined in Hardey *et al.* (2013[13]).

2.4.26 Survey effort is summarised in **Table 2.6**. Full details of all survey times, field surveyors used and weather conditions are presented in **Annex 3**.

2.4.27 The breeding raptor and owl Study Area comprised coverage of the Site and, where access allowed, areas out to 2 km (extended to 6 km in Year 2 as a precaution for searching for evidence of eagles), and as shown in **Figures 8.4a** and **8.4b**, in accordance with current NatureScot guidance (SNH, 2017[14]). Given the evolution of the Proposed Development design and alterations to the Site boundary, the breeding raptor and owl Study Area was modestly amended in Year 2, and this is discussed in **Section 3.2 - Field Survey Limitations**. The term breeding raptor and owl Study Areas is accordingly used to define these areas surveyed during the survey period.

2.4.28 Search effort and Study Areas were also informed through a review of desk study records.

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

[14] NatureScot (SNH, 2017). *Recommended bird survey methods to inform impact assessment of onshore wind farms.* Version 2. March 2017.

Table 2.6: Breeding raptor and owl search effort summary.

2019 (Year 1)			
Visit	**Date**	**Start Time (24hrs)**	**Finish Time (24hrs)**
1	10/04/2019	12:25	16:00
2	11/04/2019	12:15	18:30
3	15/05/2019	16:15	19:30
4	16/05/2019	14:20	18:05
5	24/05/2019	13:40	15:40
6	25/05/2019	14:45	16:50
7	17/06/2019	09:20	12:40
8	27/06/2019	16:15	19:15
9	28/06/2019	16:15	19:15
10	09/07/2019	15:30	18:30
11	10/07/2019	12:35	15:35
12	23/07/2019	08:20	14:20
2020 (Year 2)			
Visit	**Date**	**Start Time (24hrs)**	**Finish Time (24hrs)**
1	10/03/2020	09:50	15:50
2	24/03/2020	09:15	15:15
3	23/04/2020	09:30	17:00
4	21/05/2020	09:00	15:30
5	26/05/2020	10:10	16:10
6	27/05/2020	16:20	22:20
7	22/06/2020	14:00	20:00
8	17/07/2020	10:00	17:00

Breeding Woodland Grouse Searches

2.4.29 In accordance with current NatureScot guidance (SNH, 2017[15]), searches for lekking black grouse were undertaken in 2019 (Year 1) and 2020 (Year 2), and consisted of surveys to search for lekking breeding black grouse, between late March and the end of April.

2.4.30 The breeding woodland grouse Study Area comprised all suitable habitats (e.g. open moorland, woodland edges and tracks) within, and out to 1.5 km, of the Site where access allowed, and as shown in **Figurea 8.4a** and **8.4b,** in accordance with NatureScot guidance (SNH, 2017[16]). Given the evolution of the Proposed Development design and alterations to the Site boundary, the breeding woodland grouse Study Area was modestly amended in Year 2, and this is discussed in **Section 3.2 - Field Survey Limitations**. The term 'Breeding Woodland Grouse Study Areas' is accordingly used to define these areas surveyed during the survey period.

2.4.31 Survey effort is summarised in **Table 2.7**. Full details of all survey times, field surveyors used and weather conditions are presented in **Annex 3**.

2.4.32 Search effort and survey areas have been informed by desk study records and through consultation with NatureScot.

Table 2.7: Breeding woodland grouse search effort summary.

2019 (Year 1)			
Visit	**Date**	**Start Time (24hrs)**	**Finish Time (24hrs)**
1	28/03/2019	04:50	07:55
2	12/04/2019	05:10	08:20
2020 (Year 2)			
Visit	**Date**	**Start Time (24hrs)**	**Finish Time (24hrs)**
1	24/03/2020	05:30	08:40
2	25/03/2020	05:25	08:30
3	23/04/2020	04:40	07:40

3 RESULTS

3.1 Desk Study

Statutory Designated Sites for Nature Conservation

3.1.1 This section should be read with reference to **Figure 8.1**.

3.1.2 The records returned from the NESBReC confirm that the Site does not form part of any statutory designated site for nature conservation with qualifying ornithological interests.

3.1.3 **Table 3.1** summarises statutory designated sites with ornithological features of interest located within 10 km (extended to 20 km for those sites with qualifying migratory goose interest) of the Site.

3.1.4 Distances specified within **Table 3.1** are taken from the Site boundary to the designated site at its nearest point.

Table 3.1: Designated sites for nature conservation.
SPA – Special Protection Area; SSSI – Site of Special Scientific Interest.

Designated Site	Distance / Orientation	Ornithological Qualifying Interests
Tips of Corsemaul and Tom Mor SPA and SSSI	1.28 km, north	Breeding common gull.

[15] NatureScot (SNH, 2017). *Recommended bird survey methods to inform impact assessment of onshore wind farms.* Version 2. March 2017.
[16] NatureScot (SNH, 2017). *Recommended bird survey methods to inform impact assessment of onshore wind farms.* Version 2. March 2017.

Existing Ornithological Records

3.1.5 This section provides a summary of existing ornithological records identified through desk study sources. Only records of 'Priority Species for assessment when considering the development of onshore wind farms in Scotland' and 'Species with restricted ranges' as listed within Annex 1 of NatureScot guidance (SNH, 2018[17]) are considered in detail.

3.1.6 The consideration of existing records are also limited to those reported since 2010, to ensure that the most up to date (and thus relevant to the Proposed Development) records are considered.

3.1.7 Desk study records are presented in **Figure 8.2a**, with sensitive desk study records presented in **Figure 8.2b (Confidential)** in **Volume 5** of the EIA Report.

RSPB

3.1.8 No relevant records were returned from the RSPB.

NESRSG

3.1.9 Two records of breeding merlin (from 2015 and 2017) was returned from NESRSG. Full details are provided in **Confidential Ornithology Technical Appendix 8.3** in **Volume 5** of the EIA Report.

NESBReC

3.1.10 A total of 92 records of 16 species were returned frm NERBReC, including black grouse, hen harrier, peregrine, osprey, golden eagle and curlew. Details are provided in **Annex 2**, with sensitive records provided in **Confidential Ornithology Technical Appendix 8.3** in **Volume 5** of the EIA Report.

Garbet Wind Farm

3.1.11 A summary of the results of the ornithology surveys which supported the refused Garbet Wind Farm (now at appeal), located adjacent to the north-western Site boundary, are presented in **Table 3.2**.

Table 3.2: Ornithology survey results – Garbet Wind Farm.

Survey type	Survey Date	Results
VP flight activity surveys	September 2016 – August 2018	• Black grouse – 3 flights[18]; • Common gull – 26 flights; • Curlew – 22 flights; • Golden eagle – 2 flights; • Golden plover – 2 flights; • Greylag goose – 2 flights; • Hen harrier – 10 flights; • Merlin – 3 flights; • Peregrine – 10 flights; • Pink-footed goose – 29 flights; and • Short-eared owl – 3 flights.

[17] SNH (2018) *Assessing significance of impacts from onshore wind farms outwith designated sites. Guidance.* Version 2 – February 2018.

[18] Total number of flights recorded.

Survey type	Survey Date	Results
Breeding bird surveys	2017 and 2018 (April – July)	• Curlew (6-10[19]); • Common sandpiper (0-1); • Golden plover (0-1); • Lapwing (0-4); • Oystercatcher (1-5); and • Snipe (0-2).
Scarce breeding bird surveys	2017 and 2018 (April- August)[20]	• Barn owl (peak of two territories in 2018); • Merlin (potential territory in 2017); and • Hen harrier (one territory with confirmed breeding in 2018).
Winter walkover survey	2016/17 and 2017/18 (November – February)	• One count of 600 pink-footed goose in 2016/17. • Modest numbers of waders (including golden plover and lapwing), one hen harrier and non-breeding black grouse.
Black grouse surveys	2017 and 2018 (April - July)	• Two lek sites in both survey years, with modest numbers of black grouse present (≤5 birds).

3.2 Field Surveys

VP Flight Activity Surveys

Target Species

3.2.1 Target Species flight activity recorded during the VP survey period (March 2019 to August 2020) from all VPs combined is summarised in **Table 3.3**.

3.2.2 The total number of all flights, total number of birds recorded and the total time spent in each height band (HT) (in seconds), from all VP locations combined is presented. This includes some flights which were detected outside of the VP study area (500 m turbine buffer) and those which are not at-risk to collision. Flights recorded within the 'at risk' window (at collision heights HT2-4, and within 290 m of the turbines; which are considered for collision risk modelling) are presented in **Table 3.4**[21].

3.2.3 Detailed flight records are presented in **Annex 4**, which also indicates the total flight time for each species at the different height bands. Flight lines for each species over the survey period are illustrated in **Figures 8.5a – 8.5f**.

Table 3.3: Target species flight activity summary (all flights).

Species	Total No. of Flights	Total No. of Birds	Total Flight Time (secs)[22]
Black Grouse	2	3	40

[19] Range of territory number provided is pooling 2017 and 2018 surveys.

[20] Surveys also included a winter check for roosting barn owl in November and December 2017.

[21] Three other target species were recorded 'at risk' height during the survey period (peregrine one flight, lapwing one flight and greylag goose two flights), but these were not considered in the CRM given ≥3 flights are necessary for assessment. Furthermore, there were two additional 'at risk' golden plover flights during the non-breeding season (October and December), but given the low number were not considered for CRM.

[22] Total time multiplied by the number of birds.

Species	Total No. of Flights	Total No. of Birds	Total Flight Time (secs)[22]
Greylag goose	3	81	10,342
Pink-footed goose	13	1,395	191,754
Goosander	1	2	270
Oystercatcher	10	49	1,240
Lapwing	15	53	2,049
Golden plover	25	661	126,175
Curlew	77	106	6,971
Dunlin	1	6	180
Snipe	2	2	31
Common Gull	338	805	70,040
Osprey	2	2	111
Goshawk	26	26	4,321
Hen harrier	14	15	2,308
Long-eared owl	3	3	113
Merlin	1	1	17
Peregrine	2	2	80

Table 3.4: 'At Risk' Target species flight activity summary.

Species	Total No. of Flights	Total No. of Birds	Total Flight Time (secs)[23]
Pink-footed goose	10	979	139,310
Golden plover	3	27	3,729
Curlew	7	9	685
Common Gull	20	34	3,775
Goshawk	18	18	3,862
Hen harrier	5	6	958

Secondary Species

3.2.4 Relatively low levels of activity of the following secondary species were also recorded:

- Mallard;
- Buzzard;
- Sparrowhawk;

[23] Total time at risk height multiplied by the number of birds.

- Kestrel;
- Great black-backed gull;
- Herring gull;
- Lesser black-backed gull; and
- Raven.

Collision Risk Mortality

3.2.5 Where sufficient "at collision risk" flight activity data has allowed, collision risk mortality as a result of birds colliding with rotor blades has been assessed for those species listed in **Table 3.4** using the SNH Collision Risk Models (CRMs) as detailed in Band *et al*. (2007[24]) and NatureScot guidance (SNH, 2000[25]).

3.2.6 Full details are provided in **Technical Appendix 8.2**.

Moorland Breeding Bird Surveys

3.2.7 Surveys in 2019 (Year 1) and 2020 (Year 2) recorded a small number of breeding wader and waterfowl territories within the MBBS Study Areas, as summarised in **Table 3.5** and illustrated in **Figures 8.6a** and **8.6b.**

3.2.8 A small number of common crossbill breeding territories were also recorded in commercial forest within the Study Areas in 2019 and 2020.

Table 3.5: Moorland breeding bird species territories.

Species	No. of territories within the MBBS Study Areas	
	2019	2020
Oystercatcher	1	4
Lapwing	0	7
Curlew	6	9
Snipe	3	5

Breeding Annex 1/ Schedule 1 Raptor and Owl Searches

3.2.9 In 2019 (Year 1), a male goshawk was recorded displaying over the breeding raptor and owl Study Area during surveys in April 2019. Although no nest sites were recorded, it is considered that there is a goshawk breeding territory within the Study Area (as shown in **Figure 8.7a)**.

3.2.10 An active barn owl nest site was also recorded in the Study Area, in Year 1, and given the sensitivity of the record this is shown in **Figure 8.7b (Confidential)** in **Volume 5** of the EIA Report.

3.2.11 In 2020 (Year 2), an active hen harrier nest was recorded in the Study Area, as shown in **Figure 8.7c (Confidential)** in **Volume 5** of the EIA Report**.** Three locations were identified with evidence of

[24] Band, W., Madders, M. and Whitfield, D.P. (2007) *Developing field and analytical methods to assess avian collision risk at wind farms.* In De Lucas, M., Janss, G. and Ferrer, M. (eds) 'Birds and Wind Power'.
[25] SNH (2000) *Wind farms and Birds: Calculating a theoretical collision risk assuming no avoiding action*. SNH, Inverness.

potential barn owl nesting, with these locations shown in **Figure 8.7c (Confidential)** in **Volume 5** of the EIA Report**.**

3.2.12 Sensitive records of hen harrier and barn owl are detailed in **Confidential Ornithology Technical Appendix 8.3** in **Volume 5** of the EIA Report**.**

3.2.13 Other species recorded during the searches consisted of red kite, merlin, osprey and peregrine, although there was no evidence of breeding of these species.

3.2.14 A summary of Annex 1 / Schedule 1 breeding raptor and owl territories recorded during searches is provided in **Table 3.6.**

Table 3.6: Annex 1 / Schedule 1 breeding raptor and owl species territories.

Species	No. of territories within the breeding raptor and owl Study Areas	
	2019	2020
Hen harrier	0	1
Goshawk	1	0
Barn owl	1	3

Breeding Woodland Grouse Searches

3.2.15 During the searches in 2019 (Year 1), a total of four black grouse leks were recorded within the Woodland Grouse Study Area, with each lek comprising low numbers of birds (≤4). The location of the lek sites are shown in **Figure 8.8a (Confidential)** in **Volume 5** of the EIA Report.

3.2.16 In 2020 (Year 2), a total of five black grouse leks were recorded within the Woodland Grouse Study Area, with each lek comprising modest numbers of birds (≤7 birds). One lek was at a comparable locality (within c. 400 m) in both survey years. The location of the lek sites in Year 2 are shown in **Figure 8.8b (Confidential)** in **Volume 5** of the EIA Report.

3.2.17 The locations of black grouse lek sites are detailed in **Confidential Ornithology Technical Appendix 8.3** in **Volume 5** of the EIA Report**.**

Field Survey Limitations

3.2.18 Habitats within the Site were widely accessible. The wider Study Areas used for the MBBS (500 m), Annex 1 / Schedule 1 breeding raptor and owl searches (2 km, extended to 6 km for eagles in Year 2) and woodland grouse searches (1.5 km) were surveyed from suitable locations within the Site or public rights of way (PRoWs), scanning the Study Areas with the use of optics (telescope and binoculars). Given the good visibility across the Study Area from the PRoWs this is not considered a limitation to the results obtained.

3.2.19 Evolution of the scheme design of the Proposed Development (and changes in the Site boundary) meant that Study Areas used during the MBBS, breeding raptor and owl searches and breeding woodland grouse searches were accordingly amended during Year 2 surveys (see **Figures 8.4a** and **8.4b**). The difference in these Study Areas between Year 1 and 2 are however modest, and the extent of the Study Areas in both survey years were considered appropriate to cover the Site and to provide an accurate reflection of the target species present.

3.2.20 Plantation woodland habitats within the Study Areas were surveyed by traversing tracks and clearings rather than walking directly through dense plantation habitat, due to logistical and health and safety considerations. The Study Area was appropriately covered from the accessible tracks and clearings and this is not therefore considered a limitation to the results obtained.

3.2.21 Due to unforeseen access restrictions, VP2 had to be re-located during Year 1. The breeding season (March to August 2019) was surveyed from VP2, with the non-breeding season (September 2019 to February 2020) surveyed from VP2a, to ensure the same VP was used during each respective season. VP viewshed coverage was maximised at VP2 and VP2a and consultation with NatureScot confirmed that the VP viewshed coverage was appropriate (as detailed in **Chapter 8: Ornithology**).

3.2.22 Overall no limitations to the survey data in establishing an accurate reflection of the levels of target species activity within adopted Study Areas, and particularly the Site, are identified.

ANNEX 1 – BIRD SPECIES SUMMARY

Table A1-1 provides a list of bird species referred to within **Chapter 8: Ornithology**. Both common and species names are presented along with a summary of each species conservation status[26] using the following abbreviations:

- Annex 1 - species listed on Annex 1 of the Birds Directive (2009/147/EC);
- Schedule 1, 1A, A1 - species listed on Schedule 1, Schedule 1A or Schedule A1 of the Wildlife and Countryside Act (1981, as amended);
- SBL - species listed on the Scottish Biodiversity List; and
- BoCC - BoCCs as listed by leading bird conservation organisations in the UK, including the RSPB and the British Trust for Ornithology (BTO). Conservation status (Red and Amber categories) are also provided (Stanbury *et al*., 2021[27]).

Table A1-1: Summary of bird species.

Common Name	Species Name	Conservation Status
Black grouse	*Tetrao tetrix*	Annex 1, SBL, BoCC – Red.
Greylag goose	*Anser anser*	BoCC – Amber.
Pink-footed goose	*Anser brachyrhynchus*	BoCC – Amber.
Mallard	*Anas platyrhynchos*	BoCC – Amber.
Goosander	*Mergus merganser*	-
Grey heron	*Ardea cinerea*	-
Oystercatcher	*Haematopus ostralegus*	BoCC – Amber.
Lapwing	*Vanellus vanellus*	SBL, BoCC – Red.
Golden plover	*Pluvialis apricaria*	Annex 1, SBL.
Curlew	*Numenius arquata*	SBL, BoCC – Red.
Dunlin	*Calidris alpina*	SBL, BoCC – Red.
Woodcock	*Scolopax rusticola*	BoCC – Red.
Snipe	*Gallinago gallinago*	BoCC – Amber.
Common sandpiper	*Actitis hypoleucos*	BoCC – Amber.
Great black-backed gull	*Larus marinus*	BoCC – Amber.
Lesser black-backed gull	*Larus fuscus*	BoCC – Amber.
Common gull[28]	*Larus canus*	BoCC – Amber.
Herring gull	*Larus argentatus*	SBL, Bocc – Red.
Osprey	*Pandion haliaetus*	Annex 1, Schedule 1, SBL, BoCC – Amber.
Red kite	*Milvus milvus*	Annex 1, Schedule 1, SBL.
Goshawk	*Accipiter gentilis*	Annex 1, Schedule 1.
Sparrowhawk	*Accipiter nisus*	BoCC – Amber.
Hen harrier	*Circus cyaneus*	Annex 1, Schedule 1, Schedule 1A, SBL, BoCC – Red.
Buzzard	*Buteo buteo*	-
Barn owl	*Tyto alba*	Schedule 1.
Short-eared owl	*Asio flammeus*	Annex 1, SBL, BoCC – Amber.
Long-eared owl	*Asio otus*	-
Kestrel	*Falco tinnunculus*	SBL, BoCC – Amber.
Merlin	*Falco columbarius*	Annex 1, Schedule 1, SBL, BoCC – Red.
Peregrine falcon	*Falco peregrinus*	Annex 1, Schedule 1, SBL.
Raven	*Corvus corax*	-

[26] NESBReC confirmed as of 28th January 2022, there are no birds on the North East of Scotland "Locally Important Species" list and there are no Local Biodiversity Action Plan (LBAP) bird species.

[27] Stanbury, A., Eaton, M., Aebischer, N., Balmber, D., Brown, A., Douse, A., Lindley, P., McCulloch, N., Noble, D. and Win, I. (2021) The status of our bird populations: the fifth Birds of Conservation Concern in the United Kingdom, Channel Islands and the Isle of Man and second IUCN Red List assessment of extinction risk for Great Britain. *British Birds* 114: 723-747.

[28] Breeding common gull is the qualifying species for the nearby Tips of Corsemaul and Tom Mor SPA and SSSI.

ANNEX 2 – EXISTING ORNITHOLOGICAL RECORDS

Table A2-1 provides a summary of existing target species records returned by NESBReC, restricted to records since 2010. Sensitive records gathered are detailed in **Confidential Ornithology Technical Appendix 8.3** in **Volume 5** of the EIA Report, and such records were provided by NESBReC and NESRSG.

Table A2-1: Summary of existing ornithological records (NESBReC)

Species	No. of Records	Date Range	Summary
Goshawk	13	2012 - 2014	Included four confirmed breeding records.
Common sandpiper	10	2011 and 2015	All single birds, except for one record of a pair.
Greylag goose	1	2012	No further details provided.
Golden eagle	2	2010 and 2012	Consisting of possible / probable breeding birds.
Grey heron	7	2010, 2012 and 2015	No further details provided.
Short-eared owl	1	2012	Display and courtship.
Hen harrier	16	2010, 2011, 2012, 2014, 2015 and 2017	Included one confirmed breeding record.
Peregrine	2	2011 and 2014	Included one possible nest site.
Snipe	3	2011 and 2014	Included one possible breeding record.
Oystercatcher	9	2012 - 2015	Included a record of an adult and young.
Curlew	1	2015	Possible breeding record (male singing).
Osprey	3	2010, 2012 and 2013	Included one possible breeding record.
Golden plover	1	2013	Two birds recorded (possible breeding pair).
Woodcock	5	2014, 2016, 2017 and 2018	All possible / probable breeding records.
Black grouse	14	2010 - 2014	Included two records of lekking males and three confirmed breeding records (fledged young or active nest).
Barn owl	2	2014 and 2016	Included a bird displaying (probable breeding), and one bird recorded – probable territory.
Lapwing	2	2013 and 2016	Both possible / probable breeding records.

ANNEX 3 – ORNITHOLOGY FIELD SURVEY EFFORT

The following codes are used to record weather conditions within **Tables A3-1** to **A3-4**:

Wind Speed		**Rain**		**Cloud Cover**	
Calm	0	None	0	Out of 8	
Light air	1	Drizzle/mist	1		
Light breeze	2	Light showers	2	**Frost**	
Gentle breeze	3	Heavy showers	3	None	0
Moderate breeze	4	Heavy rain	4	Ground	1
Fresh breeze	5			All day	2
Strong breeze	6	**Visibility**			
Moderate gale	7	Poor	0	**Snow**	
Fresh gale	8	<1 km	1	None	0
Strong gale	9	>1 km	2	On site	1
Whole gale	10			High ground	2
Storm	11	**Cloud Height**			
		<150 m	0		
Wind Direction		150-500 m	1		
16 point compass		>500 m	2		

The following field surveyors carried out the ornithology surveys: Mr A. McNab (AJM), Mr A. Little (AL), Mr P. Carroll (PC), Mr D. Pointon (DP), Mr K. Little (KL), Mr M. Wood (MW), Mr R. Irvine (RI) and Mr S. Macdonald (SM).

Table A3-1: VP flight activity survey effort (March 2019 – August 2020).

Date	VP	Surveyor	Start Time	Finish Time	VP Hours	Wind Speed	Wind Direction	Rain	Cloud Cover	Cloud Height	Visibility	Frost	Snow
28/03/2019	1	PC	08:05	11:05	3	3/2/3	W/SSW/SSW	0/0/0	6/6/6	2/2/2	2/2/2	0/0/0	0/0/0
28/03/2019	1	PC	11:35	14:35	3	3/3/3	SSW/W/W	0/0/0	5/4/6	2/2/2	2/2/2	0/0/0	0/0/0
27/03/2019	2	PC	12:00	15:00	3	5/4/4	SW/WSW/WSW	0/0/0	7/7/8	2/2/2	2/2/2	0/0/0	0/0/0
27/03/2019	2	PC	15:30	18:30	3	4/4/4	W/WSW/WSW	0/0/0	7/7/3	2/2/2	2/2/2	0/0/0	0/0/0
27/03/2019	3	AJM	12:00	15:00	3	5/5/4	SW/SW/SW	0/0/0	7/7/7	2/2/2	2/2/2	0/0/0	0/0/0
27/03/2019	3	AJM	15:30	18:30	3	5/5/5	SW/SW/SW	0/0/0	7/6/4	2/2/2	2/2/2	0/0/0	0/0/0
28/03/2019	4	AJM	07:55	10:55	3	5/5/5	SSW/SSW/SSW	0/0/0	3/2/4	2/2/2	2/2/2	0/0/0	0/0/0
28/03/2019	4	AJM	11:25	14:25	3	3/3/3	SW/SW/SW	0/0/0	3/3/4	2/2/2	2/2/2	0/0/0	0/0/0
08/04/2019	1	AJM	13:55	16:55	3	1/2/2	NE/NE/NE	0/0/0	7/5/6	2/2/2	2/2/2	0/0/0	1/1/1
08/04/2019	1	AJM	17:25	20:25	3	2/1/1	NE/NE/NE	0/0/0	6/4/4	2/2/2	2/2/2	0/0/0	1/1/1
15/04/2019	1	DP	11:12	14:12	3	4/4/4-5	SE/ESE/ESE	0/0/0	7/6/8	1/1/1	2/2/2	0/0/0	0/0/0
10/04/2019	2	PC	05:50	08:50	3	2/1/1	SSW/SW/SW	0/0/0	0/0/0	2/2/2	2/2/2	1/1/0	1/1/1
10/04/2019	2	PC	09:20	12:20	3	0/2/2	-/NW/NW	0/0/0	0/1/1	2/2/2	2/2/2	0/0/0	1/1/1
17/04/2019	2	DP	10:50	13:50	3	3-4/4/4-5	SE/SE/SE	0/0/0	6/5/4	2/2/2	2/2/2	0/0/0	0/0/0
10/04/2019	3	AJM	06:00	09:00	3	1/1/1	S/S/SW	0/0/0	0/0/0	0/0/0	2/2/2	1/1/0	0/0/0
10/04/2019	3	AJM	09:30	12:30	3	1/1/2	WNW/WNW/NW	0/0/0	0/1/1	0/2/2	2/2/2	0/0/0	0/0/0
15/04/2019	3	DP	15:05	18:05	3	5/5/5-6	ESE/ESE/SE	0/1/2	8/8/8	1/0/0	2/1/1	0/0/0	0/0/0
08/04/2019	4	PC	14:20	17:20	3	2/2/2	E/E/ENE	0/0/0	7/7/7	2/2/2	2/2/2	0/0/0	1/1/1
08/04/2019	4	PC	17:50	20:50	3	2/2/2	E/E/E	0/0/0	6/6/8	2/2/2	2/2/2	0/0/0	1/1/1
17/04/2019	4	DP	14:33	17:33	3	4/4/4	SE/SE/SE	0/0/0	2/1/1	2/2/2	2/2/2	0/0/0	0/0/0
17/05/2019	1	PC	09:05	12:05	3	1/2/3	SE/SE/SE	0/0/0	7/6/4	2/2/2	2/2/2	0/0/0	0/0/0
17/05/2019	1	PC	12:35	15:35	3	3/3/3	SE/E/E	0/0/0	2/1/1	2/2/2	2/2/2	0/0/0	0/0/0
25/05/2019	1	DP	06:15	09:15	3	2/2/2	SW/SW/SW	0/0/0	8/8/7	1/1/1	2/2/2	0/0/0	0/0/0
07/05/2019	2	DP	11:50	14:50	3	1/2/2	N/NE/ENE	2/2/2	6/8/8	1/1/1	2/2/2	0/0/0	2/2/2
07/05/2019	2	DP	15:20	18:20	3	2/1/1	N/N/N	4/0/0	8/8/8	1/1/1	1/2/2	0/0/0	2/2/2
25/05/2019	2	DP	09:45	12:45	3	2-3/2-3/2	W/SW/W	0/0/2	8/8/8	1/1/1/	2/2/2	0/0/0	0/0/0
15/05/2019	3	PC	10:00	13:00	3	2/2/2	NNE/E/ESE	0/0/0	4/4/4	2/2/2	2/2/2	0/0/0	0/0/0
15/05/2019	3	PC	13:30	16:30	3	3/3/3	ESE/ESE/ESE	0/0/0	2/3/3	2/2/2	2/2/2	0/0/0	0/0/0
24/05/2019	3	DP	15:45	18:45	3	3-4/3-4/3	WNW/WNW/WNW	0/0/0	7/6/6	2-1/1-2/2	2/2/2	0/0/0	0/0/0
15/05/2019	4	AJM	09:30	12:30	3	2/2/3	SW/E/E	0/0/0	3/2/2	2/2/2	2/2/2	0/0/0	0/0/0
15/05/2019	4	AJM	13:00	16:00	3	3/3/3	E/E/E	0/0/0	1/2/2	2/2/2	2/2/2	0/0/0	0/0/0
24/05/2019	4	DP	19:30	22:30	3	3/3/3	W/WSW/WSW	1/1/1	7/8/8	1/1/1	2/2/2	0/0/0	0/0/0
17/06/2019	2	AJM	12:50	15:50	3	4/4/4	SW/SSW/SSW	3/0/0	7/5/6	2/2/2	2/2/2	0/0/0	0/0/0
17/06/2019	2	AJM	16:20	19:20	3	4/4/3	SSW/SSW/SW	2/0/0	6/6/6	2/2/2	2/2/2	0/0/0	0/0/0
17/06/2019	3	PC	12:25	15:25	3	3/3/3	SW/SW/SW	3/0/2	7/6/6	2/2/2	2/2/2	0/0/0	0/0/0
17/06/2019	3	PC	15:55	18:55	3	4/4/4	SW/SW/SW	2/0/2	6/6/6	2/2/2	2/2/2	0/0/0	0/0/0
28/06/2019	1	AL	09:00	12:00	3	2/3/3	SSW/S/S	0/0/0	0/0/0	N/A	2/2/2	0/0/0	0/0/0
28/06/2019	1	AL	12:30	15:30	3	4/3/4	S/S/SSE	0/0/0	0/0/0	N/A	2/2/2	0/0/0	0/0/0
28/06/2019	4	KL	09:15	12:15	3	3/4/4	SE/SSE/S	0/0/0	0/0/0	N/A	2/2/2	0/0/0	0/0/0
28/06/2019	4	KL	12:45	15:45	3	4/3/4	SSE/SSE/SSE	0/0/0	0/0/0	N/A	2/2/2	0/0/0	0/0/0
29/06/2019	1	AL	08:45	11:45	3	2/3/2	SSE/W/W	0/0/0	3/4/6	2/2/2	2/2/2	0/0/0	0/0/0
29/06/2019	4	KL	09:00	12:00	3	1/3/2	SSE/W/W	0/0/0	3/4/7	2/2/2	2/2/2	0/0/0	0/0/0
09/07/2019	3	PC	16:40	19:40	3	3/2/3	WSW/WSW/WSW	3/2/0	8/8/8	2/2/2	2/2/2	0/0/0	0/0/0
10/07/2019	2	PC	09:30	12:30	3	1/1/0	NW/NW/-	2/2/2	8/7/7	2/2/2	2/2/2	0/0/0	0/0/0
22/07/2019	1	PC	13:00	16:00	3	4/4/4	W/W/W	2/2/0	6/7/7	2/2/2	2/2/2	0/0/0	0/0/0
22/07/2019	1	PC	16:30	19:30	3	4/4/3	W/W/W	0/0/0	7/6/6	2/2/2	2/2/2	0/0/0	0/0/0
22/07/2019	4	AJM	16:05	19:05	3	4/4/4	SW/SW/SW	0/0/0	6/5/5	2/2/2	2/2/2	0/0/0	0/0/0
22/07/2019	4	AJM	12:35	15:35	3	4/4/4	SW/SW/SW	0/0/0	5/6/6	2/2/2	2/2/2	0/0/0	0/0/0
23/07/2019	1	PC	19:20	22:20	3	3/2/1	SSW/SSW/S	0/0/0	1/0/1	2/2/2	2/2/2	0/0/0	0/0/0
23/07/2019	4	AJM	19:25	22:25	3	3/3/3	SSW/S/SSE	0/0/0	0/0/1	/-/-/2	2/2/2	0/0/0	0/0/0
24/07/2019	2	KL	10:00	13:00	3	4/4/4	SSE/SSE/SSE	0/0/0	5/1/0	2/2/-	2/2/2	0/0/0	0/0/0
24/07/2019	2	KL	13:30	16:30	3	5/4/4	S/SSW/S	0/0/0	1/3/6	2/2/2	2/2/2	0/0/0	0/0/0
24/07/2019	3	AL	13:45	16:45	3	4/4/3	SSW/SSW/SSW	0/0/0	3/4/5	2/2/2	2/2/2	0/0/0	0/0/0
24/07/2019	3	AL	10:15	13:15	3	3/3/3	SE/SSE/S	2/0/0	7/3/2	2/2/2	2/2/2	0/0/0	0/0/0
15/08/2019	1	AL	10:15	13:15	3	4/4/4	NW/NW/NW	2/0/0	8/6/5	1/2/2	2/2/2	0/0/0	0/0/0
15/08/2019	1	AL	13:45	16:45	3	3/3/3	WNW/WNW/WNW	0/0/0	5/5/4	2/2/2	2/2/2	0/0/0	0/0/0
14/08/2019	2	KL	11:15	14:15	3	2/3/3	SE/SE/SE	2/2/0	7/8/8	2/2/2	2/2/2	0/0/0	0/0/0

Craig Watch Wind Farm
Technical Appendix 8.1: Ornithology

Date	VP	Surveyor	Start Time	Finish Time	VP Hours	Wind Speed	Wind Direction	Rain	Cloud Cover	Cloud Height	Visibility	Frost	Snow
14/08/2019	2	KL	14:45	17:45	3	3/2/2	SE/SE/SE	0/0/0	8/7/7	2/2/2	2/2/2	0/0/0	0/0/0
16/08/2019	2	KL	10:00	13:00	3	4/5/5	SE/SE/SE	0/0/0	8/7/7	2/2/2	2/2/2	0/0/0	0/0/0
16/08/2019	3	AL	10:10	13:10	3	4/4/4	S/S/S	0/0/0	8/5/8	2/2/2	2/2/2	0/0/0	0/0/0
14/08/2019	3	AL	11:00	14:00	3	3/3/3	SE/SE/SE	0/2/0	7/7/7	2/2/2	2/2/2	0/0/0	0/0/0
14/08/2019	3	AL	14:30	17:30	3	3/3/3	SSE/SSE/SE	0/0/0	6/6/6	2/2/2	2/2/2	0/0/0	0/0/0
15/08/2019	4	KL	10:15	13:15	3	4/4/4	WNW/NW/NW	1/0/2	8/6/7	2/2/2	2/2/2	0/0/0	0/0/0
15/08/2019	4	KL	13:45	16:45	3	4/4/4	WNW/WNW/WNW	0/0/0	7/4/4	2/2/2	2/2/2	0/0/0	0/0/0
23/09/2019	1	AL	16:40	19:40	3	3/3/2	S/SSE/SE	0/0/0	3/2/2	2/2/2	2/2/2	0/0/0	0/0/0
23/09/2019	1	AL	13:10	16:10	3	3/3/3	SSE/S/S	0/0/0	3/5/4	2/2/2	2/2/2	0/0/0	0/0/0
24/09/2019	2a	KL	06:30	09:30	3	2/1/2	SE/SE/SE	1/2/0	8/7/7	1/2/2	1/2/2	0/0/0	0/0/0
24/09/2019	2a	KL	10:00	13:00	3	1/2/3	SSE/SE/SE	0/0/0	8/7/7	2/1/2	2/2/2	0/0/0	0/0/0
24/09/2019	3	AL	10:00	13:00	3	3/3/3	S/S/SE	0/2/2	7/8/8	2/1/1	2/2/2	0/0/0	0/0/0
24/09/2019	3	AL	06:30	09:30	3	2/3/3	SSE/SSE/SSE	0/2/0	8/8/8	1/1/1	1/1/1	0/0/0	0/0/0
23/09/2019	4	KL	13:10	16:10	3	3/2/3	S/S/SSE	0/0/0	2/4/6	2/2/2	2/2/2	0/0/0	0/0/0
23/09/2019	4	KL	16:40	19:40	3	3/4/2	SSE/SSE/SSE	0/0/0	4/1/1	2/2/2	2/2/2	0/0/0	0/0/0
23/10/2019	1	AL	07:30	10:30	3	3/3/3	S/SSW/SSW	0/0/0	7/7/8	2/2/2	2/2/2	0/0/0	0/0/0
23/10/2019	1	AL	11:00	14:00	3	4/4/3	SW/SW/SW	0/0/0	8/8/7	2/2/2	2/2/2	0/0/0	0/0/0
22/10/2019	2a	KL	11:50	14:50	3	4/3/4	SSW/SSW/SSW	2/0/0	8/8/7	2/2/2	2/2/2	0/0/0	0/0/0
22/10/2019	2a	KL	15:20	18:20	3	4/4/4	SSW/SSW/SSW	0/0/0	7/5/4	2/2/2	2/2/2	0/0/0	0/0/0
22/10/2019	3	AL	15:20	18:20	3	3/3/3	SW/SW/SW	0/0/0	6/6/5	2/2/2	2/2/2	0/0/0	0/0/0
22/10/2019	3	AL	11:50	14:50	3	4/3/3	WSW/SW/SW	2/0/0	8/7/7	2/2/2	2/2/2	0/0/0	0/0/0
23/10/2019	4	KL	07:30	10:30	3	3/3/4	S/S/SSW	0/0/0	7/7/8	2/2/2	2/2/2	0/0/0	0/0/0
23/10/2019	4	KL	11:00	14:00	3	4/4/4	SSW/SSW/SW	0/0/0	8/8/8	2/2/2	2/2/2	0/0/0	0/0/0
29/11/2019	1	RI	08:25	11:25	3	5/5/4	NW/NNW/NNW	2/2/3	8/8/8	1/2/1	2/2/1	1/1/1	1/1/1
01/12/2019	2a	RI	08:20	11:20	3	3/4/4	W/WNW/NW	0/0/0	3/3/2	2/2/2	2/2/2	2/2/2	1/1/1
01/12/2019	2a	RI	11:50	14:50	3	4/5/4	WNW/WNW/WNW	0/0/0	2/2/2	2/2/2	2/2/2	2/2/2	1/1/1
28/11/2019	3	RI	08:30	11:30	3	4/5/5	NNW/N/N	3/3/3	8/8/8	2/1/2	2/2/2	0/0/0	2/2/2
28/11/2019	3	RI	12:00	15:00	3	5/5/5	NNW/NNW/N	2/2/2	8/7/8	1/2/2	2/2/2	0/0/0	2/2/2
30/11/2019	4	RI	08:45	11:45	3	1/1/1	SSW/S/S	0/0/0	2/1/1	2/2/2	2/2/2	2/2/2	1/1/1

Date	VP	Surveyor	Start Time	Finish Time	VP Hours	Wind Speed	Wind Direction	Rain	Cloud Cover	Cloud Height	Visibility	Frost	Snow
30/11/2019	4	RI	12:15	15:15	3	1/1/1	S/SSW/S	0/0/0	1/1/1	2/2/2	2/2/2	2/2/2	1/1/1
04/12/2019	1	RI	10:25	13:25	3	5/5/5	SW/SW/SSW	0/0/2	2/2/8	2/2/2	2/2/2	0/0/0	0/0/0
19/12/2019	1	AJM	08:40	11:40	3	3/3/2	SSE/SE/SE	0/0/0	7/5/5	2/2/2	2/2/2	0/0/0	0/0/0
19/12/2019	1	AJM	12:10	15:10	3	2/2/2	SE/ESE/ESE	0/0/1	6/6/8	2/2/1	2/2/2	0/0/0	0/0/0
19/12/2019	2a	PC	09:00	12:00	3	4/4/3	SE/SE/SE	0/0/0	8/6/4	2/2/2	2/2/2	0/0/0	0/0/0
19/12/2019	2a	PC	12:30	15:30	3	2/2/2	SSE/SE/SE	0/1/1	7/7/8	2/2/1	2/2/1	0/0/0	0/0/0
18/12/2019	3	AJM	08:50	11:50	3	2/2/3	S/S/SSE	0/0/0	2/1/2	2/2/2	2/2/2	2/2/2	1/1/1
18/12/2019	3	AJM	12:20	15:20	3	3/3/4	SSE/SSE/SE	0/0/0	3/4/6	2/2/2	2/2/2	2/2/2	1/1/1
18/12/2019	4	PC	09:05	12:05	3	3/3/3	SSW/SSW/S	0/0/0	2/1/0	2/2/2	2/2/2	1/1/1	1/1/1
18/12/2019	4	PC	12:35	15:35	3	3/3/3	SSE/SSE/S	0/0/0	4/6/8	2/2/2	2/2/2	1/0/0	1/1/1
30/01/2020	1	RI	08:20	11:20	3	3/4/4	SW/SW/SW	0/2/2	8/8/8	2/2/2	2/2/2	0/0/0	2/2/2
30/01/2020	1	RI	11:50	14:50	3	4/5/5	SW/SW/SW	0/2/3	8/7/8	2/2/2	2/2/2	0/0/0	2/2/2
28/01/2020	2	RI	09:50	12:50	3	3/2/2	SW/S/S	0/0/0	6/2/2	2/2/2	2/2/2	2/2/2	1/1/1
28/01/2020	2	RI	13:20	16:20	3	2/2/2	SW/SW/S	0/0/0	1/2/2	2/2/2	2/2/2	2/2/2	1/1/1
29/01/2020	3	RI	08:50	11:50	3	5/5/4	SW/SW/SW	0/0/0	7/7/8	2/2/2	2/2/2	2/2/2	1/1/1
29/01/2020	3	RI	12:20	15:20	3	4/3/3	SW/SW/SW	0/2/2	8/8/8	1/2/2	2/2/2	2/2/2	1/1/1
31/01/2020	4	RI	08:25	11:25	3	3/3/3	W/WSW/SW	0/0/0	5/6/2	2/2/2	2/2/2	0/0/0	0/0/0
31/01/2020	4	RI	11:55	14:55	3	3/4/5	SW/SW/WSW	0/0/0	2/6/7	2/2/2	2/2/2	0/0/0	0/0/0
18/02/2020	1	RI	07:50	10:50	3	5/4/5	SW/SW/SW	2/2/2	8/8/6	1/2/2	2/2/2	0/0/0	0/1/1
18/02/2020	1	RI	11:20	14:20	3	4/5/4	WSW/SW/WSW	0/2/0	4/2/3	2/2/2	2/2/2	0/0/0	1/1/0
13/02/2020	2a	RI	08:00	11:00	3	1/1/1	N/NW/N	0/0/0	7/8/7	2/2/2	2/2/2	2/2/2	1/1/1
13/02/2020	2a	RI	11:30	14:30	3	1/2/1	N/N/N	0/0/0	5/3/2	2/2/2	2/2/2	2/2/2	1/1/1
10/02/2020	3	RI	08:05	11:05	3	4/5/5	WSW/WSW/WSW	0/1/0	1/5/1	2/2/2	2/2/2	2/2/2	1/1/1
10/02/2020	3	RI	11:35	14:35	3	5/4/5	WSW/WSW/WSW	0/0/0	1/1/3	2/2/2	2/2/2	2/2/2	1/1/1
14/02/2020	4	RI	08:35	11:35	3	5/5/6	S/S/S	0/0/1	8/8/8	2/2/1	2/2/2	1/1/1	1/1/1
14/02/2020	4	RI	12:05	15:05	3	4/5/5	S/SSW/SSW	0/1/1	6/7/7	2/2/2	2/2/2	0/0/0	1/1/1
23/03/2020	1	AJM	10:40	13:40	3	4/4/4	S/S/S	0/0/0	8/8/8	2/2/2	2/2/2	0/0/0	0/0/0
23/03/2020	1	AJM	14:10	17:10	3	4/4/4	S/S/S	0/0/0	8/8/7	2/2/2	2/2/2	0/0/0	0/0/0
10/03/2020	2b	SM	10:25	13:25	3	4/4/4	W/W/W	0/0/3	5/5/8	2/2/2	2/2/2	0/0/0	0/0/0

Date	VP	Surveyor	Start Time	Finish Time	VP Hours	Wind Speed	Wind Direction	Rain	Cloud Cover	Cloud Height	Visibility	Frost	Snow
10/03/2020	2b	SM	13:55	16:55	3	4/4/4	W/W/W	3/0/0	8/3/2	2/2/2	2/2/2	0/0/0	0/0/0
20/04/2020	1	SM	11:10	14:10	3	3/3/3	SE/SE/ESE	0/0/0	0/0/0	/-/-/-/	2/2/2	0/0/0	0/0/0
20/04/2020	1	SM	14:40	17:40	3	3/2/2	ESE/E/E	0/0/0	0/0/0	/-/-/-/	2/2/2	0/0/0	0/0/0
22/04/2020	1	SM	15:35	18:35	3	3/2/2	ESE/SE/SE	0/0/0	1/2/1	2/2/2	2/2/2	0/0/0	0/0/0
21/04/2020	2b	SM	14:50	17:50	3	3/3/2	SE/SE/SE	0/0/0	0/0/0	/-/-/-/	2/2/2	0/0/0	0/0/0
24/04/2020	2b	SM	07:40	10:40	3	1/1/1	NNW/N/NNE	0/0/0	1/1/1	2/2/2	2/2/2	1/0/0	0/0/0
24/04/2020	2b	SM	11:10	14:10	3	1/1/1	NNE/NE/NE	0/0/0	1/1/1	2/2/2	2/2/2	0/0/0	0/0/0
14/05/2020	1	SM	09:10	12:10	3	3/4/3	W/W/WNW	0/3/2	6/8/6	2/2/2	2/2/2	0/0/0	0/0/0
14/05/2020	1	SM	12:40	15:40	3	4/4/3	WNW/WNW/NW	3/2/2	6/7/8	2/2/2	2/2/2	0/0/0	0/0/0
22/05/2020	1	MW	04:15	07:15	3	4/4/4	W/W/W	1/2/3	8/8/8	1/1/1	2/2/2	0/0/0	0/0/0
19/05/2020	2b	SM	10:10	13:10	3	1/1/2	SSW/WSW/W	0/0/0	8/8/6	2/2/2	2/2/2	0/0/0	0/0/0
19/05/2020	2b	SM	13:40	16:40	3	3/3/2	W/W/W	0/0/0	7/7/8	2/2/2	2/2/2	0/0/0	0/0/0
21/05/2020	2b	MW	16:25	19:25	3	2/2/2	NW/NW/N	0/0/0	4/4/4	2/2/2	2/2/2	0/0/0	0/0/0
04/06/2020	1	MW	08:15	11:15	3	2/2/2	SE/SE/SE	0/1/2	8/8/8	2/2/1	2/2/2	0/0/0	0/0/0
16/06/2020	1	MW	16:15	19:15	3	0/0/0	/-/-/-/	1/1/0	8/8/8	1/1/2	2/2/2	0/0/0	0/0/0
16/06/2020	1	MW	19:45	22:45	3	0/1/1	-/NE/NE	0/0/0	6/7/8	2/2/2	2/2/2	0/0/0	0/0/0
03/06/2020	2b	MW	12:55	15:55	3	2/2/2	SE/SE/SE	1/1/1	8/8/8	1/1/1	2/2/2	0/0/0	0/0/0
17/06/2020	2b	MW	19:45	22:45	3	1/1/1	SE/SE/SE	0/0/0	2/2/2	2/2/2	2/2/2	0/0/0	0/0/0
18/06/2020	2b	MW	03:45	06:45	3	1/1/1	SE/SE/SE	0/0/0	0/0/0	/-/-/-/	2/2/2	0/0/0	0/0/0
13/07/2020	1	MW	13:55	16:55	3	3/3/3	NW/NW/NW	0/0/0	5/6/6	2/2/2	2/2/2	0/0/0	0/0/0
28/07/2020	1	MW	06:35	09:35	3	4/4/4	NW/NW/NW	1/0/2	8/8/8	2/2/2	2/2/2	0/0/0	0/0/0
28/07/2020	1	MW	10:05	13:05	3	4/4/4	NW/NW/NW	2/0/0	8/8/8	1/2/2	2/2/2	0/0/0	0/0/0
15/07/2020	2b	MW	13:00	16:00	3	2/2/2	S/S/S	0/0/0	7/6/6	2/2/2	2/2/2	0/0/0	0/0/0
16/07/2020	2b	MW	16:00	19:00	3	2/2/2	SW/SW/SW	0/0/0	6/7/6	2/2/2	2/2/2	0/0/0	0/0/0
16/07/2020	2b	MW	19:30	22:30	3	2/2/1	S/S/S	0/0/0	6/5/5	2/2/2	2/2/2	0/0/0	0/0/0
12/08/2020	1	MW	13:40	16:40	3	1/1/1	SW/SW/SW	0/0/0	0/1/1	/-/2/2	2/2/2	0/0/0	0/0/0
13/08/2020	1	MW	16:30	19:30	3	2/2/2	ENE/ENE/ENE	0/0/0	8/8/8	1/1/1	2/2/2	0/0/0	0/0/0
20/08/2020	2b	MW	11:25	14:25	3	2/2/2	SW/SW/SW	0/0/0	4/4/5	2/2/2	2/2/2	0/0/0	0/0/0
20/08/2020	2b	MW	14:55	17:55	3	2/2/2	SW/SW/SW	0/2/0	5/7/6	2/2/2	2/2/2	0/0/0	0/0/0

Table A3-2: MBBS effort (Year 1 and Year 2).

Date	Surveyor	Start Time	Finish Time	Wind Speed	Wind Direction	Rain	Cloud Cover	Cloud Height	Visibility	Frost/ Snow
09/04/2019	PC	08:40	14:55	3/3/3/3/3/3/3	SE/SE/SE/SE/SSE/SSE/SSE	0/0/0/0/0/0/0	1/1/1/1/0/0/0	2/2/2/2/2/2/2	2/2/2/2/2/2/2	0/0/0/0/0/0/0
09/04/2019	AJM	08:45	14:55	3/3/3/3/2/2/2	SE/SE/SE/SE/SE/SE/SE	0/0/0/0/0/0/0	1/1/1/1/1/1/1	2/2/2/2/2/2/2	2/2/2/2/2/2/2	0/0/0/0/0/0/0
11/04/2019	PC	08:45	12:25	1/2/1/1	N/N/N/N	0/0/0/0	7/8/8/8	2/2/2/2	2/2/2/2	0/0/0/0
11/04/2019	AJM	08:45	11:45	1/1/1	NE/NE/NE	0/0/0	7/7/7	2/2/2	2/2/2	0/0/0
16/05/2019	PC	08:20	14:20	4/4/4/4/4/4	SE/SE/SE/SE/SE/SE	0/0/0/0/0/0	1/1/1/0/0/0	2/2/2/2/2/2	2/2/2/2/2/2	0/0/0/0/0/0
16/05/2019	AJM	08:30	14:30	3/4/4/3/3/3/4	SE/SE/SE/SE/SE/SE	0/0/0/0/0/0	1/0/0/0/0/0	2/-/-/-/-/-	2/2/2/2/2/2	0/0/0/0/0/0
17/05/2019	AJM	08:30	15:10	3/3/3/3/3/3/3	SE/SE/SE/SE/SE/SE/SE	0/0/0/0/0/0/0	8/6/5/5/3/3/3	2/2/2/2/2/2/2	2/2/2/2/2/2/2	0/0/0/0/0/0/0
18/06/2019	PC	09:00	15:15	3/4/4/4/4/4/4	SW/SW/SW/SW/SW/SW/SW	0/0/0/0/0/0/0	7/7/7/6/6/6/6	2/2/2/2/2/2/2	2/2/2/2/2/2/2	0/0/0/0/0/0/0
19/06/2019	PC	08:45	12:15	3/3/3/3	SW/SW/SW/SW	0/0/0/0	5/5/6/7	2/2/2/2	2/2/2/2	0/0/0/0
18/06/2019	AJM	09:00	15:05	3/4/3/4/3/3/3	SW/SW/SW/SW/SW/SW/SW	0/0/0/0/0/0/0	6/7/6/6/5/4/4	2/2/2/2/2/2/2	2/2/2/2/2/2/2	0/0/0/0/0/0/0
19/06/2019	AJM	08:45	11:55	3/2/2/2	SW/SW/SW/SW	0/0/0/0	3/4/6/6	2/2/2/2	2/2/2/2	0/0/0/0
23/07/2019	AL	08:30	14:30	4/3/4/3/2/2	SSW/SW/S/SSW/SW/SW	0/0/0/0/0/0	1/3/4/3/3/3	2/2/2/2/2/2	2/2/2/2/2/2	0/0/0/0/0/0
23/07/2019	KL	08:30	14:30	4/3/3/3/2/3	SSW/S/SSW/SSW/SSW/SSW	0/0/0/0/0/0	1/1/1/1/1/1	2/2/2/2/2/2	2/2/2/2/2/2	0/0/0/0/0/0
23/07/2019	AJM	08:30	14:45	3/3/3/3/2/2/2	SW/SW/SW/SW/SW/SW/SW	0/0/0/0/0/0/0	3/1/1/1/1/1/1	2/2/2/2/2/2/2	2/2/2/2/2/2/2	0/0/0/0/0/0/0
21/04/2020	SM	08:30	13:40	2/2/2/2/2	SE/SE/SE/SE/SE	0/0/0/0/0	0/0/0/0/0	/-/-/-/-/-/	2/2/2/2/2	0/0/0/0/0
22/04/2020	SM	08:30	14:40	1/2/3/2/2/3	ESE/SE/SE/SE/SE/ESE	0/0/0/0/0/0	1/1/1/1/1/1	2/2/2/2/2/2	2/2/2/2/2/2	0/0/0/0/0/0
13/05/2020	SM	10:00	15:30	2/2/2/2/2/2	N/N/N/NNW/NW/NW	2/2/2/0/0/0	6/7/8/8/7/7	2/2/2/2/2/2	2/2/2/2/2/2	0/0/0/0/0/0
13/05/2020	MW	09:50	14:50	2/2/2/2/2	N/N/N/N/N	2/2/0/0/0	7/8/8/8/8	2/2/2/2/2	2/2/2/2/2	0/0/0/0/0
17/06/2020	MW	07:30	13:05	0/0/0/1/1/1	-/-/-/SE/SE/SE	1/1/0/0/0/0	8/8/5/1/1/1	1/1/2/2/2/2	1/1/2/2/2/2	0/0/0/0/0/0
18/06/2020	MW	06:45	12:15	0/0/0/0/1/1	-/-/-/-/S/S	0/0/0/0/0/0	0/0/0/0/1/1	-/-/-/-/2/2	2/2/2/2/2/2	0/0/0/0/0/0
14/07/2020	MW	07:30	12:40	2/2/2/2/2/2	SW/SW/SW/SW/SW/SW	0/0/0/0/0/0	5/5/6/6/4/4	2/2/2/2/2/2	2/2/2/2/2/2	0/0/0/0/0/0
15/07/2020	MW	08:00	13:00	2/3/3/2/2	SSW/SSW/SSW/S/S	0/0/1/0/1	7/7/8/8/8	2/2/2/2/2	2/2/2/2/2	0/0/0/0/0

Table A3-3 Annex 1/Schedule 1 Breeding raptor and owl search effort (Year 1 and Year 2).

Date	Surveyor	Start Time	Finish Time	Wind Speed	Wind Direction	Rain	Cloud Cover	Cloud Height	Visibility	Frost/ Snow
10/04/2019	PC	12:25	15:25	2/2/2	NW/NW/NW	0/0/0	1/1/2	2/2/2	2/2/2	0/0/0
10/04/2019	AJM	13:00	16:00	2/2/2	NE/NE/NE	0/0/0	1/2/3	2/2/2	2/2/2	0/0/0

Date	Surveyor	Start Time	Finish Time	Wind Speed	Wind Direction	Rain	Cloud Cover	Cloud Height	Visibility	Frost/ Snow
11/04/2019	PC	12:25	17:55	1/2/2/2/2/2	N/NNE/NE/NE/E/E	0/0/0/0/0/0/0	7/7/8/7/7/7	2/2/2/2/2/2	2/2/2/2/2	0/0/0/0/0/0
11/04/2019	AJM	12:15	18:30	2/1/2/2/3/3/3	NE/NE/NE/NE/ENE/ENE/ENE	0/0/0/0/0/0/0/0	7/7/7/7/7/7/7	2/2/2/2/2/2/2	2/2/2/2/2/2/2	0/0/0/0/0/0/0
15/05/2019	PC	16:30	19:30	3/4/4	ESE/ESE/ESE	0/0/0	4/2/3	2/2/2	2/2/2	0/0/0
16/05/2019	PC	14:20	17:20	4/4/3	SE/SE/SE	0/0/0	0/0/0	2/2/2	2/2/2	0/0/0
15/05/2019	AJM	16:15	19:30	3/3/3/3	E/E/E/E	0/0/0/0	1/1/0/0	2/2/0/0	2/2/2/2	0/0/0/0
16/05/2019	AJM	15:00	18:05	3/3/4/4	SE/SE/SE/SE	0/0/0/0	0/0/0/0	N/A	2/2/2/2	0/0/0/0
24/05/2019	DP	13:40	15:40	4/3	NW/NW	0/0	6/5	2/2	2/2	0/0
25/05/2019	DP	14:45	16:50	2/2	W/W	0-1/0-1	8/8	1/1	2/2	0/0
17/06/2019	PC	09:20	12:20	3/3/3	SW/SW/SW	0/0/0	5/6/7	2/2/2	2/2/2	0/0/0
17/06/2019	AJM	09:35	12:40	3/3/3	SW/SW/SW	0/0/0	5/5/5	2/2/2	2/2/2	0/0/0
27/06/2019	AL	16:15	19:15	2/3/2	NE/NE/NE	0/0/0	0/0/0	N/A	2/2/2	0/0/0
27/06/2019	KL	16:15	19:15	2/2/3	NNE/E/ESE	0/0/0	0/0/0	N/A	2/2/2	0/0/0
28/06/2019	AL	16:15	19:15	3/3/4	SE/SSE/SSE	0/0/0	0/0/0	N/A	2/2/2	0/0/0
28/06/2019	KL	16:15	19:15	3/3/3	SE/SE/SE	0/0/0	0/0/0	N/A	2/2/2	0/0/0
09/07/2019	PC	15:30	18:30	2/3/3	WSW/WSW/WSW	0/0/0	8/8/8	2/2/2	2/2/2	0/0/0
10/07/2019	PC	12:35	15:35	2/2/2	ENE/ENE/ENE	0/2/2	7/7/7	2/2/2	2/2/2	0/0/0
23/07/2019	PC	08:20	14:20	3/3/3/3/2/2	SSW/SSW/SSW/SSW/SSW/SSW	0/0/0/0/0/0	1/2/2/2/1/1	2/2/2/2/2/2	2/2/2/2/2/2	0/0/0/0/0/0
10/03/2020	PC	09:50	15:50	4/4/4/4/4/4	W/W/W/W/W/W	2/0/0/2/3/2	4/7/6/7/7/4	2/2/2/2/2/2	2/2/2/2/2/2	0/0/0/0/0/0
24/03/2020	AJM	09:15	15:15	4/4/4/4/4/5	SW/SSW/SSW/SSW/SSW/SSW	0/0/0/0/0/0	6/6/7/7/7/6	2/2/2/2/2/2	2/2/2/2/2/2	0/0/0/0/0/0
23/04/2020	SM	09:30	17:00	1/1/1/1/2/2/2/2	SE/SE/SE/SE/SSE/SSE/SSE/SSE	0/0/0/0/0/0/0/0	0/0/0/0/0/0/0/0	/-/-/-/-/-/-/-/-	2/2/2/2/2/2/2/2	0/0/0/0/0/0/0/0
21/05/2020	SM	09:00	15:30	1/2/2/2/2/2	SW/WSW/WSW/W/W/W	0/0/0/2/0/0	7/8/8/8/7/6	2/2/2/2/2/2	2/2/2/2/2/2	0/0/0/0/0/0
26/05/2020	SM	10:10	16:10	2/3/3/2/2/2	W/W/W/W/W/W	0/0/0/0/0/0	7/6/5/4/3/3	2/2/2/2/2/2	2/2/2/2/2/2	0/0/0/0/0/0
27/05/2020	SM	16:20	22:20	2/3/3/2/2/1	E/ESE/SE/SE/SSE/SSE	0/0/0/0/0/0	2/5/5/6/7/8	2/2/2/2/2/2	2/2/2/2/2/2	0/0/0/0/0/0

Date	Surveyor	Start Time	Finish Time	Wind Speed	Wind Direction	Rain	Cloud Cover	Cloud Height	Visibility	Frost/ Snow
22/06/2020	MW	14:00	20:00	4/4/3/3/2/2	S/S/S/S/S/S	0/0/0/0/0/0	5/5/6/7/7/7	2/2/2/2/2/2	2/2/2/2/2/2	0/0/0/0/0/0
17/07/2020	MW	10:00	17:00	3/3/3/3/3/3/3	S/S/S/S/S/S/S	0/0/0/0/0/0/0	3/3/3/2/2/1/1	2/2/2/2/2/2/2	2/2/2/2/2/2/2	0/0/0/0/0/0/0

Table A3-4 Breeding woodland grouse search effort.

Date	Surveyor	Start Time	Finish Time	Wind Speed	Wind Direction	Rain	Cloud Cover	Cloud Height	Visibility	Frost	Snow
28/03/2019	PC	04:55	07:55	2/2/2	W/W/W	0/0/0	7/6/6	2/2/2	2/2/2	0/0/0	0/0/0
28/03/2019	AJM	04:50	07:50	2/2/3	SSW/SSW/SSW	0/0/0	6/6/5	2/2/2	2/2/2	0/0/0	0/0/0
12/04/2019	PC	05:15	08:15	2/2/2	SSE/SSE/SSE	0/0/0	5/4/5	2/2/2	2/2/2	0/0/0	0/0/0
12/04/2019	AJM	05:10	08:20	1/1/2	SE/SE/SE	0/0/0	5/4/3	2/2/2	2/2/2	0/0/0	0/0/0
24/03/2020	AJM	05:30	08:40	3/3/3	S/S/S	0/0/0	8/8/7	2/2/2	2/2/2	0/0/0	0/0/0
25/03/2020	AJM	05:25	08:30	1/2/2	W/WSW/W	0/0/0	6/6/6	2/2/2	2/2/2	0/0/0	0/0/0
23/04/2020	SM	04:40	07:40	0/0/1	-/-/ENE	0/0/0	0/0/1	-/-/2	2/2/2	1/1/0	0/0/0

ANNEX 4 – VP FLIGHT ACTIVITY SURVEY: TARGET SPECIES FLIGHTS

Table A4-1 presents details of target species flight lines recorded during VP flight activity surveys between March 2019 and August 2020. The species, number of birds, flight duration and duration spent at each height band (HT) is presented. Note that the flights in **Table A4-1** refer to all target species flights recorded, and not just those flights included in the collision risk modelling. HT2 to HT4 are considered as 'at-risk', with HT1 under 'at-risk' height.

Table A4-1: Target species flights (March 2019 to August 2020).

Date	VP	Species	No. of birds	Start Time (24h)	Duration (s)	HT1 (s)	HT2 (s)	HT3 (s)	HT4 (s)	Notes
28/03/2019	1	Common gull	3	11:35	15	15	0	0	0	
28/03/2019	1	Pink-footed goose	80	11:40	90	0	0	0	90	
28/03/2019	1	Common gull	2	11:43	22	22	0	0	0	
28/03/2019	1	Common gull	3	11:44	35	15	20	0	0	
28/03/2019	1	Common gull	2	11:50	15	15	0	0	0	
28/03/2019	1	Common gull	1	11:53	15	15	0	0	0	
28/03/2019	1	Common gull	1	11:55	15	15	0	0	0	
28/03/2019	1	Common gull	1	13:33	122	122	0	0	0	
28/03/2019	1	Common gull	10	08:05	25	10	15	0	0	
28/03/2019	1	Common gull	2	08:05	15	15	0	0	0	
28/03/2019	1	Common gull	5	08:06	40	0	25	15	0	
28/03/2019	1	Common gull	4	08:06	20	20	0	0	0	
28/03/2019	1	Common gull	2	08:07	15	15	0	0	0	
28/03/2019	1	Common gull	5	08:07	20	15	5	0	0	
28/03/2019	1	Common gull	3	08:08	15	15	0	0	0	
28/03/2019	1	Common gull	5	08:09	15	15	0	0	0	
28/03/2019	1	Common gull	10	08:10	20	20	0	0	0	
28/03/2019	1	Common gull	2	08:11	15	15	0	0	0	
28/03/2019	1	Common gull	3	08:12	20	0	20	0	0	
28/03/2019	1	Common gull	4	08:13	15	15	0	0	0	
28/03/2019	1	Common gull	2	08:14	25	10	15	0	0	
28/03/2019	1	Pink-footed goose	80	08:15	92	0	0	0	92	
28/03/2019	1	Common gull	5	08:17	20	20	0	0	0	
28/03/2019	1	Common gull	2	08:18	15	15	0	0	0	
28/03/2019	1	Common gull	3	08:19	25	0	25	0	0	
28/03/2019	1	Common gull	2	08:20	20	20	0	0	0	
28/03/2019	1	Common gull	3	08:21	15	15	0	0	0	
28/03/2019	1	Common gull	2	08:22	15	15	0	0	0	
28/03/2019	1	Common gull	5	08:22	15	15	0	0	0	
28/03/2019	1	Common gull	1	08:23	20	20	0	0	0	
28/03/2019	1	Common gull	2	08:24	40	0	25	15	0	
28/03/2019	1	Common gull	2	08:25	15	15	0	0	0	
28/03/2019	1	Common gull	2	08:26	20	20	0	0	0	
28/03/2019	1	Common gull	3	08:27	15	15	0	0	0	
28/03/2019	1	Common gull	4	08:28	15	15	0	0	0	
28/03/2019	1	Common gull	1	08:29	15	15	0	0	0	
28/03/2019	1	Common gull	3	08:30	20	20	0	0	0	
28/03/2019	1	Common gull	2	08:31	15	15	0	0	0	
28/03/2019	1	Common gull	2	08:32	20	20	0	0	0	
28/03/2019	1	Common gull	4	08:33	20	20	0	0	0	
28/03/2019	1	Common gull	1	08:34	15	15	0	0	0	
28/03/2019	1	Common gull	2	08:35	20	15	5	0	0	
28/03/2019	1	Common gull	1	08:36	15	15	0	0	0	
28/03/2019	1	Common gull	2	08:37	20	20	0	0	0	

Craig Watch Wind Farm
Technical Appendix 8.1: Ornithology

Date	VP	Species	No. of birds	Start Time (24h)	Duration (s)	HT1 (s)	HT2 (s)	HT3 (s)	HT4 (s)	Notes
28/03/2019	1	Common gull	2	08:38	15	15	0	0	0	
28/03/2019	1	Common gull	3	08:39	20	20	0	0	0	
28/03/2019	1	Common gull	1	08:40	15	15	0	0	0	
28/03/2019	1	Common gull	2	08:41	15	15	0	0	0	
28/03/2019	1	Common gull	1	08:42	15	15	0	0	0	
28/03/2019	1	Common gull	3	08:43	20	15	5	0	0	
28/03/2019	1	Common gull	4	08:44	20	20	0	0	0	
28/03/2019	1	Common gull	2	08:45	20	20	0	0	0	
28/03/2019	1	Pink-footed goose	180	08:46	90	0	0	0	90	
28/03/2019	1	Common gull	1	08:47	15	15	0	0	0	
28/03/2019	1	Common gull	2	08:48	15	15	0	0	0	
28/03/2019	1	Common gull	2	08:49	20	20	0	0	0	
28/03/2019	1	Common gull	2	08:50	20	20	0	0	0	
28/03/2019	1	Common gull	1	08:51	15	15	0	0	0	
28/03/2019	1	Common gull	1	08:52	15	15	0	0	0	
28/03/2019	1	Common gull	1	08:53	15	15	0	0	0	
28/03/2019	1	Common gull	3	08:54	15	15	0	0	0	
28/03/2019	1	Common gull	3	08:55	20	20	0	0	0	
28/03/2019	1	Common gull	2	08:56	20	15	5	0	0	
28/03/2019	1	Common gull	2	08:57	15	15	0	0	0	
28/03/2019	1	Common gull	2	08:58	15	15	0	0	0	
28/03/2019	1	Common gull	2	09:00	15	15	0	0	0	
28/03/2019	1	Common gull	1	09:05	15	15	0	0	0	
28/03/2019	1	Common gull	3	09:08	15	15	0	0	0	
28/03/2019	1	Common gull	3	09:12	20	20	0	0	0	

Date	VP	Species	No. of birds	Start Time (24h)	Duration (s)	HT1 (s)	HT2 (s)	HT3 (s)	HT4 (s)	Notes
28/03/2019	1	Common gull	1	09:15	20	20	0	0	0	
28/03/2019	1	Common gull	1	09:21	20	5	15	0	0	
28/03/2019	1	Common gull	1	09:23	20	0	20	0	0	
28/03/2019	1	Common gull	2	09:24	20	20	0	0	0	
28/03/2019	1	Common gull	1	09:29	15	15	0	0	0	
28/03/2019	1	Common gull	3	09:33	15	15	0	0	0	
28/03/2019	1	Common gull	1	09:40	15	15	0	0	0	
28/03/2019	1	Common gull	4	09:44	20	15	5	0	0	
28/03/2019	1	Common gull	1	09:50	15	15	0	0	0	
28/03/2019	1	Common gull	1	09:52	15	15	0	0	0	
28/03/2019	1	Common gull	2	09:59	20	20	0	0	0	
28/03/2019	1	Common gull	2	10:04	20	5	15	0	0	
28/03/2019	1	Lapwing	3	10:08	34	4	15	15	0	
28/03/2019	1	Common gull	6	10:15	15	15	0	0	0	
28/03/2019	1	Pink-footed goose	90	10:21	193	0	0	0	193	
28/03/2019	1	Common gull	2	10:30	15	15	0	0	0	
28/03/2019	1	Common gull	2	10:38	15	15	0	0	0	
28/03/2019	1	Common gull	1	10:42	15	15	0	0	0	
28/03/2019	1	Common gull	1	10:43	20	0	20	0	0	
28/03/2019	1	Common gull	1	10:49	15	15	0	0	0	
28/03/2019	1	Common gull	1	11:02	15	15	0	0	0	
27/03/2019	2	Goshawk	1	12:51	33	33	0	0	0	Adult, likely hunting.
27/03/2019	2	Common gull	3	13:24	40	0	0	40	0	
27/03/2019	2	Common gull	1	13:40	36	21	15	0	0	
27/03/2019	2	Common gull	2	17:14	122	0	0	122	0	

Date	VP	Species	No. of birds	Start Time (24h)	Duration (s)	HT1 (s)	HT2 (s)	HT3 (s)	HT4 (s)	Notes
27/03/2019	3	Hen harrier	1	13:43	135	0	135	0	0	Adult male.
28/03/2019	4	Common gull	3	08:01	140	0	30	110	0	Flew south.
28/03/2019	4	Common gull	4	08:15	125	0	15	60	50	Flew south.
28/03/2019	4	Common gull	3	08:33	75	0	45	30	0	Flew west.
28/03/2019	4	Common gull	3	08:36	135	0	30	105	0	Flew north.
28/03/2019	4	Hen harrier	1	08:58	195	195	0	0	0	Adult male hunting.
28/03/2019	4	Common gull	1	09:12	40	0	40	0	0	Flew north.
28/03/2019	4	Common gull	2	09:24	135	0	75	60	0	Flew north.
28/03/2019	4	Common gull	6	09:46	90	0	45	45	0	Flew west.
28/03/2019	4	Common gull	2	09:48	105	0	75	30	0	Flew east.
28/03/2019	4	Common gull	1	09:59	120	0	60	60	0	Flew north.
28/03/2019	4	Common gull	9	10:04	90	0	60	30	0	Flew west.
28/03/2019	4	Common gull	3	10:08	150	0	45	105	0	Flew south.
28/03/2019	4	Common gull	2	10:15	135	0	45	90	0	Flew south.
28/03/2019	4	Common gull	2	10:22	105	0	105	0	0	Flew east.
28/03/2019	4	Common gull	6	10:27	30	0	30	0	0	Flew north.
28/03/2019	4	Common gull	2	10:36	35	0	35	0	0	Flew north.
28/03/2019	4	Common gull	4	10:49	130	0	60	70	0	Flew south.
28/03/2019	4	Common gull	1	10:53	160	0	30	130	0	
28/03/2019	4	Common gull	1	11:42	185	0	30	75	80	Flew south.
28/03/2019	4	Common gull	4	12:24	225	0	45	180	0	Flew east., slowly.
28/03/2019	4	Common gull	1	12:29	180	0	15	165	0	Flew south.
28/03/2019	4	Goshawk	1	12:32	190	0	0	60	130	Male, rose very high.
28/03/2019	4	Common gull	7	12:43	120	0	15	105	0	
28/03/2019	4	Lapwing	2	12:56	25	25	0	0	0	

Date	VP	Species	No. of birds	Start Time (24h)	Duration (s)	HT1 (s)	HT2 (s)	HT3 (s)	HT4 (s)	Notes
28/03/2019	4	Common gull	2	12:57	110	0	110	0	0	
28/03/2019	4	Common gull	4	13:08	135	0	15	120	0	
28/03/2019	4	Common gull	2	13:15	95	0	95	0	0	
28/03/2019	4	Common gull	2	13:23	110	0	65	45	0	
28/03/2019	4	Common gull	3	13:28	105	0	105	0	0	
28/03/2019	4	Common gull	1	13:55	125	0	35	90	0	
28/03/2019	4	Common gull	2	14:01	95	5	30	60	0	
28/03/2019	4	Common gull	3	14:14	110	0	15	95	0	
08/04/2019	1	Common gull	31	13:55	78	59	19	0	0	
08/04/2019	1	Goshawk	1	13:56	100	25	75	0	0	Adult female slight display.
08/04/2019	1	Curlew	1	14:04	45	15	30	0	0	Display flight.
08/04/2019	1	Golden Plover	25	14:19	145	0	0	145	0	
08/04/2019	1	Hen harrier	1	15:04	150	0	0	150	0	Adult female hunting.
08/04/2019	1	Curlew	2	15:18	50	5	45	0	0	Display.
08/04/2019	1	Common gull	1	17:28	80	0	80	0	0	
08/04/2019	1	Curlew	1	17:33	105	30	75	0	0	Display.
08/04/2019	1	Golden Plover	19	17:47	255	0	45	210	0	
08/04/2019	1	Common gull	4	18:59	155	0	0	155	0	
08/04/2019	1	Curlew	2	19:10	210	15	60	135	0	Territorial flight, pair.
08/04/2019	1	Common gull	2	19:39	180	0	180	0	0	
15/04/2019	1	Curlew	1	11:18	28	28	0	0	0	Brief display flight.
15/04/2019	1	Oystercatcher	21	11:31	10	10	0	0	0	
15/04/2019	1	Curlew	1	11:49	55	10	45	0	0	Displaying.
15/04/2019	1	Curlew	3	11:53	219	24	195	0	0	Displaying.
15/04/2019	1	Curlew	2	11:58	52	0	52	0	0	

Date	VP	Species	No. of birds	Start Time (24h)	Duration (s)	HT1 (s)	HT2 (s)	HT3 (s)	HT4 (s)	Notes
15/04/2019	1	Oystercatcher	1	12:00	15	15	0	0	0	
15/04/2019	1	Curlew	1	12:21	120	75	45	0	0	
15/04/2019	1	Curlew	1	12:29	84	9	75	0	0	
15/04/2019	1	Curlew	2	12:31	116	11	60	45	0	
15/04/2019	1	Curlew	2	13:18	101	0	101	0	0	
15/04/2019	1	Common gull	16	13:21	74	74	0	0	0	
15/04/2019	1	Curlew	1	13:39	41	11	30	0	0	
15/04/2019	1	Oystercatcher	18	13:48	36	36	0	0	0	
15/04/2019	1	Curlew	1	13:52	110	80	30	0	0	Low display.
15/04/2019	1	Goshawk	1	14:07	28	13	15	0	0	
10/04/2019	2	Common gull	1	06:50	116	0	90	26	0	
10/04/2019	2	Common gull	1	07:04	93	0	93	0	0	
10/04/2019	2	Common gull	1	07:13	120	0	60	60	0	
10/04/2019	2	Common gull	1	07:52	118	15	30	73	0	
10/04/2019	2	Common gull	1	08:28	120	105	15	0	0	
10/04/2019	2	Common gull	3	08:43	90	0	0	90	0	
10/04/2019	2	Common gull	2	09:53	119	0	0	59	60	
10/04/2019	2	Goshawk	1	10:15	172	0	30	30	112	
10/04/2019	2	Common gull	1	11:03	126	111	15	0	0	
10/04/2019	2	Goshawk	1	11:26	185	0	60	30	95	
10/04/2019	2	Goshawk	1	11:45	60	0	45	15	0	
17/04/2019	2	Curlew	1	11:06	72	27	45	0	0	Displaying.
17/04/2019	2	Curlew	1	11:19	85	30	55	0	0	
17/04/2019	2	Common gull	1	12:41	132	75	57	0	0	
17/04/2019	2	Curlew	1	13:13	85	25	60	0	0	

Date	VP	Species	No. of birds	Start Time (24h)	Duration (s)	HT1 (s)	HT2 (s)	HT3 (s)	HT4 (s)	Notes
17/04/2019	2	Goshawk	1	13:24	1,544	0	90	195	1,259	Male displaying.
10/04/2019	3	Pink-footed goose	120	08:19	270	0	0	60	210	
10/04/2019	3	Hen harrier	2	11:49	255	0	30	105	120	Pair.
10/04/2019	3	Goshawk	1	12:27	160	0	0	160	0	
15/04/2019	3	Hen harrier	1	15:49	54	24	30	0	0	Male.
15/04/2019	3	Hen harrier	1	16:08	58	58	0	0	0	Male.
15/04/2019	3	Hen harrier	1	16:11	178	15	163	0	0	Male.
15/04/2019	3	Golden Plover	1	17:21	44	0	44	0	0	
08/04/2019	3	Pink-footed goose	300	14:25	125	0	0	0	125	
08/04/2019	3	Hen harrier	1	16:20	163	88	75	0	0	Adult male hunting.
08/04/2019	4	Common gull	2	17:03	352	0	15	75	262	
08/04/2019	4	Common gull	6	14:48	105	30	75	0	0	
08/04/2019	4	Common gull	2	14:54	61	61	0	0	0	
08/04/2019	4	Common gull	1	15:10	20	20	0	0	0	
08/04/2019	4	Common gull	4	15:48	58	58	0	0	0	
08/04/2019	4	Lapwing	1	15:49	18	18	0	0	0	Brief display.
08/04/2019	4	Common gull	6	15:56	92	92	0	0	0	
08/04/2019	4	Common gull	2	15:58	235	235	0	0	0	
08/04/2019	4	Common gull	6	16:01	82	82	0	0	0	
08/04/2019	4	Common gull	3	16:33	67	67	0	0	0	
08/04/2019	4	Curlew	1	16:43	19	4	15	0	0	
08/04/2019	4	Goshawk	1	16:48	247	0	67	135	45	Displaying.
08/04/2019	4	Goshawk	1	16:55	138	0	78	60	0	Displaying.
08/04/2019	4	Goshawk	1	17:01	38	8	30	0	0	
08/04/2019	4	Common gull	1	17:04	103	103	0	0	0	

Date	VP	Species	No. of birds	Start Time (24h)	Duration (s)	HT1 (s)	HT2 (s)	HT3 (s)	HT4 (s)	Notes
17/05/2019	1	Common gull	10	09:05	20	5	15	0	0	
17/05/2019	1	Common gull	3	09:05	15	15	0	0	0	
17/05/2019	1	Common gull	5	09:05	35	15	20	0	0	
17/05/2019	1	Curlew	2	09:06	58	28	30	0	0	
17/05/2019	1	Common gull	2	09:07	15	15	0	0	0	
17/05/2019	1	Common gull	3	09:07	15	15	0	0	0	
17/05/2019	1	Common gull	1	09:07	15	15	0	0	0	
17/05/2019	1	Common gull	2	09:08	15	15	0	0	0	
17/05/2019	1	Common gull	3	09:09	20	0	20	0	0	
17/05/2019	1	Common gull	2	09:11	15	15	0	0	0	
17/05/2019	1	Common gull	2	09:14	15	15	0	0	0	
17/05/2019	1	Common gull	1	09:15	20	5	15	0	0	
17/05/2019	1	Common gull	3	09:16	15	15	0	0	0	
17/05/2019	1	Common gull	1	09:18	15	15	0	0	0	
17/05/2019	1	Common gull	1	09:21	15	15	0	0	0	
17/05/2019	1	Common gull	2	09:22	15	15	0	0	0	
17/05/2019	1	Common gull	2	09:23	15	15	0	0	0	
17/05/2019	1	Common gull	1	09:25	20	0	20	0	0	
17/05/2019	1	Common gull	1	09:28	15	15	0	0	0	
17/05/2019	1	Common gull	3	09:32	15	15	0	0	0	
17/05/2019	1	Common gull	2	09:33	15	15	0	0	0	
17/05/2019	1	Common gull	2	09:35	15	15	0	0	0	
17/05/2019	1	Common gull	1	09:40	20	5	15	0	0	
17/05/2019	1	Common gull	1	09:41	20	0	20	0	0	
17/05/2019	1	Common gull	1	09:46	15	15	0	0	0	

Date	VP	Species	No. of birds	Start Time (24h)	Duration (s)	HT1 (s)	HT2 (s)	HT3 (s)	HT4 (s)	Notes
17/05/2019	1	Common gull	2	09:51	15	15	0	0	0	
17/05/2019	1	Common gull	4	09:57	15	15	0	0	0	
17/05/2019	1	Common gull	2	09:58	15	15	0	0	0	
17/05/2019	1	Common gull	2	10:03	15	15	0	0	0	
17/05/2019	1	Common gull	1	10:08	15	15	0	0	0	
17/05/2019	1	Common gull	2	10:11	20	20	0	0	0	
17/05/2019	1	Common gull	1	10:17	15	15	0	0	0	
17/05/2019	1	Common gull	1	10:18	15	15	0	0	0	
17/05/2019	1	Common gull	2	10:23	15	15	0	0	0	
17/05/2019	1	Common gull	3	10:26	15	15	0	0	0	
17/05/2019	1	Common gull	4	10:27	20	0	20	0	0	
17/05/2019	1	Common gull	1	10:32	15	15	0	0	0	
17/05/2019	1	Oystercatcher	1	10:35	62	32	30	0	0	
17/05/2019	1	Common gull	5	10:36	15	15	0	0	0	
17/05/2019	1	Common gull	1	10:42	15	15	0	0	0	
17/05/2019	1	Lapwing	1	10:44	31	31	0	0	0	
17/05/2019	1	Common gull	1	10:49	15	15	0	0	0	
17/05/2019	1	Common gull	1	10:58	20	0	20	0	0	
17/05/2019	1	Lapwing	2	11:03	126	21	30	75	0	
17/05/2019	1	Oystercatcher	1	11:07	18	18	0	0	0	
17/05/2019	1	Common gull	2	11:08	15	15	0	0	0	
17/05/2019	1	Common gull	1	11:15	15	15	0	0	0	
17/05/2019	1	Common gull	2	11:18	15	15	0	0	0	
17/05/2019	1	Common gull	1	11:23	15	15	0	0	0	
17/05/2019	1	Common gull	1	11:29	15	15	0	0	0	

Date	VP	Species	No. of birds	Start Time (24h)	Duration (s)	HT1 (s)	HT2 (s)	HT3 (s)	HT4 (s)	Notes
17/05/2019	1	Common gull	1	11:34	15	15	0	0	0	
17/05/2019	1	Common gull	1	11:46	15	15	0	0	0	
17/05/2019	1	Common gull	1	11:55	15	15	0	0	0	
17/05/2019	1	Common gull	1	12:02	15	15	0	0	0	
17/05/2019	1	Common gull	2	12:35	15	15	0	0	0	
17/05/2019	1	Common gull	1	12:41	15	15	0	0	0	
17/05/2019	1	Common gull	1	12:42	15	15	0	0	0	
17/05/2019	1	Common gull	1	12:55	15	15	0	0	0	
17/05/2019	1	Common gull	1	13:03	15	15	0	0	0	
17/05/2019	1	Curlew	1	13:19	35	20	15	0	0	
17/05/2019	1	Common gull	1	13:30	15	15	0	0	0	
17/05/2019	1	Common gull	2	13:32	15	15	0	0	0	
17/05/2019	1	Common gull	1	13:50	15	15	0	0	0	
17/05/2019	1	Common gull	2	14:02	15	15	0	0	0	
17/05/2019	1	Common gull	2	14:05	15	15	0	0	0	
17/05/2019	1	Common gull	1	14:20	15	15	0	0	0	
17/05/2019	1	Common gull	1	14:32	15	15	0	0	0	
17/05/2019	1	Common gull	1	14:33	15	15	0	0	0	
17/05/2019	1	Common gull	1	14:46	15	15	0	0	0	
17/05/2019	1	Common gull	1	14:50	15	15	0	0	0	
17/05/2019	1	Common gull	1	14:59	15	15	0	0	0	
17/05/2019	1	Common gull	1	15:18	15	15	0	0	0	
17/05/2019	1	Common gull	1	15:30	15	15	0	0	0	
25/05/2019	1	Lapwing	1	06:23	23	23	0	0	0	Short display.
25/05/2019	1	Curlew	1	06:31	31	31	0	0	0	

Date	VP	Species	No. of birds	Start Time (24h)	Duration (s)	HT1 (s)	HT2 (s)	HT3 (s)	HT4 (s)	Notes
25/05/2019	1	Common gull	4	06:54	72	72	0	0	0	
25/05/2019	1	Curlew	1	06:54	11	11	0	0	0	
25/05/2019	1	Curlew	1	06:57	22	22	0	0	0	Mobbing corvid.
25/05/2019	1	Curlew	1	07:03	37	37	0	0	0	Display.
25/05/2019	1	Curlew	1	07:05	50	35	15	0	0	Display.
25/05/2019	1	Curlew	1	07:20	26	26	0	0	0	Display.
25/05/2019	1	Goshawk	1	07:27	18	18	0	0	0	Mobbing corvid.
25/05/2019	1	Curlew	1	07:37	97	67	30	0	0	Display.
25/05/2019	1	Curlew	1	07:44	19	19	0	0	0	Display.
25/05/2019	1	Oystercatcher	2	07:48	37	0	37	0	0	
25/05/2019	1	Lapwing	1	07:54	17	17	0	0	0	Mobbing gull.
25/05/2019	1	Common gull	1	08:01	247	45	120	87	0	Mobbing hen harrier.
25/05/2019	1	Hen harrier	1	08:03	98	98	0	0	0	Male.
25/05/2019	1	Hen harrier	1	08:13	89	14	75	0	0	Male.
25/05/2019	1	Curlew	1	08:14	47	47	0	0	0	Display.
25/05/2019	1	Curlew	1	08:33	26	26	0	0	0	
25/05/2019	1	Oystercatcher	1	08:43	88	88	0	0	0	
25/05/2019	1	Lapwing	2	08:48	63	63	0	0	0	
25/05/2019	1	Common gull	2	09:06	48	48	0	0	0	
07/05/2019	2	Common gull	2	12:15	146	146	0	0	0	
07/05/2019	2	Osprey	1	12:49	58	0	58	0	0	
07/05/2019	2	Curlew	1	13:06	124	0	15	109	0	
07/05/2019	2	Common gull	2	13:29	86	86	0	0	0	
07/05/2019	2	Common gull	2	13:41	252	42	60	150	0	
07/05/2019	2	Common gull	1	13:46	211	31	180	0	0	

Date	VP	Species	No. of birds	Start Time (24h)	Duration (s)	HT1 (s)	HT2 (s)	HT3 (s)	HT4 (s)	Notes
07/05/2019	2	Common gull	2	16:01	136	0	136	0	0	
07/05/2019	2	Common gull	3	16:07	74	0	74	0	0	
07/05/2019	2	Common gull	1	16:13	53	0	53	0	0	
07/05/2019	2	Common gull	3	16:18	120	0	120	0	0	
07/05/2019	2	Common gull	1	16:28	92	0	92	0	0	
07/05/2019	2	Common gull	2	16:44	67	0	0	67	0	
07/05/2019	2	Common gull	1	17:02	148	0	148	0	0	
07/05/2019	2	Common gull	1	17:16	211	16	195	0	0	
07/05/2019	2	Common gull	2	17:21	139	0	139	0	0	
07/05/2019	2	Common gull	2	17:39	197	0	197	0	0	
07/05/2019	2	Common gull	1	17:56	283	0	15	268	0	
07/05/2019	2	Hen harrier	1	18:01	382	382	0	0	0	Male hunting, lost to view behind VP.
25/05/2019	2	Common gull	1	10:00	211	0	211	0	0	
25/05/2019	2	Common gull	1	10:21	86	0	15	71	0	
25/05/2019	2	Common gull	1	10:33	104	0	104	0	0	
25/05/2019	2	Common gull	1	10:52	73	0	73	0	0	
25/05/2019	2	Common gull	2	11:04	68	0	38	30	0	
25/05/2019	2	Common gull	5	11:06	112	0	45	67	0	
25/05/2019	2	Curlew	1	11:13	39	9	30	0	0	
25/05/2019	2	Curlew	1	11:22	58	13	45	0	0	
25/05/2019	2	Common gull	2	11:54	152	0	62	90	0	
25/05/2019	2	Common gull	2	12:13	48	0	48	0	0	
25/05/2019	2	Common gull	1	12:27	126	0	126	0	0	
24/05/2019	3	Curlew	1	17:43	47	17	30	0	0	
24/05/2019	3	Common gull	1	18:25	146	0	146	0	0	

Date	VP	Species	No. of birds	Start Time (24h)	Duration (s)	HT1 (s)	HT2 (s)	HT3 (s)	HT4 (s)	Notes
15/05/2019	4	Common gull	3	09:37	40	40	0	0	0	
15/05/2019	4	Common gull	2	09:43	35	5	30	0	0	
15/05/2019	4	Common gull	1	09:48	50	50	0	0	0	
15/05/2019	4	Common gull	3	09:50	25	10	15	0	0	
15/05/2019	4	Common gull	2	09:58	55	10	45	0	0	
15/05/2019	4	Common gull	1	10:11	95	0	60	35	0	
15/05/2019	4	Common gull	1	10:26	15	15	0	0	0	
15/05/2019	4	Curlew	1	10:27	40	10	30	0	0	Display.
15/05/2019	4	Common gull	1	10:32	105	105	0	0	0	
15/05/2019	4	Common gull	3	10:59	75	0	0	75	0	
15/05/2019	4	Common gull	1	11:03	50	0	50	0	0	
15/05/2019	4	Common gull	2	11:12	145	10	45	90	0	
15/05/2019	4	Common gull	1	11:48	25	25	0	0	0	
15/05/2019	4	Common gull	1	13:26	135	45	90	0	0	
15/05/2019	4	Common gull	1	13:34	110	0	60	50	0	
15/05/2019	4	Common gull	1	13:37	25	25	0	0	0	
15/05/2019	4	Common gull	1	13:45	35	35	0	0	0	
15/05/2019	4	Common gull	1	14:02	95	5	90	0	0	
15/05/2019	4	Common gull	1	14:19	30	30	0	0	0	
15/05/2019	4	Common gull	1	14:33	120	0	60	60	0	
15/05/2019	4	Common gull	3	15:01	225	45	180	0	0	
15/05/2019	4	Common gull	1	15:15	20	20	0	0	0	
15/05/2019	4	Common gull	1	15:44	15	15	0	0	0	
15/05/2019	4	Common gull	4	15:51	105	90	15	0	0	
17/06/2019	2	Common gull	1	13:11	65	0	65	0	0	Adult.

Date	VP	Species	No. of birds	Start Time (24h)	Duration (s)	HT1 (s)	HT2 (s)	HT3 (s)	HT4 (s)	Notes
17/06/2019	2	Common gull	1	13:50	80	0	80	0	0	Adult.
17/06/2019	2	Common gull	1	15:29	215	0	215	0	0	Adult.
17/06/2019	2	Common gull	1	15:43	165	75	45	45	0	Adult.
17/06/2019	2	Common gull	1	18:17	150	0	150	0	0	Adult.
28/06/2019	1	Curlew	1	09:44	30	30	0	0	0	Direct flight east.
28/06/2019	1	Curlew	1	11:22	15	15	0	0	0	Calling in flight.
28/06/2019	1	Lapwing	1	13:14	45	0	45	0	0	Direct flight north-east.
28/06/2019	4	Goshawk	1	13:42	30	0	0	15	15	Soaring in east of viewshed.
29/06/2019	1	Curlew	1	09:01	120	120	0	0	0	Direct flight north-east and landed on hillside.
29/06/2019	1	Golden Plover	1	09:14	60	0	0	60	0	Calling.
29/06/2019	1	Lapwing	32	09:15	30	0	30	0	0	Single flock flying from field.
10/07/2019	2	Common gull	4	09:53	175	0	30	145	0	
10/07/2019	2	Common gull	1	10:15	30	0	30	0	0	
10/07/2019	2	Common gull	2	10:16	160	0	45	115	0	
10/07/2019	2	Common gull	2	11:28	170	30	15	125	0	
10/07/2019	2	Common gull	2	12:03	182	15	45	122	0	
22/07/2019	1	Curlew	1	17:09	26	11	15	0	0	
22/07/2019	1	Curlew	1	18:06	75	15	60	0	0	
22/07/2019	4	Common gull	1	14:13	25	10	15	0	0	
24/07/2019	2	Goshawk	1	10:29	60	15	30	15	0	Female attacked pigeon.
24/07/2019	3	Golden Plover	2	11:48	15	15	0	0	0	Pair.
16/08/2019	2	Goshawk	1	12:27	360	15	150	195	0	Adult female.
15/08/2019	4	Snipe	1	12:45	15	15	0	0	0	
23/09/2019	1	Golden Plover	5	17:00	15	15	0	0	0	

Date	VP	Species	No. of birds	Start Time (24h)	Duration (s)	HT1 (s)	HT2 (s)	HT3 (s)	HT4 (s)	Notes
23/09/2019	1	Goshawk	1	14:29	120	0	15	105	0	
24/09/2019	3	Golden Plover	16	10:21	15	15	0	0	0	
24/09/2019	3	Golden Plover	16	11:24	16	1	15	0	0	
24/09/2019	3	Dunlin	6	11:41	30	30	0	0	0	
24/09/2019	3	Pink-footed goose	36	11:56	240	0	0	0	240	
24/09/2019	3	Golden Plover	16	12:01	30	30	0	0	0	
24/09/2019	3	Golden Plover	55	08:02	30	0	30	0	0	
24/09/2019	3	Golden Plover	37	08:31	90	90	0	0	0	
24/09/2019	3	Golden Plover	28	08:40	15	15	0	0	0	
23/09/2019	4	Golden Plover	63	17:02	360	15	45	240	60	
23/10/2019	1	Golden Plover	9	09:07	75	0	0	0	75	
23/10/2019	1	Golden Plover	17	09:45	180	0	0	180	0	
23/10/2019	1	Golden Plover	60	10:19	120	0	75	45	0	
23/10/2019	1	Peregrine	1	11:06	45	30	15	0	0	Juvenile.
23/10/2019	1	Golden Plover	10	11:47	60	0	0	0	60	
22/10/2019	3	Goshawk	1	13:45	45	0	30	15	0	Female.
23/10/2019	4	Golden Plover	170	09:32	420	75	150	150	45	
29/11/2019	1	Black grouse	2	09:04	10	10	0	0	0	Males.
01/12/2019	2a	Pink-footed goose	85	08:35	160	0	0	0	160	
01/12/2019	2a	Goshawk	1	13:17	10	10	0	0	0	Female adult hunting.
28/11/2019	3	Peregrine	1	09:01	35	20	15	0	0	
28/11/2019	3	Pink-footed goose	78	09:52	150	0	0	0	150	
28/11/2019	3	Pink-footed goose	60	10:04	180	0	0	0	180	
28/11/2019	3	Golden Plover	7	10:10	25	25	0	0	0	
28/11/2019	3	Pink-footed goose	170	10:15	120	0	0	0	120	

Date	VP	Species	No. of birds	Start Time (24h)	Duration (s)	HT1 (s)	HT2 (s)	HT3 (s)	HT4 (s)	Notes
28/11/2019	3	Golden Plover	31	10:47	40	0	40	0	0	
28/11/2019	3	Golden Plover	26	12:11	50	50	0	0	0	Landed behind VP.
28/11/2019	3	Golden Plover	17	14:07	30	30	0	0	0	
30/11/2019	4	Golden Plover	8	10:49	25	25	0	0	0	
30/11/2019	4	Greylag goose	37	12:16	160	0	0	0	160	
19/12/2019	1	Goshawk	1	12:50	50	0	50	0	0	Adult female hunting.
18/12/2019	3	Golden Plover	6	09:38	80	5	75	0	0	
30/01/2020	1	Goshawk	1	12:35	15	15	0	0	0	Female.
31/01/2020	4	Pink-footed goose	32	10:22	65	0	0	0	65	
31/01/2020	4	Pink-footed goose	84	10:57	90	0	0	0	90	
18/02/2020	1	Black grouse	1	08:15	20	20	0	0	0	
18/02/2020	1	Golden Plover	16	10:33	100	0	0	100	0	
18/02/2020	1	Goshawk	1	12:08	45	30	15	0	0	
13/02/2020	2a	Goshawk	1	13:53	90	90	0	0	0	Display flight briefly.
10/02/2020	3	Goosander	2	08:10	135	0	0	0	135	
20/04/2020	1	Common gull	1	11:17	44	44	0	0	0	
20/04/2020	1	Common gull	1	11:21	57	0	0	57	0	
20/04/2020	1	Curlew	1	12:05	132	72	60	0	0	
20/04/2020	1	Curlew	1	12:17	86	41	45	0	0	Displaying and landed.
20/04/2020	1	Lapwing	2	12:23	80	35	45	0	0	
20/04/2020	1	Common gull	3	13:17	71	0	71	0	0	
20/04/2020	1	Common gull	1	13:47	92	92	0	0	0	
20/04/2020	1	Common gull	1	13:53	188	15	30	75	68	
20/04/2020	1	Curlew	1	14:07	65	35	30	0	0	Displaying and landed.
20/04/2020	1	Curlew	1	14:44	55	0	55	0	0	

Date	VP	Species	No. of birds	Start Time (24h)	Duration (s)	HT1 (s)	HT2 (s)	HT3 (s)	HT4 (s)	Notes
20/04/2020	1	Hen harrier	1	14:53	10	10	0	0	0	Male.
20/04/2020	1	Lapwing	1	14:59	15	15	0	0	0	Displaying.
20/04/2020	1	Curlew	1	15:07	68	15	30	23	0	
20/04/2020	1	Curlew	2	15:18	113	60	53	0	0	
20/04/2020	1	Curlew	1	15:47	20	20	0	0	0	Landed.
20/04/2020	1	Hen harrier	1	16:15	80	80	0	0	0	Female/ringtail hunting.
20/04/2020	1	Curlew	3	16:20	92	0	92	0	0	
20/04/2020	1	Curlew	1	16:24	94	19	75	0	0	Display then landed.
22/04/2020	1	Curlew	1	16:00	77	32	45	0	0	Brief display.
22/04/2020	1	Curlew	2	16:19	92	17	75	0	0	Landed.
22/04/2020	1	Common gull	1	16:34	158	0	60	98	0	
22/04/2020	1	Common gull	3	17:07	43	0	43	0	0	
24/04/2020	2b	Curlew	2	10:29	161	0	0	161	0	
24/04/2020	2b	Goshawk	1	11:52	17	2	15	0	0	
24/04/2020	2b	Goshawk	1	12:14	531	15	96	315	105	Possibly visiting nest site.
14/05/2020	1	Curlew	1	09:16	25	25	0	0	0	Brief display.
14/05/2020	1	Common gull	3	09:21	58	58	0	0	0	
14/05/2020	1	Lapwing	1	09:32	55	40	15	0	0	Chasing corvid.
14/05/2020	1	Common gull	5	09:44	163	0	163	0	0	
14/05/2020	1	Curlew	1	10:02	64	34	30	0	0	Displaying.
14/05/2020	1	Common gull	6	11:17	37	37	0	0	0	
14/05/2020	1	Lapwing	2	11:48	69	9	60	0	0	Possible display.
14/05/2020	1	Common gull	1	11:52	30	30	0	0	0	
14/05/2020	1	Common gull	1	11:56	66	6	45	15	0	
14/05/2020	1	Curlew	1	12:04	25	0	25	0	0	Brief display.

Date	VP	Species	No. of birds	Start Time (24h)	Duration (s)	HT1 (s)	HT2 (s)	HT3 (s)	HT4 (s)	Notes
14/05/2020	1	Curlew	1	13:08	73	43	30	0	0	Displaying.
14/05/2020	1	Common gull	1	13:14	117	15	102	0	0	
14/05/2020	1	Curlew	1	13:24	18	18	0	0	0	Brief display.
14/05/2020	1	Common gull	2	13:49	35	35	0	0	0	
14/05/2020	1	Curlew	1	14:14	79	0	49	30	0	
14/05/2020	1	Curlew	1	14:33	50	5	45	0	0	Displaying.
14/05/2020	1	Common gull	1	14:56	20	20	0	0	0	
14/05/2020	1	Curlew	2	15:03	74	14	60	0	0	Chasing corvid.
22/05/2020	1	Curlew	1	04:28	36	0	36	0	0	
22/05/2020	1	Lapwing	1	05:11	57	42	15	0	0	
22/05/2020	1	Oystercatcher	2	07:03	16	1	15	0	0	
19/05/2020	2b	Common gull	1	11:08	130	0	0	130	0	
19/05/2020	2b	Common gull	1	11:29	332	0	135	180	17	
19/05/2020	2b	Common gull	1	11:38	42	0	42	0	0	
19/05/2020	2b	Common gull	3	11:52	219	0	9	180	30	
19/05/2020	2b	Common gull	1	12:00	36	0	36	0	0	
19/05/2020	2b	Goshawk	1	12:04	35	5	30	0	0	Male.
19/05/2020	2b	Common gull	2	12:39	83	0	53	30	0	
19/05/2020	2b	Common gull	2	12:48	52	52	0	0	0	Low soaring.
19/05/2020	2b	Common gull	1	12:56	38	0	38	0	0	
19/05/2020	2b	Common gull	3	13:04	70	0	70	0	0	
19/05/2020	2b	Common gull	1	13:44	27	0	27	0	0	
19/05/2020	2b	Common gull	1	14:08	42	42	0	0	0	
19/05/2020	2b	Common gull	4	14:49	163	0	0	163	0	
19/05/2020	2b	Common gull	6	15:02	202	0	15	187	0	

Date	VP	Species	No. of birds	Start Time (24h)	Duration (s)	HT1 (s)	HT2 (s)	HT3 (s)	HT4 (s)	Notes
21/05/2020	2b	Curlew	1	17:16	23	0	0	0	23	
21/05/2020	2b	Common gull	1	16:45	38	0	0	38	0	
21/05/2020	2b	Common gull	4	17:20	20	5	15	0	0	
21/05/2020	2b	Common gull	1	17:50	41	41	0	0	0	
04/06/2020	1	Curlew	2	08:27	32	2	30	0	0	
04/06/2020	1	Curlew	1	08:42	84	0	0	0	84	
04/06/2020	1	Curlew	1	08:51	117	0	0	0	117	
04/06/2020	1	Curlew	1	09:18	23	0	23	0	0	
04/06/2020	1	Greylag goose	22	09:41	42	0	42	0	0	
04/06/2020	1	Greylag goose	22	09:47	45	0	15	30	0	
04/06/2020	1	Curlew	2	10:04	27	0	27	0	0	
04/06/2020	1	Curlew	1	10:11	18	18	0	0	0	
04/06/2020	1	Oystercatcher	1	10:31	45	0	15	30	0	
04/06/2020	1	Curlew	1	10:40	27	0	27	0	0	
04/06/2020	1	Curlew	1	10:53	18	18	0	0	0	
04/06/2020	1	Common gull	1	08:36	187	97	90	0	0	
04/06/2020	1	Common gull	2	08:53	62	62	0	0	0	
04/06/2020	1	Common gull	1	09:01	204	174	30	0	0	
04/06/2020	1	Common gull	3	09:07	273	273	0	0	0	
04/06/2020	1	Common gull	1	09:14	50	20	30	0	0	
04/06/2020	1	Common gull	5	09:35	181	181	0	0	0	
04/06/2020	1	Common gull	3	09:47	92	77	15	0	0	
04/06/2020	1	Common gull	2	09:58	77	77	0	0	0	
04/06/2020	1	Common gull	6	10:12	86	86	0	0	0	
04/06/2020	1	Common gull	4	10:16	101	101	0	0	0	

Date	VP	Species	No. of birds	Start Time (24h)	Duration (s)	HT1 (s)	HT2 (s)	HT3 (s)	HT4 (s)	Notes
04/06/2020	1	Common gull	4	10:27	170	95	75	0	0	
04/06/2020	1	Common gull	3	10:40	248	188	60	0	0	
04/06/2020	1	Common gull	2	11:01	93	93	0	0	0	
04/06/2020	1	Common gull	4	11:11	65	65	0	0	0	
16/06/2020	1	Curlew	2	16:21	36	6	30	0	0	
16/06/2020	1	Curlew	1	16:42	64	0	64	0	0	
16/06/2020	1	Oystercatcher	1	17:17	48	0	48	0	0	
16/06/2020	1	Curlew	1	18:07	45	45	0	0	0	
16/06/2020	1	Curlew	1	18:38	33	3	30	0	0	
16/06/2020	1	Common gull	6	16:15	550	550	0	0	0	
16/06/2020	1	Common gull	4	16:25	213	213	0	0	0	
16/06/2020	1	Common gull	3	16:31	306	306	0	0	0	
16/06/2020	1	Common gull	2	16:35	453	453	0	0	0	
16/06/2020	1	Common gull	3	16:47	268	268	0	0	0	
16/06/2020	1	Common gull	4	17:02	94	94	0	0	0	
16/06/2020	1	Common gull	2	17;18	27	27	0	0	0	
16/06/2020	1	Common gull	3	17:23	167	167	0	0	0	
16/06/2020	1	Common gull	2	17:44	259	259	0	0	0	
16/06/2020	1	Common gull	4	18:16	147	147	0	0	0	
16/06/2020	1	Common gull	2	18:50	44	44	0	0	0	
16/06/2020	1	Common gull	3	19:08	65	65	0	0	0	
16/06/2020	1	Curlew	1	20:07	40	40	0	0	0	
16/06/2020	1	Curlew	2	20:26	79	4	75	0	0	
16/06/2020	1	Curlew	12	20:33	38	38	0	0	0	
16/06/2020	1	Snipe	1	21:20	16	16	0	0	0	

Date	VP	Species	No. of birds	Start Time (24h)	Duration (s)	HT1 (s)	HT2 (s)	HT3 (s)	HT4 (s)	Notes
16/06/2020	1	Long-eared owl	1	21:52	52	52	0	0	0	
16/06/2020	1	Long-eared owl	1	22:11	26	26	0	0	0	
16/06/2020	1	Long-eared owl	1	22:21	35	35	0	0	0	
16/06/2020	1	Common gull	4	19:46	48	48	0	0	0	
16/06/2020	1	Common gull	2	20:10	113	113	0	0	0	
16/06/2020	1	Common gull	3	20:22	156	156	0	0	0	
16/06/2020	1	Common gull	13	20:31	750	750	0	0	0	
16/06/2020	1	Common gull	4	20:55	75	75	0	0	0	
16/06/2020	1	Common gull	2	21:13	54	54	0	0	0	
17/06/2020	2b	Common gull	2	19:47	65	0	45	20	0	
17/06/2020	2b	Common gull	3	20:20	78	0	60	18	0	
17/06/2020	2b	Merlin	1	19:48	17	17	0	0	0	
18/06/2020	2b	Common gull	3	05:44	63	0	45	18	0	
13/07/2020	1	Common gull	1	14:17	31	15	16	0	0	
13/07/2020	1	Common gull	1	15:04	24	24	0	0	0	
13/07/2020	1	Hen harrier	1	16:11	206	206	0	0	0	Female.
15/07/2020	2b	Osprey	1	14:13	53	0	0	53	0	
16/07/2020	2b	Common gull	4	16:47	122	0	0	122	0	
16/07/2020	2b	Common gull	2	18:38	34	0	0	34	0	
16/07/2020	2b	Common gull	1	20:16	95	15	45	35	0	

ANNEX 5 – CUMULATIVE DEVELOPMENTS

Table A5-1: Other Wind Farm Developments identified within 25 km of the Site[29] considered in the assessment of cumulative effects on common gull. Wind farm developments considered for other species[30], located within 10 km of the Site, are in italics.

Wind Farm Site Name	Number of Turbines	Maximum Blade Tip (m)
Operational		
Berry Burn	29	100
Cairnborrow	*5*	*100*
Clashindarroch	*18*	*110*
Dorenell	*59*	*126*
Dummuie	7	75
Edintore Wind Farm	*6*	*125*
Glens of Foudland	20	78
Hill of Towie	*21*	*100*
Kellas	8	110
Kildrummy	8	93
Muirake	2	99.5
Paul's Hill	28	100
Rothes I	22	-
Rothes II	18	125
Consented		
Aultmore	13	110
Hill of Towie II	*16*	*125*
Lurg Hill	5	130
Meikle Hill	6	126.5
Paul's Hill II	7	149.9
In planning or At appeal		
Berry Burn Extension	9	149.9
Clashindarroch II	*14*	*180*
Rothes III	29	225
Garbet	*7*	*190*

[29] A 25 km study area is considered the range at which there is the potential for effects of onshore wind farm developments on foraging gulls (see Quinn, L.R. 2019. Workshop Report on Gull foraging offshore and onshore: developing apportioning approaches to casework. *Scottish Natural Heritage, Workshop 31st January 2019*).

[30] A 10 km study area to be considered for cumulative impact assessment of bird species identified in this assessment, other than common gull, given this exceeds the core foraging range for these species (documented in SNH, 2018), and signifies their maximum foraging range.

TA 8.2: Collision Risk Model Analysis

Craig Watch Wind Farm

Technical Appendix 8.2: Collision Risk Model Analysis

avianecology

CONTENTS

ANNEXES

1 INTRODUCTION

1.1.1 This Technical Appendix has been prepared to accompany **Chapter 8: Ornithology** of the Craig Watch Wind Farm ('the Proposed Development') Environmental Impact Assessment (EIA) Report.

1.1.2 It presents the details and results of collision mortality risk calculations, completed to inform the impact assessment for the Proposed Development upon ornithological interests.

1.1.3 This Technical Appendix is supplementary to **Technical Appendix 8.1** in **Volume 4**, and full details of the methodology, including the desk study, Study Areas and field surveys is provided within **Technical Appendix 8.1**.

2 METHODOLOGY

2.1 Background

2.1.1 The Band collision risk model (CRM) (Band *et al*., 2007[1] and SNH, 2000[2]) has been used to estimate the collision mortality risk to target species.

2.1.2 The Band CRM calculates collision mortality risks in three stages:

- Stage 1: the estimation of the number of birds passing through the rotor swept volume of the wind farm, based on observed Vantage Point (VP) flight activity data;
- Stage 2: the estimation of collision likelihood i.e. the probability of a bird flying through a rotor being hit, based on bird and wind farm parameters and whereby all collisions are assumed to be fatal. This provides an estimate of how many fatal collision could occur, in theory, should birds take no avoiding action; and
- After multiplying Stage 1 and Stage 2 an avoidance factor is then applied i.e. whereby it is assumed birds take action to avoid collision.

2.2 Wind Farm Parameters

2.2.1 The Proposed Development comprises 11 turbines, at 200 m maximum tip height, with a 122.5 m hub height, and 155 m maximum rotor diameter.

2.2.2 For the purposes of analysis, the flight risk volume (Vw) was determined based on a 290 m buffer constructed around the individual turbine locations (area = 272.45 ha) and a height at least equal to the rotor diameter (155 m). The 290 m buffer is in accordance with NatureScot guidance (SNH, 2009[3]).

2.2.3 Turbine parameters are summarised in **Table 2.1.** The proposed turbine is the 'Siemens Gamesa SG155-6.6 MW'. Where there is a lack of available specification for a parameter for that turbine type, specification for a comparable candidate turbine is used. Where this is done, the parameter is footnoted in **Table 2.1** and a rationale provided.

[1] Band, W., Madders, M. and Whitfield, D.P. (2007) *Developing field and analytical methods to assess avian collision risk at wind farms.* In De Lucas, M., Janss, G. and Ferrer, M. (eds) 'Birds and Wind Power'.
[2] SNH (2000) *Wind farms and Birds: Calculating a theoretical collision risk assuming no avoiding action*. SNH, Inverness.
[3] SNH (2009) *Guidance on Methods for Monitoring Bird Populations at Onshore Wind Farms.* Guidance Note. January 2009.

Table 2.1: Turbine parameters.

Parameter	Value	Unit
Size of Wind Farm *(290 m turbine buffer)*	272.45	ha
No. of rotors	11	-
No. of blades	3	-
Height to tip	200	metres
Hub height	122.5	metres
Rotor diameter	155	metres
Rotor radius	77.5	metres
Max chord	4.424	metres
Pitch	15	degrees
Rotation period	6.43[4]	seconds
Downtime	15	%

2.3 Viewsheds

2.3.1 Target species flight activity data for use in CRM Analysis calculations has been obtained from four VPs during VP flight activity surveys between March 2019 and February 2020, and two VPs between March and August 2020[5]. The number of VPs used was reduced due to design changes, where the initial four VPs covered areas which were no longer considered appropriate for the updated Proposed Development layout.

2.3.2 Visible areas for each VP location have been calculated using an observer height of 1.5 m and a 10 m vertical offset above the ground. The extent of the visible area that could be seen from each VP location was confirmed during a reconnaissance visit. The viewshed radius for all VPs was 2 km.

2.3.3 **Tables 2.2, 2.3 and 2.4** present the visible areas of each viewshed and that which falls within the "Study Area" constructed using a 290 m buffer around the turbines for the purpose of analysis, during Year 1 (breeding and non-breeding seasons) and Year 2 (breeding season), and as shown in **Figures 8.3a-c**[6]. In both survey years, VP viewshed coverage of the Study Area was maximised, in accordance with NatureScot guidance (SNH, 2017[7]).

[4] Based upon a maximum rotational speed of 11.20 r.p.m taken from a Siemens SWT-DD-142 3.5-4.1MW, with a conservative operating speed estimate derived as 20% of the maximum. Available at: https://www.siemensgamesa.com/en-int/-/media/siemensgamesa/downloads/en/products-and-services/archive/swt-dd-142.pdf [accessed 29/03/2022].
[5] Evolution of the Proposed Development layout meant that the four VP viewsheds used in Year 1 surveys now covered an extended area outside the Site, and subsequently two VPs were considered appropriate in Year 2 surveys, to maximise coverage.
[6] In Year 1 (breeding season) VP2 and VP3 were regularly undertaken simultaneously and due to some overlap (albeit relatively modest), as a precaution, the overlap area was included in VP2's viewshed and not VP3, so that there was no duplication of the survey of the overlap area.
[7] SNH (2017) *Recommended bird survey methods to inform impact assessment of onshore wind farms.* Version 2. March 2017.

Table 2.2: VP locations and viewshed visible areas – Year 1 (breeding season).

VP	Grid reference	Visible Area (ha) within 290 m turbine buffer
1	NJ 38321 32944	100.01
2	NJ 40410 35332	151.66
3	NJ 36952 34438	58.53
4	NJ 38923 36054	36.33

Table 2.3: VP locations and viewshed visible areas – (Year 1 non-breeding season).

VP	Grid reference	Visible Area (ha) within 290 m turbine buffer
1	NJ 38321 32944	100.01
2a	NJ 38653 35407	77.71
3	NJ 36952 34438	90.17
4	NJ 38923 36054	36.33

Table 2.4: VP locations and viewshed visible areas – Year 2 (breeding season).

VP	Grid reference	Visible Area (ha) within 290 m turbine buffer
1	NJ 38321 32944	97.61
2b	NJ 38653 35407	176.50

2.4 VP Flight Activity Data

2.4.1 Survey effort (hours) completed at each VP location between March 2019 and February 2020 (Year 1) is summarised in **Table 2.5,** and between March and August 2020 (Year 2) in **Table 2.6**. Full details of all target species flights during the VP flight activity surveys are presented in **Technical Appendix 8.1**, and are shown in **Figures 8.5a-f** in **Volume 3a** of the EIA Report.

Table 2.5: VP flight activity survey effort summary (hours) – Year 1.

VP	2019										2020		Total
	Breeding Season						Non-breeding season						
	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	
1	6	9	9	9	9	6	6	6	3	9	6	6	84
2	6	9	9	6	9	9	-	-	-	-			48
2a	-	-	-	-	-	-	6	6	6	6	6	6	36
3	6	9	9	6	9	9	6	6	6	6	6	6	84
4	6	9	9	9	9	6	6	6	6	6	6	6	84

Table 2.6: VP flight activity survey effort summary (hours) – Year 2.

VP	Breeding Season						Total
	Mar	Apr	May	Jun	Jul	Aug	
1	6	9	9	9	9	6	48
2b	6	9	9	6	9	6	48

2.5 'At risk' Flights

2.5.1 The flights of the following species were recorded as 'at risk'; common gull, hen harrier, goshawk, curlew, golden plover, pink-footed goose, peregrine, lapwing and greylag goose. 'At risk' was defined as those flights recorded within 290 m of the turbines and flying at collision risk height (i.e., between 45-200 m above ground level). Given the height bands used, this resulted in HT2-4 being included as 'at risk', as a precaution.

2.5.2 CRM Analysis was only undertaken on those species with three, or more, at risk flights, over the 18 month survey period, and accordingly the flights of common gull, hen harrier, goshawk, curlew and golden plover were analysed.

2.5.3 There are no designated sites with migratory goose (such as pink-footed goose) as qualifying species within 20 km of the Site. Therefore the Site is outside the defined core foraging range of the species (SNH, 2016[8]) from such designated sites. The pink-footed geese flights recorded are considered birds from outside designated site(s). Accordingly, CRM Analysis was not undertaken on pink-footed geese recorded during surveys.

2.5.4 Details of VP flight activity surveys of those target species flying 'at risk' are provided in **Annex 1**.

2.5.5 'At risk' flight activity recorded during the survey period for those species which were analysed using CRM is summarised in **Table 2.7**. Note, CRM Analysis was undertaken for common gull, goshawk and curlew during the breeding season in both Year 1 and Year 2, golden plover and hen harrier only during the breeding season in Year 1, and goshawk during the non-breeding season (Year 1).

Table 2.7: 'At collision risk' flight activity considered for CRM analysis.

Species	Total No. of Flights	Total No. of Birds	Total Flight Time (secs) at Collision Risk Height[9]
Golden plover[10]	3	27	3,729
Curlew	7	9	685
Common Gull	20	34	3,775
Goshawk	18	18	3,862
Hen harrier	5	6	958

[8] SNH (2016). Assessing connectivity with Special Protection Areas (SPAs). Guidance. Version 3. June 2016, SNH, Inverness.
[9] Total flight time at risk height multiplied by the number of birds.
[10] Two additional golden plover flights were also recorded during the non-breeding season, but given the low activity during the non-breeding survey period, only golden plover during the breeding season were subject to CRM Analysis.

2.6 Target Species Parameters

2.6.1 The target species parameters used to calculate the collision probability calculations for the species in **Table 2.7** are presented in **Table 2.8**. The results of the collision probability calculations are given in **Annex 2**.

Table 2.8: Target species parameters.
Most parameters are taken from the British Trust for Ornithology (BTO) Birdfacts website[11] in accordance with Provan & Whitfield (2006[12]), and avoidance rates are taken from NatureScot guidance (SNH, 2018[13]).

Species	Length (m)	Wingspan (m)	Flight Speed (m/s)	Collision Probability (%)[14]	Avoidance Rate (%)	Occupancy[15]
Common gull	0.41	1.2	11.6[16]	5.6	99.2[17]	Breeding Season (March – August).
Hen harrier	0.48	1.1	11.5	5.8	99	All year (with breeding season March – August).
Goshawk	0.55	1.1	10	6.6	98	All year (with breeding season March – August).
Curlew	0.55	0.90	13	5.6	98	Breeding Season (April – July, inclusive).
Golden plover	0.28	0.72	14	4.6	98	Breeding Season (April – July, inclusive).

3 COLLISION RISK ANALYSIS

3.1 Approach

3.1.1 Only those species with ≥3 flights at collision risk, over the 18 month survey period, were chosen for CRM Analysis, as flights below this number would be inconsequential at any population level (see also **Section 2.5**). As such, flights of common gull, hen harrier, goshawk, curlew and golden plover were subjected to CRM Analysis.

[11] https://www.bto.org/understanding-birds/birdfacts [accessed 16/11/2021].
[12] Provan, S. and Whitfield, D.P. (2006) *Avian Flight Speeds and Biometrics for Use in Collision Risk Modelling.* Unpublished Report to Scottish Natural Heritage.
[13] SNH (2018) *Avoidance rates for the onshore SNH wind farm collision risk model.* September 2018, v2.
[14] See **Annex 2**.
[15] Breeding seasons taken from SNH (2014) *Breeding season dates for key breeding species in Scotland* https://www.nature.scot/doc/bird-breeding-season-dates-scotland [accessed 29/03/2022]. The only exception was for common gull where the stated breeding season is April to August, but given common gulls were recorded during the March surveys, the breeding season is extended to March to August for the purposes of the assessment.
[16] Given flight speed for common gull is not provided in Robert (1932), this is taken as an average based on a comparable small gull species as presented in Robert B.B., (1932) On the normal flight-speed of birds. *British Birds* 25 (8), 220-222. https://britishbirds.co.uk/sites/default/files/V25_N08_P220-222_A041.pdf [accessed 31/01/2022].
[17] Taken from Furness, R.W. (2019) *Avoidance rates of herring gull, great black-backed gull and common gull for use in the assessment of terrestrial wind farms in Scotland.* Scottish Natural Heritage Research Report No. 1019.

3.1.2 The following important information is used in the CRM Analysis:

- Wind farm 'Study Area' (out to 290 m radius): 272.45 ha;
- Assumed daylight flying hours (potential): 2738.6 hrs and 1750.3 hrs[18] respectively during the Breeding Bird Season and Non-Breeding Bird Seasons';
- Downtime: 15 %;
- Latitude for approximate centre of the Site: 57.404745; and
- Lifespan of wind farm is 33 years.

3.1.3 **Table 2.9** presents the output from the CRM Analysis for the assessed species, with details of results provided in **Annex 3**. Note, given the classification of at-risk flights (all flights in HT2-4, thus 20 – >180 m) but in reality the turbine area is 45 – 200 m, these CRM Analysis results are considered to be precautionary (and represent a worst-case scenario). Results are provided for breeding seasons, unless otherwise stated.

Table 2.9: CRM Analysis results.

Species	Avoidance Rate (%)	Annual Collision Mortality			33 year Collision Mortality		
		Year 1	Year 2	Average	Year 1	Year 2	Average
Common gull	99.2	0.068	0.084	0.076	2.244	2.769	2.507
Hen harrier	99	0.105	0	0.053	3.470	0	1.735
Goshawk *Breeding* *Non-breeding*[19]	 98 "	 0.834 0.070	 0.078 -	 0.456 -	 27.534 2.312	 2.567 -	 15.051 -
Curlew	98	0.015	0.116	0.066	0.481	3.842	2.162
Golden plover	98	0.177	0	0.089	5.857	0	2.929

[18] Potentially active hours have been calculated using latitude of 57.404745 as per Forsythe, W.C., Rykiel, Jr., E.J., Stahl, R.S., Wu, H. and Schoolfield, R.M. (1995) A Model Comparison for Daylength as a Function of Latitude and Day of the Year. *Ecological modelling*, 80, 87-95, for the breeding and non-breeding seasons. The daylight hours during the breeding season for curlew and golden plover was 1913.5 hrs given occupancies stated in **Table 2.8.**
[19] Non-breeding surveys only undertaken in Year 1.

ANNEX 1 – 'AT RISK' FLIGHT ACTIVITY

Table A1-1 present 'at risk' flight activity for target species recorded during the survey period (March 2019 to August 2020); the number of birds, total flight duration and time spent at (HT2 – HT4) and below (HT1) collision risk height is presented. Note, of these, common gull, hen harrier, goshawk, curlew and golden plover were recorded in sufficient number 'at collision risk' height and considered appropriate for CRM Analysis to be carried out. 'Br' and 'Non-Br' in **Table A1-1** refers to 'Breeding' and 'Non-breeding', respectively.

Table A1-1: Target species 'at risk' flight activity (Wind Farm 'Study Area': out to 290 m radius).

Survey Year	Season	Date	VP	Species	No. of Birds	Start Time (24hrs)	Flight Duration (secs)	Time spent (secs)			
								HT1	HT2	HT3	HT4
1	Br	27/03/2019	3	Hen harrier	1	13:43	135	0	135	0	0
1	Br	28/03/2019	1	Pink-footed goose	80	11:40	90	0	0	0	90
1	Br	28/03/2019	1	Pink-footed goose	180	08:46	90	0	0	0	90
1	Br	28/03/2019	1	Pink-footed goose	90	10:21	193	0	0	0	193
1	Br	28/03/2019	4	Common gull	1	10:53	160	0	30	130	0
1	Br	28/03/2019	4	Goshawk	1	12:32	190	0	0	60	130
1	Br	08/04/2019	1	Golden plover	25	14:19	145	0	0	145	0
1	Br	08/04/2019	1	Common gull	2	19:39	180	0	180	0	0
1	Br	08/04/2019	3	Hen harrier	1	16:20	163	88	75	0	0
1	Br	08/04/2019	4	Goshawk	1	16:55	138	0	78	60	0
1	Br	08/04/2019	4	Goshawk	1	17:01	38	8	30	0	0
1	Br	08/04/2019	4	Goshawk	1	16:48	247	0	67	135	45
1	Br	10/04/2019	2	Goshawk	1	11:45	60	0	45	15	0
1	Br	10/04/2019	2	Common gull	1	11:03	126	111	15	0	0
1	Br	10/04/2019	2	Common gull	1	07:04	93	0	93	0	0
1	Br	10/04/2019	2	Common gull	3	08:43	90	0	0	90	0

Survey Year	Season	Date	VP	Species	No. of Birds	Start Time (24hrs)	Flight Duration (secs)	Time spent (secs)			
								HT1	HT2	HT3	HT4
1	Br	10/04/2019	2	Goshawk	1	10:15	172	0	30	30	112
1	Br	10/04/2019	2	Common gull	1	08:28	120	105	15	0	0
1	Br	10/04/2019	2	Goshawk	1	11:26	185	0	60	30	95
1	Br	10/04/2019	3	Hen harrier	2	11:49	255	0	30	105	120
1	Br	10/04/2019	3	Pink-footed goose	120	08:19	270	0	0	60	210
1	Br	10/04/2019	3	Goshawk	1	12:27	160	0	0	160	0
1	Br	15/04/2019	1	Goshawk	1	14:07	28	13	15	0	0
1	Br	15/04/2019	3	Golden plover	1	17:21	44	0	44	0	0
1	Br	15/04/2019	3	Hen harrier	1	16:11	178	15	163	0	0
1	Br	17/04/2019	2	Curlew	1	11:19	85	30	55	0	0
1	Br	17/04/2019	2	Goshawk	1	13:24	1544	0	90	195	1259
1	Br	15/05/2019	4	Curlew	1	10:27	40	10	30	0	0
1	Br	15/05/2019	4	Common gull	1	13:34	110	0	60	50	0
1	Br	24/05/2019	3	Curlew	1	17:43	47	17	30	0	0
1	Br	24/05/2019	3	Common gull	1	18:25	146	0	146	0	0
1	Br	25/05/2019	1	Hen harrier	1	08:13	89	14	75	0	0
1	Br	25/05/2019	1	Common gull	1	08:01	247	45	120	87	0
1	Br	17/06/2019	2	Common gull	1	13:11	65	0	65	0	0
1	Br	29/06/2019	1	Golden plover	1	09:14	60	0	0	60	0
1	Br	10/07/2019	2	Common gull	2	10:16	160	0	45	115	0
1	Br	10/07/2019	2	Common gull	2	11:28	170	30	15	125	0
1	Br	10/07/2019	2	Common gull	2	12:03	182	15	45	122	0

Survey Year	Season	Date	VP	Species	No. of Birds	Start Time (24hrs)	Flight Duration (secs)	Time spent (secs)			
								HT1	HT2	HT3	HT4
1	Br	16/08/2019	2	Goshawk	1	12:27	360	15	150	195	0
1	Non-Br	23/09/2019	1	Goshawk	1	14:29	120	0	15	105	0
1	Non-Br	22/10/2019	3	Goshawk	1	13:45	45	0	30	15	0
1	Non-Br	23/10/2019	1	Golden plover	60	10:19	120	0	75	45	0
1	Non-Br	28/11/2019	3	Peregrine	1	09:01	35	20	15	0	0
1	Non-Br	28/11/2019	3	Pink-footed goose	78	09:52	150	0	0	0	150
1	Non-Br	28/11/2019	3	Pink-footed goose	60	10:04	180	0	0	0	180
1	Non-Br	28/11/2019	3	Pink-footed goose	170	10:15	120	0	0	0	120
1	Non-Br	01/12/2019	2a	Pink-footed goose	85	08:35	160	0	0	0	160
1	Non-Br	18/12/2019	3	Golden plover	6	09:38	80	5	75	0	0
1	Non-Br	19/12/2019	1	Goshawk	1	12:50	50	0	50	0	0
1	Non-Br	31/01/2020	4	Pink-footed goose	84	10:57	90	0	0	0	90
1	Non-Br	31/01/2020	4	Pink-footed goose	32	10:22	65	0	0	0	65
1	Non-Br	18/02/2020	1	Goshawk	1	12:08	45	30	15	0	0
2	Br	20/04/2020	1	Curlew	1	16:24	94	19	75	0	0
2	Br	24/04/2020	2	Curlew	2	10:29	161	0	0	161	0
2	Br	24/04/2020	2	Goshawk	1	11:52	17	2	15	0	0
2	Br	24/04/2020	2	Goshawk	1	12:14	531	15	96	315	105
2	Br	14/05/2020	1	Lapwing	2	11:48	69	9	60	0	0
2	Br	19/05/2020	2	Common gull	1	11:38	42	0	42	0	0
2	Br	19/05/2020	2	Goshawk	1	12:04	35	5	30	0	0
2	Br	19/05/2020	2	Common gull	3	11:52	219	0	9	180	30

Survey Year	Season	Date	VP	Species	No. of Birds	Start Time (24hrs)	Flight Duration (secs)	Time spent (secs)			
								HT1	HT2	HT3	HT4
2	Br	21/05/2020	2	Curlew	1	17:16	23	0	0	0	23
2	Br	04/06/2020	1	Greylag goose	22	09:41	84	0	0	0	84
2	Br	04/06/2020	1	Greylag goose	22	09:47	117	0	0	0	117
2	Br	16/06/2020	1	Curlew	2	20:26	79	4	75	0	0
2	Br	17/06/2020	2	Common gull	2	19:47	65	0	45	20	0
2	Br	17/06/2020	2	Common gull	3	20:20	78	0	60	18	0
2	Br	18/06/2020	2	Common gull	3	05:44	63	0	45	18	0
2	Br	16/07/2020	2	Common gull	2	18:38	34	0	0	34	0
2	Br	16/07/2020	2	Common gull	1	20:16	95	15	45	35	0

ANNEX 2 – COLLISION PROBABILITY CALCULATIONS

Common gull

K: [1D or [3D] (0 or 1)	**1**		**Calculation of alpha and p(collision) as a function of radius**								
No. Blades	**3**						Upwind:			Downwind:	
Max Chord	**4.424**	m	r/R	c/C	α	collide		contribution	collide		contribution
Pitch (degrees)	**15**		radius	chord	alpha	length	p (collision)	from radius r	length	p (collision)	from radius r
Bird Length	**0.41**	m	0.025	0.575	6.13	23.07	0.93	0.00116	21.75	0.87	0.00109
Wingspan	**1.2**	m	0.075	0.575	2.04	8.13	0.33	0.00245	6.81	0.27	0.00205
F: Flapping (0) or gliding (+1)	**0**		0.125	0.702	1.23	5.95	0.24	0.00299	4.34	0.17	0.00218
			0.175	0.860	0.88	5.25	0.21	0.00370	3.28	0.13	0.00231
Bird speed	**11.6**	m/sec	0.225	0.994	0.68	4.85	0.19	0.00439	2.57	0.10	0.00233
Rotor Diam	**155**	m	0.275	0.947	0.56	4.01	0.16	0.00443	1.84	0.07	0.00203
Rotation Period	**6.43**	sec	0.325	0.899	0.47	3.41	0.14	0.00445	1.35	0.05	0.00176
			0.375	0.851	0.41	2.95	0.12	0.00445	1.00	0.04	0.00151
			0.425	0.804	0.36	2.59	0.10	0.00443	0.75	0.03	0.00128
			0.475	0.756	0.32	2.32	0.09	0.00443	0.59	0.02	0.00112
Bird aspect ratio: β	0.34		0.525	0.708	0.29	2.10	0.08	0.00444	0.48	0.02	0.00102
			0.575	0.660	0.27	1.92	0.08	0.00444	0.41	0.02	0.00096
			0.625	0.613	0.25	1.75	0.07	0.00441	0.47	0.02	0.00118
			0.675	0.565	0.23	1.60	0.06	0.00436	0.51	0.02	0.00138
			0.725	0.517	0.21	1.47	0.06	0.00428	0.54	0.02	0.00156
			0.775	0.470	0.20	1.34	0.05	0.00419	0.55	0.02	0.00172
			0.825	0.422	0.19	1.23	0.05	0.00407	0.56	0.02	0.00185
			0.875	0.374	0.18	1.12	0.04	0.00394	0.56	0.02	0.00197
			0.925	0.327	0.17	1.01	0.04	0.00378	0.55	0.02	0.00206
			0.975	0.279	0.16	0.92	0.04	0.00359	0.54	0.02	0.00213
				Overall p(collision) =			**Upwind**	**7.8%**		**Downwind**	**3.3%**
								Average	**5.6%**		

Hen harrier

K: [1D or [3D] (0 or 1)	**1**		**Calculation of alpha and p(collision) as a function of radius**									
No. Blades	**3**						Upwind:				Downwind:	
Max Chord	**4.424**	m	r/R	c/C	α	collide		contribution	collide		contribution
Pitch (degrees)	**15**		radius	chord	alpha	length	p (collision)	from radius r	length	p (collision)	from radius r
Bird Length	**0.48**	m	0.025	0.575	6.07	22.26	0.90	0.00113	20.95	0.85	0.00106
Wingspan	**1.1**	m	0.075	0.575	2.02	7.86	0.32	0.00239	6.54	0.27	0.00199
F: Flapping (0) or gliding (+1)	**0**		0.125	0.702	1.21	5.78	0.23	0.00293	4.17	0.17	0.00212
			0.175	0.860	0.87	5.13	0.21	0.00364	3.16	0.13	0.00224
Bird speed	**11.5**	m/sec	0.225	0.994	0.67	4.75	0.19	0.00433	2.47	0.10	0.00226
Rotor Diam	**155**	m	0.275	0.947	0.55	3.93	0.16	0.00438	1.76	0.07	0.00196
Rotation Period	**6.43**	sec	0.325	0.899	0.47	3.34	0.14	0.00440	1.28	0.05	0.00169
			0.375	0.851	0.40	2.93	0.12	0.00445	0.98	0.04	0.00149
			0.425	0.804	0.36	2.63	0.11	0.00453	0.79	0.03	0.00136
			0.475	0.756	0.32	2.38	0.10	0.00458	0.65	0.03	0.00125
Bird aspect ratio: β	0.44		0.525	0.708	0.29	2.17	0.09	0.00461	0.54	0.02	0.00116
			0.575	0.660	0.26	1.98	0.08	0.00462	0.49	0.02	0.00115
			0.625	0.613	0.24	1.82	0.07	0.00461	0.55	0.02	0.00138
			0.675	0.565	0.22	1.67	0.07	0.00457	0.58	0.02	0.00160
			0.725	0.517	0.21	1.54	0.06	0.00452	0.61	0.02	0.00179
			0.775	0.470	0.20	1.41	0.06	0.00444	0.62	0.03	0.00196
			0.825	0.422	0.18	1.30	0.05	0.00433	0.63	0.03	0.00211
			0.875	0.374	0.17	1.19	0.05	0.00421	0.63	0.03	0.00224
			0.925	0.327	0.16	1.08	0.04	0.00406	0.62	0.03	0.00234
			0.975	0.279	0.16	0.98	0.04	0.00390	0.61	0.02	0.00243
				Overall p(collision) =			**Upwind**	**8.1%**		**Downwind**	**3.6%**
								Average	**5.8%**		

Goshawk

K: [1D or [3D] (0 or 1)	**1**		**Calculation of alpha and p(collision) as a function of radius**									
No. Blades	**3**						Upwind:				Downwind:	
Max Chord	**4.424**	m	r/R	c/C	α	collide		contribution	collide		contribution
Pitch (degrees)	**15**		radius	chord	alpha	length	p (collision)	from radius r	length	p (collision)	from radius r
Bird Length	**0.55**	m	0.025	0.575	5.28	19.45	0.91	0.00113	18.13	0.85	0.00106
Wingspan	**1.1**	m	0.075	0.575	1.76	6.92	0.32	0.00242	5.60	0.26	0.00196
F: Flapping (0) or gliding (+1)	**0**		0.125	0.702	1.06	5.13	0.24	0.00299	3.53	0.16	0.00206
			0.175	0.860	0.75	4.59	0.21	0.00375	2.62	0.12	0.00214
Bird speed	**10**	m/sec	0.225	0.994	0.59	4.28	0.20	0.00449	2.00	0.09	0.00210
Rotor Diam	**155**	m	0.275	0.947	0.48	3.58	0.17	0.00459	1.41	0.07	0.00181
Rotation Period	**6.43**	sec	0.325	0.899	0.41	3.14	0.15	0.00476	1.08	0.05	0.00164
			0.375	0.851	0.35	2.81	0.13	0.00491	0.86	0.04	0.00150
			0.425	0.804	0.31	2.54	0.12	0.00503	0.70	0.03	0.00138
			0.475	0.756	0.28	2.31	0.11	0.00513	0.58	0.03	0.00129
Bird aspect ratio: β	0.50		0.525	0.708	0.25	2.12	0.10	0.00520	0.60	0.03	0.00147
			0.575	0.660	0.23	1.95	0.09	0.00524	0.66	0.03	0.00177
			0.625	0.613	0.21	1.80	0.08	0.00526	0.70	0.03	0.00204
			0.675	0.565	0.20	1.67	0.08	0.00526	0.72	0.03	0.00228
			0.725	0.517	0.18	1.55	0.07	0.00523	0.74	0.03	0.00250
			0.775	0.470	0.17	1.43	0.07	0.00517	0.75	0.03	0.00270
			0.825	0.422	0.16	1.32	0.06	0.00509	0.74	0.03	0.00287
			0.875	0.374	0.15	1.22	0.06	0.00498	0.74	0.03	0.00301
			0.925	0.327	0.14	1.12	0.05	0.00485	0.72	0.03	0.00313
			0.975	0.279	0.14	1.03	0.05	0.00469	0.71	0.03	0.00322
				Overall p(collision) =			**Upwind**	**9.0%**		**Downwind**	**4.2%**
								Average	**6.6%**		

Curlew

K: [1D or [3D] (0 or 1)	**1**		**Calculation of alpha and p(collision) as a function of radius**									
No. Blades	**3**						Upwind:				Downwind:	
Max Chord	**4.424**	m	r/R	c/C	α	collide		contribution	collide		contribution
Pitch (degrees)	**15**		radius	chord	alpha	length	p (collision)	from radius r	length	p (collision)	from radius r
Bird Length	**0.55**	m	0.025	0.575	6.87	23.71	0.85	0.00106	22.39	0.80	0.00100
Wingspan	**0.9**	m	0.075	0.575	2.29	8.34	0.30	0.00225	7.03	0.25	0.00189
F: Flapping (0) or gliding (+1)	**0**		0.125	0.702	1.37	6.16	0.22	0.00276	4.55	0.16	0.00204
			0.175	0.860	0.98	5.47	0.20	0.00344	3.50	0.13	0.00220
Bird speed	**13**	m/sec	0.225	0.994	0.76	5.07	0.18	0.00409	2.79	0.10	0.00225
Rotor Diam	**155**	m	0.275	0.947	0.62	4.17	0.15	0.00412	2.00	0.07	0.00198
Rotation Period	**6.43**	sec	0.325	0.899	0.53	3.61	0.13	0.00421	1.55	0.06	0.00181
			0.375	0.851	0.46	3.19	0.11	0.00429	1.24	0.04	0.00167
			0.425	0.804	0.40	2.86	0.10	0.00436	1.02	0.04	0.00155
			0.475	0.756	0.36	2.58	0.09	0.00440	0.85	0.03	0.00145
Bird aspect ratio: β	0.61		0.525	0.708	0.33	2.35	0.08	0.00443	0.73	0.03	0.00137
			0.575	0.660	0.30	2.15	0.08	0.00443	0.64	0.02	0.00131
			0.625	0.613	0.27	1.97	0.07	0.00442	0.57	0.02	0.00127
			0.675	0.565	0.25	1.81	0.06	0.00439	0.58	0.02	0.00141
			0.725	0.517	0.24	1.67	0.06	0.00433	0.62	0.02	0.00161
			0.775	0.470	0.22	1.53	0.05	0.00426	0.64	0.02	0.00179
			0.825	0.422	0.21	1.41	0.05	0.00417	0.66	0.02	0.00195
			0.875	0.374	0.20	1.29	0.05	0.00406	0.66	0.02	0.00209
			0.925	0.327	0.19	1.18	0.04	0.00393	0.66	0.02	0.00221
			0.975	0.279	0.18	1.08	0.04	0.00378	0.66	0.02	0.00231
				Overall p(collision) =			**Upwind**	**7.7%**		**Downwind**	**3.5%**
								Average	**5.6%**		

Golden plover

K: [1D or [3D] (0 or 1)	**1**		**Calculation of alpha and p(collision) as a function of radius**									
No. Blades	**3**						Upwind:				Downwind:	
Max Chord	**4.424**	m	r/R	c/C	α	collide		contribution	collide		contribution
Pitch (degrees)	**15**		radius	chord	alpha	length	p (collision)	from radius r	length	p (collision)	from radius r
Bird Length	**0.28**	m	0.025	0.575	7.39	24.15	0.80	0.00101	22.84	0.76	0.00095
Wingspan	**0.72**	m	0.075	0.575	2.46	8.49	0.28	0.00212	7.17	0.24	0.00179
F: Flapping (0) or gliding (+1)	**0**		0.125	0.702	1.48	6.30	0.21	0.00263	4.69	0.16	0.00196
			0.175	0.860	1.06	5.63	0.19	0.00328	3.66	0.12	0.00213
Bird speed	**14**	m/sec	0.225	0.994	0.82	5.22	0.17	0.00392	2.94	0.10	0.00221
Rotor Diam	**155**	m	0.275	0.947	0.67	4.29	0.14	0.00393	2.12	0.07	0.00194
Rotation Period	**6.43**	sec	0.325	0.899	0.57	3.62	0.12	0.00393	1.57	0.05	0.00170
			0.375	0.851	0.49	3.12	0.10	0.00390	1.17	0.04	0.00147
			0.425	0.804	0.43	2.73	0.09	0.00386	0.89	0.03	0.00126
			0.475	0.756	0.39	2.40	0.08	0.00380	0.67	0.02	0.00106
Bird aspect ratio: β	0.39		0.525	0.708	0.35	2.16	0.07	0.00377	0.53	0.02	0.00094
			0.575	0.660	0.32	1.94	0.06	0.00372	0.43	0.01	0.00083
			0.625	0.613	0.30	1.76	0.06	0.00366	0.35	0.01	0.00074
			0.675	0.565	0.27	1.59	0.05	0.00357	0.29	0.01	0.00066
			0.725	0.517	0.25	1.44	0.05	0.00347	0.31	0.01	0.00075
			0.775	0.470	0.24	1.30	0.04	0.00335	0.34	0.01	0.00088
			0.825	0.422	0.22	1.17	0.04	0.00321	0.36	0.01	0.00099
			0.875	0.374	0.21	1.05	0.03	0.00305	0.37	0.01	0.00108
			0.925	0.327	0.20	0.93	0.03	0.00288	0.38	0.01	0.00116
			0.975	0.279	0.19	0.83	0.03	0.00268	0.37	0.01	0.00121
				Overall p(collision) =			**Upwind**	**6.6%**		**Downwind**	**2.6%**
								Average	**4.6%**		

ANNEX 3 – COLLISION RISK MODEL ANALYSIS

Common gull (Year 1 – breeding season)

VP	Watch data			Flying time (s)	Flying time hahr-1	Weighted flying time ha hr^-1	
	Area (ha)	Time (hrs)	HaHr	Risk height	Risk height	Weighting	Risk height
1	100.01	48.0	4800.48	264.82	0.0000153235	0.288604161	0.0000044224
2	151.66	48.0	7279.68	320.24	0.0000122196	0.437653306	0.0000053479
3	58.53	48.0	2809.44	38.70	0.0000038267	0.168903125	0.0000006463
4	36.33	48.0	1743.84	74.96	0.0000119403	0.104839408	0.0000012518
Totals	346.53	192.0	16633.44	698.72	0.0000433101	1.0000000000	0.0000116685

Mean activity hr^-1 in wind farm				WIND FARM DATA			
Risk height	0.00318	0.3179 %		Wind farm area (ha)	272.45		
Daylight hours			2738.6				
Downtime			15	0.85		D	155.0
Vw =			422297500			L + d	4.834
Vr =			1002842	No. of turbines	11	R	77.5
Vr/Vw =			0.0023747				
Speed			11.6				
Vw Occupancy =			8.706	31342.5			
Vr Occupancy =			0.021	74.4			
Transit time =			0.417				
Transits =			178.607				
Collision probability from NatureScot sheet			0.056				
Collisions with no avoidance			10.002				

Collisions with 99.2% avoidance	0.080				
Collisions with 99.2% avoidance & downtime	0.068				
33 year mortality	2.641				
33 year mortality with 15% downtime etc	2.244				
Years for 1 death	14.703				

Common gull (Year 2 – breeding season)

VP	Watch data			Flying time (s)	Flying time hahr-1	Weighted flying time ha hr^-1	
	Area (ha)	Time (hrs)	HaHr	Risk height	Risk height	Weighting	Risk height
1	97.61	48.0	4685.28	0.00	0.0000000000	0.356097917	0.0000000000
2b	176.50	48.0	8472.00	681.85	0.0000223563	0.643902083	0.0000143952
Totals	274.11	96.0	13157.28	681.85	0.0000223563	1.0000000000	0.0000143952
Mean activity hr^-1 in wind farm				**WIND FARM DATA**			
Risk height	0.00392	0.3922 %		**Wind farm area (ha)**	272.45		

Daylight hours	2738.6			
Downtime	15	0.85	**D**	155.0
Vw =	422297500		**L + d**	4.834
Vr =	1002842	**No. of turbines**	11	**R**	77.5
Vr/Vw =	0.0023747			
Speed	11.6			
Vw Occupancy =	10.741	38666.7		
Vr Occupancy =	0.026	91.8		

Transit time =	0.417				
Transits =	220.344				
Collision probability from NatureScot sheet	0.056				
Collisions with no avoidance	12.339				
Collisions with 99.2 % avoidance	0.099				
Collisions with 99.2 % avoidance & downtime	0.084				
33 year mortality	3.258				
33 year mortality with 15 % downtime etc	2.769				
Years for 1 death	11.918				

Curlew (Year 1 – breeding season)

VP	Watch data			Flying time (s)	Flying time hahr-1	Weighted flying time ha hr^-1	
	Area (ha)	Time (hrs)	HaHr	Risk height	Risk height	Weighting	Risk height
1	100.01	36.0	3600.36	0.00	0.0000000000	0.303968674	0.0000000000
2	151.66	33.0	5004.78	7.68	0.0000004264	0.422540063	0.0000001802
3	58.53	33.0	1931.49	44.88	0.0000064547	0.163070486	0.0000010526
4	36.33	36.0	1307.88	1.94	0.0000004114	0.110420777	0.0000000454
Totals	346.53	138.0	11844.51	54.50	0.0000072924	1.0000000000	0.0000012782
Mean activity hr^-1 in wind farm				**WIND FARM DATA**			
Risk height	0.00035	0.0348 %		**Wind farm area (ha)**	272.45		

Daylight hours	1913.5			
Downtime	15	0.85	**D**	155.0

Vw =	422297500			**L + d**	4.974
Vr =	1031886	**No. of turbines**	11	**R**	77.5
Vr/Vw =	0.0024435				
Speed	13				
Vw Occupancy =	0.666	2398.9			
Vr Occupancy =	0.002	5.9			
Transit time =	0.383				
Transits =	15.320				
Collision probability from NatureScot sheet	0.056				
Collisions with no avoidance	0.858				
Collisions with 98 % avoidance	0.017				
Collisions with 98 % avoidance & downtime	0.015				
33 year mortality	0.566				
33 year mortality with 15 % downtime etc	0.481				
Years for 1 death	68.566				

Curlew (Year 2 – breeding season)

VP	Watch data			Flying time (s)	Flying time hahr-1	Weighted flying time ha hr^-1	
	Area (ha)	Time (hrs)	HaHr	Risk height	Risk height	Weighting	Risk height
1	97.61	36.0	3513.96	30.52	0.0000024129	0.356097917	0.0000008592
2b	176.50	36.0	6354.00	331.94	0.0000145113	0.643902083	0.0000093438
Totals	274.11	72.0	9867.96	362.46	0.0000169241	1.0000000000	0.0000102031

Mean activity hr^-1 in wind farm				**WIND FARM DATA**			
Risk height	0.00278	0.2780 %		**Wind farm area (ha)**	272.45		
Daylight hours			1913.5				
Downtime			15	0.85		**D**	155.0
Vw =			422297500			**L + d**	4.974
Vr =			1031886	**No. of turbines**	11	**R**	77.5
Vr/Vw =			0.0024435				
Speed			13				
Vw Occupancy =			5.319	19149.1			
Vr Occupancy =			0.013	46.8			
Transit time =			0.383				
Transits =			122.292				
Collision probability from NatureScot sheet			0.056				
Collisions with no avoidance			6.848				
Collisions with 98 % avoidance			0.137				
Collisions with 98 % avoidance & downtime			0.116				
33 year mortality			4.520				
33 year mortality with 15 % downtime etc			3.842				
Years for 1 death			8.589				

Hen harrier (Year 1 – breeding season)

VP	Watch data			Flying time (s)	Flying time hahr-1	Weighted flying time ha hr^-1	
	Area (ha)	Time (hrs)	HaHr	Risk height	Risk height	Weighting	Risk height
1	100.01	48.0	4800.48	73.97	0.0000042804	0.288604161	0.0000012353
2	151.66	48.0	7279.68	0.00	0.0000000000	0.437653306	0.0000000000
3	58.53	48.0	2809.44	767.75	0.0000759101	0.168903125	0.0000128214
4	36.33	48.0	1743.84	0.00	0.0000000000	0.104839408	0.0000000000
Totals	346.53	192.0	16633.44	841.73	0.0000801904	1.0000000000	0.0000140568

Mean activity hr^-1 in wind farm				WIND FARM DATA			
Risk height	0.00383	0.3830 %		Wind farm area (ha)	272.45		
Daylight hours			1913.5				
Downtime			15	0.85		D	155.0
Vw =			422297500			L + d	4.904
Vr =			1017364	No. of turbines	11	R	77.5
Vr/Vw =			0.0024091				
Speed			11.5				
Vw Occupancy =			10.488	37757.5			
Vr Occupancy =			0.025	91.0			
Transit time =			0.426				
Transits =			213.309				
Collision probability from NatureScot sheet			0.058				
Collisions with no avoidance			12.372				
Collisions with 99 % avoidance			0.124				
Collisions with 99 % avoidance & downtime			0.105				
33 year mortality			4.083				
33 year mortality with 15 % downtime etc			3.470				
Years for 1 death			9.509				

Golden plover (Year 1 – breeding season)

VP	Watch data			Flying time (s)	Flying time hahr-1	Weighted flying time ha hr^-1	
	Area (ha)	Time (hrs)	HaHr	Risk height	Risk height	Weighting	Risk height
1	100.01	36.0	3600.36	684.77	0.0000528319	0.303968674	0.0000160593
2	151.66	33.0	5004.78	0.00	0.0000000000	0.422540063	0.0000000000
3	58.53	33.0	1931.49	64.96	0.0000093428	0.163070486	0.0000015235
4	36.33	36.0	1307.88	0.00	0.0000000000	0.110420777	0.0000000000
Totals	346.53	138.0	11844.51	749.73	0.0000621748	1.0000000000	0.0000175828

Mean activity hr^-1 in wind farm				WIND FARM DATA			
Risk height	0.00479	0.4790 %		Wind farm area (ha)	272.45		
Daylight hours			1913.5				
Downtime			15	0.85		D	155.0
Vw =			422297500			L + d	4.704
Vr =			975872	No. of turbines	11	R	77.5
Vr/Vw =			0.0023109				
Speed			14				

Vw Occupancy =	9.166	32999.4			
Vr Occupancy =	0.021	76.3			
Transit time =	0.336				
Transits =	226.956				
Collision probability from NatureScot sheet	0.046				
Collisions with no avoidance	10.440				
Collisions with 98 % avoidance	0.209				
Collisions with 98 % avoidance & downtime	0.177				
33 year mortality	6.890				
33 year mortality with 15 % downtime etc	5.857				
Years for 1 death	5.634				

Goshawk (Year 1 – breeding season)

VP	Watch data			Flying time (s)	Flying time hahr-1	Weighted flying time ha hr^-1	
	Area (ha)	Time (hrs)	HaHr	Risk height	Risk height	Weighting	Risk height
1	100.01	48.0	4800.48	30.68	0.0000017755	0.288604161	0.0000005124
2	151.66	48.0	7279.68	2550.24	0.0000973119	0.437653306	0.0000425889
3	58.53	48.0	2809.44	212.01	0.0000209619	0.168903125	0.0000035405
4	36.33	48.0	1743.84	581.64	0.0000926498	0.104839408	0.0000097134
Totals	346.53	192.0	16633.44	3374.57	0.0002126991	1.0000000000	0.0000563552

Mean activity hr^-1 in wind farm				**WIND FARM DATA**	
Risk height	0.01535	1.5354 %		**Wind farm area (ha)**	272.45

Daylight hours	2738.6				
Downtime	15	0.85		**D**	155.0
Vw =	422297500			**L + d**	4.974
Vr =	1031886	**No. of turbines**	11	**R**	77.5
Vr/Vw =	0.0024435				
Speed	10				
Vw Occupancy =	42.048	151374.2			
Vr Occupancy =	0.103	369.9			
Transit time =	0.497				
Transits =	743.634				
Collision probability from NatureScot sheet	0.066				
Collisions with no avoidance	49.080				
Collisions with 98 % avoidance	0.982				
Collisions with 98 % avoidance & downtime	0.834				
33 year mortality	32.393				
33 year mortality with 15% downtime etc	27.534				
Years for 1 death	1.199				

Goshawk (Year 2 – breeding season)

VP	Watch data			Flying time (s)	Flying time hahr-1	Weighted flying time ha hr^-1	
	Area (ha)	Time (hrs)	HaHr	Risk height	Risk height	Weighting	Risk height
1	97.61	48.0	4685.28	0.00	0.0000000000	0.356097917	0.0000000000

2b	176.50	48.0	8472.00	248.89	0.0000081605	0.643902083	0.0000052546
Totals	274.11	96.0	13157.28	248.89	0.0000081605	1.0000000000	0.0000052546

Mean activity hr^-1 in wind farm				**WIND FARM DATA**			
Risk height	0.00143	0.1432 %		**Wind farm area (ha)**	272.45		
Daylight hours			2738.6				
Downtime			15	0.85		**D**	155.0
Vw =			422297500			**L + d**	4.974
Vr =			1031886	**No. of turbines**	11	**R**	77.5
Vr/Vw =			0.0024435				
Speed			10				
Vw Occupancy =			3.921	14114.2			
Vr Occupancy =			0.010	34.5			
Transit time =			0.497				
Transits =			69.337				
Collision probability from NatureScot sheet			0.066				
Collisions with no avoidance			4.576				
Collisions with 98 % avoidance			0.092				
Collisions with 98 % avoidance & downtime			0.078				
33 year mortality			3.020				
33 year mortality with 15 % downtime etc			2.567				
Years for 1 death			12.854				

Goshawk (Year 1 – non-breeding season)

VP	Watch data			Flying time (s)	Flying time hahr-1	Weighted flying time ha hr^-1	
	Area (ha)	Time (hrs)	HaHr	Risk height	Risk height	Weighting	Risk height
1	100.01	36.0	3600.36	184.08	0.0000142026	0.328742358	0.0000046690
2a	77.71	36.0	2797.56	0.00	0.0000000000	0.255440142	0.0000000000
3	90.17	36.0	3246.12	107.80	0.0000092249	0.296397344	0.0000027342
4	36.33	36.0	1307.88	0.00	0.0000000000	0.119420156	0.0000000000
Totals	304.22	144.0	10951.92	291.89	0.0000234275	1.0000000000	0.0000074032

Mean activity hr^-1 in wind farm				**WIND FARM DATA**			
Risk height	0.00202	0.2017 %		**Wind farm area (ha)**	272.45		
Daylight hours			1750.3				
Downtime			15	0.85		**D**	155.0
Vw =			422297500			**L + d**	4.974
Vr =			1031886	**No. of turbines**	11	**R**	77.5
Vr/Vw =			0.0024435				
Speed			10				
Vw Occupancy =			3.530	12709.4			
Vr Occupancy =			0.009	31.1			
Transit time =			0.497				
Transits =			62.435				
Collision probability from NatureScot sheet			0.066				
Collisions with no avoidance			4.121				
Collisions with 98 % avoidance			0.082				

Collisions with 98 % avoidance & downtime	0.070				
33 year mortality	2.720				
33 year mortality with 15% downtime etc	2.312				
Years for 1 death	14.275				

Technical Appendix 9: Hydrology, Hydrogeology and Geology

TA 9.1: Watercourse Crossing Assessment

TA 9.2: Groundwater Dependent Terrestrial Ecosystems (GWDTEs)

TA 9.3: Private Water Supplies Assessment

TA 9.1: Watercourse Crossing Assessment

Technical Appendix 9.1: Watercourse Crossing Assessment

1.1 Introduction

1.1.1 As part of the Environmental Impact Assessment (EIA) process, it was identified that several new watercourse crossings would be required associated with access tracks for the Proposed Development This Technical Appendix has been produced in order to meet the requirements of the Water Framework Directive (WFD)[1] as set out below.

1.1.2 The purpose of this Technical Appendix is to provide a conceptual assessment of watercourse crossings and to outline the strategic approach to proposed crossings. This Technical Appendix does not comment on the detailed engineering design. Post-consent of the Proposed Development, the Principal Contractor (the 'Contractor') would have overall responsibility for designing water crossings, for the production of a final Watercourse Crossing Plan and for compliance with Controlled Activity Regulations (CAR)[2] and the Scottish Environment Protection Agency's (SEPA) good practice guidance[3].

1.1.3 Following the provision of the proposed design layout of the Site, an email response from Susan Haslam of SEPA (response received 27 August 2021, Ref.: 2312 - ECU00002177 Craig Watch Wind Farm SEPA consultation) (Technical Appendix 1.1) stated that:

"as there are no significant watercourse crossings required – so we would be content with an approach whereby the EIA Report simply committed to all crossings being oversized bottomless arched culverts or traditional style bridges, with no further baseline watercourse information required."

1.1.4 This Technical Appendix identifies the locations of proposed crossings and sets out the general principles of design which the Contractor would be required to follow in order to minimise changes to the hydrological regime and reduce any potential impacts on river morphology and aquatic ecology, without detailed baseline assessment of watercourses.

1.2 Legislation

1.2.1 The principal legislation with regard to the water environment is provided by the WFD which aims to protect and enhance the quality of surface freshwater (including lakes, rivers and streams), groundwater, Groundwater Dependent Terrestrial Ecosystems (GWDTEs), estuaries and coastal waters. The key objectives of the WFD relevant to this assessment are:

- to prevent deterioration and enhance aquatic ecosystems; and
- to establish a framework of protection of surface freshwater and groundwater.

1.2.2 The WFD has been transposed into Scottish legislation as the Water Environment and Water Services (Scotland) Act 2003 (WEWS Act)[4], which gives Scottish Ministers powers to introduce regulatory controls over water activities, in order to protect, improve and promote sustainable use of Scotland's water environment. The water environment includes wetlands, rivers, lochs, transitional waters (estuaries), coastal waters and groundwater. The CAR[2] came into force in 2011 and has since been amended in 2013 and 2017.

1.2.3 SEPA is the public body responsible for environmental protection in Scotland under both the Environment Act 1995 and the WEWS Act. Many SEPA policies relating to water are now delivered by the regulatory methods produced to implement the CAR. The CAR mean it is an offence to undertake the following activities with regard to watercourse crossings without an authorisation under the CAR:

- Discharges to all wetlands, surface waters and groundwaters (replacing the Control of Pollution Act 1974);
- Impoundments (dams and weirs) of rivers, lochs, wetlands and transitional waters; and
- Undertaking of engineering works in inland waters and wetlands.

1.2.4 Any proposed access track water crossings would therefore require authorisation under the CAR. This Technical Appendix takes into account guidance provided by SEPA with regards to the implementation of CAR[5].

1.2.5 In particular, Section 6 of the Water Environment Regulation Practical Guide[5] sets out that CAR requires authorisation for the carrying out of building or engineering works, or works other than impounding works in:

- Inland surface water (other than groundwater) or wetland; or
- In the vicinity of inland water or wetlands and having, or likely to have, a significant adverse impact on the water environment.

1.2.6 In order to allow for proportionate regulation based on the risk an activity poses to the water environment, there are three types of CAR authorisation: general binding rules, registrations and licences.

1.2.7 The SEPA Position Statement on Culverting of Watercourses (WAT-PS-06-02)[6] and Supporting Guidance on Sediment Management (WAT-SG-78)[7] have also been taken into account within this Technical Appendix, along with the supporting guidance provided in the River Crossings Good Practice Guide[8].

1.3 Identification of Watercourse Crossing Locations

1.3.1 Following a desk based review of surface water features (based on OS 1:10,000 mapping and aerial imagery), the desk based identification of surface water features was followed up with a site walkover which was conducted by Ramboll in March and July 2021. These field surveys of likely crossings, based on the proposed alignment of the Proposed Development, have been used to determine various watercourse characteristics in order to identify the likely level of CAR authorisation required. A total of two potential watercourse crossings and two field drain crossings were identified and are presented in Figure 9.1.1.

1 The Water Framework Directive (WFD) (2000/60/EC)

2 Water Environment (Controlled Activities) (Scotland) Regulations 2011 (as amended) (CAR)

3 Scottish Government and SEPA, 2010. Engineering in the water environment: good practice guide: River crossings Version 2.

4 UK Government, 2003. Water Environment and Water Services (Scotland) Act 2003. Online: Available at: untitled (legislation.gov.uk) [accessed 17/02/2022]

5 SEPA (2019). The Water Environment (Controlled Activities) (Scotland) Regulations 2011 (as amended): A Practical Guide, Version 8.4, October 2019, https://www.sepa.org.uk/media/34761/car_a_practical_guide.pdf [accessed 17/02/2022]

6 SEPA (2015), SEPA Position Statement to support the implementation of the Water Environment (Controlled Activities) (Scotland) Regulations 2011: WAT-PS-06-02: Culverting of Watercourses Position Statement and Supporting Guidance. Version 2.0, June 2015. https://www.sepa.org.uk/media/150919/wat_ps_06_02.pdf [Last accessed January 2022]

7 SEPA (2012), Supporting Guidance (WAT-SG-78) Sediment Management Authorisation (replacing WAT-PS-06-03), Version 1, December 2012, https://www.sepa.org.uk/media/151062/wat-sg-78.pdf [Last accessed January 2022]

8 SEPA (2010), Engineering in the water environment: good practice guide: River crossings. Second edition, November 2010 https://www.sepa.org.uk/media/151036/wat-sg-25.pdf [Last accessed January 2022]

Table 9.1.1: Watercourse Crossing Identification				
WCC ID	Crossing Category	Description	Grid Reference	
			X	Y
WC1	New Crossing	Field Drain	336866	833064
WC2	New Crossing	Field Drain	337017	833229
WC3	New Crossing	Watercourse	338186	834051
WC4	Upgrade	Watercourse	339715	835217

1.4 Type of Crossing

1.4.1 Watercourse characteristics, both physical and ecological, will be matched to the most appropriate crossing type as part of detailed design. The potential crossing types typically considered are described below:

- Single span structures: recommended where there is a need to minimise disturbance to the bank and bed of the watercourse. Where it is possible to set back abutments from the watercourse, it is possible to maintain bank habitats under the crossing. Taking into account the maximum width of crossings to be undertaken on the Proposed Development, it is not anticipated that in-stream supports would be necessary at any crossings. Such crossings include half barrel culverts with a sufficient span to incorporate the existing bed and banks of watercourses;
- Bottomless Box/ Arches[9]: can be used where there are watercourses narrower than those appropriate for bridge construction, but which have a requirement to provide mammal and/ or fish passage and ensure sufficient hydraulic capacity during peak flow periods. Arches minimise disruption to the stream bed. Box culverts may incorporate mammal ledges and can be buried below stream bed level to enable bed material replacement;
- Circular Culverts: where potential impact is negligible due to the size, location or typology of the watercourse, circular culverts can be embedded into the channel to allow the natural bed to re-establish and, where necessary, provision can be made for mammals adjacent to the culvert. Where a circular culvert is utilised, it is assumed that neither natural bed material, nor water velocity nor depth are critical other than in the purely hydraulic sense; and
- Porous granular rock fill blanket and perforated pipes – where there is no clearly defined channel flow, flow can be maintained by a drainage blanket wrapped in geotextile placed below the road construction. Where such a crossing structure is utilised, flow is predominantly sub-surface interflow and a porous fill below the track provides flow continuity without concentrating the discharges into a narrow channel.

1.4.2 It is noted that SEPA has requested that either bottomless culverts or single span bridges be the preferred options for watercourses wherever feasible.

1.5 Levels of CAR Authorisation

General Binding Rules

1.5.1 General Binding Rules (GBRs) represent a set of mandatory rules which cover specific low risk activities. Activities complying with the rules do not require an application to be made to SEPA, as compliance with a GBR is considered to be compliance with an authorisation.

1.5.2 SEPA uses its statutory role in the land use planning system to highlight GBRs that may apply to a given proposal. The individual GBRs are described in more detail in the appropriate regime-specific sections of the Water Environment Regulation Practical Guide. The GBRs are numbered according to Schedule 3 of the CAR.

Registrations

1.5.3 Registrations allow for the registration of small-scale activities that individually pose low environmental risk but, cumulatively, can result in greater environmental risk. The Contractor must apply to SEPA to register these activities. A registration will include details of the scale of the activity and its location, and there will be a number of conditions of registration that must be complied with.

Licences

1.5.4 These allow for site-specific conditions to be set to protect the water environment from activities that pose a higher risk. Licences can cover linked activities on a number of sites over a wide area, as well as single or multiple activities on a single site. SEPA has simple licences and complex licences for activities.

1.5.5 A key feature of CAR licences, unlike GBRs and registrations, is that they require an applicant to nominate a 'responsible person' (i.e., an individual/ partnership/ company) to be held accountable for securing compliance with the terms of the licence.

1.6 Proposed Development Likely Levels of CAR Authorisation

1.6.1 Based on assessment of the watercourses crossed by proposed access tracks it is anticipated that the following levels of authorisation would be required under CAR:

Table 9.1.2: Likely Levels of CAR Authorisation				
WCC ID	Likely Level of CAR Authorisation	Basis of CAR Assessment	X	Y
WC1	Registration	Field drain with a width <2 m. A circular culvert may be required due to the small size of the field drain. However, as the drain width is <2 m the threshold for which a licence would be required would not be met.	336866	833064
WC2	Registration	Field drain with a width <2 m. A circular culvert may be required due to the small size of the field drain. However, as the drain width is <2m the threshold for which a licence would be required would not be met.	337017	833229
WC3	Registration	No construction on watercourse bed as a bottomless culvert would be proposed in accordance with SEPA requirements and ≤20 m of total bank affected	338186	834051
WC4	Registration	No construction on watercourse bed as a bottomless culvert would be proposed in accordance with SEPA requirements and ≤20 m of total bank affected	339715	835217

1.7 Watercourse Crossings

1.7.1 The detailed design of each watercourse crossing would seek to ensure hydraulic conveyance is maintained to prevent any restriction of flows, as well as allowing the free passage of mammals and aquatic ecology. Therefore, it is proposed each crossing would have sufficient capacity to convey the climate change-adjusted 1:200-year flood including an allowance for potential partial blockage.

[9] Assessment of the suitability of culverting of watercourses and anticipated choice of culverting method follows WAT-PS-06-02: Culverting of Watercourses - Position Statement and Supporting Guidance. Available at: https://www.sepa.org.uk/media/150919/wat_ps_06_02.pdf [accessed 17/022022]

Anticipated watercourse crossing types are specified in Table 9.1.3 below. For the watercourses identified (WC 3 & 4) an Open Bottomed Single Span culvert is the most likely design option. For the two field drains which are of much smaller size, such a design is less likely to be feasible.

1.7.2 Flow calculations would be undertaken by the Contractor in order to inform detailed design and applications for CAR authorisation. Should any new crossings be identified, consideration would be given to any local variations in channel dimensions and to bankside conditions. Where feasible within micro-siting allowances, the narrowest locations would be selected, and the stability of the channel banks considered.

1.7.3 Design of closed culverts would ensure that bed level and slope would be maintained and that the culvert outfall would be designed such that bed scour would be minimised.

1.7.4 Splash boards and runoff diversion measures, including silt fencing adjacent and parallel to watercourses beneath crossings, would be used at all crossings during construction to prevent direct siltation of watercourses and would be delivered via means of a detailed Construction Environmental Management Plan (CEMP) to be prepared by the Contractor post-consent. An Outline CEMP (OCEMP) is included in Technical Appendix 2.1: OCEMP setting out the principles for the protection of water quality during construction.

Table 9.1.3: Anticipated Watercourse Crossing Type

WCC ID	Crossing Category	Description	Likely Crossing Type	Justification
WC1	New Crossing	Field Drain	Circular Culvert*	Limited potential hydraulic or ecological impact
WC2	New Crossing	Field Drain	Circular Culvert*	Limited potential hydraulic or ecological impact
WC3	New Crossing	Watercourse	Open Bottomed Single Span	Minimise disturbance to bed and banks, ensure 1:200 flow capacity, maintain fish passage.
WC4	Upgrade	Watercourse	Open Bottomed Single Span	Minimise disturbance to bed and banks, ensure 1:200 flow capacity, maintain fish passage.

*A bottomless culvert is unlikely to be feasible due to the small size of these field drains which are not considered to be watercourses

1.8 Track Drainage

1.8.1 To ensure that all drainage measures employed during the construction phase of the Proposed Development are maintained appropriately and remain effective, the performance of the drainage measures would be monitored. The drainage management works would, therefore, be supervised by the Environmental Clerk of Works (ECoW). All monitoring and supervision of the drainage management works would be recorded. An OCEMP is included in Technical Appendix 2.1 setting out the principles for the protection of water quality during construction. It is also anticipated that the Site would be subject to a construction site license (the Proposed Development incorporates a road or track length in excess of 5 km) and preparation of suitable materials for such a licence would be undertaken by the Contractor.

1.8.2 Greenfield 'clean' runoff and track runoff should be kept separate, where possible, and be channelled separately to suitably vegetated areas at least 50 m from watercourses to allow for the settlement of solids. Silt traps or settlement lagoons would be utilised and monitored to ensure stored surface water would be kept to a minimum.

1.8.3 Cross drains would be installed at regular intervals along trackside drainage. Cross drains would be installed as pipe culverts under the track surface. The frequency of cross drains should increase in areas where higher flows are anticipated such as in areas of high surface flow (e.g. flushes or low-lying areas); where bank seepages are noted; and where historical or active drains are intercepted. Requirements for a temporary silt trap at each end of a cross drain would be assessed prior to the works being undertaken.

1.8.4 Pipe culverts used for cross drainage would be long enough so that road fill would not extend beyond the end of a culvert. Pipes would be laid at grades at least 2% (1:50) but no greater than 10% (1:10) and angled 30º to 45º cross-track to improve inlet efficiency. Check dams would be installed immediately above a cross drain inlet and silt traps are required at the inlet points to prevent blockage of the pipe due to silt build up.

Legend

- Site Boundary
- Proposed Turbine
- Proposed Turbine Hardstanding
- Proposed Temporary Construction Compound (CC)
- Proposed Substation
- Proposed Met Mast
- Proposed Met Mast Hardstanding
- Proposed Borrow Pit Search Area
- Proposed New Track
- Proposed Existing Track Upgrade
- Proposed Emergency Vehicle Access
- Proposed Turning Head
- New Watercourse Crossing
- Upgraded Watercourse Crossing
- Field Drain Crossing

Figure Title

Figure 9.1.1: Watercourse Crossing Locations

Project Name

Craig Watch Wind Farm
EIA Report

Project Number	Figure No.
1620010178	9.1.1
Date	Prepared By
May 2022	AB
Scale	Issue
1:22,500 @A3	1

Client

Craig Watch Wind Farm Limited

RAMBOLL

0 500 1,000 Metres

Coordinate System: British National Grid. Projection: Transverse Mercator. Datum: OSGB 1936.