AI Appendix 8F
Population Viability Analysis Report

Lewis Wind Power

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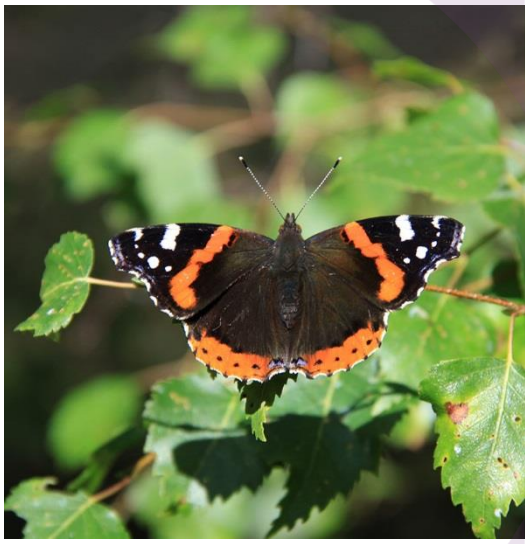
Stornoway Wind Farm Ltd

Stornoway Wind Farm

Additional Information

Chapter 8 Ornithology

Appendix 8F Population Viability Analysis



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Report for

Grant Folley
Development Manager
Stornoway Wind Farm
C/O EDF Renewables

Main contributors

Colin Ormston

Issued by

[redacted]

Colin Ormston

Approved by

[redacted]

Ian Simms

Wood

Partnership House
Regent Farm Road
Gosforth
Newcastle upon Tyne NE3 3AF
United Kingdom
Tel +44 (0) 191 272 6100

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Document revisions

No.	Details	Date
1	Draft Report	15/12/2019
2	Final Report	18/02/2020

Executive summary

Purpose of this report

Stornoway Wind Farm Limited (the Applicant) is proposing to construct and operate a wind farm currently anticipated to comprise up to 35 turbines with a generating capacity in excess of 50MW on the site of the existing consented (but not yet built) Stornoway Wind Farm. The Consented Stornoway Wind Farm gained section 36 consent and planning permission in September 2012 (Stornoway Wind Farm 2012) and in 2015 an application was made to amend this consent with regard to the layout, output and size of the wind turbines, this being granted in spring 2016 (Stornoway Wind Farm Variation 2016), with turbine tip heights of 145m and a turbine rotor diameter of 128m. The site of the consented Stornoway Wind Farm is located to the south west of the town of Stornoway on the Isle of Lewis and centred on National Grid Reference (NGR) E137149, N933373.

The current application (Proposed Development) would comprise a revised layout, with turbine tip heights of approximately 156m and 180m and turbine rotor diameters of 136m and 150m respectively.

Changes to the consented wind farm layout and / or turbine specifications could potentially have implications on the existing assessed ornithological impacts of the wind farm. Furthermore, the status of the baseline bird populations and flight activity patterns will have potentially changed since the original application. Therefore, a comprehensive suite of survey work was initiated in October 2017 and continued until September 2019 to provide two years baseline information.

This Appendix forms part of Chapter 8 Ornithology of the Additional Information (**AI**) submitted in support of the **EIA** for the Proposed Development and supersedes **EIA Appendix 8G** of that submission. In this Appendix population viability analysis (PVA) is used to compare expected bird population sizes with and without additional mortality (attributable to the Proposed Development) to the end of the expected life of the project, either alone, or in combination with other projects.

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1. Introduction

1.1 Background

1.1.1 Stornoway Wind Farm Limited has submitted an application under section 36 of the Electricity Act (1989) (as amended) to construct and operate a wind farm currently anticipated to comprise up to 35 turbines with a generating capacity in excess of 50MW on the site of the consented Stornoway Wind Farm Variation 2016. The application for the proposed wind farm scheme is hereafter referred to as the 'Proposed Development'.

1.1.2 The consented Stornoway Wind Farm 2012 gained section 36 consent and deemed planning permission in September 2012 to construct and operate 36 wind turbines. In May 2015, an application was made under the Electricity Act 1989 to amend this consent with regard to the layout, output and size of the wind turbines, with this being granted in spring 2016. Stornoway Wind Farm currently has a consented maximum generating capacity of 180MW, with each turbine having an output of up to 5MW. A further direction to extend the commencement of development date to 06 September 2020 was granted in June 2017.

1.1.3 The site of the consented Stornoway Wind Farm 2016 (hereafter referred to as the 'Site') is located to the south west of the town of Stornoway on the Isle of Lewis and centred on National Grid Reference (NGR) E137149, N933373.

1.1.4 The Proposed Development comprises a revised layout, with turbine tip heights of approximately 156m and 180m and turbine rotor diameters of potentially 136m and 150m respectively. The proposed blade tip heights and rotor diameters would maximise potential renewable energy generation at the Site.

1.1.5 Changes to the consented wind farm layout and / or turbine specifications could potentially have implications on the existing assessed ornithological impacts of the wind farm. Furthermore, the status of the baseline bird populations and flight activity patterns will have potentially changed since the original application. Therefore, a comprehensive suite of survey work was initiated in October 2017 and continued until September 2019 to provide two years baseline information.

1.1.6 This Appendix forms part of **Chapter 8 Ornithology** of the Additional Information (**AI**) submitted in support of the **EIA** for the Proposed Development. In this Appendix population viability analysis (PVA) is used to compare expected bird population sizes with and without additional mortality (attributable to the Proposed Development) to the end of the expected life of the project, either alone, or in combination with other projects – the output of which is known as the counterfactual of population size.

1.1.7 The demographic model requires initial numbers of animals in a starting year, estimates of age of first breeding (attaining adulthood), the probability that an individual will survive and remain within the population from one year to the next, and estimates of breeding productivity. The survival and breeding productivity rates are referred to as demographic rates. Demographic rates may vary between age classes, among individuals of a given age class, as well as in different years.

1.1.8 Models for the Western Isles golden eagle and white-tailed eagle populations were derived from PVA carried out by Natural Research (2019).

1.1.9 It should be noted that none of the models incorporated density dependence, i.e. reductions in survival and/or productivity as populations expand. Any attempt at incorporating density dependent processes into these models can be nothing other than speculation because:

- There is no data on likely maximum population sizes and population densities at which density dependent processes would become apparent;
- There is no data on how density dependence would be manifested or if it would be the same for all species;
- There is no information on how the two expanding eagle populations in particular, would interact with each other. Would inter-specific competition become a significant factor in the population dynamics of both species?

1.1.10 Natural Research (2019) noted that while density dependence cannot be realistically modelled in the absence of reliable information about mechanisms it is reasonable to conclude that these unconstrained 25 year estimates will not be achieved, even in the absence of wind farm collisions. Therefore, if collisions have the effect of decreasing the growth rates compared with a no-collision scenario it is likely that the overall effect will be less than that predicted by these models because the extra mortality would delay or reduce density dependent processes that would suppress the 25 year growth. The caveat to this conclusion is that it would only apply in those scenarios in which the probability of a significant negative effect, in the presence of wind farm collisions, was not predicted.

2. Golden Eagle: Western Isles Population Cumulative PVA

2.1 Model Parameters

2.1.1 The model was built around a number of age classes – for golden eagle this was based on five age classes (four juvenile/sub-adult and one adult class). Sub-adults are defined in these models as individuals less than the usual first age of breeding (although there may be a small number that breed earlier). Only the adult class is assumed to fledge young in this model.

2.1.2 Age classes were s0 (fledged-1 year), s1 (1-2 years), s2 (2-3 years), s3 (3-4 years), and Adults (4+ years old).

2.1.3 The most recent, and comprehensive, assessment of the Western Isles golden eagle population was undertaken as part of the 2015 national survey. Occupancy and productivity data can be found in Challis et al (2016), and this data forms the baseline for this assessment. Although there are earlier and later data sets available collected as part of the Scottish Raptor Monitoring Scheme, these are much less comprehensive because 2015 was a national survey year.

- Challis et al (2016) provides a figure of 95 occupied ranges (69 on Lewis and Harris and 26 on the Uists);
- The mean fledging rate from the three national surveys (1982, 1992 and 2003) was 0.33. The estimate in 2015 was only 0.28 but this seems to have been a particularly poor year in many regions and SRMS data for 2016 and 2017 suggests much better years although the survey effort may have been biased towards productive pairs. The NHZ mean for 2013-2017, using SRMS data, was 0.44 (119 fledged from 272 range/years). These productivity estimates include both sexes. Population growth is modelled using a precautionary worst-case scenario of 0.33. The models described below are female-based, as it is female productivity that drives a population trajectory and assume a 50% sex ratio at fledging and the observed fledging rates are therefore halved in the models;
- Survivorship values are unknown. Whitfield et al (2006) identified minimum values consistent with favourable conservation status. If these are used in the population models the results should be conservative since these rates represent minimum acceptable values. The models are female-based and assume that survival rates are the same for each sex. It is also assumed that survival rates are the same for the four juvenile/sub-adult classes at 0.795. This equates to a 40% survival from fledging to adulthood (0.7954 = 0.3995). The annual survival rate for adults is 0.9512, an expected average of 20 years of territory occupation by an adult.

2.2 Cumulative Predicted Collision Risk

2.2.1 The annual predicted collision rate for the Proposed Development was derived by summing the predicted breeding and non-breeding collision rates for Year 1 (September 2017-August 2018: 0.161 predicted collisions per year) and Year 2 (September 2018 – August 2019: 0.453 predicted collisions per year) presented within **AI Appendix 8E** separately then calculating the average of the two figures (0.307 predicted collisions per year).

2.2.2 The collision rates for all existing consented and operational wind farms on Lewis and Harris was added to that of the combined average annual predicted collision rate from the Proposed

Development (**Table 8F.2.1**) and the total was applied to a simple deterministic population model over a 25 year period, with calculations presented in **Annex A**.

Table 8F.2.1 Cumulative Assessment: Western Isles Golden Eagle

Wind farm Site	Number of turbines	Status	Distance from Proposed Development (km)	Predicted annual mortality
Stornoway	35	Proposed	0.0	0.307
Beinn Greidaig	3	Operational	0.4	0.02
Pentland Road	6	Operational	0.7	0.08
Arnish	3	Operational	1.9	0.00
Creed	1	Operational	2.0	0.00
Bridge cottages	1	Operational	3.1	0.00
Horshader	1	Operational	16.1	0.00
Muaitheabhal	33	Consented	16.6	0.268
Druim Leathann	14	Consented	16.6	0.02
Baile an Truseil	3	Operational	16.8	0.00
North Tolsta	1	Operational	17.0	0.00
Muaitheabhal East and South Extensions	12	Consented	17.0	0.236
Monan	3	Operational	33.2	0.044
Loch Carnan	3	Operational	102	0.06
Cumulative annual mortality				**1.036**

2.3 Model Results

2.3.1 In the absence of any additional mortality, and with a constant fledging rate of 0.33, the model predicts that there would be 129 pairs of golden eagle in the Western Isles in 25 years' time. This is an increase of 36 pairs over the 2015 estimate and 48 pairs over the 2003 population.

2.3.2 With an assumed additional loss of 1.036 birds per year as a result of collisions with turbines (assumed to all be breeding adults as a worst-case scenario) the population is still predicted to rise, albeit at a slower rate, to 105 pairs over the course of a 25 year period.

3. Hen Harrier: Isle of Lewis PVA

3.1 Model Parameters

3.1.1 The models described below are female based, as it is female productivity that drives a population trajectory and assumes a 50% sex ratio at fledging. All reference to fledging rates discussed below and in the model thus relate to the number of females fledged per occupied site.

3.1.2 Age classes were s0 (fledged-1 year), s1 (1-2 years) and Adults (2+ years old), and it is assumed that both females in S1 and adult age classes will attempt to breed. Although the model allows for different fledging rates in the adult and 1-2 years age class, it is assumed that the fledging rate is the same for both age classes.

3.1.3 A review by Fielding et al (2011) found that fledging rates varied across the thirteen Natural Heritage Zones (NHZ's) in Scotland from 0.36 to 2.00 females, with an average of 0.838. Data collected from breeding attempts from the population on the Isle of Lewis over the period 2015 – 2019 indicates a mean fledging rate at the lower end of the spectrum, of 0.47 females fledged per occupied site (**Table 8F.3.1**), a figure influenced by the poor year of 2019, where only one out of seven nests monitored successfully fledging young. Only one year, 2018, provides a similar rate of females fledged to the national average.

Table 8F.3.1 Cumulative Assessment: Western Isles Hen Harrier

	Pairs known to lay eggs	Minimum number of young fledged	Annual Productivity (both sexes)
2015	1	1	1
2016	4	2	0.5
2017	0	0	0
2018	5	9	1.8
2019	7	4	0.57

3.1.4 The most recent survey of the Isle of Lewis hen harrier population is presented in **AI Appendix 8B** and **AI Appendix 8C** and covers the 2019 breeding season. Data indicates that there were nine proven breeding attempts and one probable breeding attempt. Therefore the model assumes that the starting population stands at ten breeding females.

3.1.5 Survival rates for hen harriers in 'other [non-grouse] moorland' has been reported at 0.361 (95% confidence limits 0.281-0.632) for s0 and 0.778 (0.570-0.984) for s1 and Adults (Etheridge *et al* 1997).

3.2 Model Results

3.2.1 In the absence of any additional mortality, and with an average female fledging rate of 0.47, the model predicts that there would be 16 adult and 5 s1 females on the Isle of Lewis in 25 years' time. The population increases to 24 adult and 8 s1 females if the national average female fledging rate of 0.838 is applied to the model instead - calculations are presented in **Annex B.**

3.2.2 With an assumed additional loss of 0.145 birds per year (**AI Appendix 8E**) as a result of collisions with turbines (assumed to all be breeding adult females as a worst-case scenario) and using a fledging rate of 0.47, the population is predicted to increase to 13 adult and 4 s1 females in 25 years' time. The population increases to 20 adult and 6 s1 females if the national average female fledging rate of 0.838 is applied to the model instead.

4. Red-throated Diver: Lewis Peatlands SPA Population PVA

4.1 Collision Risk Modelling

4.1.1 This section presents the approach taken to providing a collision risk estimate for the red-throated diver population associated with the Lewis Peatlands SPA which can then be applied to a PVA for this population. It follows the same approach as that taken in 2018, using observations collected from Focal Watch (FW) surveys to provide data for input into a Regular Collision Risk Model (CRM). The regular modelling method for birds with predictable flight activity such as divers travelling from breeding lochans to feed at sea or on larger water bodies requires the calculation of the number of birds flying through the turbine rotor swept area.

4.1.2 The 2018 surveys identified five active red-throated diver breeding locations, four of which fell within the survey area (see **EIA Appendix 8D**). Of the three sites within the SPA that were monitored, two were located to the west of the Proposed Development, and one to the North.

4.1.3 In 2019, eight breeding attempts were recorded, five of which fell within the survey area (**AI Appendix 8C**). One was considered to be a failed late breeding attempt, and no FW surveys were established at this location, leaving four breeding attempts where FW surveys were undertaken. Of the three breeding attempts within the SPA that were monitored, two were located to the west of the Proposed Development, and one to the North.

4.1.4 Three of the monitored breeding attempts in 2019 took place at the same locations used in 2018. The fourth breeding attempt monitored in in 2019 was c750m from the closest 2018 breeding location, and it was assumed that this was the same pair. Although red-throated diver can change nesting locations between years it was apparent that there was a degree of site fidelity regarding breeding locations across the 2018 and 2019 breeding season. In both years, a single site (used in both years), located within the Proposed Development fell outside of the SPA. However, it was deemed precautionary to assume that all pairs monitored in 2018 and 2019 would be associated with the SPA population in some years.

4.1.5 Therefore a Regular CRM was carried out using data collected from FW surveys for four breeding attempts in 2018 and four breeding attempts in 2019, using the parameters of the Proposed Development. By way of comparison it also provides Regular CRM results using the turbine parameters of the consented Stornoway Wind Farm Variation 2016 and using the data collected in 2018 and 2019.

Methodology

4.1.6 The approach to regular CRM follows that described in **Appendix AI 8E.**

Selection of Flights

4.1.7 The first step was to identify the risk window relevant for red-throated diver. This was defined as 'a window of width equal to the width of the wind farm perpendicular to the general flight direction of the birds' (SNH, 2000). The length of the risk window also includes for a 50 m micro-siting allowance plus an additional 75 m either side to allow for the radius of the rotor blade. **Table 8F.4.1** presents the risk window selected for red-throated diver and the number of turbines within that risk window whilst the relevant risk window is illustrated in **AI Figure 8F.4.1, (Annex C).**

4.1.8 Calculations of available active time were based on the appropriate season (**AI Appendix 8E**), and survey effort covered FW locations monitored across 2018 and 2019. As a precautionary measure, the total number of birds recorded during Focal Watch surveys at PCH within a 500m buffer of the wind farm polygon was included for analysis, regardless of whether it actually crossed the risk window or not (**AI Figure 8F.4.1**).

4.1.9 Full details of all flights included in the random CRM models and details of CRM calculations are presented in **Annex C**. Note that the data and model for the 2018 breeding season is re-presented due to it being apparent that there was a mis-calculation in the model presented in **EIA Appendix 8D**.

Table 8F.4.1 Lewis Peatlands SPA Red-throated Diver: Number of Birds Observed Passing through Risk Window

Season	Period	Scheme	Risk window (m)	Number of turbines	Total number flights	Total number birds	Total number birds at PCH
Breeding	2018	Proposed	6,052	35	143	174	153
		Consented	6,123	36	143	174	173
	2019	Proposed	6,052	35	137	183	162
		Consented	6,123	36	137	183	181

Model Parameters

4.1.10 The same turbine and bird parameters used in **AI Appendix 8E** were included in the Regular CRM.

Results

4.1.11 A summary of the CRM results is shown in **Table 8F.4.2** below, whilst details of model calculations are presented in **Annex C**.

Table 8F.4.2 Predicted Collision Rates for Lewis Peatlands SPA: Red-throated Diver

Avoidance Rate %	Potential collisions	Proposed Development			Consented Development		
		2018	2019	Combined average	2018	2019	Combined average
99.5	Per year	0.559	0.360	**0.460**	0.587	0.373	**0.480**
	Over 25 years	13.98	8.99	**11.49**	14.69	9.33	**12.01**

4.2 Lewis Peatlands SPA PVA

4.2.1 The combined average predicted collision rate from the Proposed Development for the Lewis Peatlands SPA red-throated diver population was applied to a simple deterministic population model over a 25 year period, with calculations presented in **Annex D**.

4.2.2 Population model parameters were as follows (the same parameters as those used in the Consented Stornoway Wind Farm Variation 2016):

- Age classes were s0 (fledged-1 year), s1 (1-2 years), and adults (2+ years old);
- SPA breeding population size at the start of the model is assumed to be:
  - Adults – 156 individuals;
  - s1 – 33 individuals;
  - s0 – 47 individuals.
- Background adult survival rate is 0.84 (figure from Hemmingsson & Eriksson 2002);
- Background survival rate for fledglings and non-breeding individuals is 0.75 (figure derived from Viking Wind Farm and from Hemmingsson & Eriksson 2002[1]); and
- Fledging rate is 0.6 young per pair per year.

Results

4.2.3 In the absence of any additional mortality, and with a constant fledging rate of 0.6, the model predicts that there would be 93 pairs of red-throated diver within the Lewis Peatlands SPA in 25 years' time. This is an increase of 15 pairs over the existing cited SPA population.

4.2.4 With an assumed additional loss of 0.46 birds per year as a result of collisions with turbines (assumed to all be breeding adults as a worst-case scenario) the population is still predicted to rise to 87 pairs and 39 non-breeding individuals over the course of a 25 year period.

4.3 Lewis Peatlands SPA Cumulative PVA

4.3.1 The collision rates for all existing consented and operational wind farms on Lewis and Harris was added to that of the combined average predicted collision rate from the Proposed Development (**Table 8F.4.3**) and the total was applied to a simple deterministic population model over a 25 year period, with calculations presented in **Annex D**.

Table 8F.4.3 Cumulative Assessment: Western Isles Red-throated Diver

Wind farm Site	Number of turbines	Status	Distance from Proposed Development (km)	Predicted annual mortality
Stornoway	35	Proposed	0.0	0.46
Beinn Greidaig	3	Operational	0.4	0.09
Pentland Road	6	Operational	0.7	0.00
Arnish	3	Operational	1.9	0.00
Creed	1	Operational	2.0	0.00

[1] The rate provided by Hemmingsson and Eriksson (2002) for survival of red-throated diver, 0.37 to age two, would result in the UK population declining rapidly. The rate used for the analysis here is less pessimistic than this, but more pessimistic than the figure presented within the Viking Wind Farm ES. The survival rate is that estimated by D. Okil for the Shetland red-throated diver population and provided by SNH (NB. This estimate is used for birds from 0.1 to two years old to be precautionary).

Wind farm Site	Number of turbines	Status	Distance from Proposed Development (km)	Predicted annual mortality
Bridge cottages	1	Operational	3.1	0.00
Horshader	1	Operational	16.1	0.00
Muaitheabhal	33	Consented	16.6	0.00
Druim Leathann	14	Consented	16.6	0.00
Baile an Truseil	3	Operational	16.8	0.00
North Tolsta	1	Operational	17.0	0.00
Muaitheabhal East and South Extensions	12	Consented	17.0	0.02
Monan	3	Operational	33.2	0.00
Cumulative annual mortality				0.57

Results

4.3.2 In the absence of any additional mortality, and with a constant fledging rate of 0.6, the model predicts that there would be 93 pairs of red-throated diver within the Lewis Peatlands SPA in 25 years' time. This is an increase of 15 pairs over the existing cited SPA population.

4.3.3 With a predicted additional cumulative loss of 0.57 birds per year as a result of collisions with turbines (assumed to all be breeding adults as a worst-case scenario) the population is still predicted to rise to 86 pairs and 38 non-breeding individuals over the course of a 25 year period.

5. White-tailed Eagle: Western Isles Population Cumulative PVA

5.1 Model Parameters

5.1.1 The model was built around a number of age classes – for white-tailed eagle this was based on five age classes (five juvenile/sub-adult and one adult class). Sub-adults are defined in these models as individuals less than the usual first age of breeding (although there may be a small number that breed earlier). Only the adult class is assumed to fledge young in this model.

5.1.2 Age classes were s0 (fledged-1 year), s1 (1-2 years), s2 (2-3 years), s3 (3-4 years), s4 (4-5 years) and Adults (5+ years old).

5.1.3 The number of breeding pairs of white-tailed eagles has been increasing quite rapidly in recent years. For example, nationally there were 42 pairs in 2007 but 128 pairs by 2018 (Challis et al 2018). Although the national population is almost certainly the appropriate scale for modelling white-tailed eagles a conservative approach modelling the potential impacts on the Western Isles population is described here. The rationale for a national, rather than a regional model, is based on the findings of Whitfield et al (2009) who examined natal dispersal rates in the Scottish population meaning that it is very unlikely that birds breeding on the Outer Hebrides are isolated from other populations. Therefore, a model restricted to the Western Isles is very conservative. The most recent SRMS report records a minimum of 32 pairs in the Western Isles in 2018 (Challis et al 2018).

5.1.4 The mean national productivity was recorded by Evans et al (2009) was 0.76. SRMS data records that 139 Western Isles pairs fledged 130 young over the period 2012-2017 giving a pooled estimate of 0.94. However, 2013 seems to have been a very productive year (1.58), compared with 2016 which was a poor year (0.55). An estimate of 0.76 is considered conservative for the Western Isles and is that used as the mean fledging rate for this model. This productivity estimate includes both sexes. The models described below are female-based, as it is female productivity that drives a population trajectory and assume a 50% sex ratio at fledging and the observed fledging rates are therefore halved in the models.

5.1.5 Survival rates are those for wild bred birds presented in Evans *et al* (2009) and are shown in **Table 8F.5.1**

Table 8F.5.1 Survival Rates: White-tailed Eagle

Age	0 – 1 years	1 – 2 years	1 – 2 years	2 – 3 years	3 – 4 years	4 – 5 years
Survival rate	0.819	0.821	0.857	0.951	0.966	0.966

5.2 Cumulative Predicted Collision Risk

5.2.1 The annual predicted collision rate for the Proposed Development was derived by summing the predicted breeding and non-breeding collision rates for Year 1 (September 2017-August 2018: 0.582 predicted collisions per year) and Year 2 (September 2018 – August 2019: 0.686 predicted collisions per year) presented within **AI Appendix 8E** separately then calculating the average of the two figures (0.634 predicted collisions per year).

5.2.2 The collision rates for all existing consented and operational wind farms on Lewis and Harris was added to that of the combined average annual predicted collision rate from the Proposed Development (**Table 8F.5.2**) and the total was applied to a simple deterministic population model over a 25 year period, with calculations presented in **Annex E**.

Table 8F.5.2 Cumulative Assessment: Western Isles White-tailed Eagle

Wind farm Site	Number of turbines	Status	Distance from Proposed Development (km)	Predicted annual mortality
Stornoway	35	Proposed	0.0	0.634
Beinn Greidaig	3	Operational	0.4	0.00
Pentland Road	6	Operational	0.7	0.00
Arnish	3	Operational	1.9	0.00
Creed	1	Operational	2.0	0.00
Bridge cottages	1	Operational	3.1	0.00
Horshader	1	Operational	16.1	0.00
Muaitheabhal	33	Consented	16.6	0.08
Druim Leathann	14	Consented	16.6	0.00
Baile an Truseil	3	Operational	16.8	0.00
North Tolsta	1	Operational	17.0	0.00
Muaitheabhal East and South Extensions	12	Consented	17.0	0.37
Monan	3	Operational	33.2	0.06
Loch Carnan	3	Operational	102	0.04
Cumulative annual mortality				**1.184**

5.3 Model Results

5.3.1 In the absence of any additional mortality, and with a constant fledging rate of 0.38, the model predicts that there would be 318 pairs of white-tailed eagles in the Western Isles in 25 years' time, an increase of 286 pairs. This would mean, including young birds, something approaching 1,000 white-tailed eagles active in the Western Isles or more than one eagle per 3 km^2.

5.3.2 With an assumed additional loss of 1.184 birds per year as a result of collisions with turbines (assumed to all be breeding adults as a worst-case scenario) the population is still predicted to rise, albeit at a slower rate, to 233 pairs over the course of a 25 year period.

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Annex A
Western Isles: Golden Eagle PVA

A.1 Western Isles: Golden Eagle Cumulative PVA

Fledging rate (Female)	Survival Rate: adult	Survival Rate:s0 to s3	Additional annual mortality
0.165	0.9512	0.795	1.036

Background Model - no additional mortality

	Adults	s3	s2	s1	s0
Year 0	95.0	8.0	11.0	13.0	17.0
Year 1	96.7	8.7	10.3	13.5	14.9
Year 2	99.0	8.2	10.7	11.9	15.2
Year 3	100.7	8.5	9.4	12.1	15.5
Year 4	102.5	7.5	9.6	12.3	15.8
Year 5	103.5	7.6	9.8	12.6	16.1
Year 6	104.5	7.8	10.0	12.8	16.2
Year 7	105.6	7.9	10.2	12.9	16.4
Year 8	106.8	8.1	10.3	13.0	16.6
Year 9	108.0	8.2	10.4	13.2	16.8
Year 10	109.2	8.2	10.5	13.3	16.9
Year 11	110.4	8.3	10.6	13.5	17.1
Year 12	111.7	8.4	10.7	13.6	17.3
Year 13	112.9	8.5	10.8	13.8	17.5
Year 14	114.2	8.6	11.0	13.9	17.7
Year 15	115.4	8.7	11.1	14.1	17.9
Year 16	116.7	8.8	11.2	14.2	18.1
Year 17	118.0	8.9	11.3	14.4	18.3
Year 18	119.3	9.0	11.5	14.6	18.5
Year 19	120.7	9.1	11.6	14.7	18.7
Year 20	122.0	9.2	11.7	14.9	18.9
Year 21	123.4	9.3	11.8	15.1	19.2
Year 22	124.8	9.4	12.0	15.2	19.4
Year 23	126.2	9.5	12.1	15.4	19.6
Year 24	127.6	9.6	12.2	15.6	19.8
Year 25	129.0	9.7	12.4	15.7	20.0

Additional mortality

	Adults	s3	s2	s1	s0
Year 0	95.0	8.0	11.0	13.0	17.0
Year 1	95.7	8.7	10.3	13.5	14.9
Year 2	96.9	8.2	10.7	11.9	15.0
Year 3	97.7	8.5	9.4	11.9	15.2
Year 4	98.7	7.5	9.5	12.1	15.3
Year 5	98.8	7.5	9.6	12.2	15.5
Year 6	98.9	7.6	9.7	12.3	15.5
Year 7	99.2	7.7	9.8	12.3	15.5
Year 8	99.4	7.8	9.8	12.3	15.6
Year 9	99.7	7.8	9.8	12.4	15.6
Year 10	100.0	7.8	9.8	12.4	15.6
Year 11	100.3	7.8	9.9	12.4	15.7
Year 12	100.6	7.8	9.9	12.5	15.7
Year 13	100.9	7.9	9.9	12.5	15.8
Year 14	101.2	7.9	9.9	12.5	15.8
Year 15	101.5	7.9	10.0	12.6	15.9
Year 16	101.8	7.9	10.0	12.6	15.9
Year 17	102.1	8.0	10.0	12.7	16.0
Year 18	102.4	8.0	10.1	12.7	16.0
Year 19	102.7	8.0	10.1	12.7	16.1
Year 20	103.0	8.0	10.1	12.8	16.1
Year 21	103.3	8.0	10.2	12.8	16.2
Year 22	103.6	8.1	10.2	12.9	16.2
Year 23	104.0	8.1	10.2	12.9	16.3
Year 24	104.3	8.1	10.2	12.9	16.3
Year 25	104.6	8.1	10.3	13.0	16.4

Annex B
Isle of Lewis: Hen Harrier PVA

B.1 Isle of Lewis: Hen Harrier PVA

Fledging rate (Female)	Survival rate: adult and s1	Survival rate: s0	Additional mortality
0.47	0.778	0.361	0.145

Background Model - no additional mortality

	Adults	s1	s0
Year 0	10.0	3.0	8.0
Year 1	10.1	2.9	8.9
Year 2	10.1	3.2	8.9
Year 3	10.4	3.2	9.0
Year 4	10.6	3.3	9.2
Year 5	10.8	3.3	9.4
Year 6	11.0	3.4	9.6
Year 7	11.2	3.5	9.8
Year 8	11.4	3.5	10.0
Year 9	11.6	3.6	10.2
Year 10	11.8	3.7	10.3
Year 11	12.1	3.7	10.5
Year 12	12.3	3.8	10.7
Year 13	12.5	3.9	10.9
Year 14	12.8	4.0	11.2
Year 15	13.0	4.0	11.4
Year 16	13.2	4.1	11.6
Year 17	13.5	4.2	11.8
Year 18	13.8	4.3	12.0
Year 19	14.0	4.3	12.3
Year 20	14.3	4.4	12.5
Year 21	14.6	4.5	12.7
Year 22	14.8	4.6	13.0
Year 23	15.1	4.7	13.2
Year 24	15.4	4.8	13.5
Year 25	15.7	4.9	13.7

Additional mortality

	Adults	s1	s0
Year 0	10.0	3.0	8.0
Year 1	10.0	2.9	8.9
Year 2	9.9	3.2	8.8
Year 3	10.0	3.2	8.8
Year 4	10.1	3.2	9.0
Year 5	10.2	3.2	9.0
Year 6	10.3	3.3	9.1
Year 7	10.4	3.3	9.2
Year 8	10.5	3.3	9.3
Year 9	10.6	3.4	9.4
Year 10	10.7	3.4	9.5
Year 11	10.9	3.4	9.6
Year 12	11.0	3.5	9.7
Year 13	11.1	3.5	9.8
Year 14	11.2	3.5	9.9
Year 15	11.3	3.6	10.0
Year 16	11.4	3.6	10.1
Year 17	11.6	3.7	10.2
Year 18	11.7	3.7	10.3
Year 19	11.8	3.7	10.5
Year 20	12.0	3.8	10.6
Year 21	12.1	3.8	10.7
Year 22	12.2	3.9	10.8
Year 23	12.4	3.9	10.9
Year 24	12.5	3.9	11.1
Year 25	12.7	4.0	11.2

Annex C
Lewis Peatlands SPA: red-throated Diver CRM

C.1. Lewis Peatlands SPA: Red-throated Diver CRM – Figure 8F.4.1

134000 135000 136000 137000 138000 139000 140000 141000

936000 935000 934000 933000 932000 931000 930000

N

Key

- Development site boundary
- CRZ
- Wind turbine 180m to blade tip
- Wind turbine 156m to blade tip
- Beinn Grideag wind turbine
- Pentland road wind turbine
- FW Flightline at height band A
- FW Flightline at height band B and C
- FW Flightline at height band D
- Risk window

0 0.5 1 1.5 km

Scale at A3: 1:25,000

Client

Lewis Wind Power
Cumhachd Gaoithe

Stornoway Wind Farm
Additional Information

AI Figure 8F.4.1a
Red-throated diver: Clipped FW flights included in CRM – Breeding (April-August 2018)

January 2020

wood.

40001-Gos542a

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134000 135000 136000 137000 138000 139000 140000 141000

936000 935000 934000 933000 932000 931000 930000

Key

- Development site boundary
- CRZ
- Wind turbine 180m to blade tip
- Wind turbine 156m to blade tip
- Beinn Grideag wind turbine
- Pentland road wind turbine
- FW Flightline at height band A
- FW flightline at height band B and C
- FW flightline at height band D
- Risk window

0 0.5 1 1.5 km

Scale at A3: 1:25,000

Client

Lewis Wind Power
Cumhachd Gaoithe

Stornoway Wind Farm
Additional Information

AI Figure 8F.4.1b
Red-throated diver: Clipped FW flights included in CRM – Breeding (April-August 2019)

January 2020

wood.

40001-Gos543a

C.2 Lewis Peatlands SPA: Red-throated Diver CRM – Focal Watch Flight Data

April – August 2018

GISID	VP	Species	Date	Time	Seconds	Length (m)	Clipped length (m)	Clipped length %	Count	Height band	Total flight time (seconds)
BS_SW_0160_a	DFW1	RH	12/06/2018	05:41	45	1189.81	1189.81	100	1	B	45
BS_SW_0235_a	DFW1	RH	12/06/2018	06:19	15	597.48	597.48	100	1	A	15
BS_SW_0278	DFW1	RH	12/06/2018	20:47	105	1741.55	1741.55	100	2	C	210
BS_SW_1004_a	DFW2	RH	17/06/2018	05:37	15	204.26	204.26	100	1	A	15
BS_SW_1005	DFW2	RH	17/06/2018	06:15	15	167.38	167.38	100	1	A	15
BS_SW_1064_a	DFW2	RH	28/06/2018	04:35	15	236.77	236.77	100	1	A	15
BS_SW_1065	DFW2	RH	28/06/2018	05:05	75	4132.27	2576.91	62	1	B	47
BS_SW_1066_a	DFW2	RH	28/06/2018	05:09	30	1033.65	1033.65	100	2	B	60
BS_SW_1067	DFW2	RH	28/06/2018	06:10	45	1294.59	1082.95	84	1	B	38
BS_SW_1002	DFW2	RH	30/06/2018	04:56	45	1220.82	811.35	66	1	A	30
BS_SW_1003_a	DFW2	RH	30/06/2018	05:50	15	541.29	250.27	46	1	A	7
BS_SW_1054_a	DFW1	RH	30/06/2018	20:39	45	767.77	767.77	100	1	A	45
BS_SW_1055_a	DFW1	RH	30/06/2018	20:53	45	2059.45	2059.45	100	2	C	90
BS_SW_1056	DFW1	RH	30/06/2018	21:19	30	747.26	747.26	100	1	A	30
BS_SW_1057_a	DFW1	RH	30/06/2018	21:58	30	407.34	407.34	100	1	A	30
BS_SW_1059_c	DFW5	RH	05/07/2018	20:52	30	1179.88	267.18	23	1	C	7
BS_SW_1060_a	DFW5	RH	05/07/2018	21:46	30	681.05	681.05	100	1	C	30
BS_SW_1061_c	DFW5	RH	05/07/2018	21:50	45	1289.24	345.23	27	1	C	12

GISID	VP	Species	Date	Time	Seconds	Length (m)	Clipped length (m)	Clipped length %	Count	Height band	Total flight time (seconds)
BS_SW_1063_a	DFW5	RH	05/07/2018	22:35	15	366.45	21.10	6	1	A	1
BS_SW_1063_d	DFW5	RH	05/07/2018	22:35	15	251.38	86.85	35	1	D	5
BS_SW_0669_a	DFW5	RH	07/07/2018	05:02	15	544.17	244.82	45	1	A	7
BS_SW_1001	DFW5	RH	07/07/2018	05:58	225	3018.42	2184.93	72	1	B	163
BS_SW_1006	DFW2	RH	12/07/2018	18:14	60	2740.65	2740.65	100	1	B	60
BS_SW_1007_a	DFW2	RH	12/07/2018	18:38	30	1407.07	1407.07	100	1	B	30
BS_SW_1008_a	DFW2	RH	12/07/2018	19:25	15	588.54	588.54	100	1	A	15
BS_SW_1040_a	DFW4	RH	12/07/2018	06:34	60	1268.33	1268.33	100	1	B	60
BS_SW_1041_a	DFW4	RH	12/07/2018	07:01	30	572.96	268.32	47	1	A	14
BS_SW_1042_a	DFW4	RH	12/07/2018	07:12	45	944.78	944.78	100	1	C	45
BS_SW_1043_c	DFW4	RH	12/07/2018	07:48	60	1766.74	952.46	54	2	A	65
BS_SW_1044_a	DFW4	RH	12/07/2018	07:58	45	1023.32	1023.32	100	1	B	45
BS_SW_1045_a	DFW4	RH	12/07/2018	08:26	75	1768.49	1768.49	100	1	C	75
BS_SW_1046_b	DFW4	RH	12/07/2018	08:37	45	1616.49	1517.83	94	1	B	42
BS_SW_1047_a	DFW1	RH	12/07/2018	18:37	15	198.11	198.11	100	1	A	15
BS_SW_1048_a	DFW1	RH	12/07/2018	19:21	30	931.06	931.06	100	1	B	30
BS_SW_1049	DFW1	RH	12/07/2018	19:41	150	4012.31	4012.31	100	2	B	300
BS_SW_1050	DFW1	RH	12/07/2018	19:56	90	2009.12	2009.12	100	1	B	90
BS_SW_1051_c	DFW5	RH	13/07/2018	19:35	45	919.64	325.61	35	1	C	16
BS_SW_1052_a	DFW2	RH	14/07/2018	06:02	30	691.61	691.61	100	1	A	30

GISID	VP	Species	Date	Time	Seconds	Length (m)	Clipped length (m)	Clipped length %	Count	Height band	Total flight time (seconds)
BS_SW_1016_a	DFW4	RH	15/07/2018	21:31	45	1744.36	1744.36	100	1	B	45
BS_SW_1017_b	DFW4	RH	15/07/2018	21:38	150	3643.90	2971.39	82	1	B	122
BS_SW_0004_a	DFW2	RH	16/07/2018	20:21	30	695.63	695.63	100	1	A	30
BS_SW_0989_a	DFW2	RH	16/07/2018	18:26	15	364.06	364.06	100	1	B	15
BS_SW_0991_a	DFW2	RH	16/07/2018	18:53	45	982.09	982.09	100	1	A	45
BS_SW_1019_a	DFW1	RH	16/07/2018	18:34	15	479.48	479.48	100	1	A	15
BS_SW_1020_a	DFW1	RH	16/07/2018	18:53	30	557.51	557.51	100	1	B	30
BS_SW_1021_a	DFW1	RH	16/07/2018	19:11	60	1579.49	1579.49	100	1	B	60
BS_SW_1022_a	DFW1	RH	16/07/2018	19:59	45	688.63	688.63	100	1	B	45
BS_SW_1023	DFW1	RH	16/07/2018	20:12	15	489.89	489.89	100	1	B	15
BS_SW_1024	DFW1	RH	16/07/2018	20:29	45	1132.74	1132.74	100	1	A	45
BS_SW_1025	DFW1	RH	16/07/2018	20:32	45	786.20	786.20	100	1	A	45
BS_SW_1026	DFW1	RH	16/07/2018	Not Rec	266	6512.79	6512.79	100	1	B	266
BS_SW_1027_a	DFW1	RH	16/07/2018	20:44	15	435.55	435.55	100	1	B	15
BS_SW_1028	DFW1	RH	16/07/2018	20:49	75	1144.35	1144.35	100	1	A	75
BS_SW_1029	DFW1	RH	16/07/2018	20:44	60	1862.09	1862.09	100	2	B	120
BS_SW_1030	DFW1	RH	16/07/2018	21:14	75	2271.44	2271.44	100	1	B	75
BS_SW_1036_a	DFW4	RH	17/07/2018	06:03	30	1097.83	677.55	62	1	A	19
BS_SW_1037	DFW4	RH	17/07/2018	06:29	60	661.51	481.68	73	1	A	44
BS_SW_1038_a	DFW4	RH	17/07/2018	06:53	45	208.74	208.74	100	1	A	45

GISID	VP	Species	Date	Time	Seconds	Length (m)	Clipped length (m)	Clipped length %	Count	Height band	Total flight time (seconds)
BS_SW_1039_a	DFW4	RH	17/07/2018	07:09	15	1571.12	782.09	50	1	B	7
BS_SW_1069_a	DFW2	RH	24/07/2018	05:32	60	2477.21	2477.21	100	2	B	120
BS_SW_1070_a	DFW2	RH	24/07/2018	06:15	75	4382.18	1685.24	38	2	B	58
BS_SW_1071_a	DFW2	RH	24/07/2018	06:24	60	2650.18	2514.79	95	2	B	114
BS_SW_1072	DFW2	RH	24/07/2018	07:51	60	2068.66	1635.76	79	2	C	95
BS_SW_1089_a	DFW2	RH	24/07/2018	07:14	45	1652.20	1652.20	100	1	B	45
BS_SW_1081	DFW1	RH	26/07/2018	18:56	15	76.96	76.96	100	1	A	15
BS_SW_1082	DFW1	RH	26/07/2018	18:59	15	340.90	340.90	100	1	A	15
BS_SW_1083	DFW1	RH	26/07/2018	19:03	75	1902.10	1902.10	100	2	B	150
BS_SW_1084	DFW1	RH	26/07/2018	19:50	15	608.49	608.49	100	1	A	15
BS_SW_1085_a	DFW1	RH	26/07/2018	19:51	75	2299.03	2299.03	100	2	B	150
BS_SW_1075	DFW5	RH	29/07/2018	18:15	30	773.57	346.75	45	1	A	13
BS_SW_1077_a	DFW5	RH	29/07/2018	19:20	30	380.17	178.61	47	1	A	14
BS_SW_1079_a	DFW5	RH	29/07/2018	19:25	75	1870.25	477.17	26	1	B	19
BS_SW_1080_a	DFW5	RH	29/07/2018	19:26	60	1879.54	1256.45	67	1	A	40
BS_SW_1086_b	DFW5	RH	08/08/2018	19:20	45	1788.50	639.48	36	1	B	16
BS_SW_1090_a	DFW4	RH	09/08/2018	18:06	30	1040.60	1040.60	100	1	B	30
BS_SW_1091_a	DFW4	RH	09/08/2018	18:34	90	4633.09	898.31	19	1	B	17
BS_SW_1092_a	DFW4	RH	09/08/2018	19:36	45	1107.96	1107.96	100	1	B	45
BS_SW_1093_a	DFW4	RH	09/08/2018	19:44	75	1635.94	1635.94	100	1	C	75

GISID	VP	Species	Date	Time	Seconds	Length (m)	Clipped length (m)	Clipped length %	Count	Height band	Total flight time (seconds)
BS_SW_1096	DFW4	RH	09/08/2018	20:00	75	1380.56	1380.56	100	1	B	75
BS_SW_1097_a	DFW2	RH	10/08/2018	20:12	15	478.43	478.43	100	1	A	15
BS_SW_1098	DFW2	RH	10/08/2018	20:36	80	3249.68	2448.14	75	2	C	121
BS_SW_1099_a	DFW4	RH	11/08/2018	18:38	45	1507.40	1507.40	100	1	B	45
BS_SW_1100_a	DFW4	RH	11/08/2018	18:44	15	829.65	155.91	19	1	A	3
BS_SW_1101_a	DFW4	RH	11/08/2018	18:59	15	760.56	95.86	13	1	A	2
BS_SW_1104_a	DFW4	RH	11/08/2018	21:13	15	604.10	604.10	100	1	B	15
BS_SW_1105	DFW2	RH	11/08/2018	06:27	75	4598.23	4598.23	100	1	B	75
BS_SW_1106_a	DFW2	RH	11/08/2018	07:09	15	369.65	369.65	100	1	A	15
BS_SW_1107_a	DFW2	RH	11/08/2018	08:15	15	604.84	604.84	100	2	B	30
BS_SW_1109	DFW2	RH	11/08/2018	06:15	90	2674.17	1077.07	40	2	B	72
BS_SW_1110	DFW2	RH	11/08/2018	07:35	226	7770.92	7682.81	99	1	B	223
BS_SW_1112	DFW2	RH	11/08/2018	06:18	25	1540.86	5.71	0	1	A	0
BS_SW_1116_a	DFW1	RH	14/08/2018	06:48	45	842.83	842.83	100	1	A	45
BS_SW_1117_a	DFW1	RH	14/08/2018	07:36	30	409.57	409.57	100	1	B	30
BS_SW_1118_a	DFW1	RH	14/08/2018	08:25	60	1627.09	1627.09	100	1	A	60
BS_SW_1130_a	DFW2	RH	14/08/2018	19:22	60	1724.22	1724.22	100	1	B	60
BS_SW_1131	DFW2	RH	14/08/2018	20:30	15	429.80	429.80	100	1	B	15
BS_SW_1132_a	DFW2	RH	14/08/2018	20:40	15	536.49	468.77	87	1	A	13
BS_SW_1133_a	DFW2	RH	14/08/2018	21:01	30	1039.83	1039.83	100	1	B	30

GISID	VP	Species	Date	Time	Seconds	Length (m)	Clipped length (m)	Clipped length %	Count	Height band	Total flight time (seconds)
BS_SW_1134_a	DFW2	RH	14/08/2018	21:12	30	975.23	975.23	100	1	B	30
BS_SW_1135	DFW2	RH	14/08/2018	19:05	45	1333.45	372.79	28	2	B	25
BS_SW_1136	DFW2	RH	14/08/2018	21:05	75	2610.48	2610.48	100	1	B	75
BS_SW_1137	DFW2	RH	14/08/2018	18:52	30	598.88	598.88	100	1	B	30
BS_SW_1119_a	DFW4	RH	15/08/2018	06:23	15	521.85	221.22	42	1	A	6
BS_SW_1120_a	DFW4	RH	15/08/2018	07:11	60	1110.45	1110.45	100	1	B	60
BS_SW_1121_a	DFW4	RH	15/08/2018	07:47	45	1212.85	686.35	57	1	A	25
BS_SW_1122_a	DFW4	RH	15/08/2018	08:14	30	712.39	712.39	100	1	B	30
BS_SW_1123_a	DFW4	RH	15/08/2018	08:17	75	4172.81	283.64	7	2	A	10
BS_SW_1124_a	DFW4	RH	15/08/2018	08:34	60	963.19	963.19	100	2	B	120
BS_SW_1139_b	DFW5	RH	15/08/2018	07:47	15	235.36	30.84	13	2	A	4
BS_SW_1140	DFW5	RH	15/08/2018	07:14	45	1249.42	1249.42	100	2	B	90
BS_SW_1143_a	DFW5	RH	15/08/2018	07:00	120	2003.70	44.35	2	3	B	8
BS_SW_1144_a	DFW5	RH	15/08/2018	06:18	90	4337.56	470.29	11	1	C	10
BS_SW_1146	DFW5	RH	15/08/2018	08:28	60	1393.43	1393.43	100	2	B	120
BS_SW_1148	DFW5	RH	15/08/2018	07:43	160	4850.19	1999.61	41	2	C	132
BS_SW_1149	DFW5	RH	15/08/2018	08:23	160	4633.29	59.47	1	2	B	4
BS_SW_1150	DFW5	RH	15/08/2018	08:13	240	6058.75	169.50	3	1	C	7
BS_SW_1151	DFW5	RH	15/08/2018	08:15	90	2628.39	158.95	6	2	C	11
BS_SW_1125	DFW2	RH	16/08/2018	06:28	150	3475.39	3475.39	100	2	C	300

GISID	VP	Species	Date	Time	Seconds	Length (m)	Clipped length (m)	Clipped length %	Count	Height band	Total flight time (seconds)
BS_SW_1126	DFW2	RH	16/08/2018	06:35	30	855.29	578.51	68	1	A	20
BS_SW_1127_a	DFW2	RH	16/08/2018	07:03	45	780.72	124.22	16	2	A	14
BS_SW_1128	DFW2	RH	16/08/2018	07:20	30	816.98	587.25	72	1	A	22
BS_SW_1129_a	DFW2	RH	16/08/2018	07:23	60	989.58	989.58	100	1	A	60
BS_SW_1155_a	DFW1	RH	16/08/2018	06:17	30	712.49	712.49	100	1	B	30
BS_SW_1156_a	DFW1	RH	16/08/2018	06:20	15	523.90	523.90	100	1	A	15
BS_SW_1157_a	DFW1	RH	16/08/2018	06:43	30	876.46	876.46	100	1	B	30
BS_SW_1158	DFW1	RH	16/08/2018	06:47	75	1406.12	1406.12	100	1	A	75
BS_SW_1159	DFW1	RH	16/08/2018	07:27	15	281.73	281.73	100	1	A	15
BS_SW_1160_a	DFW1	RH	16/08/2018	07:31	45	1214.00	1214.00	100	2	B	90
BS_SW_1161	DFW1	RH	16/08/2018	06:48	90	3503.31	3434.54	98	1	B	88
BS_SW_1162	DFW1	RH	16/08/2018	06:22	90	3687.68	3687.68	100	2	B	180
BS_SW_1163	DFW1	RH	16/08/2018	06:29	30	782.80	782.80	100	2	B	60
BS_SW_1164	DFW1	RH	16/08/2018	09:17	45	1393.18	1393.18	100	1	C	45
BS_SW_1165	DFW1	RH	16/08/2018	08:34	35	2188.76	2188.76	100	1	B	35
BS_SW_1166	DFW1	RH	16/08/2018	09:23	20	758.72	758.72	100	1	B	20
BS_SW_1167	DFW1	RH	16/08/2018	09:08	30	510.70	510.70	100	1	B	30
BS_SW_1168_a	DFW1	RH	16/08/2018	08:10	60	1269.15	1269.15	100	1	B	60
BS_SW_1169_a	DFW1	RH	16/08/2018	08:15	15	341.99	341.99	100	1	A	15
BS_SW_1170_a	DFW1	RH	16/08/2018	08:37	15	1079.82	1079.82	100	1	B	15

GISID	VP	Species	Date	Time	Seconds	Length (m)	Clipped length (m)	Clipped length %	Count	Height band	Total flight time (seconds)
BS_SW_1171_a	DFW1	RH	16/08/2018	08:42	75	1523.00	1523.00	100	1	B	75
BS_SW_1172_a	DFW1	RH	16/08/2018	08:58	15	487.60	487.60	100	1	B	15
BS_SW_1152_a	DFW2	RH	22/08/2018	19:04	15	251.93	251.93	100	1	A	15
BS_SW_1153	DFW2	RH	22/08/2018	19:57	105	1605.81	793.36	49	1	B	52
BS_SW_1154_a	DFW2	RH	22/08/2018	20:33	60	1439.91	1439.91	100	1	B	60

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GISID	VP	Species	Date	Time	Seconds	Length (m)	Clipped length (m)	Clipped length %	Count	Height band	Total flight time (seconds)
40001_VP_1014	DFW 4	RH	08/06/2019	20:33	90	5092.70	3212.28	63	2	B	114
40001_VP_1015_a	DFW 4	RH	08/06/2019	20:34	45	5099.96	1903.36	37	3	B	50
40001_VP_1016	DFW 4	RH	08/06/2019	20:34	75	7965.45	5029.94	63	1	B	47
40001_VP_1017	DFW 4	RH	08/06/2019	20:35	75	6097.66	3761.21	62	2	B	93
40001_VP_1018_a	DFW 4	RH	08/06/2019	20:48	30	815.69	698.42	86	1	A	26
40001_VP_1020_a	DFW 4	RH	08/06/2019	21:32	45	1575.71	875.49	56	1	B	25
40001_VP_0930_a	DFW 7	RH	09/06/2019	20:10	30	586.41	45.56	8	1	A	2
40001_VP_0931_a	DFW 7	RH	09/06/2019	20:55	30	743.70	741.67	100	1	C	30
40001_VP_0932_a	DFW 7	RH	09/06/2019	21:42	45	659.24	659.24	100	1	A	45
40001_VP_0933_a	DFW 2	RH	09/06/2019	21:49	15	199.70	199.70	100	1	A	15
40001_VP_0934_a	DFW 2	RH	09/06/2019	22:10	15	211.80	211.80	100	1	A	15

GISID	VP	Species	Date	Time	Seconds	Length (m)	Clipped length (m)	Clipped length %	Count	Height band	Total flight time (seconds)
40001_VP_1021_a	DFW 4	RH	09/06/2019	05:20	30	2015.62	2015.62	100	1	B	30
40001_VP_1022	DFW 4	RH	09/06/2019	06:11	135	4154.56	3943.13	95	1	B	128
40001_VP_1023_a	DFW 4	RH	09/06/2019	06:26	90	1872.22	1354.19	72	1	B	65
40001_VP_1186	DFW 2	RH	12/06/2019	06:10	15	896.41	483.51	54	1	B	8
40001_VP_1188	DFW 2	RH	12/06/2019	07:05	15	1953.49	1953.49	100	1	B	15
40001_VP_1194_a	DFW 4	RH	13/06/2019	07:10	30	2293.70	2293.70	100	2	B	60
40001_VP_1178_a	DFW 7	RH	22/06/2019	06:45	15	744.36	605.14	81	4	B	49
40001_VP_1181	DFW 7	RH	22/06/2019	21;50	60	2328.68	1340.27	58	1	B	35
40001_VP_0484	DFW 2	RH	26/06/2019	05:27	90	1764.46	1764.46	100	2	B	180
40001_VP_0485_a	DFW 2	RH	26/06/2019	05:55	150	2996.42	2616.27	87	2	B	262
40001_VP_0486	DFW 2	RH	26/06/2019	05:59	60	1557.05	1273.63	82	2	A	98
40001_VP_0487_a	DFW 1	RH	26/06/2019	19:36	45	1229.69	1229.69	100	1	A	45
40001_VP_0489	DFW 1	RH	26/06/2019	20:09	60	900.27	900.27	100	1	A	60
40001_VP_0490_a	DFW 1	RH	26/06/2019	20:09	90	2636.66	2636.66	100	1	A	90
40001_VP_0491	DFW 1	RH	26/06/2019	20:22	60	1846.14	1846.14	100	1	B	60
40001_VP_0492_a	DFW 1	RH	26/06/2019	21:04	90	1518.67	1518.67	100	1	B	90
40001_VP_0493_a	DFW 1	RH	26/06/2019	21:36	15	256.97	256.97	100	1	A	15
40001_VP_0494	DFW 1	RH	26/06/2019	21:36	225	2740.73	2740.73	100	2	B	450
40001_VP_0495	DFW 1	RH	26/06/2019	21:48	45	1405.72	1405.72	100	1	B	45
40001_VP_0496	DFW 1	RH	26/06/2019	21:56	135	1960.25	1960.25	100	1	B	135

GISID	VP	Species	Date	Time	Seconds	Length (m)	Clipped length (m)	Clipped length %	Count	Height band	Total flight time (seconds)
40001_VP_0497_a	DFW 1	RH	26/06/2019	22:24	30	1193.95	1193.95	100	2	B	60
40001_VP_0498_a	DFW 2	RH	27/06/2019	19:47	30	1182.78	1182.78	100	1	A	30
40001_VP_0499_a	DFW 2	RH	27/06/2019	19:55	30	768.84	768.84	100	2	B	60
40001_VP_0500_a	DFW 2	RH	27/06/2019	20:11	15	310.08	310.08	100	1	A	15
40001_VP_0501_a	DFW 2	RH	27/06/2019	21:14	15	357.22	357.22	100	1	A	15
40001_VP_0981	DFW 4	RH	02/07/2019	20:14	60	1364.68	1351.40	99	1	B	59
40001_VP_0982	DFW 4	RH	02/07/2019	20:19	45	1442.70	1243.86	86	1	B	39
40001_VP_0983_a	DFW 4	RH	02/07/2019	20:38	30	999.48	999.48	100	1	C	30
40001_VP_0984_a	DFW 4	RH	02/07/2019	21:00	45	1320.20	1216.76	92	1	B	41
40001_VP_0985	DFW 4	RH	02/07/2019	21:49	60	1354.23	1333.96	99	1	B	59
40001_VP_0986	DFW 4	RH	02/07/2019	21:57	120	2167.37	2027.60	94	1	B	112
40001_VP_0988_b	DFW 4	RH	02/07/2019	22:30	45	1665.85	172.16	10	1	C	5
40001_VP_0998	DFW 7	RH	03/07/2019	20:30	75	1924.76	1119.66	58	1	B	44
40001_VP_1003	DFW 7	RH	03/07/2019	21:53	150	2732.72	224.38	8	1	B	12
40001_VP_1009_a	DFW 7	RH	03/07/2019	05:15	45	752.05	334.53	44	1	B	20
40001_VP_1011	DFW 7	RH	03/07/2019	05:35	75	2054.87	37.08	2	1	B	1
40001_VP_1012	DFW 7	RH	03/07/2019	05:39	30	1112.67	470.12	42	2	B	25
40001_VP_1258	DFW 7	RH	03/07/2019	20:30	75	1727.85	1043.23	60	1	B	45
40001_VP_1263	DFW 7	RH	03/07/2019	21:53	150	2623.21	165.90	6	1	B	9
40001_VP_0957	DFW 2	RH	04/07/2019	19:45	30	2034.80	1967.42	97	1	B	29

GISID	VP	Species	Date	Time	Seconds	Length (m)	Clipped length (m)	Clipped length %	Count	Height band	Total flight time (seconds)
40001_VP_0958	DFW 2	RH	04/07/2019	20:10	45	1287.31	1287.31	100	1	B	45
40001_VP_0959	DFW 2	RH	04/07/2019	20:23	105	2378.04	2119.80	89	1	B	94
40001_VP_0960	DFW 1	RH	05/07/2019	04:30	135	2629.69	2629.69	100	1	B	135
40001_VP_0961_a	DFW 1	RH	05/07/2019	05:18	105	5630.76	5630.76	100	2	B	210
40001_VP_0962_a	DFW 1	RH	05/07/2019	05:25	180	4348.34	4348.34	100	2	B	360
40001_VP_0963_a	DFW 1	RH	05/07/2019	05:50	45	873.83	873.83	100	2	A	90
40001_VP_0964_a	DFW 1	RH	05/07/2019	06:05	195	3342.96	3342.96	100	2	B	390
40001_VP_0965	DFW 1	RH	05/07/2019	06:14	120	3399.27	3281.27	97	2	B	232
40001_VP_0966_a	DFW 1	RH	05/07/2019	07:05	75	2455.55	2304.16	94	1	B	70
40001_VP_0967	DFW 1	RH	05/07/2019	07:25	60	949.42	949.42	100	2	B	120
40001_VP_0955_a	DFW 1	RH	06/07/2019	19:59	150	3967.23	3967.23	100	2	C	300
40001_VP_0974	DFW 2	RH	06/07/2019	04:45	75	1787.98	1787.98	100	1	B	75
40001_VP_0975	DFW 2	RH	06/07/2019	05:25	45	1898.63	1898.63	100	1	B	45
40001_VP_0976_a	DFW 2	RH	06/07/2019	05:35	30	642.87	642.87	100	2	B	60
40001_VP_0977	DFW 2	RH	06/07/2019	05:40	90	2457.70	2349.82	96	2	B	172
40001_VP_0978	DFW 2	RH	06/07/2019	06:37	75	1050.74	1050.74	100	1	B	75
40001_VP_0979	DFW 2	RH	06/07/2019	06:50	75	1447.00	1447.00	100	1	B	75
40001_VP_0980	DFW 2	RH	06/07/2019	07:00	90	1922.28	256.34	13	1	B	12
40001_VP_1140	DFW 7	RH	11/07/2019	21:29	135	1876.83	556.80	30	1	B	40
40001_VP_1142	DFW 7	RH	11/07/2019	21:42	90	2300.06	211.58	9	2	B	17

GISID	VP	Species	Date	Time	Seconds	Length (m)	Clipped length (m)	Clipped length %	Count	Height band	Total flight time (seconds)
40001_VP_1143_a	DFW 4	RH	12/07/2019	19:53	30	287.66	287.66	100	1	B	30
40001_VP_1144_a	DFW 4	RH	12/07/2019	20:03	105	1985.26	1384.48	70	2	A	146
40001_VP_1145_a	DFW 4	RH	12/07/2019	20:11	45	552.18	427.21	77	1	A	35
40001_VP_1146_a	DFW 4	RH	12/07/2019	20:28	45	502.33	502.33	100	1	A	45
40001_VP_1147_a	DFW 4	RH	12/07/2019	20:39	30	789.35	789.35	100	1	B	30
40001_VP_1148	DFW 4	RH	12/07/2019	21:07	90	1851.39	1792.21	97	1	B	87
40001_VP_1199	DFW 7	RH	12/07/2019	21:30	90	2532.48	706.25	28	2	B	50
40001_VP_1131_a	DFW 2	RH	13/07/2019	20:22	30	949.10	949.10	100	1	B	30
40001_VP_1132_a	DFW 2	RH	13/07/2019	20:35	30	543.24	530.62	98	1	A	29
40001_VP_1133_a	DFW 2	RH	13/07/2019	20:50	30	900.20	900.20	100	1	B	30
40001_VP_1134	DFW 2	RH	13/07/2019	22:00	45	1436.74	1276.86	89	1	B	40
40001_VP_1135_a	DFW 2	RH	13/07/2019	22:06	90	2054.58	2054.58	100	2	B	180
40001_VP_1200	DFW 4	RH	14/07/2019	07:30	30	904.31	758.72	84	1	B	25
40001_VP_1201_a	DFW 2	RH	18/07/2019	06:10	15	702.56	702.56	100	1	B	15
40001_VP_1035_a	DFW 7	RH	19/07/2019	20:43	30	619.02	619.02	100	1	A	30
40001_VP_1028_a	DFW 2	RH	20/07/2019	19:49	60	1360.86	1360.86	100	1	B	60
40001_VP_1029	DFW 2	RH	20/07/2019	20:01	165	2695.56	1578.79	59	2	D	193
40001_VP_1030_a	DFW 2	RH	20/07/2019	20:39	15	266.20	266.20	100	1	A	15
40001_VP_1031_a	DFW 2	RH	20/07/2019	21:41	45	1136.61	1136.61	100	2	B	90
40001_VP_1032_b	DFW 2	RH	20/07/2019	21:55	45	346.88	346.88	100	1	B	45

GISID	VP	Species	Date	Time	Seconds	Length (m)	Clipped length (m)	Clipped length %	Count	Height band	Total flight time (seconds)
40001_VP_1154_a	DFW 4	RH	22/07/2019	19:39	15	304.99	191.73	63	1	A	9
40001_VP_1156	DFW 4	RH	22/07/2019	20:03	30	891.90	529.99	59	1	A	18
40001_VP_1160_a	DFW 7	RH	22/07/2019	05:57	15	379.32	30.56	8	1	A	1
40001_VP_1024_a	DFW 2	RH	23/07/2019	19:26	15	268.06	268.06	100	1	A	15
40001_VP_1025	DFW 2	RH	23/07/2019	19:56	30	681.37	504.04	74	1	A	22
40001_VP_1026_a	DFW 2	RH	23/07/2019	21:45	15	290.65	290.65	100	1	A	15
40001_VP_1158_a	DFW 2	RH	23/07/2019	05:12	15	223.27	223.27	100	1	A	15
40001_VP_1159_a	DFW 2	RH	23/07/2019	06:39	15	258.59	258.59	100	1	A	15
40001_VP_1161	DFW 4	RH	23/07/2019	06:02	120	3590.54	1649.10	46	2	B	110
40001_VP_1162	DFW 4	RH	23/07/2019	06:51	90	1737.43	595.25	34	1	B	31
40001_VP_1163	DFW 4	RH	23/07/2019	19:20	135	2854.28	1900.76	67	2	B	180
40001_VP_1164	DFW 4	RH	23/07/2019	19:54	150	3823.64	2348.13	61	3	B	276
40001_VP_1165	DFW 4	RH	23/07/2019	20:38	90	1472.25	1388.68	94	1	B	85
40001_VP_1166_a	DFW 4	RH	23/07/2019	21:17	60	1138.49	497.10	44	1	B	26
40001_VP_1167_a	DFW 4	RH	23/07/2019	21:30	75	1164.92	981.39	84	1	B	63
40001_VP_0989	DFW 2	RH	24/07/2019	05:46	75	1761.85	346.86	20	2	B	30
40001_VP_0990	DFW 2	RH	24/07/2019	06:49	30	1983.03	1772.56	89	1	B	27
40001_VP_0991_a	DFW 2	RH	24/07/2019	07:49	75	2702.64	688.50	25	4	B	76
40001_VP_0992_a	DFW 2	RH	24/07/2019	07:54	60	1720.22	1720.22	100	2	B	120
40001_VP_0993_a	DFW 2	RH	24/07/2019	08:05	75	1025.88	817.46	80	2	B	120

GISID	VP	Species	Date	Time	Seconds	Length (m)	Clipped length (m)	Clipped length %	Count	Height band	Total flight time (seconds)
40001_VP_0994	DFW 2	RH	24/07/2019	08:06	90	3333.33	2260.68	68	2	B	122
40001_VP_0995_a	DFW 2	RH	24/07/2019	08:45	45	1904.10	1641.50	86	2	B	78
40001_VP_1006	DFW 7	RH	24/07/2019	21:20	210	3615.05	867.60	24	2	B	101
40001_VP_1027_a	DFW 4	RH	24/07/2019	06:35	15	198.40	150.66	76	1	A	11
40001_VP_1168	DFW 2	RH	24/07/2019	19:31	30	1201.66	1201.66	100	1	B	30
40001_VP_1169_a	DFW 2	RH	24/07/2019	21:46	15	228.07	228.07	100	1	A	15
40001_VP_0970_a	DFW 4	RH	25/07/2019	07:25	90	4081.90	594.85	15	2	B	26
40001_VP_0973_b	DFW 4	RH	25/07/2019	09:01	150	2414.97	2397.37	99	2	B	298
40001_VP_1171_b	DFW 4	RH	25/07/2019	20:48	15	858.91	384.44	45	1	A	7
40001_VP_1173	DFW 7	RH	26/07/2019	06:15	45	1143.39	1143.39	100	2	A	90
40001_VP_1203	DFW 7	RH	26/07/2019	20:13	30	1436.12	610.41	43	1	B	13
40001_VP_1204	DFW 4	RH	26/07/2019	07:35	15	726.56	694.59	96	1	A	14
40001_VP_1206	DFW 4	RH	26/07/2019	08:05	15	774.02	714.69	92	1	A	14
40001_VP_0943_b	DFW 7	RH	02/08/2019	19:48	45	349.91	74.78	21	1	B	10
40001_VP_0944_a	DFW 7	RH	02/08/2019	21:35	30	253.55	253.55	100	1	C	30
40001_VP_0945_a	DFW 7	RH	03/08/2019	05:35	15	197.33	197.33	100	1	A	15
40001_VP_0946_a	DFW 7	RH	03/08/2019	08:02	15	241.05	241.05	100	1	C	15
40001_VP_0947_b	DFW 7	RH	03/08/2019	20:19	15	286.54	46.18	16	1	B	2
40001_VP_0948_a	DFW 7	RH	03/08/2019	20:53	30	595.97	595.97	100	1	A	30
40001_VP_0949_a	DFW 7	RH	04/08/2019	07:22	45	1051.59	1051.59	100	1	C	45

GISID	VP	Species	Date	Time	Seconds	Length (m)	Clipped length (m)	Clipped length %	Count	Height band	Total flight time (seconds)
40001_VP_0950_c	DFW 7	RH	04/08/2019	20:09	15	151.30	87.82	58	1	A	9
40001_VP_0951_a	DFW 7	RH	06/08/2019	05:30	30	655.91	481.58	73	1	A	22
40001_VP_0952_b	DFW 7	RH	06/08/2019	06:51	15	186.79	41.76	22	1	A	3
40001_VP_0953_a	DFW 7	RH	06/08/2019	08:16	15	480.48	478.30	100	1	A	15
40001_VP_0954	DFW 7	RH	06/08/2019	21:25	60	1375.86	46.66	3	1	A	2
40001_VP_1057_c	DFW 7	RH	15/08/2019	21:10	15	291.81	245.93	84	1	A	13

C.3 Lewis Peatlands SPA: Red-throated Diver CRM – Models

April – August 2018

Band Model: Regular Flights Proposed Development Year 1
Species: Red-throated diver - SPA population
Season: Breeding season 2018 (April - August)

Bird Parameters	
length (m)	0.69
wingspan (m)	1.16
flapping (0)or gliding (1)	0
Assumed flight speed (m/s)	17.89
Available hours active	2816.94
Survey effort (hours)	111
No birds observed in risk window	153
Avoidance Rate 99.5%	0.005

Wind Farm Parameters	
Max height of turbines (m)	180
Number turbines	35
Rotor diameter (m)	150
Hub height (m)	105
Max chord (m)	4.2
Pitch (degrees)	12
Rotation period (secs)	4.7
Turbine operation time 85%	0.85
Risk window width (m)	6052

Calculations	
Risk window area (m2)	1089360
Area occupied by rotors	618501
Rotor area as a proportion of risk window area	0.568
No of birds per hour of observation	1.378
Potential number birds crossing windfarm area	3883
Number birds through rotors	2204.53
Stage 2 Probability of collision	0.060

Calculation of number collisions	No avoidance	Avoidance 99.5%
Collisions per year	111.85	0.559
Years per collision	0.009	1.79
Over 25 years	2796.24	13.98

April – August 2019

Band Model: Regular Flights Proposed Development Year 2
Species: Red-throated diver - SPA population
Season: Breeding season 2019 (April - August)

Bird Parameters	
length (m)	0.69
wingspan (m)	1.16
flapping (0)or gliding (1)	0
Assumed flight speed (m/s)	17.89
Available hours active	2816.77
Survey effort (hours)	182.75
No birds observed in risk window	162
Avoidance Rate 99.5%	0.005

Wind Farm Parameters	
Max height of turbines (m)	180
Number turbines	35
Rotor diameter (m)	150
Hub height (m)	105
Max chord (m)	4.2
Pitch (degrees)	12
Rotation period (secs)	4.7
Turbine operation time 85%	0.85
Risk window width (m)	6052

Calculations	
Risk window area (m2)	1089360
Area occupied by rotors	618501
Rotor area as a proportion of risk window area	0.568
No of birds per hour of observation	0.886
Potential number birds crossing windfarm area	2497
Number birds through rotors	1417.68
Stage 2 Probability of collision	0.060

Calculation of number collisions	No avoidance	Avoidance 99.5%
Collisions per year	71.93	0.360
Years per collision	0.014	2.78
Over 25 years	1798.20	8.99

Annex D
Lewis Peatlands SPA: Red-throated Diver PVA

D.1 Lewis Peatlands SPA: Red-throated Diver PVA

Fledging rate (Female)	Survival rate: adult	Survival rate: s0 and s1	Additional mortality	Additional Cumulative mortality
0.6	0.84	0.75	0.46	0.145

Background Model - no additional mortality

	Adults	s1	s0
Year 0	156.0	33.0	47.0
Year 1	155.8	35.3	46.7
Year 2	157.3	35.1	47.2
Year 3	158.4	35.4	47.5
Year 4	159.6	35.6	47.9
Year 5	160.8	35.9	48.2
Year 6	162.0	36.2	48.6
Year 7	163.2	36.5	49.0
Year 8	164.5	36.7	49.3
Year 9	165.7	37.0	49.7
Year 10	166.9	37.3	50.1
Year 11	168.2	37.6	50.5
Year 12	169.4	37.8	50.8
Year 13	170.7	38.1	51.2
Year 14	172.0	38.4	51.6
Year 15	173.3	38.7	52.0
Year 16	174.6	39.0	52.4
Year 17	175.9	39.3	52.8
Year 18	177.2	39.6	53.2
Year 19	178.5	39.9	53.6
Year 20	179.9	40.2	54.0
Year 21	181.2	40.5	54.4
Year 22	182.6	40.8	54.8
Year 23	183.9	41.1	55.2
Year 24	185.3	41.4	55.6
Year 25	186.7	41.7	56.0

Additional mortality

	Adults	s1	s0
Year 0	156.0	33.0	47.0
Year 1	155.3	35.3	46.6
Year 2	156.5	34.9	46.9
Year 3	157.2	35.2	47.2
Year 4	158.0	35.4	47.4
Year 5	158.8	35.5	47.6
Year 6	159.6	35.7	47.9
Year 7	160.4	35.9	48.1
Year 8	161.2	36.1	48.3
Year 9	162.0	36.3	48.6
Year 10	162.8	36.4	48.8
Year 11	163.6	36.6	49.1
Year 12	164.5	36.8	49.3
Year 13	165.3	37.0	49.6
Year 14	166.1	37.2	49.8
Year 15	167.0	37.4	50.1
Year 16	167.8	37.6	50.4
Year 17	168.7	37.8	50.6
Year 18	169.6	38.0	50.9
Year 19	170.5	38.2	51.1
Year 20	171.3	38.4	51.4
Year 21	172.2	38.6	51.7
Year 22	173.1	38.8	51.9
Year 23	174.0	39.0	52.2
Year 24	174.9	39.2	52.5
Year 25	175.9	39.4	52.8

Additional cumulative mortality

	Adults	s1	s0
Year 0	156.0	33.0	47.0
Year 1	155.2	35.3	46.6
Year 2	156.3	34.9	46.9
Year 3	156.9	35.2	47.1
Year 4	157.6	35.3	47.3
Year 5	158.3	35.5	47.5
Year 6	159.0	35.6	47.7
Year 7	159.7	35.8	47.9
Year 8	160.4	35.9	48.1
Year 9	161.2	36.1	48.4
Year 10	161.9	36.3	48.6
Year 11	162.6	36.4	48.8
Year 12	163.4	36.6	49.0
Year 13	164.1	36.8	49.2
Year 14	164.9	36.9	49.5
Year 15	165.6	37.1	49.7
Year 16	166.4	37.3	49.9
Year 17	167.1	37.4	50.1
Year 18	167.9	37.6	50.4
Year 19	168.7	37.8	50.6
Year 20	169.5	38.0	50.8
Year 21	170.3	38.1	51.1
Year 22	171.1	38.3	51.3
Year 23	171.9	38.5	51.6
Year 24	172.7	38.7	51.8
Year 25	173.5	38.9	52.0

Annex E
Western Isles: White-tailed Eagle PVA

E.1 Western Isles: White-tailed Eagle PVA

Fledging rate (Female)	Survival Rate: adult and s4	Survival Rate: s3	Survival Rate: s2	Survival Rate: s1	Survival Rate: s0	Additional Mortality:
0.38	0.966	0.951	0.857	0.821	0.819	1.184

Background Model - no additional mortality

	Adults	s4	s3	s2	s1	s0
Year 0	32.0	6.0	7.0	8.0	10.0	12.0
Year 1	36.7	6.7	6.9	8.2	9.8	11.7
Year 2	41.9	6.5	7.0	8.1	9.6	13.5
Year 3	46.8	6.7	6.9	7.9	11.0	15.4
Year 4	51.6	6.6	6.8	9.1	12.6	17.2
Year 5	56.2	6.4	7.8	10.3	14.1	19.0
Year 6	60.5	7.4	8.9	11.5	15.5	20.6
Year 7	65.6	8.4	9.9	12.7	16.9	22.2
Year 8	71.5	9.4	10.9	13.9	18.2	24.1
Year 9	78.2	10.4	11.9	14.9	19.7	26.3
Year 10	85.6	11.3	12.8	16.2	21.5	28.7
Year 11	93.6	12.2	13.9	17.7	23.5	31.4
Year 12	102.2	13.2	15.1	19.3	25.7	34.4
Year 13	111.4	14.4	16.5	21.1	28.1	37.5
Year 14	121.5	15.7	18.1	23.1	30.7	40.9
Year 15	132.6	17.2	19.8	25.2	33.5	44.6
Year 16	144.7	18.8	21.6	27.5	36.5	48.7
Year 17	158.0	20.6	23.6	30.0	39.9	53.1
Year 18	172.5	22.4	25.7	32.7	43.5	58.0
Year 19	188.3	24.5	28.1	35.7	47.5	63.3
Year 20	205.5	26.7	30.6	39.0	51.9	69.1
Year 21	224.3	29.1	33.4	42.6	56.6	75.4
Year 22	244.8	31.8	36.5	46.5	61.8	82.3
Year 23	267.1	34.7	39.8	50.7	67.4	89.8
Year 24	291.6	37.9	43.5	55.4	73.6	98.1
Year 25	318.2	41.3	47.4	60.4	80.3	107.0

Additional mortality

	Adults	s4	s3	s2	s1	s0
Year 0	32.0	6.0	7.0	8.0	10.0	12.0
Year 1	35.3	6.7	6.9	8.2	9.8	12.0
Year 2	39.1	6.5	7.0	8.1	9.8	13.2
Year 3	42.6	6.7	6.9	8.1	10.8	14.6
Year 4	46.1	6.6	6.9	8.9	12.0	16.0
Year 5	49.4	6.6	7.6	9.8	13.1	17.3
Year 6	52.6	7.2	8.4	10.7	14.1	18.5
Year 7	56.2	8.0	9.2	11.6	15.2	19.7
Year 8	60.5	8.7	10.0	12.4	16.1	21.1
Year 9	65.3	9.5	10.7	13.2	17.2	22.6
Year 10	70.6	10.1	11.3	14.2	18.6	24.4
Year 11	76.3	10.8	12.1	15.2	20.0	26.4
Year 12	82.4	11.5	13.1	16.4	21.6	28.6
Year 13	89.0	12.4	14.1	17.8	23.4	30.9
Year 14	96.2	13.4	15.2	19.2	25.3	33.3
Year 15	104.0	14.5	16.5	20.7	27.3	36.0
Year 16	112.6	15.7	17.8	22.4	29.5	38.9
Year 17	121.9	16.9	19.2	24.2	31.9	42.1
Year 18	132.1	18.3	20.8	26.2	34.5	45.6
Year 19	143.2	19.7	22.4	28.3	37.4	49.5
Year 20	155.2	21.3	24.3	30.7	40.5	53.6
Year 21	168.3	23.1	26.3	33.3	43.9	58.1
Year 22	182.5	25.0	28.5	36.0	47.6	63.0
Year 23	198.1	27.1	30.9	39.1	51.6	68.3
Year 24	215.0	29.4	33.5	42.4	56.0	74.2
Year 25	233.4	31.8	36.3	46.0	60.7	80.5