7. ORNITHOLOGY

INTRODUCTION

7.1 This chapter assesses the effects of the proposed Wind farm on the area's bird interests. It contains:

- A brief description of the site's wider conservation context for birds;
- A baseline description of the site's existing bird interest, identified through consultation, desk studies and survey work carried out from 2004 to 2007;
- Analysis (including collision risk modelling) of the development's likely impacts on key bird interests in and around the site, arising from construction, operation and decommissioning;
- Mitigation to reduce impacts; and
- A statement explaining the significance of the residual impacts, after mitigation, of the Wind farm on important bird interests.

SUMMARY OF KEY ISSUES AND FINDINGS

7.2 The proposed Spittal Wind farm covers an area of heathland, improved and semi-improved farmland, the majority of which is used for sheep grazing. In this respect it is unremarkable, a fact reflected in its limited populations of waders and raptors (either breeding or over-wintering).

The site's notable bird interest comprises wildfowl, specifically greylag geese, pink-footed geese and whooper swans which winter in the area to varying degrees.

The presence of these species is important because of the nearby Caithness Lochs Special Protection Area (SPA), for which greylag geese and whooper swans are qualifying species. Having closely examined data collected for this EIA over 2004-2007 (on their presence on site, flight behaviour across it and their feeding and roosting locations around it) the conclusion is reached that the proposed development will not have an adverse impact on the SPA's qualifying interests, either singly or in combination with other relevant plans and projects. This conclusion is based on analysis of potential disturbance during construction, loss of foraging or roosting habitat as a result of displacement, and estimated mortality arising from the Wind farm.

In terms of its impact on birds therefore, the proposed Wind farm at Spittal is not predicted to have any significant impacts on SPA-qualifying wildfowl, any other Annex 1, Schedule 1 birds or other birds of conservation concern. In addition, it is not predicted to have any significant impacts on any designated natural heritage sites.

IDENTIFICATION OF KEY INTERESTS AND EXISTING DATA

7.3 Consultation with Scottish Natural Heritage (SNH), Royal Society for the Protection of Birds (RSPB Scotland), Scottish Wildlife Trust (SWT), Scottish Ornithologists Club (SOC) and Wildfowl and Wetlands Trust (WWT) was carried out in 2003 to identify key bird interests, existing data and appropriate survey methods for the proposed Spittal Wind farm

7.4 The proposed Wind farm is located approximately 5 km southeast of Halkirk (centre point grid reference approx. ND8455) (Figure 7.1). This lies approximately 2km southwest of the Caithness Loch Special Protection Area (SPA) designed to protect over-wintering populations of Greenland white-fronted geese, greylag geese and whooper swans.

7.5 Responses were received from SNH and RSPB Scotland. A follow-up meeting was also held in December 2003 with both organisations. SNH provided information on designated sites and Wetlands Birds Survey (WeBS) data was also obtained from the British Trust for Ornithology.

7.6 Further information on geese and local bird movements was obtained from local ornithologist Stan Laybourne in the form of SNH commissioned reports and personal records.

7.7 A scoping survey (walkover) was also conducted (on 29th November 2003) to make a preliminary assessment of birds likely to be of particular ornithological interest. In combination with feedback from SNH and RSPB Scotland, this enabled appropriate methodologies and target species to be identified for this site.

BASELINE SURVEY METHODS

7.8 In view of the above, baseline bird surveys were carried out to quantify use of the proposed wind farm area by breeding and non-breeding birds. This included collection of flight data to enable the risk of bird collisions to be predicted.

7.9 As a result, the surveys carried out for the EIA were:-

- Upland Breeding Bird Survey (target group waders)
- Breeding Raptor Survey (target species hen harrier and short-eared owl),
- Vantage Point Watches (target species geese, swans, divers, skuas, Annex 1 (European Birds Directive) waders and raptors)

7.10 Survey work extended from January 2004 to April 2006 and from September 2006 to December 2006. A summary of the bird surveys completed for the EIA is given in Table 1. All were carried out by a suitably qualified ornithological surveyor and completed in accordance with standard methodologies.

Table 1. Summary of Ornithological Surveys Carried Out for EIA: January 2004 to December 2006

Survey Type	Target Species.	Duration	Comments
Brown and Shepherd Upland Breeding Bird Survey	Waders	2 visits over May/June 2004 3 visits over May/June 2005	
Breeding Raptor Survey Bibby and Etheridge (1993)	Hen harrier and short-eared owl	6 visits over May-June 2005 covering the entire site and suitable habitat within 2km	No breeding raptors were recorded.
Vantage Point Watches	Winter and passage swans and geese, winter raptors, and breeding raptors and waders	290 VP watches (608.3hrs) were completed from January 2004 to December 2006.	Original VPs were changed because of concerns about the presence of a surveyor influencing bird movement across the proposed wind farm.
Feeding and Roosting Survey	Winter and passage swans and geese	September 2005 to April 2006 and September to December 2006	To identify the main roosting and feeding locations used by wildfowl in and around the proposed wind farm

DETAILS OF UPLAND BREEDING BIRD SURVEYS 2004 AND 2005

7.11 Breeding bird surveys were undertaken in 2004 and 2005 in accordance with the methods set out by Brown and Shepherd (1993), covering the areas shown in Figure 7.2 and 7.3. (the survey boundary itself was relatively large, reflecting the footprint of the original wind farm layout. The whole area was covered during the 2005 survey, but the data presented in Figure 7.3 only show the results from approximately 1km around the final Wind farm layout). Two survey visits were made in 2004 and two in 2005, details of which are given in Table 2. In both instances, the target species were waders.

Table 2: Timing and Coverage of 2005 Breeding Bird Survey Visits

	Date	Weather	Start Time	End Time	Area Covered
2004					
Visit 1	13th May 2004	Good	0900	1700	Whole Site
Visit 2	12th June 2004	Cloudy but good	1100	1800	Whole Site
2005					
Visit 1	22nd May 2005	Good	10.30	18.00	Banniskirk House, Achalone south to Balbeg
	23rd May 2005	Fine but occasional shower	08.00	15.30	Spittal Hill and Crofts of Hillpark area
	24th May 2005	Fine but occasional shower	10.30	18.00	Banniskirk Moss to Ouglassy Parks area
Visit 2	14th June 2005	Cloudy but good visibility	08.00	15.00	Banniskirk House, Achalone south to Balbeg
	16th June 2005	Cloudy but good visibility	08.00	14.30	Spittal Hill and Crofts of Hillpark area
	17th June 2005	Cloudy but good visibility	09.30	15.30	Banniskirk Moss to Ouglassy Parks area

7.12 Each survey visit was undertaken by a single observer who approached all parts of the survey area to within 100m.

7.13 The behaviour and location of birds were recorded on 1:10,000 scale maps for each visit, using standard British Trust for Ornithology (BTO) codes. Birds were assumed to be breeding or holding territory at the recorded location if one or more of the following was observed:

- Courtship, displaying or singing
- Presence of a nest, eggs or young (including newly fledged)
- Agitated behaviour, including alarm calls or distraction display
- Adults carrying food or nesting material
- Territorial dispute

7.14 In the absence of any of these indicative behaviours, a pair observed together in suitable habitat was also considered to represent a breeding pair. Other records were considered to be of non-breeding birdsFor each visit, birds of the same species that showed territorial behaviour were, by convention, considered to be from the same pair if they were less than 500m apart for waders and 200m for passerines. Those further apart were considered separate pairs. Exceptions were only made if the surveyor saw evidence of birds within these distances being different pairs, or alternatively birds further apart being from the same pair.

7.15 Estimates of the number of pairs/territories were derived by comparing the two visit maps. Between visits, breeding records or territories were, by convention, considered to be separate from each other if they were more than 1000m apart for most waders (500m for snipe) and more than 500m for passerines. The central point of each territory/breeding location was plotted on a final map for presentation (Figures 7.2 and 7.3).

7.16 It is acknowledged that the Brown and Shepherd survey technique is likely to under-estimate the number of breeding snipe. The ‘drumming’ display indicative of breeding usually occurs at dawn and dusk before/after the recommended survey times. In addition, snipe appear to be more active on days when the weather is less suitable for general wader survey. RSPB Scotland also highlighted that the Brown and Shepherd method was less likely to detect golden plover, as their movements during the breeding season tend to be around dawn and dusk. This is not considered significant at this site because there is no suitable breeding habitat for golden plover within at least 500m of the proposed Wind farm.

DETAILS OF THE BREEDING HEN HARRIER AND SHORT-EARED OWL SURVEY 2005

7.17 Specialist surveys to identify breeding or foraging hen harriers and short-eared owls were also undertaken as a precaution, for all suitable habitats within 2km of the proposed wind farm. No harrier or short-eared owl breeding records had previously been identified on site, although winter foraging had previously been recorded by various observers (including the 29th November 2003 scoping visit).

7.18 The survey followed the method of Bibby and Etheridge (1993), as summarised in Gilbert *et al.* (1998) and took place in 2005.

VANTAGE POINT (VP) WATCHES

7.19 Vantage point (VP) watches were undertaken using the methodology specified by SNH[1]. Each VP watch was undertaken by a single observer in conditions of good visibility. The surveyor positioned himself as inconspicuously as possible to minimise their effects on the birds’ natural behaviour. VP watches were generally limited to three hours duration.

7.20 During each watch, the landscape was scanned continuously until a target bird species[2] was detected. Once detected, the bird was observed until it landed or flew out of sight. The time of first detection was noted, and the flight height was recorded for each 15 second period that the bird was in view, in one of three height bands: <10m, 10-100m and >100m. The paths of all observed flights were drawn as accurately as possible onto 1:10,000 scale maps in the field.

7.21 A map of the paths of each of the observed target species flights was compiled in a GIS and the flight duration and height data collected in the field were entered into a Microsoft Access database and prepared for use in a collision risk model.

7.22 In line with requests from SNH and RSPB Scotland, winter watches covered September to April, during which geese and whooper swans were the target species. Breeding season watches were completed from March to August, for Annex 1 waders, hen harrier, short-eared owl, peregrine, merlin and osprey.

7.23 Watches were carried out from seven VPs over the January 2004 to December 2006 period. Not all VPs were used throughout (Table 4). This was because Spittal Hill was originally selected as the most obvious location from which to get 360-degree coverage of the initial project area. However, this was dropped after the first year because of concerns that such prominent positioning of the surveyor might influence bird movements.

[1] Scottish Natural Heritage (2005) Guidance: Survey Methods For Use In Assessing The Impacts of Onshore Wind farms On Bird Communities.
[2] Target species were divers, grebes, swans, geese, Annex 1 (European Birds Directive) raptors, Annex 1 waders, Barn Owl and Short-eared Owl.

7.24 Figures 7.4 and 7.5 show vantage point locations and the visible area from the VPs, super-imposed onto the proposed layout of the turbines. Table 4 lists the locations of the VPs.

7.25 RSPB Scotland requested a minimum survey effort of 15 hours per vantage point during April-July (breeding season) to detect raptor activity. This minimum was exceeded for all four original VPs in 2004 and 2005 but not for the latter three VPs in 2005. These (VP 5, 6 and 7) only had 12 hours accumulated watch time. However, given the limited presence of raptors on site, this shortfall is not considered likely to cause a significant under–estimate of predicted raptor collisions.

7.26 Full details of each VP watch (date, timing, duration, weather etc.) can be provided in electronic form on request. The key VP results (number of flights observed, flight times for target species etc.) are given in the results section below.

BASELINE SURVEY RESULTS

Scoping Survey

7.27 This initial half-day winter scoping visit by two surveyors identified 16 species (26th November 2003). Most notable was a single ringtail hen harrier foraging on Spittal Hill. Of waders and wildfowl, one snipe was flushed from rush pasture. Eleven whooper swans were present in a pasture field near Banniskirk Mains. Later on these birds re-located to Banniskirk Dam, where there were also 11 wigeon and 66 teal, both Amber-listed Birds of Conservation Concern (BoCC). Of the other species recorded during the walkover, the only Red-listed ones were house sparrow and starling, with fieldfare the one other Amber-listed species.

Upland breeding bird survey 2004 and 2005

7.28 Four wader species were recorded in the study area over this period. These were curlew, lapwing, oystercatcher, and snipe. Table 3 shows the estimated number of territories (derived by applying the method for determining territory numbers described by Brown and Shepherd 1993). Only those territories within 300m of the proposed wind farm are included in the Table. Evidence suggests breeding waders are unlikely to be affected by the proposed wind farm beyond this distance[3]. Figures 7.2 and 7.3 show the resulting estimated locations of wader territories for 2004 and 2005, revealing that within the proposed wind farm area itself, snipe and curlew are the most abundant breeding waders.

Table 3: Breeding waders recorded during the 2004 and 2005 breeding bird survey within 300m of the wind farm

Species	Number of territories 2004	Number of territories 2005
Lapwing	1	2
Curlew	4	5
Snipe	1	11-12
Oystercatcher	0	1

7.29 Records of non-waders in 2004 included skylark as the only Red-listed BoCC noted on site, with meadow pipit and red grouse the only Amber-listed ones. Birds recorded over-flying the site during the 2004 breeding bird visits were buzzard, kestrel (Amber-listed), grey heron, and barn swallow (Amber-listed).

7.30 In 2005 non-target species were more fully monitored in comparison to 2004, when the survey focus had been more narrowly restricted to target species. Therefore, in addition to species recorded on site in 2004, reed bunting was the one extra Red-listed BoCC, and cuckoo, stonechat and willow warbler the extra Amber-listed BoCC. Birds recorded over-flying the site were the same as 2004 with the addition of common gull (Amber-listed), great black-backed gull and raven.

[3] Winkleman, J. E. (1995) Bird/Wind turbine investigations in Europe. *Proceedings of the National Avian-Wind Power Planning Meeting, Denver, Colorado, CO. July 1994* pp. 110-140. NWCC c/o Resolve, Washington, DC and LGL Ltd., King City, Ontario.

Table 4: Location and VP Watch Times Per Month 2004 – 2006

VP	Grid Reference	2004												2005												2006												
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
1*	ND 16850 55800	2	3	3	3	6	6	6		2	6	6	6	6	6	6	6	4	4	4																		85
2*	ND 16834 55605	2	3	3	3	6	6	6		2	6	6	6	6	6	6	6	4	4	4																		85
3	ND 16705 55500	2	3	3	3	6	6	6																														29
4	ND 16260 55509		3	3	3	6	6	6		2	6	6	6	6	6	6	6	4	4	4																		83
5*	ND 17124 57040																	4	4	4	8	6	12	12	6	6	6	12	12					3	7	5	5.3	112.3
6	ND 14606 56915																	4	4	4	8	6	12	12	6	6	6	12	12									92
7*	ND18433 55687																	4	4	4	8	6	12	12	6	6	6	12	12					5	5	5	5	112
Total		6	12	12	12	24	24	24		6	18	18	18	18	18	18	18	24	24	24	24	18	36	36	18	18	18	36	36					8	12	10	10.3	598.3

Blue = winter season, Light Green = transition from winter to summer season and summer to autumn, Dark Green – Main breeding season, *VP's covering the final development footprint

Breeding Raptor Survey 2005

7.31 The 2005 breeding raptor surveys found no hen harrier or short-eared owl breeding within 2km of the Wind farm. However, 2005 was a particularly poor breeding year for both species in Caithness so the lack of records needs to be considered in this context. There is, however, no history of breeding hen harrier or short-eared owl on the proposed site.

7.32 As a further check, all breeding season (April to August) VP observations were scrutinised for hen harrier from 2004 (84hrs), 2005 (114hrs) and April 2006 (36hrs). The only hen harrier flights observed in 2004 were two early season hunting flights in April 2004 (1st and 8th April) and one flight in July (9th July). None of these flights were within 500m of the proposed Wind farm. The only 2005 records were two late season flights of a male hen harrier in 2005 (24th and 30th August 2005), which were across the site but none of which were indicative of breeding activity. No hen harrier flights were recorded in April 2006.

7.33 The only breeding season (mid-March to August) VP observations for short-eared owls from 2004, 2005 and March/April 2006 were concentrated 3km to the west of the proposed Wind farm. All were recorded on 22nd March 2006, when two birds (presumably a prospecting pair) chased off a third individual.

7.34 On the basis of these results, neither the site nor any suitable habitat within 2km had nesting hen harriers or short-eared owls in 2005, or appear from vantage point data to have had this species breeding in 2004, 2005, or 2006.

Vantage Point (VP) Watches

7.35 VP watches spanned the periods January 2004 to April 2006, and September to December 2006: representing three winters (2004/2005, 2005/2006 and 2006), two complete breeding seasons (2004 and 2005), half of a fourth winter (January-March 2004) and the first one and a half months of the 2006 breeding season.

7.36 Table 5 summarises the findings for target species. Full explanations of flight patterns for each of these species are provided in the sections below but in summary, within the 500m buffer zone greylag geese flights were the most frequently occurring of the target species, with numbers of pink-footed geese flights also recorded.

7.37 On the basis of these findings, collision risk modelling was only carried out for these two species. Flight activity for other target birds was infrequent so collision risk modelling was not calculated. Collision risk for these other species recorded is judged negligible.

7.38 The timing and duration of observations at each VP during the breeding and winter periods are given in Tables 6 and 7. Two breeding seasons were covered from VPs 1-4 (2004 and 2005), with the exception of August in both years, (see Table 3). Winter observations for 2004/2005 were from VPs 1-4 and from VPs 5-7 for 2005/2006 and 2006/2007. As can be seen from the VP viewsheds, however (Figures 7.4 and 7.5), the only VPs over-looking the ultimate position and extent of the proposed wind farm were VPs 1, 2, 5 and 7.

Table 5 Summary VP Results for Target and Other Locally Notable Species Within 500m of the Proposed Wind farm

	Number of flights recorded in study area (no. of flights within 200m of turbines) [no. of flights within 200m of turbines at collision height] {no. of birds within 200m of turbines at collision height)						
	Winter				**Breeding**		**Post-breeding**
Target Species	**Jan. 2004-April 2004**	**Sept. 2004-April 2005**	**Sept. 2005-April 2006**	**Sept. 2006-Dec. 2006**	**March-July 2004**	**March-July 2005**	**August 2005**
Greylag geese	6 (1) [0] {0}	66 (16) [16] {892}	55 (29) [9] {360}	6 (0) [0] {0}	0 (0) [0] {0}	0 (0) [0] {0}	0 (0) [0] {0}
Greenland whitefronted geese	0 (0) [0] {0}	0 (0) [0] {0}	0 (0) [0] {0}	0 (0) [0] {0}	*	*	*
Pink-footed geese	3 (0) [0] {0}	3 (1) [0] {0}	31 (10) [7] {2254}	2 (0) [0] {0}	0 (0) [0] {0}	0 (0) [0] {0}	0 (0) [0] {0}
Whooper swan	1 (0) [0] {0}	21 (1) [1] {9}	15 (2) [2] {9}	8 (0) [0] {0}	*	*	*
	Jan. '04-March '04	Sept. '04-March '05	Sept. '05-March '06	Sept.-Dec'06	April-July '04	April-July '05	August 2005
Osprey	0 (0) [0] {0}	0 (0) [0] {0}	0 (0) [0] {0}	Absent from area	2 (0) [0] {0}	0 (0) [0] {0}	1 (1) [1] {1}
Hen harrier	4 (2) [0] {0}	13 (11) [2] {2}	7 (1) [0] {0}	7 (4) [0] {0} (Dec)	3 (0) [0] {0}	0 (0) [0] {0}	3 (3) [0] {0}
Short-eared owl	0 (0) [0] {0}	0 (0) [0] {0}	7 (0) [0] {0}	0 (0) [0] {0}	0 (0) [0] {0}	0 (0) [0] {0}	0 (0) [0] {0}
Merlin	0 (0) [0] {0}	1 (0) [0] {0}	5 (0) [0] {0}	2 (1) [0] {0}	0 (0) [0] {0}	1 (1) [0] {0}	0 (0) [0] {0}
Golden plover	No data collected	6 (1) [0] {0}	25 (2) [0] {0}	3 (0) [0] {0}	No data collected	0 (0) [0] {0} **	0 (0) [0] {0} **
Black-throated diver	0 (0) [0] {0}	0 (0) [0] {0}	0 (0) [0] {0}	0 (0) [0] {0}	0 (0) [0] {0}	1 (1) [1] {1}	0 (0) [0] {0}
Arctic skua	0 (0) [0] {0}	0 (0) [0] {0}	0 (0) [0] {0}	0 (0) [0] {0}	0 (0) [0] {0}	1 (0) [0] {0}	0 (0) [0] {0}

*** Does not breed locally** **** April golden plover records during April were categorised as winter birds because they were on passage, rather than resident breeders on or near the site.**

Table 6: Vantage point observation time for raptors and waders, by season.

VP	OBSERVATION TIME (HH:MM)									
	Breeding Season 2004 (Raptors)	Breeding Season 2005 (Raptors)	Breeding Season 2004 (Waders)	Breeding Season 2005 (Waders)	Winter 2004/05 (Raptors)	Winter 2005/06 (Raptors)	Winter 2006/07 (Raptors)	Winter 2004/05 (Waders)	Winter 2005/06 (Waders)	Winter 2006/07 (Waders)
	April-August	April-August	March-July	March-July	September - March	September - March	September - December	August - February	August - February	September - December
1	21:00	18:00	24:00	24:00	38:00	N/A	N/A	32:00	N/A	N/A
2	21:00	18:00	24:00	24:00	38:00	N/A	N/A	32:00	N/A	N/A
5	N/A	N/A	N/A	N/A	N/A	60:00	20:20	N/A	56:00	20:20
6						60:00			56:00	
7	N/A	N/A	N/A	N/A	N/A	60:00	20:00	N/A	56:00	20:00

Table 7: Vantage point observation duration for geese and swans, by season.

VP	OBSERVATION TIME (HH:MM)									
	Autumn Passage 2004	Mid-winter 2004/2005	Spring Passage 2005	Winter Total 2004/2005	Autumn Passage 2005	Mid-winter 2005/2006	Spring Passage 2006	Winter Total 2005/2006	Autumn Passage 2006	Mid-winter 2006/2007
	Sept - Nov	Dec - Feb	Mar - Apr	Sept - April	Sept - Nov	Dec - Feb	Mar - Apr	Sept - Apr	Sept - Nov	Dec
1	14:00	18:00	12:00	44:00	N/A	N/A	N/A	N/A		
2	14:00	18:00	12:00	44:00	N/A	N/A	N/A	N/A		
5	N/A	N/A	N/A	N/A	30:00	12:00	24:00	66:00	15:00	5:20
6										
7	N/A	N/A	N/A	N/A	30:00	12:00	23:00	65:00	15:00	5:00

7.39 Predicted collision risk to geese and swans is based on three winters' data, September 2004 to April 2005, September 2005 to April 2006 and September to December 2006. For all three years, an attempt was made to ensure survey effort included dawn and dusk periods, as well as daytime. A summary of effort at the relevant VPs is provided in Tables 8 to 10 below.

Table 8: Number of hours of observations from each vantage point during dawn, daytime and dusk between September 2004 and April 2005.

VP	Time	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	Total	TOTAL
1	Dawn		4:00		2:00	2:00		2:00	2:00	**12:00**	**44:00**
	Daytime	2:00		6:00	2:00	2:00	4:00	2:00	2:00	**20:00**	
	Dusk		2:00		2:00	2:00	2:00	2:00	2:00	**12:00**	
2	Dawn	2:00		2:00			2:00			**6:00**	**44:00**
	Daytime		6:00	4:00	6:00	6:00	2:00	6:00	6:00	**36:00**	
	Dusk						2:00			**2:00**	

Table 9: Number of hours of observations from each vantage point during dawn, daytime and dusk between September 2005 and April 2006.

VP	Time	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	Total	TOTAL
5	Dawn	2:00	2:00	2:00	2:00		2:00	2:00	2:00	**14:00**	**72:00**
	Daytime	2:00	10:00	8:00	4:00	4:00	4:00	8:00	6:00	**46:00**	
	Dusk	2:00		2:00		2:00		2:00	4:00	**12:00**	
7	Dawn		2:00	2:00	2:00		2:00	2:00	2:00	**12:00**	**70:00**
	Daytime	4:00	8:00	8:00	4:00	4:00	4:00	8:00	6:00	**46:00**	
	Dusk	2:00	2:00	2:00		2:00		2:00	2:00	**12:00**	

Table 10: Number of hours of observations from each vantage point during dawn, daytime and dusk between September 2006 and April 2007.

VP	Time	Sep	Oct	Nov	Dec	Total	TOTAL
5	Dawn		2:00	2:00		**4:00**	**20:20**
	Daytime	3:00	3:00	3:00	3:00	**12:00**	
	Dusk		2:00		2:20	**4:20**	
7	Dawn	2:00			2:00	**4:00**	**20:00**
	Daytime	3:00	3:00	3:00	3:00	**12:00**	
	Dusk		2:00	2:00		**4:00**	

VP Results for 2004, 2005, and 2006: Raptors

7.40 VP results are presented for the target raptor species. Findings are described, accompanied by flight line maps and VP observation statistics.

7.41 **Hen Harrier:** Summary – Harriers were the most common target (and Annex 1) raptor present on site. The level of use varied considerably between years, with individuals frequently seen in winter 2004/2005 but considerably less so in 2005/2006 and 2006/2007. Birds were observed foraging around the study area, including the wind farm. There was no recorded breeding activity identified in the proposed wind farm area or within 2km.

7.42 In more detail, over the January 2004 to December 2006 study period, 37 hen harrier flights were seen across the study area, from all VP's. These sightings were from 27 out of the 277 VP watches (i.e. just under 10% of watches produced sightings of hen harriers). This makes it by far the most common Annex 1 raptor present on site.

7.43 Winter harrier activity was much more prevalent than breeding season sightings, accounting for 31 out of the 37 flights recorded, with 20 of the 31 being within 500m of the proposed wind farm (Figure 7.6 and Table 11).

7.44 Distribution of winter flight activity varied considerably between the four years. Most were observed in winter 2004/2005 (13 of the 31 flights) when birds (mostly males) were recorded in September, October and December. The area used was the central part of the wind farm (around ND182557), coinciding with the location of the one 2005/2006 winter flight in the wind farm area (of the seven recorded in the wider study area. This location also coincides with that of the three August 2005 flights). Results therefore suggest that at least for winter 2004/2005 and late summer 2005 this central wind farm area provided foraging habitat (it was also used by merlin – see below).

7.45 The earlier harrier flights, from January to March 2004, were from Spittal Hill on the western side of the wind farm. Three of the four were within the 500m buffer and all were within a day of each other (a male on 14th February and three flights – two of a male and one of a female – on 15th February), probably involving the same two individuals.

7.46 Three breeding season (two April and one July) flights were observed in 2004 - 550m, 800m and 1.5km from the site (Figure 7.6). There were no 2005 records in the main breeding period but there were three late-August 2005 observations of single males across the proposed site. There was no behaviour however, to suggest these were associated with any breeding activity. No harriers were recorded in the early part of the 2006-breeding season (April).

7.47 Overall therefore, whilst the data show hen harrier do use the proposed Wind farm, the frequency of this use is relatively low (present on 27 out of 277 watches) and the great majority of flights are below collision risk height (97%). As a result, collision risk modelling was not carried out for this species.

7.48 From the VP results and the breeding raptor survey results, it can be concluded this species is not likely to be significantly affected by the Wind farm.

Table 11: Hen harrier summary flight activity January 2004 – December 2006

Season	VP	Total observation time (hh:mm)	No. of observed flights		Total flight duration (bird seconds)	Total observed duration a PCH (bird seconds)
			All	In 500m buffer	In 500m buffer zone	In 500m buffer zone
Winter 2004 (January – March)	1	8:00	1	0	0	0
	2	8:00	3	3	345	0
	3	8:00	0	0	0	0
	4	6:00	0	0	0	0
Winter 2004-2005 (September-March)	1	38:00	5	3	360	60
	2	38:00	8	8	600	15
	4	38:00	0	0	0	0
Winter 2005-2006 (September-March)	5	60:00	2	1	60	60
	6	60:00	3	0	0	0
	7	59:00	1	1	90	0
Winter 2006-2007 (September-December)	5	20:20	0	0	0	0
	6	N/A	0	0	0	0
	7	20:00	0	0	0	0
Breeding Season 2004 (April-August)	1	21:00	1	0	0	0
	2	21:00	2	0	0	0
	3	21:00	0	0	0	0
	4	21:00	0	0	0	0
Breeding Season 2005 (April-August)	1	18:00	0	0	0	0
	2	18:00	0	0	0	0
	4	18:00	0	0	0	0
	5	12:00	2	2	150	0
	6	12:00	0	0	0	0
	7	12:00	1	1	210	0

PCH: Potential Collision Height

7.49 **Short-eared Owl:** There were only seven flights recorded over the study period, none within the 500m buffer. Five were records located approximately 3km west of the proposed wind farm (Figure 7.7) from winter 2005/2006. The remaining two flights were recorded at the start of the 2005 breeding season, on 22nd March. These were also in the same area and involved two birds (probably a prospecting pair) chasing off a third individual. Given the absence of any short-eared owl activity on or near the wind farm, no collision risk modelling has been completed for this species. The low level of activity, in combination with the breeding raptor surveys results, mean it can be safely concluded this species is not likely to be significantly affected by the wind farm.

7.50 **Merlin:** Eleven flights were recorded, all below turbine height. Five flights were clustered at a location roughly 3km west northwest of the proposed wind farm (Figure 7.7). Three of the remaining flights were winter records approximately 600m northwest of the site, hunting around Banniskirk Quarry and Loch Banniskirk. The final three flights were within the proposed wind farm (12th April 2005, 3rd March 2006 and 13th October 2006). These three were of an individual male, observed foraging in the same part of the proposed wind farm as the hen harrier activity.

7.51 The low level of use by merlin (three flights) means collision modelling is not considered likely to add any additional insights to the impact assessment. From the VP results and breeding raptor survey results it can be concluded that the Wind farm will not significantly affect this species.

7.52 **Osprey:** Three flights were recorded, two within the 500m buffer and one of these (24th August 2005) across the wind farm site itself (Figure 7.7). Given this limited occurrence within 500m around the proposed wind farm (total flight time of 90 seconds at collision risk height out of 210 hours of breeding season watches) data strongly suggest the wind farm will not significantly affect the species.

7.53 **Peregrine:** Two peregrine flights were recorded, between approximately 400-1000m northwest of the site (Figure 7.7). They were within a day of each other (8th and 9th April 2006) and included a bird flushed by the surveyor off a ploughed field and the second hunting over the same field. This was probably the same bird drawn by the flocks of golden plover gathered in these fields on the same days (the occurrence of golden plover is discussed below). Given the limited occurrence of peregrine within 500m around the proposed wind farm, collision modelling is not considered likely to add any additional insights to the impact assessment. Data indicate the wind farm will not significantly affect this species.

VP Results for 2004 and 2005:Waders

7.54 VP results are presented for waders - the second target group. Findings are described for breeding and non-breeding seasons, with accompanying flight line maps and VP observation statistics.

7.55 **Summary:** Within the 500m buffer, flights of five wader species were recorded from VPs: golden plover, lapwing, curlew, snipe and oystercatcher. Golden plover and lapwing flights were concentrated in the Banniskirk Mains area (Figures 7.8 and 7.9) and as a result, most avoided the collision risk area. Snipe and curlew flights were the only waders whose flight activity was frequently within the proposed turbine area.

7.56 light distribution for lapwing, curlew, and oystercatcher generally tallied with their breeding distribution (see Figure 7.2 and 7.3 for wader territory locations).

7.57 **Golden Plover:** There were 34 golden plover flights were recorded in the study area from September 2004 to December 2006, all birds arriving or leaving fields southeast of Banniskirk Mains (Figure 7.8). Records were almost entirely in April (pre-breeding aggregations of birds on route to breeding grounds) with the remainder over the winter period (31 flights of the 34 flights recorded were during April and only 3 outside this period, either in October or November). Only three of the 34 flights were within 200m from the nearest turbines, all of which were below collision risk height.

7.58 There were no other noteworthy numbers of wader flights within 500m of the Wind farm, with the majority of the small number of oystercatcher and lapwing flights associated with birds nesting in the fields southeast of Banniskirk Mains. All curlew and the majority of snipe flights were within the turbine area. The location of curlew flights tended to confirm there were three to four breeding pairs in the proposed turbine area in 2004 and 2005 (see Figures 7.2 and 7.3).

7.59 On the basis of the above information, in combination with the breeding bird survey, it can be concluded that the Wind farm will not have a significant impact on Annex 1 breeding, wintering or passage waders. It is possible that it may reduce breeding success or displace the curlew and snipe breeding on site but this impact would only constitute a negligible impact at the local population level.

VP Results for 2004 to 2006: Whooper Swan

7.60 Figures 7.10 to 7.13 show the 45 whooper swan flights recorded in the study area. All occurred between October to March, with only 6 of the 45 (13%) within 500m of the proposed wind farm (Table 12).

7.61 Nearly all flights were movements to or from feeding/roosting sites in the Banniskirk Mains/Banniskirk House/Banniskirk Dam area (600m-1500m northwest of the nearest proposed turbine). Birds arriving or departing from here generally headed along a southwest/northeast axis, with 30 of these 32 arrival/departure flights outside the wind farm's 500m buffer site. The remaining two flights, comprising nine swans on 19th January 2005 and four swans on the 8th February 2006, were at collision risk height.

7.62 Five flights did not fit this southwest/northeast flight pattern. Four were parallel flights 300m to 1500m northeast of the site (two inside the 500m buffer) and suggest a commuting route parallel to the A882, probably linked to movements between Loch Watten and Loch Scamclate.

7.63 The remaining flight crossing the proposed wind farm area was of 5 birds on 4th November 2005, at collision height, a flight that does not fit the other two patterns of movement. The most likely interpretation is that these birds were moving from Loch Watten to Loch of Toftingall.

7.64 Figure 7.14 provides feeding locations for whooper swan in the surrounding landscape to the application boundary collated during 2005 to 2006. The predominant concentrations are located around the Loch Scamclate and Loch Watten area to the north, east, and north-west of the application boundary.

7.65 In combination with the flightline data, the evidence shows the feeding and roosting locations of whooper swans around Spittal were distributed in such a way that the birds do not commute across the Wind farm to any significant degree. Given these results, with only three flights recorded across the Wind farm in over 300 hours of observation (nine birds on 19th January 2005, four on 8th February 2006 and five on 4th November 2006) it can be concluded this species will not be significantly affected by the wind farm.

Table 12: Whooper Swan: Summary of Flight Activity January 2004 – December 2006

Season	VP	Total observation time (hh:mm)	No. of observed flights		Total flight duration (bird seconds)	Total observed duration at PCH (bird seconds)
			Study Area	In 500m buffer	In 500m buffer	In 500m buffer
Winter 2004 (January – April)	1	11:00	1	0	0	0
	2	11:00	0	0	0	0
	3	11:00	0	0	0	0
Winter 2004-2005 (September-April)	1	42:00	14	0	0	0
	2	42:00	3	1	405	405
Winter 2005-2006 (September-April)	5	72:00	9	1	300	60
	7	71:00	5	3	625	225
Winter 2006-2007 (September-December)	5	20:20	6	0	0	0
	7	20:00	2	0	0	0

PCH: Potential Collision Height

VP Results for 2004 to 2006: Greylag Geese

7.66 Greylag geese flights were by far the most common of the wildfowl species encountered. The great majority of their flights were recorded during Autumn migration.

7.67 Six flight lines of Greylag geese were observed during January to April 2004. Of these, five were recorded within the application boundary. Of these five flights, only two were inside the 500m buffer of the proposed turbine layout. Neither were at collision risk height and only involved a pair and a single individual (Figure 7.15).

7.68 The following Autumn (September to November 2004 - Figure 7.16) accounted for the majority (86%) of greylag flightlines over the entire winter (September 2004 to April 2005). These flights were aggregated over the north and to the west of the application boundary. Flightlines over the north converged on the area between Banniskirk Mains and close to the sheepfold.

7.69 Over this period, fifty flights were recorded within the application boundary, of which 23 were within 500m buffer of the proposed Wind farm. Of these, 13 were at collision risk height.

7.70 VP monitoring throughout December 2004 to February 2005 only observed five flights of greylag geese within the application area, two of which were within the 500m buffer of the Wind farm. Only one single flight was at collision risk height (one goose on 25th January 2005) (Figure 7.17).

7.71 VP monitoring throughout March 2004 to April 2005 only observed six flights of greylag geese within the application area (Figure 7.18), two of which were within the 500m buffer of the proposed turbine layout. Both of these flights were at collision risk height (10 geese on 17th March 2005 and six geese on 20th April 2005).

7.72 VP monitoring during Autumn 2005 (September to November – Figure 7.19) identified a similar peak to the previous Autumn, with September-November flights accounting for 83% of the greylag flights recorded in the application boundary over winter 2005/2006.

7.73 Over Autumn 2005, 40 greylag goose flights were recorded within the application boundary. Within the 500m buffer of the proposed turbine layout 22 flights were observed, of which three were at collision risk height (two birds on 30th September 2005, 21 birds on 28th September and six birds on 4th November 2005).

7.74 VP monitoring throughout December 2005 to February 2006 only observed nine greylag flights, eight of which were within the 500m buffer of the proposed turbine layout. Of these, three were at collision risk height (Figure 7.20) (flights of 13 and 150 birds on 22nd February).

7.75 VP monitoring throughout March to April 2006 only observed three greylag flights within the application area, of which two were within 500m of the Wind farm (38 and 100 geese on 20th March 2006). Both were at collision risk height (Figure 7.21).

7.76 Greylag geese VP monitoring during Autumn 2006 (September to November – Figure 7.22) identified a significant reduction in the number of flights to previous Autumn monitoring periods. There were five flights within the application boundary, all of which were outside the 500m buffer.

7.77 No flights of greylag geese were recorded during December 2006. Grey goose numbers across north-eastern Scotland and Caithness during the winter 2006/2007 were significantly lower than usual (Martyn Elwell, *pers comm*. 2007). Goose numbers on Orkney have remained higher through the core wintering period as geese appear to have chosen not to migrate further south due to mild conditions.

7.78 Overall, of the 133 greylag flights observed in the application area between January 2004 to December 2006, 72% (96 flights) were during Autumn (September to November). Thirty-three per cent (45 flights) were within 500m of the proposed wind farm. Of these, 19% (25 flights) were at collision height (Figures 7.15 to 7.22). In terms of flight path direction, a west/east and southwest/northeast orientation is discernable just to the north of the proposed wind farm.

7.79 Figure 7.23 provides feeding field locations for greylag geese in the area surrounding the Wind farm, collected over 2005 to 2006. The predominant concentrations are between Loch Scamclate and Loch Watten area to the east and north of the application boundary. These aggregations range from approximately 500m to 2,200m from the proposed Wind farm. Additional locations for greylag feeding were to the west around Achlachan Moss and Harpsdale Mains, 4-5km from the site.

7.80 Given the number of greylag flights in the Wind farm area collision risk modelling has been carried out for this species, the results of which are given later in this chapter.

Table 13 Greylag Geese: Summary of Flight Activity Jan 2004 – Dec 2006

Season	VP	Total observation time (hh:mm)	No. of observed flights		Total flight duration (bird seconds)	Total observed duration at PCH (bird seconds)
			Study Area	In 500m buffer	In 500m buffer	In 500m buffer
Winter 2004 (January – April)	1	11:00	2	1	60	0
	2	11:00	2	1	120	0
	3	11:00	0	0	0	0
Winter 2004-2005 (September -April)	1	42:00	31	8	21 765	17 985
	2	42:00	23	19	72 600	40 065
Winter 2005-2006 (September -April)	5	72:00	21	11	15 435	1 575
	7	71:00	22	21	34 980	9 285
Winter 2006 (September -December)	5	20:20	4	0	0	0
	7	20:00	2	0	0	0

PCH: Potential Collision Height

VP Results for 2004 to 2006 Pink-footed Geese

7.81 Winter flight lines of pink-footed geese over the survey period (January 2004 to December 2006) show no clear, consistent, and defined orientation (Figure 7.24).

7.82 The only exception to this occurred with five to six March 2006 flights near the eastern end of the site, that appear to have been associated with a feeding opportunity in one field within the site boundary (Figures 7.14 and 7.24). Otherwise, in terms of number of birds and number of flights, records were spread relatively evenly over the landscape, with no particular concentrations of activity in or around 500m of the proposed development.

7.83 Over January 2004 to December 2006, there were 14 flights within the 500m buffer, six of which were at collision height. Details of these are shown in Table 14.

7.84 Figure 7.14 shows the feeding field locations for pink-footed geese in the surrounding landscape to the application boundary collated during 2005 to 2006. The predominant concentrations are located in similar fields to greylag geese around the Loch Scamclate and Loch Watten area to the east and north of the application boundary, approximately 500-2,200m from the Wind farm. Additional locations for pink-footed geese feeding were also in similar locations to the west around Achlachan Moss and Harpsdale Mains 4-5km away.

7.85 Given the number of pink-footed geese flights in the wind farm area, collision risk modelling has been carried out for this species, the results of which are given below.

Table 14: Pink-footed Geese: Summary of Flight Activity Jan 2004 – Dec 2006

Season	VP	Total observation time (hh:mm)	No. of observed flights		Total flight duration (bird seconds)	Total observed duration at PCH (bird seconds)
			Study Area	In 500m buffer	In 500m buffer	In 500m buffer
Winter 2004 (January – April)	1	11:00	0	0	0	0
	2	11:00	0	0	0	0
	3	11:00	0	0	0	0
Winter 2004-2005 (September -April)	1	42:00	0	0	0	0
	2	42:00	1	1	90	0
Winter 2005-2006 (September -April)	5	72:00	10	6	32,730	24,120
	7	71:00	7	6	110,850	54,750
Winter 2006 (September -December)	5	20:20	2	1	1 500	1 500
	7	20:00	0	0	0	0

PCH: Potential Collision Height

VP Results for Other Species

7.86 **Black-throated Diver:** One black-throated diver flight was recorded, on 26th May 2005, lasting 30 seconds at collision risk height. Given this very low use within 500m of the proposed Wind farm, the data show this species is not likely to suffer any impact from the development.

EVALUATION OF NATURE CONSERVATION VALUE OF THE SITE

Upland Waders

7.87 On the basis of consultations and survey results, the proposed Spittal Wind farm site has been identified as being of low nature conservation importance for waders. This is based on breeding and non-breeding records collected during the monitoring period.

7.88 The study area holds four breeding species of wader; curlew, lapwing, oystercatcher, and snipe. Snipe are the most abundant, followed by curlew, lapwing, and oystercatcher (Figures 7.2 and 7.3, Table 4). All four wader species are UK Amber-listed species and are therefore classified of medium conservation concern[4]. This is based upon a widespread decline in upland breeding wader population, particularly in south Scotland, England and Wales.

7.89 VP monitoring of the study area during January 2004 to December 2006 identified that flight activity of wader species of high conservation concern across and within the current wind farm footprint was low. The majority of aggregated wader activity for golden plover (Annex 1) and lapwing (Amber-listed) occurred outside of the 500m buffer of the proposed turbines in the Banniskirk mains area to the north west of the site (Figures 7.8 and 7.9).

[4] www.bto.org/psob/index/htm.

Caithness is a UK strong hold for wader species, particularly snipe, but also curlew, lapwing and oystercatcher as indicated by the Breeding Bird Survey (BBS), BTO[5]. Within this context, the importance of the proposed wind farm area for breeding and non-breeding waders, and of waders in flight is judged to be of local significance only.

Raptors

7.90 On the basis of consultations and survey work, the proposed Spittal Wind farm site has been identified as of low nature conservation importance for raptor species in Caithness.

7.91 The study area extending to 2km during the monitoring from January 2004 to December 2006 held no breeding records of Annex 1 upland raptors, specifically hen harrier (Red-listed), merlin (Amber-listed) and short-eared owl (Amber-listed). In addition, there were no breeding records of osprey within the wind farm site.

7.92 Martyn Elwell and Stan Laybourne (Local Bird Recorder for Caithness) highlighted historical breeding sites for hen harrier within 2km, in the Toftingall area to the south of the site and possible sites in young conifer plantations 300m-1.75km to the west.

7.93 Martyn Elwell confirmed there were no known historical hen harrier winter roosts present within the site. No roosts were identified during the monitoring on site or in the wider area of search (covered by the goose feeding and roosting study). This was discussed in light of the apparent concentration of hen harrier flight lines within the proposed wind farm site (Figure 7.6). However, this cluster of flight lines comprises flights recorded over a considerable period and this level of use is not atypical in comparison to flight activity across the Caithness landscape (Figure 7.6).

7.94 VP monitoring identified less than ten raptor flight lines across the wind farm site for merlin, peregrine, and osprey. No flights for short-eared owl were recorded within the study site (Figure 7.7).

7.95 On the basis of this evidence, the proposed site is considered to be of local significance for raptors. The wind farm is not considered likely to have any significant impact on Annex 1 or other target raptors at the local population level.

Waterfowl (Geese & Swans)

7.96 The proposed Spittal Wind farm is on the Banniskirk/Spittal hill area between two corridors of lower ground utilised by migratory geese and swans. To the east of the site in a northwest-southeast direction, lies the corridor including Loch Scamclate-Loch Watten-Wick river valley. To the west of the site on a broadly similar topographic orientation lies the corridor between Loch Calder-Loch More-River Thurso, which takes in Loch Olginey, and Black Loch (Figure 7.1).

7.97 Migratory grey geese (greylag and pink-footed) and whooper swan utilise key Caithness lochs (Loch Scamclate, Loch Watten, Loch Calder, Loch Olginey and Black Loch) which form part of the Caithness Lochs SPA both during passage and as resident locations for the winter in Caithness (Figure 7.1).

7.98 On the basis of consultations and survey findings, the proposed Spittal Wind farm site has been identified as being of minor nature conservation importance for migratory whooper swans. The number of wintering whooper swan flights recorded over the study site and within 500m were very low with only three flights recorded. However, whooper swan flights were recorded more regularly in the Banniskirk mains area to the north-west of the proposed wind farm site. This activity has a clear association with available feeding and roosting grounds and flights orientate towards the SPA lochs in close proximity 2-4km (Loch Scamclate and Loch Watten).

[5] www.bto.org.

7.99 On the basis of consultations and surveys, the proposed Spittal Wind farm site has been identified as being of moderate nature conservation importance for migratory 'grey geese' (greylag and pink-footed geese).

7.100 Greylag geese are present predominantly during the autumn passage period from September to November (Figures 7.15-7.24). Spring northerly passage has been less evident from the monitoring conducted across the proposed Spittal site.

7.101 Of the two 'grey geese' species recorded in the study area, pink-footed geese were much less abundant and predictable in their routine, pattern, presence, and nature of flight movements. The total number of flightlines recorded between January 2004 and December 2006 was considerably less than those for greylag geese.

COLLISION RISK MODELLING

7.102 In light of survey results and the evaluation of the site's bird interests, collision risk modelling has been done to help predict the wind farm's impact on greylag and pink-footed geese.

Methodology

7.103 The risk of birds colliding with the rotating turbine blades has been assessed using a model developed by Band *et al* [6]. This estimates the number of bird collisions with the turbine rotors during a specified time period. It is calculated in two stages:

Estimating the number of birds passing through the area or volume swept by the rotors

Estimating the probability that a bird will be struck by a rotor blade when passing through the area swept by the rotors

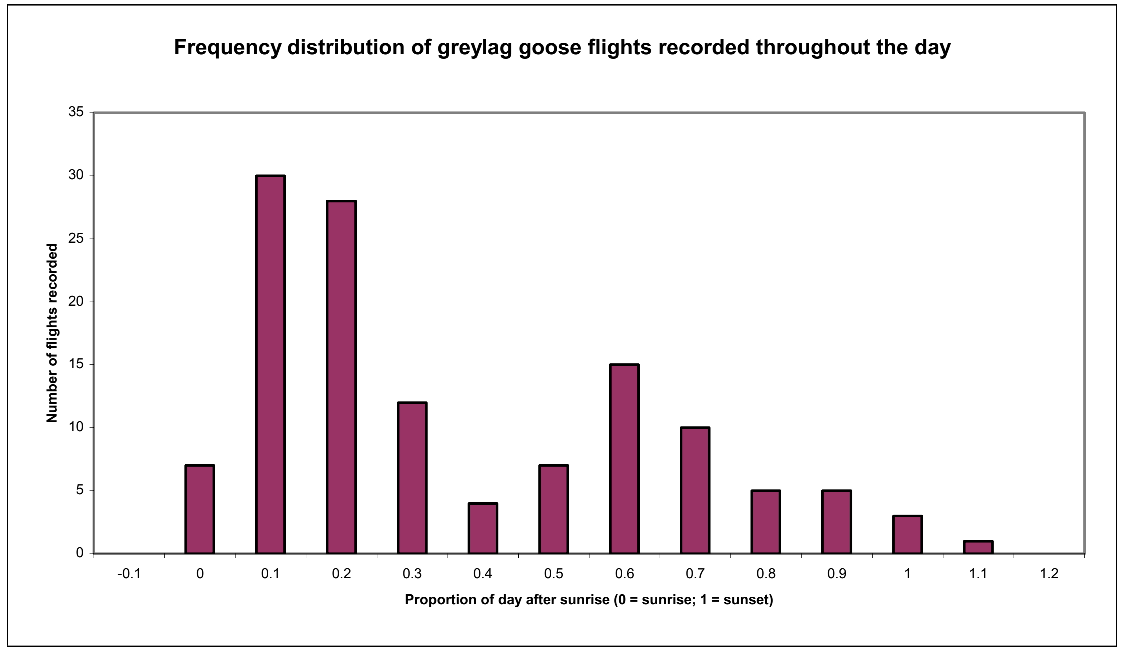
7.104 The modelling process is different for two different situations:

- Regular flights of waterfowl between feeding and roosting grounds
- Less predictable and generally more local movements by birds, such as foraging and display activity by raptors and waders

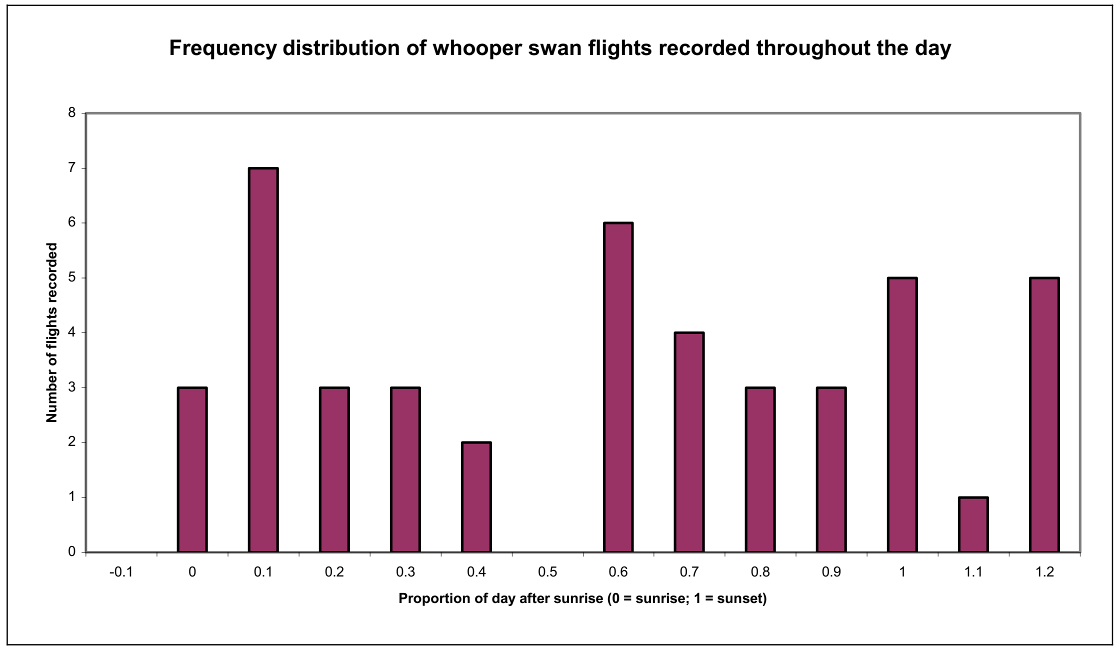
7.105 Data for both scenarios were collected by observing and recording bird flight activity in and around the site during timed watches from vantage points selected to give good visible coverage of the site. However, given that findings show geese to be the only potentially significant bird interest at this location, modelling has only been done for the first of these situations.

7.106 The graphs below shows the frequency distribution of flights recorded throughout the day. The x-axis describes the proportion of the day before or after sunrise, where 0 is sunrise and 1 is sunset. The graph shows that flights were recorded throughout the day. The highest number of flights was recorded in the 1-2 hours after sunrise. However, for the purposes of the collision risk modelling, analysis has not been performed on different parts of the day. The collision risk model therefore averages out activity throughout the available active hours in a day, which is defined as all time between sunrise and sunset plus 25% of hours between sunset and sunrise (to account for night-time movements, in accordance with SNH guidelines).

[6] Band W., Madders M. & Whitfield D.P. (in press) Developing field and analytical methods to assess avian collision risk at wind farms. In de Lucas M., Janss G. & Ferrer M. (eds.) *Birds and Wind Power*. Lynx Edicions, Barcelona.

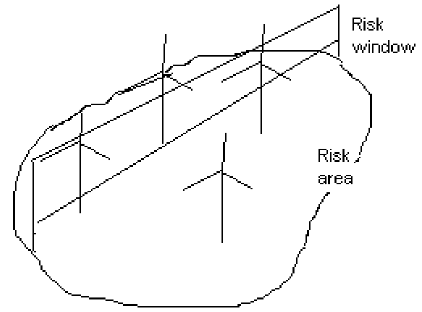


Whooper swans flights were also recorded throughout the day, with no clear pattern of activity (see graph below).



Modelling stage 1

7.107 All observed flight lines were digitised in a GIS and superimposed onto a map detailing the proposed locations of the turbines (Figures 7.6 to 7.25). A risk area was defined as the area within 200m (plus 40m to account for the rotor blades) of the envelope surrounding the outermost turbines. The 200m is added as a precaution, in accordance with the SNH guidance, to account for any inaccuracy in judging flightline distances from the wind farm.



7.108 From the entire data-set of flight-lines observed, those flights of greylag geese that intersected with the risk area were identified (in a GIS) and retained for use in the model. Flight records that did not intersect with the risk area were discarded from the model. The unique identifier applied to each retained flight line was cross-referenced to the record of flight duration and height stored in an Access database. Retained flight records with no part of the flight recorded at risk height were discarded from the model, leaving only those flights recorded through the risk window at risk height.

7.109 The mean number of geese flying through the risk window at collision risk height per hour of observation was determined for each month in each season, broken down into Autumn passage, mid-winter and Spring passage (to reflect migration patterns). The observation time from the VP's was summed in this case because each of the two relevant vantage points used overlooked almost all of the proposed wind farm location. A single surveyor, carried out all the VP watches and considered that any geese over-flying the proposed wind farm location would have been detected from either VP.

7.110 It was assumed that each flight line with at least one recorded altitude at potential collision height intersecting the risk area represented one traverse through the risk window.

7.111 The number of hours that geese were potentially active each month was calculated using approximate average day-lengths for each month (between sunrise and sunset) and allowing for activity during 25% of nocturnal hours (between sunset and sunrise). The potential number of birds passing through the risk window at risk height during each season (n) was determined by multiplying the number of birds passing through the risk window per hour by the number of hours that birds were potentially active in each season.

7.112 The area (A) presented by the wind farm rotors in the risk window was calculated as $N \times \pi R^2$, where N is the number of turbines in the risk window and R is the radius of the rotor. In this case, N is 30 and R is 40m. Thus the area presented by the rotors = $30 \times \pi \times (40)^2$ = 150,796 m^2.

7.113 The proportion of the risk window occupied by the rotors is A / W = 0.882. Thus, the number of geese assumed to transit through the area swept by the turbine rotors each winter is $n \times A / W$. The following sections describe the Stage 1 calculations of the potential number of greylag and pink-footed geese flying through the turbine rotors each season.

Greylag Geese Collision Risk Results

7.114 Early 2004 (January – April): No greylag geese were observed flying through the risk window at risk height, therefore the predicted collision risk for that period is zero.

Table 15: Greylag Goose VP Results Autumn 2004 (September – November)

Greylag Goose		Sep	Oct	Nov	
No. of birds through risk window at PCH		0	873	0	
Hours of observation	VP1	2	6	6	
	VP2	2	6	6	
	TOTAL	4	12	12	
No. of birds per hour of observation		0	72.8	0	
Hours available	Average day length	12	9	7	
	Days in month	30	31	30	
	Potentially active hrs	450	348.8	262.5	
Potential no. of birds flying through the risk window per season		0	25371.6	0	**TOTAL 25371.6**
Potential no. of birds flying through the rotor swept area per season					**22373.9**

Table 16: Greylag Geese VP Results Winter 2004/05 (December – February)

Greylag Goose		Dec	Jan	Feb	
No. of birds through risk window at PCH		0	1	0	
Hours of observation	VP1	6	6	6	
	VP2	6	6	6	
	TOTAL	12	12	12	
No. of birds per hour of observation		0	0.08	0	
Hours available	Average day length	6	7	8	
	Days in month	31	31	30	
	Potentially active hrs	225	271.2	300	
Potential no. of birds flying through the risk window per season		0	22.6	0	**TOTAL 22.6**
Potential no. of birds flying through the rotor swept area per season					**19.9**

Table 17: Greylag Geese VP Results Spring 2005 (March – April)

Greylag Goose		Mar	Apr	
No. of birds through risk window at PCH		10	6	
Hours of observation	VP1	6	6	
	VP2	6	6	
	TOTAL	12	12	
No. of birds per hour of observation		0.833	0.5	
Hours available	Average day length	11	14	
	Days in month	31	30	
	Potentially active hrs	426.2	525	
Potential no. of birds flying through the risk window per season		355.2	262.5	**TOTAL 617.7**
Potential no. of birds flying through the rotor swept area per season				**544.7**

Table 18: Greylag Geese VP Results Autumn 2005 (September – November)

Greylag Goose		Sep	Oct	Nov	
No. of birds through risk window at PCH		23	0	6	
Hours of observation	VP1	6	13.5	12	
	VP2	6	12	12	
	TOTAL	12	25.5	24	
No. of birds per hour of observation		1.92	0	0.25	
Hours available	Average day length	12	9	7	
	Days in month	30	31	30	
	Potentially active hrs	450	348.8	262.5	
Potential no. of birds flying through the risk window per season		862.5	0	65.6	**TOTAL 928.1**
Potential no. of birds flying through the rotor swept area per season					**818.4**

Table 19: Greylag Geese VP Results Winter 2005/06 (December – February)

Greylag Goose		Dec	Jan	Feb	
No. of birds through risk window at PCH		0	0	193	
Hours of observation	VP1	6	6	6	
	VP2	6	6	6	
	TOTAL	12	12	12	
No. of birds per hour of observation		0	0	16.1	
Hours available	Average day length	6	7	8	
	Days in month	31	31	28	
	Potentially active hrs	225	271.2	280	
Potential no. of birds flying through the risk window per season		0	0	4503.3	**TOTAL 4503.3**
Potential no. of birds flying through the rotor swept area per season					**3971.3**

PCH: Potential Collision Height (risk height)

Table 20: Greylag Geese VP Results Spring 2006 (March – April)

Greylag Goose		Mar	Apr	
No. of birds through risk window at PCH		138	0	
Hours of observation	VP1	12	12	
	VP2	11	12	
	TOTAL	23	24	
No. of birds per hour of observation		6	0	
Hours available	Average day length	11	14	
	Days in month	31	30	
	Potentially active hrs	426.2	525	
Potential no. of birds flying through the risk window per season		2557.5	0	**TOTAL 2557.5**
Potential no. of birds flying through the rotor swept area per season				**2255.3**

PCH: Potential Collision Height (risk height)

7.115 Autumn and Winter 2006/07 (September – December): None of the observed flights of greylag goose recorded so far during the September to December part of the winter were within 200m of the proposed turbine locations. Based on the observations conducted so far in autumn and winter 2006/07, the estimated collision risk to these species is zero.

7.116 Pink-footed goose flights across the wind farm at collision risk height were limited to the Spring 2006 season and collision risk modelling has therefore been carried out accordingly.

Table 21: Pink-footed Geese VP Results Spring 2006 (March – April)

Pink-footed Goose		Mar	Apr	
No. of birds through risk window at PCH		1850	4	
Hours of observation	VP1	12	12	
	VP2	11	12	
	TOTAL	23	24	
No. of birds per hour of observation		80.4	0.2	
Hours available	Average day length	11	14	
	Days in month	31	30	
	Potentially active hrs	426.2	525	
Potential no. of birds flying through the risk window per season		34285.3	87.5	**TOTAL 34372.8**
Potential no. of birds flying through the rotor swept area per season				**34372.8**

Modelling stage 2

7.117 The probability of a bird that flies through the area swept by the rotors being hit by a rotor blade depends on a number of parameters: the dimensions of the bird and type of flight (speed, and flapping or gliding), and the size and rotation speed of the rotors. These parameters are input into the Excel spreadsheet (available on the SNH website at www.snh.gov.uk) that calculates the average risk of colliding with a blade for a bird passing through a rotor, expressed as a percentage.

7.118 Table 22 shows the physical parameters of greylag geese and pink-footed geese used in the collision risk modelling analysis. Bird lengths and wing spans have been taken as the upper (*i.e.* worst-case) value of the ranges given in *Handbook of Birds of Europe, the Middle East and North Africa – The Birds of the Western Palearctic, Vol. 1* (Cramp and Simmons, 1977). Flight speeds have been estimated based on observed flight activity at a number of proposed wind farm sites in Scotland. Table 23 shows the physical parameters of the wind farm and wind turbines.

Table 22: Biometric parameters used in collision risk modelling.

Species	Length (metres)	Wing span (metres)	Typical flight speed (metres per second)
Greylag goose	0.84	1.68	13
Pink-footed goose	0.76	1.61	13

Table 23: Physical wind farm parameters* used in collision risk modelling.

Item	Quantity	Source
Hub height	60-70 metres	Developer proposal
Rotor radius	40 metres	Developer proposal
No. of turbines	30	Developer proposal
No. of rotor blades	3	Developer proposal
Maximum chord width	3.2 metres	Estimated
Rotation period	3.77 seconds	Estimated
Pitch	6 degrees	Estimated
Estimated operational rate	85% of time	BWEA factsheet

* A turbine model has not yet been selected for use at Spittal, so values have been estimated for physical turbine parameters, based on current 2.5MW turbines, such as the Nordex N80 and Vestas V80.

7.119 Table 24 shows the calculated percentage of flights of each species through the rotors that would result in collision, assuming equal numbers of upwind and downwind flights (see Annex 2 for full calculations).

Table 24: Percentage of flights resulting in collision.

Species	Percentage
Greylag goose	10.5%
Pink-footed goose	10.1%

7.120 The predicted number of bird collisions per year is the result of Stage 1 (number of bird transits through rotors) × the result of Stage 2 (probability of collision). This figure is reduced by 15% to allow for the likelihood that turbines would only be operative 85% of the time.

7.121 The next stage in the model is to incorporate an avoidance factor. The model therefore takes into account that birds will take some degree of avoiding action rather than blindly fly into the turbines. Recent reviews during 2006 (Fernley et al, 2006[7]; Patterson, 2006[8]; & Pendlebury, 2006[9]) suggest the avoidance rate for geese is very high probably in excess of 99%. Band et al. (in press)[10] state that the limited evidence available suggests that avoidance can be substantial and may typically be above the 95% value assumed in their examples. More recent emerging guidance from SNH (Andy Douse, *pers. comm. 2007,* Roger McMichael, SNH Renewables Casework Support Office for North Scotland *pers. comm.* 2007) is that the 99% avoidance figure has been adopted by SNH as the avoidance figure for geese. For the purpose of this assessment, a range of avoidance values has been used to estimate mortality (Tables 25-27) but for the final assessment of impacts the 99% figure has been used, as requested by Roger McMichael.

Table 25: Summary of estimated mortality of greylag geese due to collision based on data collected between January 2004 and December 2006.

	Estimated mortality (birds per season)		
Season	**95% avoidance**	**98% avoidance**	**99% avoidance**
Jan-Apr 04	**0**	**0**	**0**
Autumn04	100.12	40.05	20.02
Core04-05	0.09	0.04	0.02
Spring05	2.44	0.98	0.49
Winter 04-05	**102.64**	**41.06**	**20.53**
Autumn05	3.66	1.46	0.73
Core05-06	17.77	7.11	3.55
Spring06	10.09	4.04	2.02
Winter 05-06	**31.52**	**12.61**	**6.30**
Winter 06-07*	**0**	**0**	**0**

* Based on data collected between September and December 2006.

Table 26: Summary of estimated mortality of pink-footed geese due to collision based on data collected between January 2004 and December 2006.

	Estimated mortality (birds per season)		
Season	**95% avoidance**	**98% avoidance**	**99% avoidance**
Jan-Apr 04	**0**	**0**	**0**
Winter 04-05	**0**	**0**	**0**
Autumn05	0	0	0
Core05-06	0	0	0
Spring06	146.9	58.8	29.4
Winter 05-06	**146.9**	**58.8**	**29.4**
Winter 06-07*	**0**	**0**	**0**

* Based on data collected between September and December 2006.

These data, covering three winters of monitoring, give an estimated average annual greylag goose mortality of:

- **45 geese per year @ 95% avoidance**
- **18 geese per year @ 98% avoidance**
- **9 geese per year @ 99% avoidance**

and an estimated average annual pink-footed goose mortality of:

- **49 geese per year @ 95% avoidance**
- **20 geese per year @ 98% avoidance**
- **10 geese per year @ 99% avoidance**

[7] Fernley, J., Lowther, S. & Whitfield, P. (2006) A review of goose collisions at operating wind farms and estimation of the goose avoidance rate. *Natural Research, West Coast Energy & Hyder Consulting.*
[8] Patterson, I.J. (2006) *Geese and Wind farms in Scotland.* SNH Internal Research Report.
[9] Pendlebury, C. (2006) *BTO Research Report No. 455.* An appraisal of "A review of goose collisions at operating wind farms and estimation of the goose avoidance rate" by Fernley, J., Lowther, S. and Whitfield, P. (November 2006).
[10] See note 1.

MITIGATION & ENHANCEMENT

Operational Effects - Managed Collision Risk

7.122 The VP results show there were periods when the collision risk was much higher than in others. This was predominantly during Autumn migration periods in 2004 and 2005 when greylag geese occurred close to the proposed turbine layout. This appears to have arisen because of movements between Banniskirk Dam and feeding fields nearby, on and just off the site.

7.123 In spring 2006, this was also the case for pink-footed geese, when four flights came from Loch Watten into the area around the proposed turbines 23 and 27, with skeins containing between 250-800 geese.

7.124 In order to minimise the risk to geese from turbine collision, measures will be undertaken to make fields on site less attractive to foraging geese. These would be achieved by allowing vegetation to grow to a sward height sufficient to render the fields unattractive for geese. In addition, use of scaring techniques (e.g. gas guns) will further dissuade the geese from flying near the wind farm site[11], thus reducing the potential risk of collision. The details and framework to secure these measures will be concluded in liaison with SNH, the Council and RSPB Scotland.

7.125 The potential impact of these measures can be examined by re-running collision risk calculations with these flight lines removed (*i.e.* 'managed out'). The resulting collision risk for greylag would be significantly reduced, as shown in Table 27.

Table 27: Summary of estimated mortality of greylag geese due to collision based on data collected between January 2004 and December 2006, if flights associated with use of fields within the northeast of the site are 'managed out'.

	Estimated mortality (birds per season)		
Season	**95% avoidance**	**98% avoidance**	**99% avoidance**
Jan-Apr 04	**0**	**0**	**0**
Autumn04	30.05	12.02	6.01
Core04-05	0.09	0.04	0.02
Spring05	2.44	0.98	0.49
Winter 04-05	**32.57**	**13.03**	**6.51**
Autumn05	3.66	1.46	0.73
Core05-06	1.47	0.59	0.29
Spring06	0.00	0.00	0.00
Winter 05-06	**5.14**	**2.05**	**1.03**
Winter 06-07*	**0**	**0**	**0**

* Based on data collected between September and December 2006

7.126 This gives an estimated average annual greylag goose mortality of:

- 12 - 13 birds per year @ 95% avoidance
- 5 birds per year @ 98% avoidance
- 2 - 3 birds per year @ 99% avoidance

7.127 For pink-footed geese, managing out the flights associated with birds flying to and from fields within the site reduces the potential collision risk to a negligible level. All four of the flights recorded in March would no longer occur and would therefore be excluded from the model, leaving only one flight of four birds (recorded in April). Modelling one flight of four birds would result in an output of negligible collision risk for pink-footed geese.

7.128 No other mitigation is proposed as it is believed the above would be sufficient to reduce any impacts on geese to an acceptable minimum.

[11] Bishop J et al (2003). Review of international literature regarding the effectiveness of auditory bird scaring techniques and potential alternatives. DEFRA Research Report.

ASSESSMENT OF POTENTIAL IMPACTS

7.129 The potential impacts of the development on the site's key bird interests, and those of the surrounding area, are examined below, for each of the three phases of development: construction, operation (including routine maintenance) and de-commissioning. This is based on consultations, survey data, knowledge of the site and emerging understanding of Wind farm/ bird interactions[12].

Potential Construction Effects

Disturbance to Waterfowl (Geese & Swans) During Construction

7.130 Pink-footed and greylag geese wintering in north east Scotland have been shown to avoid the proximity of roads when foraging on agricultural land[13]. Flocks were found a medium distance of 400m from the nearest road (100-1100m), and not within 100m[14]. Avoidance of roads by geese has also been shown by Madsen (1985)[15]. Keller (1996) identified that flight distances of geese ranged from 100-250m (mean = 190m, n=6), whereas Madsen found that flight distances were about 500m in autumn and 300-400m in spring.

7.131 It was suggested that this was due to the habituation of geese from the study in Scotland as they were exposed to much higher traffic density than those in Denmark. In Scotland, at distances where geese did not show any reaction to passing cars they often reacted to cars stopping on the road or other kinds of disturbance such as tractors or walkers[13].

7.132 Construction during the winter period within 300m of potential feeding areas (agricultural fields) is likely to cause grey geese, whooper swan flocks, or airborne skeins to temporarily avoid the area concerned.

Disturbance to Raptors During Construction

7.133 Breeding hen harrier, merlin, and short-eared owl have not been recorded within the proposed wind farm footprint or within 2km during the monitoring of the study area. Both hen harriers and merlin have been recorded using the wind farm site for foraging, mainly over Autumn and Winter. Published evidence of raptor response to wind farm construction is limited but it is likely that birds will be deterred from foraging over the site during construction. This is not considered significant because their use of the site is relatively infrequent and there are abundant alternative foraging locations in the locality.

Disturbance to Waders

7.134 Disturbance to wader species due to construction effects from building turbines and access tracks may occur at the proposed Spittal Wind farm.

[12] e.g. Langston, R.H.W. & Pullan, J.D. (2003) Wind farms and birds: an analysis of the effects of wind farms on birds and guidance on environmental assessment criteria and site selection issues. Birdlife International Report to the Bern Convention on the conservation of European Wildlife and Natural Habitats.
[13] Bright, J.A., Langston, R.H.W., Bullman, R., Evans, R.J., Gardner, S., Pearce-Higgins, J. & Wilson, E. (2006) Bird Sensitivity Map to provide locational guidance for onshore wind farms in Scotland. RSPB Research Report No. 20. (June 2006).
14 Keller, V.E. (1996) The effect of disturbance from roads on the distribution of feeding sites of geese (Anser brachyrhynchos, A. anser), wintering in north-east Scotland. Ardea 79: 229-232.
[15] Madsen, J. (1985) Impact of disturbance on field utilization of Pink-footed geese in West Jutland, Denmark. *Biological Conservation* 33: 53-63.

7.135 Wader species including curlew, lapwing, snipe and oystercatcher have been documented as being susceptible to disturbance due to human activities [12,16,171819]. However, studies in Germany investigating the breeding density and spatial distribution of several species of waders (oystercatcher, lapwing, redshank and black-tailed godwit) both before and after installation of the turbines did not show consistent effects with some increases and some decreases. Breeding density in some cases increased near the wind turbines because of the alteration of farming practice post-construction. The implication being that for some species, habitat quality remains the most important criteria and outweighs any negative effects from the turbines[12].

7.136 In addition, no effect on numbers or spatial distribution of oystercatcher and lapwing was observed within 1km of the wind farm.

7.137 Published research indicates that breeding waders were not strongly disturbed by the presence of turbines, although species-specific differences do exist as noted earlier[12]. The low number of waders on the proposed Spittal Wind farm site and their likely behavioural response to construction works will likely result in small space and time disturbance. This disturbance/displacement effect is unlikely to extend to more than circa 200m and it remains highly probable that the quality of the remaining breeding habitat will be a greater longer term determinant of wader numbers on site rather than the negative temporary effects of the wind farm[12].

Potential Operational Effects

Habitat Loss

7.138 Habitat loss from wind farms will arise from direct land take for infrastructure (roads, borrow pits etc) and can result from displacement and barrier effects. Direct habitat loss has been covered in the previous chapter.

Barrier to Movement

7.139 Turbine layouts in arrays or groups may present a barrier to the movement of less agile birds in flight such as geese or swans.

If geese and swans regularly had to fly over and around an obstacle such as a wind farm, itwould result in greater energy expenditure. During a wintering period this might ultimately reduce the efficiency with which birds are able to put down fat reserves. In a worst-case scenario, this might lead to a reduction in fitness for the return migration.

The resulting energetic consequences for individual waterfowl due to negotiating a potential barrier is difficult to predict with certainty. It is not, however, considered likely that the wind farm would create such an obstacle and there are many instances where geese have been observed flying over operational sites (such as at Tangy, Kintyre). Even with the proportion of lower altitude flights, where birds taking avoidance action would have to use extra energy getting themselves from collision risk height over the wind farm this is not realistically likely to have significant detrimental additional energy cost.

Displacement

7.140 Evidence to date provides no or few indications of hen harrier displacement from six operational wind farms[20]. Preliminary results from post-construction monitoring in Argyll and Northern Ireland also suggest foraging may be little affected and nesting attempts may be locally displaced only by 200-300m around turbine bases[18]. Observations of breeding merlins at the Dunn Law and Black Law Wind farms in south Scotland also suggest a degree of tolerance to the proximity of wind turbines (unpublished data).

Disturbance due to operation

7.141 Disturbance due to wind farm operation is broadly considered to produce a similar range of responses by the receptor species, to construction disturbance.

Geese are unlikely to habituate to vehicles and people using the access track network because this frequency of use is relatively low. Observations of response distances during fieldwork suggest that disturbance effects are dependent on topography, and may be limited to around 300m. On this basis, a buffer around the turbines and new access tracks of 300m is considered a reasonable assumption on which to account for disturbance effects for geese.

Collision Risk to Waterfowl (Geese and swans)

7.142 A comprehensive assessment of collision risk to geese has already been provided in previous sections.

Potential Decommissioning Effects

Habitat Loss

7.143 Small scale residual habitat loss would remain (from tracks, turbine bases etc.) but the majority of the site would again be available to foraging geese after decommissioning.

Disturbance

7.144 Potential disturbance effects are assumed to be identical to those identified for construction.

Assessment of effects in relation to Caithness Lochs SPA, Highland Region (UK900171A)

7.145 The Caithness Lochs Special Protection Area (1,378ha) consists of a suite of six lochs and one mire (Broubster Leans) in Caithness. The SPA includes Broubster Leans SSSI, Loch Heilen SSSI, Loch Scamclate SSSI, Loch Watten SSSI, and Loch of Wester SSSI. The site qualifies under Article 4.1 by regularly supporting, in winter, populations of European importance of Annex 1 species:

- Whooper swan (1993/94-1997/98) winter peak mean of 240 representing 4% of GB and 1% of Icelandic population).
- And Greenland white-fronted goose (1993/94-1997/98 winter peak mean of 440 representing 3% of GB and 1% of Icelandic population).
- The site also qualifies under Article 4.2 by regularly supporting in winter, a population of European importance of:
- Greylag goose (1993/94-1997/980 winter peak mean of 7,190 representing 7% of the GB and Icelandic populations).

7.146 The conservation objectives of the site are to:

"To avoid deterioration of the habitats of the qualifying species, or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained; and to ensure for the qualifying species that the following are maintained in the long term":

- Population of the species as a viable component of the site.
- Distribution of the species within the site.
- Distribution and extent of habitats supporting the species.
- Structure, function, and supporting processes of habitats supporting the species.
- No significant disturbance of the species.

[16] Fitzpatrick, S. & Bouchez, B. (1998) Effects of recreational disturbance on the foraging behaviour of waders on a rocky beach. *Bird Study*. 45, 157-171.
[17] Gill, J.A. (2007) Approaches to measuring the effects of human disturbance on birds. *Ibis* 149 (Suppl. 1), 9-14.
[18] Hirvonen, H. (2001) Impacts of highway construction and traffic on a wetland bird community. *http://repositories.cdlib.org/jmie/roadeco/Hirvonen2001a*.
[19] Burton, N.H.K., Rehfisch, M.M. & Clark, N.A. (2002) Impacts of disturbance from construction work on the densities and feeding behaviour of waterbirds using the intertidal mudflats of Cardiff Bay, UK. Environmental Mangement. Vol: 30(6) 865-871.
[20] Madders, M. & Whitfield, D.P. (2006) Upland raptors and the assessment of wind farm impacts. *Ibis*. 148: 43-56.

18.147 The proposed Spittal wind farm has been identified from the ornithological monitoring to be in an area used by waterfowl (greylag geese) both resident in the UK and from migratory over-wintering populations (Icelandic greylag geese, Icelandic whooper swan) both qualifying species for the Caithness Lochs SPA. The nearest qualifying lochs are Loch Scamclate and Loch Watten at circa 2km away.

18.148 The monitoring and subsequent analysis indicates that the potential effects from the construction of a wind farm would not significantly affect the integrity of the Caithness Lochs SPA, and there would be no significant adverse impact on the conservation objectives highlighted above.

7.149 It is considered that the populations of the three qualifying species would continue to be supported as a viable component of the Caithness Lochs SPA if the proposed Spittal wind farm is constructed (Objective 1). This is based on the ornithological monitoring and assessments made here, including the limited numbers feeding on the site and the very low predicted level of collision risk. Any potential additive mortality would be insignificant in terms of the SPA's over-wintering population (predicted to be nine greylag geese per year – assuming no management was carried out to deter geese from the wind farm area - out of an average winter population peak of 7,190 birds).

7.150 The proposed Spittal wind farm would not significantly influence the distribution of the qualifying species within the SPA, as the proposed wind farm is not within the SPA designated habitat (Objective 2.).

7.151 The proposed Spittal wind farm would not significantly influence the distribution and extent of habitats supporting the qualifying species in the SPA and wider countryside due to its limited area (Objective 3.). Furthermore, the qualifying species were found to utilise the proposed wind farm area for feeding infrequently (whooper swan and greylag goose) or not at all (Greenland white-fronted goose). This is in contrast to areas around Banniskirk Mains and further afield more routinely used for foraging. It is considered that the habitats within the proposed wind farm site do not play an important role in supporting the qualifying species of the SPA. (Objective 4.).

7.152 The proposed Spittal Wind farm would not pose significant disturbance to geese and designated features of the Caithness Lochs SPA as it is approximately 2km removed from the nearest qualifying lochs.

7.153 On the basis of the above analysis, it is concluded that this development does not, in itself, pose any significant risk to the integrity of the Caithness Lochs SPA.

Cumulative Impact

7.154 The site has been assessed as of moderate importance for migratory grey geese and pink-footed geese. The mortality of these species that might result from the operation of the wind farm is predicted to be low (nine greylag geese and ten pink-footed geese, assuming 99% avoidance) or negligible (whooper swan), particularly following mitigation to reduce the attractiveness of the fields to feeding geese. It is considered very unlikely that mortality of this magnitude when added to the unknown mortality arising from other plans or projects in the area will constitute a significant threat to the goose populations of the SPA and nationally.

7.155 A full assessment of the cumulative impact of the proposed Spittal Wind farm in combination with other relevant plans and projects is reliant in information provided by SNH. This has still to be provided in sufficient detail and was therefore not available to the developer at the time of writing. This will be provided as part of the Addendum to be submitted with the 2007 winter and breeding season bird monitoring results.

7.156 The importance of the site to breeding waders, breeding raptors, feeding grey geese and feeding whooper swans has, however, been assessed as low and no significant cumulative impacts are expected.

Further Monitoring

7.157 Continued monitoring of goose and swan movements is being undertaken at the site until April 2007. During this period, it is proposed to monitor flight activity as in previous winters. Breeding birds will also be monitored during 2007.

7.158 In awareness of the post-construction ornithological monitoring guidelines to be issued shortly by SNH (*Pers comm*. Rhys Bullman), it is recommended that construction and post-construction monitoring for geese and swans be undertaken over at least five subsequent winters. This is to monitor the effects of the construction and operation phases of the development on grey geese, swans and foraging raptors, and would involve robust September to April (inclusive) monitoring of flight behaviour and carcass searches, methodologies for which would be agreed in liaison with SNH and RSPB Scotland.

SUMMARY OF EFFECTS

Table 28: Summary of Effects

Project Phase	**Effect**	**Impact**	**Mitigation**	**Residual Effect**	**Significance**
Construction					
	Disturbance	Activity within 300m likely to result in geese and swans abandoning feeding areas	Construction near feeding areas restricted during September - November	No Impact	**Not significant**
Operation					
	Habitat Loss	Areas within 300m of turbines considered as Habitat Loss	No mitigation planned. Few geese and swans recorded feeding within the wind farm footprint.	Geese and swans will use alternate feeding areas. Minor displacement	**Minor negative**
	Barriers to Movement	Potential for minor reduction in fitness as a result of disrupted energy budget	Clustered layout, outwith of main flight corridors, avoids blocking regular flight lines between feeding and roosting areas.	Minimal number of flight lines affected	**Minor negative**
	Disturbance	Birds within 300m of turbines and tracks temporarily displaced	No Mitigation planned. Few geese and swans recorded feeding within the wind farm footprint.	Geese and swans using secondary feeding areas. Minor displacement	**Minor negative**
	Collision	Potential very low level of mortality for greylag and pink-footed geese.	Land management and agricultural scaring devices employed to dissuade waterfowl from wind farm area. Very few geese and swans recorded feeding/flightlines within the wind farm footprint.	Low predicted level of mortality is not significant at the population level given numbers of birds affected	**Minor negative**
Decommissioning					
	Habitat Loss	Habitat loss assumed to be permanent	No mitigation	Habitat loss	**Not significant**
	Disturbance	Activity within 300m may result in birds abandoning feeding areas	Timing of decommissioning works near feeding areas restricted to May-September	No Impact	**Not significant**

Statement of Significance

7.156 The significance of each impact has been assessed in this chapter based on three years of data from the site, knowledge of the birds and habitats concerned, of bird/wind farm interactions elsewhere and the guidelines produced by SNH, the BWEA and the IEEM.

7.157 This chapter presents an assessment of the impact on target species, based on both desk-based information and the collection of data since 2004. This assessment indicates that impacts from the construction, operational and decommissioning phases of the development on target bird species will be of minor-negative significance or less.

References

Band W., Madders M. & Whitfield D.P. (in press). Developing field and analytical methods to assess avian collision risk at wind farms. In de Lucas M., Janss G. & Ferrer M. (eds.) *Birds and Wind Power*. Lynx Edicions, Barcelona.

Bright, J.A., Langston, R.H.W., Bullman, R., Evans, R.J., Gardner, S., Pearce-Higgins, J. & Wilson, E. (2006). *Bird Sensitivity Map to provide locational guidance for onshore wind farms in Scotland*. RSPB Research Report No. 20. (June 2006).

Burton, N.H.K., Rehfisch, M.M. & Clark, N.A. (2002). Impacts of disturbance from construction work on the densities and feeding behaviour of waterbirds using the intertidal mudflats of Cardiff Bay, UK. *Environmental Mangement*. Vol: 30(6) 865-871.

Cramp, S. & Simmons, K.E.L. (eds.) (1977). *Handbook of the Birds of Europe, the Middle East and North Africa. The Birds of the Western Palearctic. Volume 1.* Oxford University Press, Oxford.

Fernley, J., Lowther, S. & Whitfield, P. (2006). A review of goose collisions at operating wind farms and estimation of the goose avoidance rate. *Natural Research, West Coast Energy & Hyder Consulting*.

Fitzpatrick, S. & Bouchez, B. (1998). Effects of recreational disturbance on the foraging behaviour of waders on a rocky beach. *Bird Study*. 45, 157-171.

Gill, J.A. (2007). Approaches to measuring the effects of human disturbance on birds. *Ibis* 149 (Suppl. 1), 9-14.

Hirvonen, H. (2001). Impacts of highway construction and traffic on a wetland bird community. *http://repositories.cdlib.org/jmie/roadeco/Hirvonen2001a.*

Keller, V.E. (1996). The effect of disturbance from roads on the distribution of feeding sites of geese (*Anser brachyrhynchos, A. anser*), wintering in north-east Scotland. *Ardea* 79: 229-232.

Langston, R.H.W. & Pullan, J.D. (2003). *Wind farms and birds: an analysis of the effects of wind farms on birds and guidance on environmental assessment criteria and site selection issues*. Birdlife International Report to the Bern Convention on the conservation of European Wildlife and Natural Habitats.

Madders, M. & Whitfield, D.P (2006). Upland raptors and the assessment of wind farm impacts. *Ibis*. 148: 43-56.

Madsen, J. (1985). Impact of disturbance on field utilization of Pink-footed geese in West Jutland, Denmark. *Biological Conservation* 33: 53-63.

Patterson, I.J. (2006). *Geese and Wind farms in Scotland*. SNH Internal Research Report.

Pendlebury, C. (2006). *BTO Research Report No. 455.* An appraisal of “A review of goose collisions at operating wind farms and estimation of the goose avoidance rate” by Fernley, J., Lowther, S. and Whitfield, P. (November 2006).

Scottish Natural Heritage (2005). *Guidance: Survey Methods For Use In Assessing The Impacts of Onshore Wind farms On Bird Communities*.

Winkleman, J. E. (1995). Bird/Wind turbine investigations in Europe. *Proceedings of the National Avian-Wind Power Planning Meeting, Denver, Colorado, CO. July 1994* pp. 110-140. NWCC c/o Resolve, Washington, DC and LGL Ltd., King City, Ontario.

www.bto.org.

www.bto.org/psob/index/htm.

ANNEX 1.

CALCULATION OF COLLISION RISK FOR A GREYLAG GOOSE PASSING THROUGH ROTOR AREA

Only enter input parameters in blue — W Band 22/01/2007

K: [1D or [3D] (0 or 1)	1	
NoBlades	3	
MaxChord	3.2	m
Pitch (degrees)	6	
BirdLength	0.84	m
Wingspan	1.68	m
F: Flapping (0) or gliding (+1)	0	
Bird speed	13	m/sec
RotorDiam	80	m
RotationPeriod	3.77	sec
Bird aspect ratio:	0.50	

Calculation of alpha and p(collision) as a function of radius

r/R radius	c/C chord	alpha	Upwind: collide length	Upwind: p(collision)	Upwind: contribution from radius r	Downwind: collide length	Downwind: p(collision)	Downwind: contribution from radius r
0.025	0.575	7.80	27.57	1.00	0.00125	27.19	1.00	0.00125
0.075	0.575	2.60	9.32	0.57	0.00428	8.93	0.55	0.00410
0.125	0.702	1.56	6.34	0.39	0.00485	5.87	0.36	0.00449
0.175	0.860	1.11	5.21	0.32	0.00558	4.63	0.28	0.00496
0.225	0.994	0.87	4.53	0.28	0.00624	3.87	0.24	0.00532
0.275	0.947	0.71	3.64	0.22	0.00613	3.01	0.18	0.00507
0.325	0.899	0.60	3.03	0.19	0.00602	2.42	0.15	0.00482
0.375	0.851	0.52	2.57	0.16	0.00589	2.00	0.12	0.00459
0.425	0.804	0.46	2.28	0.14	0.00594	1.74	0.11	0.00454
0.475	0.756	0.41	2.08	0.13	0.00605	1.57	0.10	0.00458
0.525	0.708	0.37	1.91	0.12	0.00615	1.44	0.09	0.00463
0.575	0.660	0.34	1.77	0.11	0.00624	1.33	0.08	0.00469
0.625	0.613	0.31	1.65	0.10	0.00633	1.24	0.08	0.00476
0.675	0.565	0.29	1.55	0.09	0.00640	1.17	0.07	0.00484
0.725	0.517	0.27	1.46	0.09	0.00646	1.11	0.07	0.00493
0.775	0.470	0.25	1.37	0.08	0.00651	1.06	0.06	0.00502
0.825	0.422	0.24	1.30	0.08	0.00656	1.02	0.06	0.00513
0.875	0.374	0.22	1.23	0.08	0.00659	0.98	0.06	0.00525
0.925	0.327	0.21	1.17	0.07	0.00662	0.95	0.06	0.00538
0.975	0.279	0.20	1.11	0.07	0.00663	0.92	0.06	0.00552
	Overall p(collision) =			**Upwind**	**11.7%**		**Downwind**	**9.4%**
					Average	**10.5%**		

CALCULATION OF COLLISION RISK FOR A PINK-FOOTED GOOSE PASSING THROUGH ROTOR AREA

Only enter input parameters in blue

W Band 24/01/2007

K: [1D or [3D] (0 or 1)	1	
NoBlades	3	
MaxChord	3.2	m
Pitch (degrees)	6	
BirdLength	0.76	m
Wingspan	1.61	m
F: Flapping (0) or gliding (+1)	0	
Bird speed	13	m/sec
RotorDiam	80	m
RotationPeriod	3.77	sec
Bird aspect ratio:	0.47	

Calculation of alpha and p(collision) as a function of radius

			Upwind:			Downwind:		
r/R radius	c/C chord	alpha	collide length	p(collision)	contribution from radius r	collide length	p(collision)	contribution from radius r
0.025	0.575	7.80	27.02	1.00	0.00125	26.64	1.00	0.00125
0.075	0.575	2.60	9.14	0.56	0.00419	8.75	0.54	0.00402
0.125	0.702	1.56	6.23	0.38	0.00477	5.76	0.35	0.00441
0.175	0.860	1.11	5.13	0.31	0.00550	4.56	0.28	0.00488
0.225	0.994	0.87	4.47	0.27	0.00616	3.81	0.23	0.00524
0.275	0.947	0.71	3.59	0.22	0.00605	2.96	0.18	0.00498
0.325	0.899	0.60	2.98	0.18	0.00593	2.38	0.15	0.00474
0.375	0.851	0.52	2.53	0.15	0.00581	1.96	0.12	0.00450
0.425	0.804	0.46	2.20	0.13	0.00573	1.66	0.10	0.00433
0.475	0.756	0.41	2.00	0.12	0.00582	1.49	0.09	0.00435
0.525	0.708	0.37	1.83	0.11	0.00589	1.36	0.08	0.00437
0.575	0.660	0.34	1.69	0.10	0.00596	1.25	0.08	0.00441
0.625	0.613	0.31	1.57	0.10	0.00602	1.16	0.07	0.00445
0.675	0.565	0.29	1.47	0.09	0.00607	1.09	0.07	0.00451
0.725	0.517	0.27	1.38	0.08	0.00611	1.03	0.06	0.00457
0.775	0.470	0.25	1.29	0.08	0.00613	0.98	0.06	0.00464
0.825	0.422	0.24	1.22	0.07	0.00615	0.94	0.06	0.00473
0.875	0.374	0.22	1.15	0.07	0.00616	0.90	0.06	0.00482
0.925	0.327	0.21	1.09	0.07	0.00616	0.87	0.05	0.00493
0.975	0.279	0.20	1.03	0.06	0.00615	0.84	0.05	0.00504

Overall p(collision) = Upwind 11.2% **Downwind 8.9%**

Average 10.1%