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Volume 7B Proposed Development (Offshore) Appendices

Appendix 6-5 Migratory Collision Risk Modelling Technical Report
Annex 3 Migratory Collision Risk Modelling Results (Caledonia South)

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Volume 7B Appendix 6-5 Annex 3 Migratory Collision Risk Modelling Results (Caledonia South)

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Acronyms and Abbreviations

| | |
|-------------|------------------------------------|
| mCRM | Migratory Collision Risk Modelling |
| OWF | Offshore Wind Farm |
| SD | Standard Deviation |
| WCS | Worst-case Scenario |
| WTG | Wind Turbine Generator |

1 Introduction

1.1.1.1 The results of the migratory Collision Risk Modelling (mCRM) for the Caledonia Offshore Wind Farm (OWF), specifically the Caledonia South Site, are presented within this annex. Three Wind Turbine Generator (WTG) options have been modelled using the Marine Scotland Avian Migration Collision Risk Model Shiny Application ("mCRM Application"; HiDef Aerial Surveying Ltd., 2024¹). The full mCRM methodology is outlined in Volume 7B, Appendix 6-5: Migratory Collision Risk Modelling Technical Report.

1.1.1.2 The WTG parameters used within the mCRM for the Caledonia South Site are presented in (Table 1-1). Scoping results are presented in Section 2, and estimated seasonal collisions are presented in Section 3.

Table 1-1: OWF and WTG parameters used for mCRM for the Caledonia South Site.

| Parameter | WTG 1 (S) | | WTG 2 (S) | WTG 3 (S) | |
|-------------------------|---------------------|---------------------|---------------------|---------------------|---------------------|
| | Fixed | Floating | Fixed | Fixed | Floating |
| Number of WTGs | 24 | 29 | 47 | 39 | 39 |
| Latitude (degrees) | 58.13 | 58.13 | 58.13 | 58.13 | 58.13 |
| Width (km) | 28.90 | 28.90 | 28.90 | 28.90 | 28.90 |
| Number of blades | 3 | 3 | 3 | 3 | 3 |
| Rotor radius (m) | 155 | 145 | 155 | 118 | 118 |
| Blade width (m) | 7.50 | 7.50 | 7.50 | 7.50 | 7.50 |
| Average pitch (°) | 2 | 2 | 2 | 2 | 2 |
| Average pitch SD (°) | No data (assumed 0) | No data (assumed 0) | No data (assumed 0) | No data (assumed 0) | No data (assumed 0) |
| Rotation speed (rpm) | 8.4 | 8.4 | 8.4 | 8.4 | 8.4 |
| Rotation speed SD (rpm) | No data (assumed 0) | No data (assumed 0) | No data (assumed 0) | No data (assumed 0) | No data (assumed 0) |

2 Scoping Results

- 2.1.1.1 The results from the scoping process (methodology described in Volume 7B, Appendix 6-5: Migratory Collision Risk Modelling Technical Report) are presented in Table 2-1 to Table 2-4. For each table, the species UK Population estimate (and corresponding Standard Deviation (SD)) predicted to intersect the Caledonia South Site on migration, based on the default UK population sizes within the model are presented. The population estimate predicted to intersect the Caledonia South Site is calculated based on the proportion of randomly generated migration lines which intersect the Caledonia South Site within the species defined migratory corridor. Further detail on population estimation can be found within the mCRM Application github repository (HiDef Aerial Surveying Ltd., 2024¹).
- 2.1.1.2 The percentage of the UK population predicted to intersect the Caledonia South Site (and thus at potential risk of collision) on migration is also provided within Table 2-1 to Table 2-4. In accordance with the Scoping methodology (described in Volume 7B, Appendix 6-5: Migratory Collision Risk Modelling Technical Report) where less than 1% of the UK population is predicted to intersect the Caledonia South Site, the species has been scoped out of further modelling. The species that have been scoped in have been carried through into Section 3.

Table 2-1: Caledonia South Site scenario WTG 1a initial scoping results.

| Species | Population Estimate | SD | % at Collision Risk | Scoped In/Out |
|---|---------------------|-------|---------------------|---------------|
| Bar-tailed godwit (<i>Limosa lapponica</i>) | 7,688 | 1,547 | 1.1 | In |
| Bean goose (<i>Anser fabalis</i>) | 16 | 3 | 1.6 | In |
| Bittern (<i>Botaurus stellaris</i>) | - | - | 0.0 | Out |
| Black-tailed godwit (<i>Limosa limosa</i>) | - | - | 0.0 | Out |
| Black-throated Diver (<i>Gavia arctica</i>) | 15 | 3 | 1.2 | In |
| Canadian Light-bellied brent goose (<i>Branta bernicla hrota</i>) | - | - | 0.0 | Out |
| Common scoter (<i>Melanitta nigra</i>) | 1,261 | 252 | 0.9 | Out |
| Corncrake (<i>Crex crex</i>) | 170 | 36 | 1.0 | In |
| Curlew (<i>Numenius arquata</i>) | 1,665 | 334 | 1.2 | In |
| Dotterel (<i>Charadrius morinellus</i>) | 8 | 2 | 2.0 | In |
| Dunlin (<i>Calidris alpina</i>) | 20,229 | 4,111 | 1.0 | In |
| Eider (<i>Somateria mollissima</i>) | 1,214 | 211 | 1.1 | In |
| Golden plover (<i>Pluvialis apricaria</i>) | 31,515 | 6,795 | 1.0 | In |
| Goldeneye (<i>Bucephala clangula</i>) | 388 | 92 | 1.0 | In |
| Goosander (<i>Mergus merganser</i>) | 405 | 62 | 2.3 | In |
| Great crested grebe (<i>Podiceps cristatus</i>) | - | - | 0.0 | Out |
| Great northern diver (<i>Gavia immer</i>) | 102 | 23 | 0.9 | Out |

| Species | Population Estimate | SD | % at Collision Risk | Scoped In/Out |
|---|---------------------|-------|---------------------|---------------|
| Greenshank (<i>Tringa nebularia</i>) | 76 | 15 | 1.1 | In |
| Grey plover (<i>Pluvialis squatarola</i>) | 1,278 | 296 | 1.0 | In |
| Hen harrier (<i>Circus cyaneus</i>) | 24 | 5 | 1.1 | In |
| Icelandic greylag goose (<i>Anser anser</i>) | 33 | 34 | 0.0 | Out |
| Knot (<i>Calidris canutus</i>) | 3,575 | 814 | 1.0 | In |
| Lapwing (<i>Vanellus vanellus</i>) | 37,356 | 8,751 | 0.9 | Out |
| Long-tailed duck (<i>Clangula hyemalis</i>) | 177 | 30 | 1.4 | In |
| Mallard (<i>Anas platyrhynchos</i>) | 10,251 | 2,104 | 1.2 | In |
| Marsh harrier (<i>Circus aeruginosus</i>) | 35 | 7 | 1.3 | In |
| Merlin (<i>Falco columbarius</i>) | 29 | 11 | 0.3 | Out |
| Nightjar (<i>Caprimulgus europaeus</i>) | 53 | 14 | 0.7 | Out |
| Osprey (<i>Pandion haliaetus</i>) | 11 | 2 | 1.6 | In |
| Oystercatcher (<i>Haematopus ostralegus</i>) | 3,997 | 825 | 1.1 | In |
| Pink-footed goose (<i>Anser brachyrhynchus</i>) | 180 | 220 | 0.0 | Out |
| Pintail (<i>Anas acuta</i>) | 231 | 49 | 1.1 | In |
| Purple sandpiper (<i>Calidris maritima</i>) | 301 | 56 | 1.2 | In |
| Red-breasted merganser (<i>Mergus serrator</i>) | 183 | 39 | 1.2 | In |

| Species | Population Estimate | SD | % at Collision Risk | Scoped In/Out |
|---|---------------------|--------|---------------------|---------------|
| Redshank (<i>Tringa totanus</i>) | 3,592 | 798 | 0.9 | Out |
| Red-throated diver (<i>Gavia stellata</i>) | 470 | 84 | 1.4 | In |
| Ringed plover (<i>Charadrius hiaticula</i>) | 2,627 | 598 | 0.9 | Out |
| Ruff (<i>Calidris pugnax</i>) | 327 | 75 | 1.1 | In |
| Sanderling (<i>Calidris alba</i>) | 2,169 | 474 | 1.1 | In |
| Scaup (<i>Aythya marila</i>) | 55 | 14 | 0.8 | Out |
| Shelduck (<i>Tadorna tadorna</i>) | 640 | 154 | 1.0 | In |
| Short-eared owl (<i>Asio flammeus</i>) | 154 | 35 | 1.0 | In |
| Shoveler (<i>Anas clypeata</i>) | 158 | 45 | 0.7 | Out |
| Slavonian grebe (<i>Podiceps auritus</i>) | 12 | 3 | 1.2 | In |
| Snipe (<i>Gallinago gallinago</i>) | 55,587 | 12,502 | 0.9 | Out |
| Spotted crake (<i>Porzana porzana</i>) | 1 | - | 3.8 | In |
| Svalbard barnacle goose (<i>Branta leucopsis</i>) | 1,093 | 164 | 2.5 | In |
| Svalbard light-bellied brent goose (<i>Branta bernicla hrota</i>) | 223 | 33 | 2.2 | In |
| Teal (<i>Anas crecca</i>) | 698 | 369 | 0.2 | Out |
| Tufted duck (<i>Aythya fuligula</i>) | 1,394 | 321 | 0.9 | Out |
| Turnstone (<i>Arenaria interpres</i>) | 3,610 | 738 | 1.0 | In |

| Species | Population Estimate | SD | % at Collision Risk | Scoped In/Out |
|---|---------------------|-------|---------------------|---------------|
| Velvet scoter (<i>Melanitta fusca</i>) | 40 | 9 | 1.2 | In |
| Whimbrel (<i>Numenius phaeopus</i>) | 50 | 11 | 1.1 | In |
| White-tailed eagle (<i>Haliaeetus albicilla</i>) | 2 | 1 | 0.7 | Out |
| Whooper swan (<i>Cygnus cygnus</i>) | 729 | 119 | 1.8 | In |
| Wigeon (<i>Anas penelope</i>) | 5,108 | 1,086 | 1.1 | In |
| Wood sandpiper (<i>Tringa glareola</i>) | 1 | - | 1.9 | In |

Table 2-2: Caledonia South Site scenario WTG 1b scoping results.

| Species | Population Estimate | SD | % at Collision Risk | Scoped In/Out |
|------------------------------------|---------------------|-------|---------------------|---------------|
| Bar-tailed godwit | 7,688 | 1,547 | 1.10 | In |
| Bean goose | 16 | 3 | 1.60 | In |
| Bittern | - | - | 0.00 | Out |
| Black-tailed godwit | - | - | 0.00 | Out |
| Black-throated diver | 15 | 3 | 1.20 | In |
| Canadian light-bellied brent goose | - | - | 0.00 | Out |
| Common scoter | 1,261 | 252 | 0.90 | Out |
| Corncrake | 170 | 36 | 1.00 | In |
| Curlew | 1,665 | 334 | 1.20 | In |
| Dotterel | 8 | 2 | 2.00 | In |
| Dunlin | 20,229 | 4,111 | 1.00 | In |
| Eider | 1,214 | 211 | 1.10 | In |
| Golden plover | 31,515 | 6,795 | 1.00 | In |
| Goldeneye | 388 | 92 | 1.00 | In |
| Goosander | 405 | 62 | 2.30 | In |
| Great crested grebe | - | - | 0.00 | Out |
| Great northern diver | 102 | 23 | 0.90 | Out |
| Greenshank | 76 | 15 | 1.10 | In |
| Grey plover | 1,278 | 296 | 1.00 | In |
| Hen harrier | 24 | 5 | 1.10 | In |
| Icelandic greylag goose | 33 | 34 | 0.00 | Out |
| Knot | 3,575 | 814 | 1.00 | In |
| Lapwing | 37,356 | 8,751 | 0.90 | Out |
| Long-tailed duck | 177 | 30 | 1.40 | In |

| Species | Population Estimate | SD | % at Collision Risk | Scoped In/Out |
|------------------------------------|---------------------|--------|---------------------|---------------|
| Mallard | 10,251 | 2,104 | 1.20 | In |
| Marsh harrier | 35 | 7 | 1.30 | In |
| Merlin | 29 | 11 | 0.30 | Out |
| Nightjar | 53 | 14 | 0.70 | Out |
| Osprey | 11 | 2 | 1.60 | In |
| Oystercatcher | 3,997 | 825 | 1.10 | In |
| Pink-footed Goose | 180 | 220 | 0.00 | Out |
| Pintail | 231 | 49 | 1.10 | In |
| Purple sandpiper | 301 | 56 | 1.20 | In |
| Red-breasted merganser | 183 | 39 | 1.20 | In |
| Redshank | 3,592 | 798 | 0.90 | Out |
| Red-throated diver | 470 | 84 | 1.40 | In |
| Ringed plover | 2,627 | 598 | 0.90 | Out |
| Ruff | 327 | 75 | 1.10 | In |
| Sanderling | 2,169 | 474 | 1.10 | In |
| Scaup | 55 | 14 | 0.80 | Out |
| Shelduck | 640 | 154 | 1.00 | In |
| Short-eared owl | 154 | 35 | 1.00 | In |
| Shoveler | 158 | 45 | 0.70 | Out |
| Slavonian grebe | 12 | 3 | 1.20 | In |
| Snipe | 55,587 | 12,502 | 0.90 | Out |
| Spotted crake | 1 | - | 3.80 | In |
| Svalbard barnacle goose | 1,093 | 164 | 2.50 | In |
| Svalbard light-bellied brent goose | 223 | 33 | 2.20 | In |

| Species | Population Estimate | SD | % at Collision Risk | Scoped In/Out |
|--------------------|---------------------|-------|---------------------|---------------|
| Teal | 698 | 369 | 0.20 | Out |
| Tufted duck | 1,394 | 321 | 0.90 | Out |
| Turnstone | 3,610 | 738 | 1.00 | In |
| Velvet scoter | 40 | 9 | 1.20 | In |
| Whimbrel | 50 | 11 | 1.10 | In |
| White-tailed Eagle | 2 | 1 | 0.70 | Out |
| Whooper swan | 729 | 119 | 1.80 | In |
| Wigeon | 5,108 | 1,086 | 1.10 | In |
| Wood sandpiper | 1 | - | 1.90 | In |

Table 2-3: Caledonia South Site scenario WTG 2 scoping results.

| Species | Population Estimate | SD | % at Collision Risk | Scoped In/Out |
|------------------------------------|---------------------|-------|---------------------|---------------|
| Bar-tailed godwit | 7,688 | 1,547 | 1.10 | In |
| Bean goose | 16 | 3 | 1.60 | In |
| Bittern | - | - | 0.00 | Out |
| Black-tailed godwit | - | - | 0.00 | Out |
| Black-throated diver | 15 | 3 | 1.20 | In |
| Canadian light-bellied brent goose | - | - | 0.00 | Out |
| Common scoter | 1,261 | 252 | 0.90 | Out |
| Corncrake | 170 | 36 | 1.00 | In |
| Curlew | 1,665 | 334 | 1.20 | In |
| Dotterel | 8 | 2 | 2.00 | In |
| Dunlin | 20,229 | 4,111 | 1.00 | In |
| Eider | 1,214 | 211 | 1.10 | In |
| Golden plover | 31,515 | 6,795 | 1.00 | In |
| Goldeneye | 388 | 92 | 1.00 | In |
| Goosander | 405 | 62 | 2.30 | In |
| Great crested grebe | - | - | 0.00 | Out |
| Great northern diver | 102 | 23 | 0.90 | Out |
| Greenshank | 76 | 15 | 1.10 | In |
| Grey plover | 1,278 | 296 | 1.00 | Out |
| Hen harrier | 24 | 5 | 1.10 | In |
| Icelandic greylag goose | 33 | 34 | 0.00 | Out |
| Knot | 3,575 | 814 | 1.00 | In |
| Lapwing | 37,356 | 8,751 | 0.90 | Out |
| Long-tailed duck | 177 | 30 | 1.40 | In |

| Species | Population Estimate | SD | % at Collision Risk | Scoped In/Out |
|------------------------------------|---------------------|--------|---------------------|---------------|
| Mallard | 10,251 | 2,104 | 1.20 | In |
| Marsh harrier | 35 | 7 | 1.30 | In |
| Merlin | 29 | 11 | 0.30 | Out |
| Nightjar | 53 | 14 | 0.70 | Out |
| Osprey | 11 | 2 | 1.60 | In |
| Oystercatcher | 3,997 | 825 | 1.10 | In |
| Pink-footed Goose | 180 | 220 | 0.00 | Out |
| Pintail | 231 | 49 | 1.10 | In |
| Purple sandpiper | 301 | 56 | 1.20 | In |
| Red-breasted merganser | 183 | 39 | 1.20 | In |
| Redshank | 3,592 | 798 | 0.90 | Out |
| Red-throated diver | 470 | 84 | 1.40 | In |
| Ringed plover | 2,627 | 598 | 0.90 | Out |
| Ruff | 327 | 75 | 1.10 | In |
| Sanderling | 2,169 | 474 | 1.10 | In |
| Scaup | 55 | 14 | 0.80 | Out |
| Shelduck | 640 | 154 | 1.00 | In |
| Short-eared owl | 154 | 35 | 1.00 | In |
| Shoveler | 158 | 45 | 0.70 | Out |
| Slavonian grebe | 12 | 3 | 1.20 | In |
| Snipe | 55,587 | 12,502 | 0.90 | Out |
| Spotted crake | 1 | - | 3.80 | In |
| Svalbard barnacle goose | 1,093 | 164 | 2.50 | In |
| Svalbard light-bellied brent goose | 223 | 33 | 2.20 | In |

| Species | Population Estimate | SD | % at Collision Risk | Scoped In/Out |
|--------------------|---------------------|-------|---------------------|---------------|
| Teal | 698 | 369 | 0.20 | Out |
| Tufted duck | 1,394 | 321 | 0.90 | Out |
| Turnstone | 3,610 | 738 | 1.00 | In |
| Velvet scoter | 40 | 9 | 1.20 | In |
| Whimbrel | 50 | 11 | 1.10 | In |
| White-tailed Eagle | 2 | 1 | 0.70 | Out |
| Whooper swan | 729 | 119 | 1.80 | In |
| Wigeon | 5,108 | 1,086 | 1.10 | In |
| Wood sandpiper | 1 | - | 1.90 | In |

Table 2-4: Caledonia South Site scenario WTG 3 (combined fixed and floating) scoping results.

| Species | Population Estimate | SD | % at Collision Risk | Scoped In/Out |
|------------------------------------|---------------------|-------|---------------------|---------------|
| Bar-tailed godwit | 7,739 | 1,488 | 1.10 | In |
| Bean goose | 16 | 3 | 1.60 | In |
| Bittern | - | - | 0.00 | Out |
| Black-tailed godwit | - | - | 0.00 | Out |
| Black-throated diver | 15 | 3 | 1.30 | In |
| Canadian light-bellied brent goose | - | - | 0.00 | Out |
| Common scoter | 1,226 | 309 | 0.90 | Out |
| Corncrake | 178 | 34 | 1.00 | In |
| Curlew | 1,621 | 367 | 1.10 | In |
| Dotterel | 8 | 2 | 2.00 | In |
| Dunlin | 19,825 | 4,396 | 1.00 | In |
| Eider | 1,206 | 250 | 1.10 | In |
| Golden plover | 30,098 | 6,813 | 0.90 | Out |
| Goldeneye | 399 | 90 | 1.10 | In |
| Goosander | 397 | 56 | 2.30 | In |
| Great crested grebe | - | - | 0.00 | Out |
| Great northern diver | 104 | 24 | 0.90 | Out |
| Greenshank | 74 | 16 | 1.00 | In |
| Grey plover | 1,285 | 267 | 1.00 | In |
| Hen harrier | 24 | 5 | 1.10 | In |
| Icelandic greylag goose | 31 | 32 | 0.00 | Out |
| Knot | 3,701 | 908 | 1.00 | In |
| Lapwing | 38,164 | 9,337 | 1.00 | In |
| Long-tailed duck | 176 | 31 | 1.40 | In |

| Species | Population Estimate | SD | % at Collision Risk | Scoped In/Out |
|------------------------------------|---------------------|--------|---------------------|---------------|
| Mallard | 10,728 | 1,956 | 1.30 | In |
| Marsh harrier | 34 | 7 | 1.30 | In |
| Merlin | 29 | 11 | 0.30 | Out |
| Nightjar | 53 | 15 | 0.70 | Out |
| Osprey | 11 | 2 | 1.50 | In |
| Oystercatcher | 3,988 | 854 | 1.10 | In |
| Pink-footed Goose | 200 | 247 | 0.00 | Out |
| Pintail | 224 | 52 | 1.10 | In |
| Purple sandpiper | 304 | 55 | 1.20 | In |
| Red-breasted merganser | 181 | 32 | 1.10 | In |
| Redshank | 3,310 | 777 | 0.80 | Out |
| Red-throated diver | 461 | 76 | 1.40 | In |
| Ringed plover | 2,573 | 590 | 0.90 | Out |
| Ruff | 336 | 73 | 1.10 | In |
| Sanderling | 2,110 | 422 | 1.10 | In |
| Scaup | 54 | 15 | 0.80 | Out |
| Shelduck | 622 | 137 | 1.00 | In |
| Short-eared owl | 158 | 38 | 1.10 | In |
| Shoveler | 165 | 39 | 0.70 | Out |
| Slavonian grebe | 13 | 3 | 1.20 | In |
| Snipe | 55,893 | 13,043 | 0.90 | Out |
| Spotted crake | 1 | - | 3.80 | In |
| Svalbard barnacle goose | 1,115 | 168 | 2.60 | In |
| Svalbard light-bellied brent goose | 216 | 33 | 2.20 | In |

| Species | Population Estimate | SD | % at Collision Risk | Scoped In/Out |
|--------------------|---------------------|-------|---------------------|---------------|
| Teal | 674 | 360 | 0.20 | Out |
| Tufted duck | 1,421 | 357 | 0.90 | Out |
| Turnstone | 3,714 | 777 | 1.10 | In |
| Velvet scoter | 39 | 8 | 1.10 | In |
| Whimbrel | 49 | 10 | 1.00 | In |
| White-tailed Eagle | 2 | 1 | 0.70 | Out |
| Whooper swan | 727 | 112 | 1.80 | In |
| Wigeon | 5,559 | 1,095 | 1.20 | In |
| Wood sandpiper | 1 | - | 1.90 | In |

3 Results

3.1.1.1 The mCRM results for Scenarios 1, 2 and 3 for the Caledonia South Site are presented below in Table 3-1 to Table 3-3.

3.1.1.2 Scenario 1 results are presented as a combination of WTG 1 (bottom-fixed) and WTG 1 (floating). The same species were scoped out (Section 2), therefore the predicted collisions have been combined to present one total for the WTG 1 scenario for the Caledonia South Site (Table 3-1). The worst-case scenario (WCS) for the Caledonia South Site, determined by comparing scenarios for the majority highest estimated annual collision rate, is WTG 3.

Table 3-1: Summary of estimated seasonal migratory collisions for the Caledonia South Site scenario WTG 1.

| Species | Pre-breeding | Post-breeding | Other | Total |
|------------------------|---------------|---------------|---------------|---------------|
| Bar-tailed godwit | 0.124 ± 0.026 | 0.122 ± 0.026 | 0 ± 0 | 0.246 ± 0.037 |
| Bean goose | 0 ± 0 | 0 ± 0 | 0 ± 0 | 0 ± 0 |
| Black-throated diver | 0 ± 0 | 0 ± 0 | 0 ± 0 | 0 ± 0 |
| Corncrake | 0.014 ± 0.003 | 0.014 ± 0.003 | 0 ± 0 | 0.028 ± 0.004 |
| Curlew | 0.033 ± 0.007 | 0.033 ± 0.007 | 0 ± 0 | 0.066 ± 0.01 |
| Dotterel | 0 ± 0 | 0 ± 0 | 0 ± 0 | 0 ± 0 |
| Dunlin | 0.303 ± 0.063 | 0.297 ± 0.062 | 0 ± 0 | 0.6 ± 0.088 |
| Eider | 0.088 ± 0.018 | 0.09 ± 0.018 | 0 ± 0 | 0.178 ± 0.026 |
| Golden plover | 0.510 ± 0.109 | 0.501 ± 0.108 | 0 ± 0 | 1.011 ± 0.153 |
| Goldeneye | 0.100 ± 0.024 | 0.101 ± 0.024 | 0 ± 0 | 0.201 ± 0.034 |
| Goosander | 0.111 ± 0.016 | 0.108 ± 0.016 | 0 ± 0 | 0.219 ± 0.022 |
| Greenshank | 0.002 ± 0 | 0.002 ± 0 | 0 ± 0 | 0.004 ± 0 |
| Grey Plover | 0.020 ± 0.005 | 0.020 ± 0.005 | 0 ± 0 | 0.040 ± 0.007 |
| Hen Harrier | 0.002 ± 0 | 0.002 ± 0 | 0 ± 0 | 0.004 ± 0 |
| Knot | 0.053 ± 0.012 | 0.053 ± 0.011 | 0 ± 0 | 0.106 ± 0.016 |
| Long-tailed duck | 0.045 ± 0.009 | 0.045 ± 0.009 | 0 ± 0 | 0.090 ± 0.013 |
| Mallard | 2.939 ± 0.588 | 2.994 ± 0.6 | 3.035 ± 0.608 | 8.968 ± 1.037 |
| Marsh harrier | 0.002 ± 0 | 0.002 ± 0 | 0 ± 0 | 0.004 ± 0 |
| Osprey | 0 ± 0 | 0 ± 0 | 0 ± 0 | 0 ± 0 |
| Oystercatcher | 0.076 ± 0.016 | 0.074 ± 0.016 | 0 ± 0 | 0.150 ± 0.023 |
| Pintail | 0.059 ± 0.013 | 0.059 ± 0.013 | 0 ± 0 | 0.118 ± 0.018 |
| Purple sandpiper | 0.005 ± 0.001 | 0.005 ± 0.001 | 0 ± 0 | 0.010 ± 0.001 |
| Red-breasted merganser | 0.045 ± 0.01 | 0.046 ± 0.01 | 0 ± 0 | 0.091 ± 0.014 |

| Species | Pre-breeding | Post-breeding | Other | Total |
|------------------------------------|---------------|---------------|---------------|---------------|
| Red-throated diver | 0.011 ± 0.002 | 0.011 ± 0.002 | 0 ± 0 | 0.022 ± 0.002 |
| Ruff | 0.005 ± 0.002 | 0.005 ± 0.002 | 0 ± 0 | 0.010 ± 0.002 |
| Sanderling | 0.031 ± 0.007 | 0.031 ± 0.007 | 0 ± 0 | 0.062 ± 0.01 |
| Shelduck | 0.094 ± 0.023 | 0.089 ± 0.022 | 0.093 ± 0.023 | 0.276 ± 0.039 |
| Short-eared owl | 0.015 ± 0.004 | 0.015 ± 0.004 | 0 ± 0 | 0.030 ± 0.006 |
| Slavonian grebe | 0.001 ± 0 | 0.001 ± 0 | 0 ± 0 | 0.002 ± 0 |
| Spotted crake | 0 ± 0 | 0 ± 0 | 0 ± 0 | 0 ± 0 |
| Svalbard barnacle goose | 0.022 ± 0.004 | 0.022 ± 0.004 | 0 ± 0 | 0.044 ± 0.006 |
| Svalbard light-bellied brent goose | 0.002 ± 0 | 0.002 ± 0 | 0 ± 0 | 0.004 ± 0 |
| Turnstone | 0.064 ± 0.018 | 0.062 ± 0.018 | 0 ± 0 | 0.126 ± 0.025 |
| Velvet scoter | 0.011 ± 0.002 | 0.011 ± 0.002 | 0 ± 0 | 0.022 ± 0.002 |
| Whimbrel | 0 ± 0 | 0 ± 0 | 0 ± 0 | 0 ± 0 |
| Whooper swan | 0.127 ± 0.029 | 0.128 ± 0.029 | 0 ± 0 | 0.255 ± 0.041 |
| Wigeon | 1.359 ± 0.294 | 1.355 ± 0.293 | 0 ± 0 | 2.714 ± 0.415 |
| Wood sandpiper | 0 ± 0 | 0 ± 0 | 0 ± 0 | 0 ± 0 |

Table 3-2: Summary of estimated seasonal migratory collisions for the Caledonia South Site scenario WTG 2.

| Species | Pre-breeding | Post-breeding | Other | Total |
|------------------------|---------------|---------------|---------------|---------------|
| Bar-tailed godwit | 0.115 ± 0.023 | 0.113 ± 0.023 | 0 ± 0 | 0.228 ± 0.033 |
| Bean goose | 0 ± 0 | 0 ± 0 | 0 ± 0 | 0 ± 0 |
| Black-throated diver | 0 ± 0 | 0 ± 0 | 0 ± 0 | 0 ± 0 |
| Curlew | 0.029 ± 0.006 | 0.029 ± 0.006 | 0 ± 0 | 0.058 ± 0.008 |
| Corncrake | 0.013 ± 0.003 | 0.012 ± 0.003 | 0 ± 0 | 0.025 ± 0.004 |
| Dotterel | 0 ± 0 | 0 ± 0 | 0 ± 0 | 0 ± 0 |
| Dunlin | 0.269 ± 0.055 | 0.265 ± 0.054 | 0 ± 0 | 0.534 ± 0.077 |
| Eider | 0.078 ± 0.014 | 0.079 ± 0.014 | 0 ± 0 | 0.157 ± 0.02 |
| Golden plover | 0.453 ± 0.097 | 0.445 ± 0.095 | 0 ± 0 | 0.898 ± 0.136 |
| Goldeneye | 0.089 ± 0.022 | 0.089 ± 0.022 | 0 ± 0 | 0.178 ± 0.031 |
| Goosander | 0.100 ± 0.016 | 0.098 ± 0.016 | 0 ± 0 | 0.198 ± 0.023 |
| Greenshank | 0.001 ± 0 | 0.001 ± 0 | 0 ± 0 | 0.002 ± 0 |
| Hen harrier | 0.002 ± 0 | 0.002 ± 0 | 0 ± 0 | 0.004 ± 0 |
| Knot | 0.047 ± 0.011 | 0.047 ± 0.011 | 0 ± 0 | 0.094 ± 0.016 |
| Long-tailed duck | 0.04 ± 0.007 | 0.04 ± 0.007 | 0 ± 0 | 0.08 ± 0.01 |
| Mallard | 2.602 ± 0.557 | 2.651 ± 0.567 | 2.687 ± 0.575 | 7.94 ± 0.981 |
| Marsh harrier | 0.002 ± 0 | 0.002 ± 0 | 0 ± 0 | 0.004 ± 0 |
| Osprey | 0.001 ± 0 | 0.001 ± 0 | 0 ± 0 | 0.002 ± 0 |
| Oystercatcher | 0.069 ± 0.015 | 0.067 ± 0.014 | 0 ± 0 | 0.136 ± 0.021 |
| Pintail | 0.054 ± 0.012 | 0.055 ± 0.012 | 0 ± 0 | 0.109 ± 0.017 |
| Purple sandpiper | 0.004 ± 0.001 | 0.004 ± 0.001 | 0 ± 0 | 0.008 ± 0.001 |
| Red-breasted merganser | 0.042 ± 0.009 | 0.043 ± 0.009 | 0 ± 0 | 0.085 ± 0.013 |
| Red-throated diver | 0.010 ± 0.002 | 0.010 ± 0.002 | 0 ± 0 | 0.020 ± 0.003 |

| Species | Pre-breeding | Post-breeding | Other | Total |
|------------------------------------|---------------|---------------|---------------|---------------|
| Ruff | 0.005 ± 0.001 | 0.005 ± 0.001 | 0 ± 0 | 0.010 ± 0.001 |
| Sanderling | 0.028 ± 0.006 | 0.028 ± 0.006 | 0 ± 0 | 0.056 ± 0.008 |
| Shelduck | 0.084 ± 0.022 | 0.079 ± 0.021 | 0.083 ± 0.021 | 0.246 ± 0.037 |
| Short-eared owl | 0.014 ± 0.003 | 0.014 ± 0.003 | 0 ± 0 | 0.028 ± 0.004 |
| Slavonian grebe | 0.001 ± 0 | 0.001 ± 0 | 0 ± 0 | 0.002 ± 0 |
| Spotted crake | 0 ± 0 | 0 ± 0 | 0 ± 0 | 0 ± 0 |
| Svalbard barnacle goose | 0.019 ± 0.003 | 0.019 ± 0.003 | 0 ± 0 | 0.038 ± 0.004 |
| Svalbard light-bellied brent goose | 0.002 ± 0.001 | 0.002 ± 0.001 | 0 ± 0 | 0.004 ± 0.001 |
| Turnstone | 0.057 ± 0.016 | 0.055 ± 0.015 | 0 ± 0 | 0.112 ± 0.022 |
| Velvet scoter | 0.01 ± 0.002 | 0.009 ± 0.002 | 0 ± 0 | 0.019 ± 0.003 |
| Whimbrel | 0.001 ± 0 | 0.001 ± 0 | 0 ± 0 | 0.002 ± 0 |
| Whooper swan | 0.116 ± 0.027 | 0.117 ± 0.028 | 0 ± 0 | 0.233 ± 0.039 |
| Wigeon | 1.207 ± 0.262 | 1.203 ± 0.261 | 0 ± 0 | 2.41 ± 0.37 |
| Wood sandpiper | 0 ± 0 | 0 ± 0 | 0 ± 0 | 0 ± 0 |

Table 3-3: Summary of estimated seasonal migratory collisions for the Caledonia South Site scenario WTG 3 (WCS).

| Species | Pre-breeding | Post-breeding | Other | Total |
|------------------------|---------------|---------------|---------------|----------------|
| Bar-tailed godwit | 0.183 ± 0.035 | 0.179 ± 0.034 | 0 ± 0 | 0.362 ± 0.049 |
| Bean goose | 0 ± 0 | 0 ± 0 | 0 ± 0 | 0 ± 0 |
| Black-throated diver | 0 ± 0 | 0 ± 0 | 0 ± 0 | 0 ± 0 |
| Corncrake | 0.021 ± 0.004 | 0.020 ± 0.004 | 0 ± 0 | 0.041 ± 0.006 |
| Curlew | 0.043 ± 0.01 | 0.043 ± 0.01 | 0 ± 0 | 0.086 ± 0.014 |
| Dotterel | 0 ± 0 | 0 ± 0 | 0 ± 0 | 0 ± 0 |
| Dunlin | 0.425 ± 0.094 | 0.418 ± 0.092 | 0 ± 0 | 0.843 ± 0.132 |
| Eider | 0.119 ± 0.025 | 0.121 ± 0.025 | 0 ± 0 | 0.24 ± 0.035 |
| Goldeneye | 0.143 ± 0.033 | 0.144 ± 0.034 | 0 ± 0 | 0.287 ± 0.047 |
| Goosander | 0.151 ± 0.023 | 0.148 ± 0.022 | 0 ± 0 | 0.299 ± 0.032 |
| Greenshank | 0.002 ± 0 | 0.002 ± 0 | 0 ± 0 | 0.004 ± 0 |
| Grey Plover | 0.029 ± 0.006 | 0.029 ± 0.006 | 0 ± 0 | 0.058 ± 0.008 |
| Hen Harrier | 0.003 ± 0.001 | 0.003 ± 0.001 | 0 ± 0 | 0.006 ± 0.001 |
| Knot | 0.080 ± 0.019 | 0.078 ± 0.019 | 0 ± 0 | 0.158 ± 0.027 |
| Lapwing | 0.929 ± 0.222 | 0.942 ± 0.225 | 0 ± 0 | 1.871 ± 0.316 |
| Long-tailed duck | 0.062 ± 0.011 | 0.063 ± 0.011 | 0 ± 0 | 0.125 ± 0.016 |
| Mallard | 4.169 ± 0.795 | 4.248 ± 0.81 | 4.306 ± 0.821 | 12.723 ± 1.401 |
| Marsh Harrier | 0.002 ± 0.001 | 0.002 ± 0.001 | 0 ± 0 | 0.004 ± 0.001 |
| Osprey | 0.001 ± 0 | 0.001 ± 0 | 0 ± 0 | 0.002 ± 0 |
| Oystercatcher | 0.105 ± 0.023 | 0.103 ± 0.022 | 0 ± 0 | 0.208 ± 0.032 |
| Pintail | 0.082 ± 0.019 | 0.083 ± 0.019 | 0 ± 0 | 0.165 ± 0.027 |
| Purple Sandpiper | 0.007 ± 0.001 | 0.007 ± 0.001 | 0 ± 0 | 0.014 ± 0.001 |
| Red-breasted Merganser | 0.064 ± 0.012 | 0.066 ± 0.012 | 0 ± 0 | 0.130 ± 0.017 |

| Species | Pre-breeding | Post-breeding | Other | Total |
|------------------------------------|---------------|---------------|---------------|----------------|
| Red-throated Diver | 0.015 ± 0.003 | 0.015 ± 0.003 | 0 ± 0 | 0.030 ± 0.004 |
| Ruff | 0.007 ± 0.002 | 0.007 ± 0.002 | 0 ± 0 | 0.014 ± 0.003 |
| Sanderling | 0.044 ± 0.009 | 0.044 ± 0.009 | 0 ± 0 | 0.088 ± 0.013 |
| Shelduck | 0.125 ± 0.029 | 0.119 ± 0.028 | 0.124 ± 0.029 | 0.368 ± 0.050 |
| Short-eared Owl | 0.022 ± 0.005 | 0.021 ± 0.005 | 0 ± 0 | 0.043 ± 0.007 |
| Slavonian Grebe | 0.001 ± 0 | 0.001 ± 0 | 0 ± 0 | 0.002 ± 0 |
| Spotted Crake | 0 ± 0 | 0 ± 0 | 0 ± 0 | 0 ± 0 |
| Svalbard Barnacle Goose | 0.03 ± 0.005 | 0.03 ± 0.005 | 0 ± 0 | 0.06 ± 0.007 |
| Svalbard Light-Bellied Brent Goose | 0.003 ± 0.001 | 0.003 ± 0.001 | 0 ± 0 | 0.006 ± 0.001 |
| Turnstone | 0.091 ± 0.023 | 0.088 ± 0.022 | 0 ± 0 | 0.179 ± 0.032 |
| Velvet Scoter | 0.015 ± 0.003 | 0.014 ± 0.003 | 0 ± 0 | 0.029 ± 0.004* |
| Whimbrel | 0.001 ± 0 | 0.001 ± 0 | 0 ± 0 | 0.002 ± 0* |
| Whooper Swan | 0.168 ± 0.036 | 0.169 ± 0.036 | 0 ± 0 | 0.337 ± 0.051* |
| Wigeon | 2.049 ± 0.412 | 2.042 ± 0.411 | 0 ± 0 | 4.091 ± 0.582 |
| Wood Sandpiper | 0 ± 0 | 0 ± 0 | 0 ± 0 | 0 ± 0 |

4 References

¹ HiDef Aerial Surveying Ltd. (2024). 'mCRM: Avian Migration Collision Risk Model'. R package version f0.4.1. Available at: <https://hidefdevo.shinyapps.io/mCRM/> (Accessed 13/05/2024)

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